March—April, 2000 Vol. 6 No. 2

# Literature Update on

# Wheat, Barley, and Triticale



CIMMYT

ICARDA

Distribution Restricted to Developing Countries Only.

Mar-Apr, 2000 Vol. 6 No. 2

# Literature Update on

# Wheat, Barley, and Triticale



CIMMYT










Distribution Restricted to Developing Countries Only.

CIMMYT and ICARDA are two internationally funded, nonprofit scientific research and training organizations headquartered in Mexico and Syria respectively. Together with 16 other nonprofit international agricultural research and training centers, CIMMYT and ICARDA are supported by the Consultative Group on International Agricultural Research (CGIAR), which is sponsored by the Food and Agriculture Organization (FAO) of the United Nations, the International Bank for Reconstruction and Development (World Bank), and the United Nations Development Programme (UNDP). The CGIAR consists of some 40 donor countries, international and regional organizations, and private foundations.

**The Institute for Scientific Information (ISI)**, based in Philadelphia, Pennsylvania, USA, maintains one of the largest bibliographic databases in the world. A wide range of information resources - in a variety of media - are created from this database, including *"Current Contents on CD-ROM with Abstracts"*. ISI has generously made a special dispensation permitting CIMMYT and ICARDA to reproduce its records and distribute them to developing countries.

**The International Information System for the Agricultural Sciences and Technology (AGRIS)**, with headquarters at Rome, is coordinated by the Food and Agriculture Organization (FAO) of the United Nations. It is a worldwide cooperative information network of some 135 national, regional and international centers and produces a database growing at the rate of about 120 000 bibliographic records per year.

Inquiries concerning current mailings and back numbers of *Literature Update on Wheat, Barley and Triticale* should be sent to the Library, CIMMYT, A.P. 6-641, 06600 Mexico, DF.

**Copyright notice:** Part of the data presented in *Literature Update on Wheat, Barley and Triticale* is extracted from the Licensed Product of the Institute for Scientific Information®, Inc. (ISI®), Philadelphia, Pennsylvania USA: © Copyright Institute for Scientific Information® 1995. In accordance with normal practice, single copies may be made for non-commercial use in research and study, but the distribution of both the original and any copies is restricted to persons in developing countries.

**ISSN 1405-1672**

**Several CIMMYT staff made important contributions to this document:** Kelly Cassaday, Senior Publications Manager; Efrén Orozco, Library Manager (editor); Fernando García, Electronic Information Specialist, and Pedro Santamaría, Database Administrator (data processing); José Juan Caballero, Cataloguer (categorization); Miguel Mellado, Coordinator of Design and Photography Department, and Eliot Sánchez, Design Assistant (design); Ma. Concepción Zavala, Bilingual Secretary (production, coordination and distribution).

# Literature Update on Wheat, Barley, and Triticale

## CONTENTS


Page

Preface ..... iv

Sample Entries ..... vi

Notes to Readers ..... vi

Citations and Abstracts ..... 1

Author Index ..... 111

Keyword Index ..... 117

How to Obtain the Full Text of Documents ..... 133

CIMMYT Addresses ..... 134

ICARDA Addresses ..... 135


## Subject Headings and Reference Numbers


| | Ref. No. | | Ref. No. |
|---|---|---|---|
| Legislation | 396 | Animal Feeding | 980-991 |
| Agricultural Economics and Policies | 397-399 | Animal Physiology - Nutrition | 992-1010 |
| Development Economics and Policies | 400 | Pests of Animals | 1011 |
| Production Economics | 401-407 | Agricultural Machinery and Equipment | 1012 |
| Organization, Administration and Management of Agricultural Enterprises or Farms | 408 | Renewable Energy Resources | 1013-1014 |
| Agro-Industry | 409-410 | Soil Chemistry and Physics | 1015-1017 |
| Trade, Marketing and Distribution | 411-415 | Soil Biology | 1018-1019 |
| International Trade | 416 | Soil Fertility | 1020-1032 |
| Crop Husbandry | 417-478 | Soil Erosion, Conservation and Reclamation | 1033 |
| Plant Propagation | 479-489 | Processing of Agricultural Products | 1034 |
| Seed Production | 490 | Food Science and Technology | 1035-1037 |
| Fertilizing | 491-535 | Food Processing and Preservation | 1038-1062 |
| Irrigation | 536 | Food Contamination and Toxicology | 1063-1068 |
| Soil Cultivation | 537-552 | Food Composition | 1069-1143 |
| Cropping Patterns and Systems | 553-566 | Food Additives | 1144-1145 |
| Plant Genetics and Breeding | 567-735 | Feed Technology | 1146 |
| Plant Ecology | 736 | Feed Processing and Preservation | 1147 |
| Plant Structure | 737-738 | Feed Composition | 1148-1156 |
| Plant Physiology and Biochemistry | 739-766 | Feed Additives | 1157-1158 |
| Plant Physiology - Nutrition | 767-798 | Processing of Non-Food or Non-Feed Agricultural Products | 1159-1163 |
| Plant Physiology - Growth and Development | 799-829 | Human Nutrition - General Aspects | 1164 |
| Pests of Plants | 830-846 | Pollution | 1165 |
| Plant Diseases | 847-901 | Mathematical and Statistical Methods | 1166-1169 |
| Miscellaneous Plant Disorders | 902-940 | Research Methods | 1170-1173 |
| Weeds | 941-975 | | |
| Handling, Transport, Storage and Protection of Plant Products | 976-979 | | |

# PREFACE

To maintain quality in their research and training work, scientists need prompt and reliable access to up-to-date scientific information. However, in developing countries, the information resources are often weak, and the scientists are at a great disadvantage as compared with their colleagues in more developed countries and in international institutions. For lack of foreign currency, their librarians may be unable to buy the more recent scientific books and journals; and, for lack of access to bibliographic data, the scientists themselves cannot easily identify the most useful reprints to request from their colleagues in other countries.

CIMMYT and ICARDA seek to offset these disadvantages: they sponsor workshops at which researchers can exchange knowledge, and they produce publications which are made available free of charge to research institutions in developing countries. For a decade or so (1984-1994), CIMMYT also purchased bulk subscriptions to *Wheat, Barley and Triticale Abstracts* from CAB International, and the individual issues were sent directly to developing-country recipients that CIMMYT had nominated.

Both CIMMYT and ICARDA recognize the high quality of the products from CAB International; however, our budgetary realities require that we look for the least costly means to provide announcements of current information. In 1994, contacts were made with the Institute for Scientific Information (ISI), the private corporation based in Philadelphia, Pennsylvania, which produces *Current Contents: Agriculture, Biology and Environmental Sciences*. This is a weekly CD-ROM service giving abstracts of articles from the current issues of the world's most influential scientific journals. ISI has authorized us to extract the abstracts that deal with wheat, barley and triticale and to distribute these abstracts - in printed form - to collaborators in developing countries.

This authorization is the basis on which CIMMYT and ICARDA are now offering *Literature Update on Wheat, Barley and Triticale*. However, since *Current Contents* covers only the more prominent journals, it lacks coverage of other types of publication - for example, reports and conference proceedings - and it does not report the articles that appear in the less well known journals, many of which are published in the developing countries themselves. Therefore, to give more balance to the product, we are also including references and abstracts from the AGRIS database.

AGRIS, the International Information System for the Agricultural Sciences and Technology, is managed by FAO, and its database is constructed by contributions from some 135 participating centers which represent most of the countries of the world plus many of the regional and international organizations working in the agricultural sector. Relevant AGRIS items are extracted from tapes obtained from FAO and are merged with the items from *Current Contents*. Because CIMMYT and ICARDA are two of the centers contributing to the AGRIS database, we are able to use this material without payment of royalties.

Today's product was designed for greater economy, but we believe recipients will now welcome speed of reporting on the one hand (material from *Current Contents*) and in-depth coverage on the other (material from AGRIS).

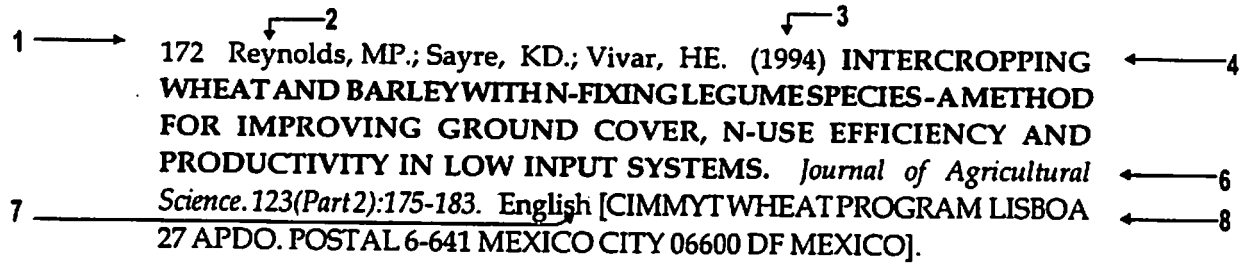
CIMMYT and ICARDA back up this product with an offer to provide photocopies of individual articles that readers need and are unable to obtain. Details are explained separately, but this service has to be on a very limited basis, both to respect copyright restrictions and because of our own modest capacity to respond.

We welcome comments and suggestions on how to improve our product: we emphasize that it can be distributed only in developing countries; we thank the Institute for Scientific Information for allowing us to reproduce its material; and we salute our fellow-participants who, with the leadership of FAO, have built AGRIS into one of the world's richest sources of bibliographic information in agriculture.

Timothy Reeves
Director General, CIMMYT

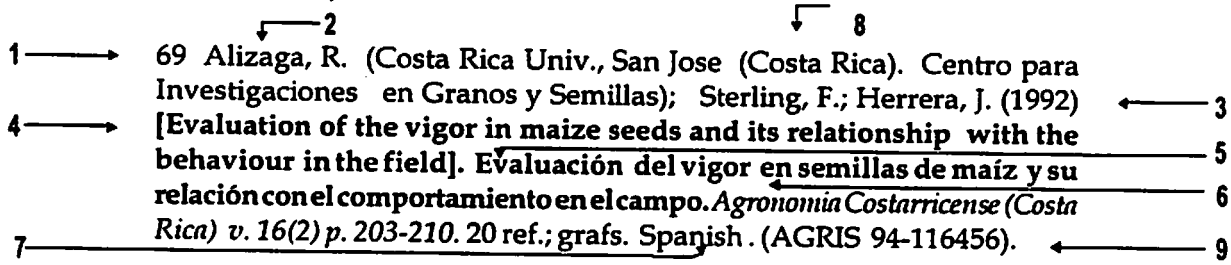
Adel El-Beltagy
Director General, ICARDA

*a) Sample entry retrieved from ISI-Current Contents (journal article)*



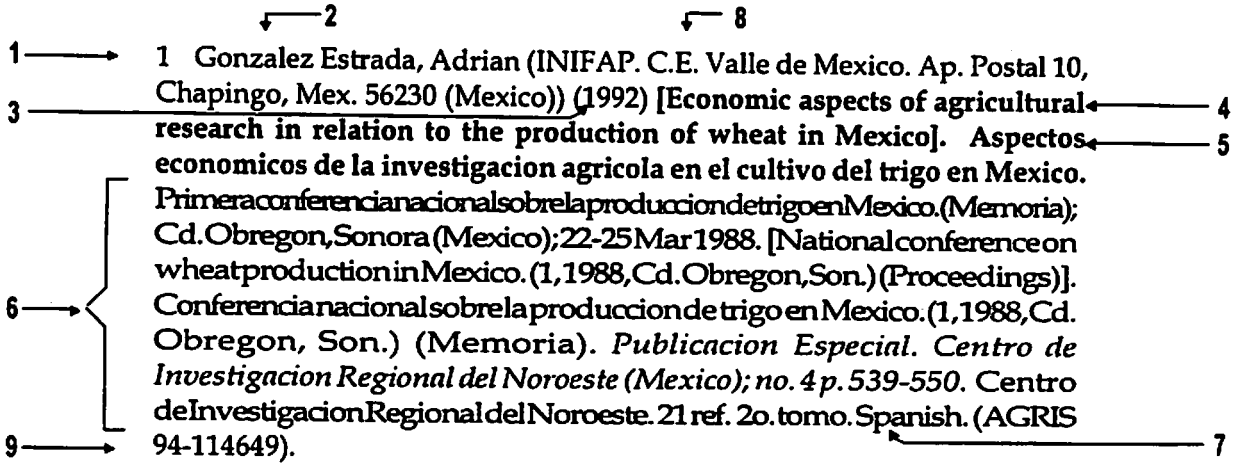

172 Reynolds, MP.; Sayre, KD.; Vivar, HE. (1994) **INTERCROPPING WHEAT AND BARLEY WITH N-FIXING LEGUME SPECIES - A METHOD FOR IMPROVING GROUND COVER, N-USE EFFICIENCY AND PRODUCTIVITY IN LOW INPUT SYSTEMS.** *Journal of Agricultural Science. 123(Part 2):175-183.* English [CIMMYT WHEAT PROGRAM LISBOA 27 APDO. POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

*b) Sample entry retrieved from AGRIS (journal article)*




69 Alizaga, R. (Costa Rica Univ., San Jose (Costa Rica). Centro para Investigaciones en Granos y Semillas); Sterling, F.; Herrera, J. (1992) **[Evaluation of the vigor in maize seeds and its relationship with the behaviour in the field]. Evaluación del vigor en semillas de maíz y su relación con el comportamiento en el campo.** *Agronomia Costarricense (Costa Rica) v. 16(2) p. 203-210.* 20 ref.; grafs. Spanish. (AGRIS 94-116456).

*c) Sample entry retrieved from AGRIS (article in conference proceedings)*




1 Gonzalez Estrada, Adrian (INIFAP. C.E. Valle de Mexico. Ap. Postal 10, Chapingo, Mex. 56230 (Mexico)) (1992) **[Economic aspects of agricultural research in relation to the production of wheat in Mexico]. Aspectos economicos de la investigacion agricola en el cultivo del trigo en Mexico.** Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 539-550.* Centro de Investigacion Regional del Noroeste. 21 ref. 2o. tomo. Spanish. (AGRIS 94-114649).

1 Entry number
2 Author(s)
3 Publication year
4 Title in English
5 Original title (only in entries retrieved from AGRIS)
6 Source
7 Language of text
8 Organization where work was carried out
9 AGRIS Reference Number; only for entries retrieved from AGRIS

**Note to Readers**

The source of each entry - whether *Current Contents* or AGRIS - can be readily inferred from its appearance: TITLES from *Current Contents* are wholly in uppercase, whereas those from AGRIS are in upper and lower case. For non-English documents, *Current Contents* gives only an English translation of the title, but AGRIS normally gives both the translation and the title in its original language. There are many other minor differences in the presentation and sequencing of data from the two sources. In the case of entries from AGRIS, please note the reference number given in parentheses at the end of the bibliographic description: often, this number may be used as a surrogate for the whole description in communications between libraries seeking loans or photocopies.

Users of the indexes are also cautioned that the same item may appear in two slightly different forms: for example, the author Kim, S.K. may also be listed as Kim, SK and the subject AFLATOXIN may be followed by a separate entry for AFLATOXINS. To harmonize such data from two different systems would require complex programming and operations, and we hope that our readers will not find these minor anomalies too troublesome.

## D50 LEGISLATION

396 Swanson,T.; Goschl,T. (2000) **Property rights issues involving plant genetic resources: implications of owner-ship for economic efficiency.** *Ecological Economics. 32(1):75-92.* English. [Univ Coll London,Sch Publ Policy & CSERGE,Dept Econ Gower St London WC1E 6BT England].

The economic theory of property rights is applied to the issue of the conservation of plant genetic diversity,an issue often discussed in terms of benefit sharing,in order to demonstrate that the assignment of property rights is important for reasons of efficiency as well as for equity. Given the existence of transaction costs within an industry,the location of a property rights assignment is a crucial factor determining the incentives for efficient levels of investment at various levels of that industry. In the context of plant genetic resources,this means that property rights that are located at the retail end of the pharmaceutical and plant breeding industries may not have sufficient effect to generate the incentives to supply adequate amounts of plant genetic resources to the research and development sectors at the base of these industries. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 32].

## E10 AGRICULTURAL ECONOMICS AND POLICIES

397 Anon. (1999) **Statistics: barley.** *Boissons Bios Conditionnement (France) v. 30(282) p. 28-40.* 9 tableaux,9 p. p. seulement. English. (AGRIS 2000-000185).

Les donnees sont presentees dans les tableaux suivants: superficie et production d'orge en France de 1995/1996 a 1998/1999,quantites d'orge commercialisees de 1988 a 1998 en France,importations francaises d'orge de 1994/1995 a 1997/1998,exportations francaises d'orge de 1994/1995 a 1997/1998,superficie - rendements et recoltes d'orge dans l'Union europeenne de 1996 a 1998,production mondiale d'orge de 1996 a 1998,les principaux producteurs d'orge,les 10 premiers exportateurs d'orge,commerce exterieur mondial d'orge en 1996 et 1997,liste officielle de Malteurs de France.

398 Fahmy,F.A.H. (Ain Sham Univ.,Cairo (Egypt). Faculty of Agriculture); Atia,A.A.M. (1996) **Economic evaluation for the methods of weeds controlling on wheat crop in Beni-Swef governorate [Egypt].** 6. Conference of Agricultural Development Research. Cairo (Egypt). 17-19 Dec 1996. *Annals of Agricultural Science (Egypt) Special Issue,p. 309-323.* 6 tables; 6 ref. English. (AGRIS 2000-000172).

399 Lepage Carlotti,B. (Institut National Agronomique Paris Grignon,Paris (France). Departement Agronomie Environnement); Capillon,A. (1999) **Impact of the durum wheat premium on crop farming in the western Aude region of France.** *Cahiers d'Etudes et de Recherches Francophones Agricultures (France) v. 8(3) p. 163-170.* 5 ref.,1 tableaux,5 graph. French. (AGRIS 2000-000212).

La nouvelle Politique agricole commune de l'Union europeenne (PAC) prevoit un regime particulier pour le ble dur. Outre la reduction du prix d'intervention,la reforme organise une redistribution geographique de la culture,en la recentrant sur les zones dites traditionnelles de production. En France,ces zones correspondent aux regions Provence-Alpes-Cote d'Azur et Languedoc-Roussillon. Dans l'Ouest du departement de l'Aude,cette mesure associee a la deprise agricole encourage fortement les agriculteurs vers la production de ble dur. Ceci bouleverse fortement la configuration d'une region qui,depuis l'introduction de l'irrigation a la fin des annees 70,s'est orientee vers la production de semences. Aujourd'hui elles sont concurrencees par le ble dur,a tel point que l'on voit s'inflechir les strategies des agriculteurs,ce qui entraine une evolution importante des systemes de production.

## E14 DEVELOPMENT ECONOMICS AND POLICIES

400 Walburger,AM.; Klein,KK.; Folkins,T. (1999) **Diffusion of wheat varieties in three agro-climatic zones of western Canada.** *Canadian Journal of Agricultural Economics-Revue Canadienne d Economie Rurale. 47(3):293-304.* English. [Univ Lethbridge Lethbridge AB Canada].

Diffusion patterns of all major bread wheat varieties released in western Canada over the period 1950-92 are analyzed. Agronomic,quality and disease attributes of each variety are examined to explain diffusion patterns. It is found that the pattern of diffusion is affected most by yield,days to maturity,test weight lodging and bunt. The relative importance of these attributes varies somewhat by agroclimatic region within the prairie provinces. [References: 22].

## E16 PRODUCTION ECONOMICS

401 Adamska,H.; Paczkowski,L. (University of Agriculture,Wroclaw (Poland). Lab. of Agriculture Environment and Plant Protection Economy) (1999) **Changes of the costs and prices and the profitability of the cultivation of winter wheat in the years 1981/82-97.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 23-30.* 3 tables; 7 ref. Polish. (AGRIS 2000-007778).

The varying rate of price increases of agricultural products of the means of production brings about fluctuations in the profitability of plant production. The aim of the work is to show wheather the prices of plant products make up for the cost increases and to what extent the profitability depended on production increases as compared to prices of plant products. The study is based on material gathered over 1981/82-97. The results of the research show great variability of costs increase,prices,profits as weel as crop yields.

402 Dahl,BL.; Wilson,WW. (1999) **Factors affecting spring wheat variety choices: Comparisons between Canada and the United States.** *Canadian Journal of Agricultural Economics-Revue Canadienne d Economie Rurale. 47(3):305-320.* English. [N Dakota State Univ,Dept Agr Econ Fargo,ND 58105 USA].

The demand for high-quality hard wheats has been increasing in the 1980s and 1990s. In this article,factors affecting the varieties planted of hard red spring wheat in Canadian producing regions and North Dakota are compared. Differences exist in the development and release of varieties,which affect the supply and quality of hard wheats produced. Wheat areas in the Canadian provinces are more concentrated in the top variety than those in North Dakota. However,in recent years,there appears to be a tendency toward increased varietal concentration in North Dakota and less in Canada. Econometric models are developed to compare and contrast factors affecting variety choice. In Canada,agronomic factors including relative yields are significant variables affecting variety choice. In North Dakota,agronomic factors generally have less effect on adoption rates,but economic variables are important Varieties in North Dakota and Manitoba have shorter life cycles and reach their maximum utilization by farmers earlier than in Alberta or Saskatchewan. The longer varietal life cycles and higher concentration of the dominant variety suggest end-use variability should be lower in Canada than in North Dakota. [References: 21].

403 Dos,Santos,HP.; Ambrosi,I.; Ignaczak,JC.; Wobeto,C. (1999) **Economic analysis of crop rotation systems for wheat,over a ten year period,under no-tillage.** *Pesquisa Agropecuaria Brasileira. 34(12):2175-2183.* Portuguese. [EMBRAPA,Ctr Nacl Pesquisa Trigo Caixa Postal 451 BR-99001970 Passo Fundo RS Brazil].

From 1984 to 1993,in Guarapuava,Parana,Brazil,the effect of crop rotation systems on wheat were assessed. Four rotation systems for wheat were studied: system I (wheat/soybean); system II (wheat/soybean and common vetch/corn,from 1984 to 1989,and

wheat/soybean and white oats/soybean,from 1990 to 1993); system III (wheat/soybean,flax/soybean,and common vetch/corn,from:1984 to 1989,and wheat/soybean,common vetch/corn,and white oats/soybean,from 1990 to 1993); and system IV (wheat/soybean,legume/corn,barley/soybean,and white oats/soybean). The economic analysis on that period is presented in this paper. From 1984 to 1989,systems I,II,III,and IV showed no differences in their net return means. Similarly,from 1990 to 1993,systems II,III,and IV mean net returns did not differ significantly in relation to the system I; however,considering the annual comparison,the system II showed higher profit than the system I in six years and did not differ in four years,making it a good alternative,mainly in the first period. [References: 14].

404 Paluch,F. (Akademia Rolnicza,Wroclaw (Poland). Katedra Ekonomiki i Organizacji Rolnictwa) (1998) **Dynamics of cereal and potato yields in Jelenia Gora voivodeship in 1975-95.** *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rolnictwo (Poland) (no.346) p. 181-202.* 8 tables; 17 ref. Polish. (AGRIS 2000-007774).

The study was aimed at the evaluation of cereal and potato yields,with respect to variations and dynamics in Jelenia Gora voivodeship. The yields obtained on private farms for 21 years were the objectives of the study. The basic statistical methods were used. The yield coefficients of the crop species under cultivation were positive and statistically significant. The values obtained with cereals under favourable conditions were approximate and markedly lower than those characteristic of adverse conditions. Especially high diversification was occurred in potato yields obtained in the entire voivodeship and in the villages under investigation. Great differences in between the yields of cereals were found on poor soils of Osiecznica and Wegliniec communities.

405 Piorr,H. P. (1999) **[Site-specific biomass formation,nitrogen fixation and nutrient extraction in ecological farming].** 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte". AMS Berlin (Germany). 23-25 Febr 1999. Zentrum fuer Agrarlandschafts- und Landnutzungsforschung e.V.,Muencheberg (Germany). Abteilung Landschaftsentwicklung. . Hoffmann,H.;Muller,S. *Beitrage zur 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte" [Proceedings of the fifth scientific conference on ecological farming "From the periphery to the focus of attention"] p. 329-332. Zentrum fuer Agrarlandschafts- und Landnutzungsforschung e.V.,Muencheberg (Germany). Abteilung Landschaftsentwicklung.* Dr. Koster. German. (AGRIS 2000-000294).

Fur die vorliegende Untesuchung wurde in Anlehnung an die Berechnung der Standarddeckungsbeitrage der Betriebstyp "mittlerer Viehbesatz" mit 0,5 GV/ha und eine entsprechende Fruchtfolge zur Erzeugung einer angepassten Futtermenge gewahlt. Die Fruchtfolgen werden an den Standorteigenschaften (6 Gruppen klassifiziert nach Ackerzahlen,Bodenarten und Niederschlagen) der Region ausgerichtet. Am Beispiel des Winterweizens wird der Einfluss des Standortes Brandenburg auf den Ertrag vorgestellt. Verschiedene eigene Standortuntersuchungen und Angaben aus der Literatur wurden hinsichtlich des Einflusses der Ackerzahl und des Niederschlages auf den Kornertrag ausgewertet,um die durch diesen Einflussfaktor bewirkte Ertragsvarianz im Organischen Landbau zu berucksichtigen.

406 Tawakoul,H.M.L. (1998) **[An economic study for the production possibilities of wheat in Egypt].** Alexandria Univ. (Egypt). Faculty of Agriculture. 63 tables; Bibliography: p. 200-207; Appendixes: 191-199. 212 p. Arabic. (AGRIS 2000-000310).

407 Zuppiroli,M.; Mancini,M.C. (Parma Univ. (Italy). Istituto di Economia Agraria e Forestale) (1998) **[The prospects of the barley crop [Hordeum vulgare L. - Italy]].** *Informatore Agrario (Italy) v. 54(33) p. 29-32.* 4 tables; 4 graphs. Italian. (AGRIS 2000-000286).

## E20 ORGANIZATION,ADMINISTRATION AND MANAGEMENT OF AGRICULTURAL ENTERPRISES OR FARMS

408 Fouquin,G. (Ed.) (Soufflet Maltings,Nogent sur Seine (France)) (1999) **Spring malting barley production: an extra plus for Normandy (France).** *Boissons Bios Conditionnement (France) v. 30(282) p. 86-87.* Orge,malt,biere. English. (AGRIS 2000-000399).

## E21 AGRO-INDUSTRY

409 Balla,A. (Faculte Universitaire des Sciences Agronomiques,Gembloux (Belgique). Unite de Technologie des Industries Agro Alimentaires); Blecker,C.; Razafindralambo,H.; Paquot,M. (1999) **Mixed monolayers of gluten-emulsifiers at the air-water interface.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998az. *Colloques de l'INRA (France); no. 91 p. 213-216. Institut National de la Recherche Agronomique,Paris (France).* INRA. 7 ref. English. (AGRIS 2000-000462).

The interactions and miscibility analysis of gluten-emulsifiers mixed film show that those films are not completely miscible as demonstrated by the presence of both two transition zones and also by the deviation of the mean molecular areas of mixed films from the values calculated according to the rule of additivity (GAINES,1966). Furthermore,the free energy excess of mixing is positive in presence of emulsifiers,confirming the partial miscibility of gluten emulsifier monolayers.

410 Mangavel,C. (Institut National de la Recherche Agronomique,Nantes (France). Centre de Nantes,Unite de Biochimie et Technologie des Proteines); Carre,P.; Sanchez,A.C.; Barbot,J.; Popineau,Y.; Gueguen,J. (1999) **Film formation from wheat gluten proteins: a Fourier Transform Infrared Spectroscopic study.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998az. *Colloques de l'INRA (France); no. 91 p. 257-261. Institut National de la Recherche Agronomique,Paris (France).* INRA. 5 ref. English. (AGRIS 2000-000463).

The modifications of gliadins secondary structures during the film-formation process have been studied by Fourier Transform Infrared spectroscopy. The conformation of proteins in film-forming solutions (in alkaline conditions) presented two major components: beta-turns and Random Coil. In the film state,hydrogen-bonded beta-sheets were present. It has been demonstrated that the presence of the plasticizer did not influence the protein secondary structure,neither in film-forming solution nor in the film state. The second part of this work concerned the study of films from highly purified wheat gluten proteins. Though these films presented very different mechanical properties (depending) on the primary structure of each protein),the secondary structures of the proteins were very similar (same characteristic bands in the infrared spectra).

## E70 TRADE,MARKETING AND DISTRIBUTION

411 Anon. (1999) **[Global wheat crop not enough for demand].** *Ernaehrungsdienst (Germany) (26) p. 3.* German. (AGRIS 2000-000589).

Nach Ansicht des Internationalen Getreiderats (IGC),London,wird die globale Weizenproduktion im Wirtschaftsjahr 1999/2000 unter dem Bedarf bzw. Verbrauch liegen. Grund zur Beunruhigung gibt es bislang nicht,da die Bestande an Weizen aus vorangegangenen hohen Ernten noch sehr reichlich vorhanden sind. Die IGC-Prognosen zu Produktion und

Verbrauch fur 1999/2000 liegen bei einem Defizit von 23 Mio. t Weizen. Es wird mit einer Welt-Weizenproduktion von 568,8 Mio. t gerechnet,demsteht ein geschatzter Verbrauch von 592 Mio. t gegenuber.

412 De Villiers,N. (1999) **Falling number: It's reliability as a grading norm at the 'intake' of wheat for determinating pre-harvest sprouting.** *Maize (South Africa) p. 49.* English. (AGRIS 2000-008074).

413 Hubbard,LJ.; Lingard,J.; Webster,JPG. (2000) **Romanian wheat prices: is there a need for stabilisation?** *Food Policy. 25(1):55-67.* English. [Univ Newcastle Upon Tyne,Dept Agr Econ & Food Mkt Newcastle Upon Tyne NE1 7RU Tyne & Wear England].

This paper addresses the question of whether Romania should introduce a price stabilisation scheme for wheat. We examine,at the macro level,world market conditions for wheat and,at the micro level,current problems confronting Romanian farmers. Although reduction of price risk may be desirable,we conclude that it is not an urgent priority in Romania. Even a scheme which is self-financing,and therefore requiring no state funds,will use scarce management skills and expertise that would be better employed elsewhere. Elimination of market imperfections and distortions in the agri-food chain,particularly with respect to finance,grain storage and market information,will result in more immediate gains. (C) 2000 Elsevier Science Ltd. All rights reserved. [References: 11].

414 Zuppiroli,M.; Mancini M.C. (Parma Univ. (Italy). Istituto di Economia Agraria e Forestale) (1998) **[Market situation and prospects for coarse grains].** *Informatore Agrario (Italy) v. 54(37) p. 40-43.* 6 tables; 1 graph. Italian. (AGRIS 2000-000574).

415 Zuppiroli,M.; Mancini,M.C. (Parma Univ. (Italy). Istituto di Economia Agraria e Forestale) (1998) **[Situation and prospects for soft wheat [Triticum aestivum L. - Italy]].** *Informatore Agrario (Italy) v. 54(34) p. 37-40.* 3 tables; 3 graphs. Italian. (AGRIS 2000-000576).

## E71 INTERNATIONAL TRADE

416 Gerstenkorn,P.; Lindhauer,M.G. (1999) **(International durum wheat situation in the cereals years 1996/97 and 1997/98).** Bundesanstalt fuer Getreide-,Kartoffel- und Fettforschung,Detmold (Germany). Inst. fuer Getreide-,Kartoffel- und Staerketechnologie. *Getreide Mehl und Brot (Germany) v. 53(3) p. 131-134.* German. (AGRIS 2000-000648).

Berichtet wird uber die Erzeugung und Qualitat von Durumweizen in Kanada,USA,Turkei,Italien,Griechenland,Osterreich,Spanien,Frankreich und in der Bundesrepublik Deutschland. Die Durumweizenernte 1997 betrug in Kanada 4,35 Mio. t und in den USA 2,4 Mio. t. Die Erntemengen waren somit gegenuber 1996 etwas rucklaufig. In den USA wurde ein Proteinniveau von 16,2 % i.Tr. ermittelt. Innerhalb der Europaischen Union ist Italien mit 4,4 Mio. t Durumweizen das wichtigste Erzeugerland,gefolgt von Griechenland mit 1,4 Mio. t,Spanien mit 1,1 Mio. t und Frankreich mit 940 000 t. Die Gesamternte 1997 innerhalb der EU lag bei 8,0 Mio. t. An dieser Menge ist die Bundesrepublik Deutschland nur mit 34 000 t beteiligt. Die Glasigkeit lag bei der deutschen Ernte 1997 bei 86 % und der Proteingehalt wieder auf dem beachtlichen Niveau von 16,0 % i.Tr. Aufgrund des guten Mahlverhaltens,der guten Farbe und auch des vorhandenen Kochpotentials wird der Verarbeitungswert des deutschen Durumweizens der Ernte 1997 mit gut beurteilt.

## F01 CROP HUSBANDRY

417 Alaru,M.; Jaama,E.; Kasearu,P.; Laur,U. (Estonian Agricultural Univ.,Tartu (Estonia)) (1999) **Formation of winter triticale yield depending of seeding rate and nitrogen fertilisation in Estonia.** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 3-10.* Latvia University of Agriculture. 1 ill.,5 ref. English. (AGRIS 2000-000950).

Since 1996,the influence of different seeding rates and nitrogen rates on the yield structure and formation of winter triticale yield has been investigated at the Dept. of Field Crop Husbandry,Estonian Agricultural University. Field trials established with seeding rates of 200-700 viable seeds mE-2 on different N fertilisation levels. Formation of above ground biomass,including total and spike-bearing tillering,the lenght of tillers,No. of kernels spikelet E-1 and spike E-1,1000 kernel weight has been determined and the effect of above-mentioned factors studied. The yield was mainly dependent on the number of spike-bearing tillers per plant and plant density (i.e. seeding rate). The seeding rate was in a negative correlation with spike-bearing tillering.

418 Asseng,S.; van,Keulen,H.; Stol,W. (2000) **Performance and application of the APSIM Nwheat model in the Netherlands.** *European Journal of Agronomy. 12(1):37-54.* English. [CSIRO Private Bag PO Wembly WA 6014 Australia].

APSIM Nwheat is a crop system simulation model,consisting of modules that incorporate aspects of soil water,nitrogen (N),crop residues,and crop growth and development. The model was applied to simulate above- and below-ground growth,grain yield,water and N uptake,and soil water and soil N of wheat crops in the Netherlands. Model outputs were compared with detailed measurements of held experiments from three locations with two different soil types. The experiments covered two seasons and a range of N-fertiliser applications. The overall APSIM Nwheat model simulations of soil mineral N,N uptake,shoot growth,phenology,kernels m(-2),specific grain weight and grain N were acceptable. Grain yields (dry weight) and grain protein concentrations were well simulated with a root mean square deviation (RMSD) of 0.8 t ha(-1) and 1.6 protein%,respectively. Additionally,the model simulations were compared with grain yields from a long-term winter wheat experiment with different N applications,two additional N experiments and regional grain yield records. The model reproduced the general effects of N treatments on yields. Simulations showed a good consistency with the higher yields of the long-term experiment,but overpredicted the lower yields. Simulations and earlier regional yields differed,but they showed uniformity for the last decade. In a simulation experiment,the APSIM Nwheat model was used with historical weather data to study the relationship between rate and timing of N fertiliser and grain yield,grain protein and soil residual N. A median grain yield of 4.5 t ha(-1) was achieved without applying fertiliser,utilising mineral soil N from previous seasons,from mineralisation and N deposition. Application of N fertiliser in February to increase soil mineral N to 140 kg N ha(-1) improved the median yield to 7.8 t ha(-1) but had little effect on grain protein concentration with a range of 8-10%. Nitrogen applications at tillering and the beginning of stem elongation further increased grain yield and in particular grain protein,but did not affect soil residual N,except in a year with low rainfall during stem elongation. A late N application at flag leaf stage increased grain protein content by several per cent. This increase had only a small effect on grain yield and did not increase soil residual N with up to 40 kg N ha(-1) applied,except when N uptake was limited by low rainfall in the period after the flag leaf stage. The economic and environmental optima in winter wheat were identified with up to 140 kg N ha(-1) in February,90 kg N ha(-1) between tillering and beginning of stem elongation and 40 kg N ha(-1) at flag leaf stage resulting in a median of 8.5 t ha(-1) grain yield,14.0% grain protein and 13 kg N ha(-1) soil residual N after the harvest. The maximum simulated yield with maximum N input from two locations in the Netherlands was 9.9 t ha(-1). (C) 2000 Elsevier Science B.V. All rights reserved. [References: 44].

419 Austin,RB. (1999) **Yield of wheat in the United Kingdom: Recent advances and prospects.** *Crop Science. 39(6):1604-1610.* English. [15 Wingate Way Cambridge CB2 2HD England].

From 1948 to the present,wheat (Triticum aestivum L,),yields in the UK have increased by an average of 110 kg ha-L each year. This rate of increase has been at least maintained in recent years. The greater yields have been associated with the adoption of cultivars of shorter stature,,which are resistant to lodging and reach anthesis approximate to 1 wk earlier than old cultivars. In the last two decades,most of these cultivars have carried the rht Dib dwarfing gene. The full yield benefits from modern cultivars have depended on high rates of N fertilization and the use of herbicides and effective fungicides,Data from recent trials with candidate cultivars and F-1 hybrids suggest that further genetic gain in yield will he achieved during the next decade. Improved crop protection through chemicals may also enable farmers to obtain greater yields,In the longer term,substantial genetic gain in yield may be achieved if breeders are able to produce cultivars with faster growth rates and greater biomass at maturity. One way to achieve this would be to modify the photosynthetic enzyme rubisco so that its oxygenase activity is reduced. However,cultivars with potentially faster growth rates would require even more N fertilizer if their greater yield potential is to be realized. [References: 24].

420 Bachinger,J.; Frielinghaus,M.; Pauly,J.; Wirth,S. (1999) **[Decision support for planning of winter grain seed under consideration of the goals of soil protection and production in ecologically managed large farms in North East Germany].** 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte". AMS Berlin (Germany). 23-25 Febr 1999. Zentrum fuer Agrarlandschafts- und Landnutzungsforschung e.V.,Muencheberg (Germany). Inst. fuer Landnutzungssysteme und Landschaftsoekologie. . Hoffmann,H.;Muller,S. *Beitrage zur 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte" [Proceedings of the fifth scientific conference on ecological farming "From the periphery to the focus of attention"] p. 126-129. Zentrum fuer Agrarlandschafts- und Landnutzungsforschung e.V.,Muencheberg (Germany). Inst. fuer Landnutzungssysteme und Landschaftsoekologie.* Dr. Koster. German. (AGRIS 2000-000951).

Im Rahmen von Feldversuchen (Parzellen- und Praxisversuchen,1995-1998) zur Entwicklung eines Entscheidungshilfesystems fur Wintergetreideanbau im Okologischen Landbau wurde u.a. untersucht,welchen Einfluss der Aussaattermin sowiedie Aussaatstarke bei Winterroggen und Winterweizen auf N-Aufnahme (N-Gehalt im Spross),Nmin-Gehalte (0-90 cm Bodentiefe) und Bodenbedeckung zu Vegetationsende (Mitte Nov.) haben. Hier dargestellt sind Ergebnisse aus 1996/1997.

421 Ball,BC.; Parker,JP.; Scott,A. (1999) **Soil and residue management effects on cropping conditions and nitrous oxide fluxes under controlled traffic in Scotland 2. Nitrous oxide,soil N status and weather.** *Soil & Tillage Research. 52(3-4):191-201.* English. [SAC,Environm Div W Mains Rd Edinburgh EH9 3JG Midlothian Scotland].

Nitrogen from fertilisers and crop residues can be lost as nitrous oxide N2O),a greenhouse gas that causes an increase in global warming and also depletes stratospheric ozone. Nitrous oxide emissions,soil chemical status,temperature and N2O concentration in the soil atmosphere were measured in a field experiment on soil compaction in loam and sandy loam (cambisols) soils in south-east Scotland. The overall objective was to discover how the intensity and distribution of soil compaction by tractor wheels or by roller just before sowing influenced crop performance,soil conditions and production and emissions of N2O under controlled traffic conditions. Compaction treatments were zero,light compaction by roller (up to 1 Mg per metre of length) and heavy compaction by loaded tractor (up to 4.2 Mg). In this paper we report the effects on production and emissions of N2O and relate them to soil and crop conditions. Nitrous oxide fluxes were substantial only when the soil water content was high (>27 g per 100 g). Fertiliser application stimulated emissions in the spring whereas crop residues stimulated emissions in autumn and winter. Heavy compaction increased N2O emissions after fertiliser application or residue incorporation more than light or zero compaction. The bulk densities of the heavily and lightly compacted soils were up to 89% and 82% of the theoretical (Proctor) maxima. Higher soil cone resistances,temperatures and nitrogen availability and lower gas diffusivities and air-filled porosities combined to make the heavily compacted soil more anaerobic and likely to denitrify than the zero or lightly compacted soil. Compaction sufficient to increase N2O emissions significantly corresponded with adverse soil conditions for winter barley (Hordeum vulgare L.) growth. Soil tillage,which ensures that soil compaction is no greater than in our light treatment and is confined to near the soil surface,may help to mitigate both surface fluxes of N2O and losses to the subsoil. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 20].

422 Ball,BC.; Ritchie,RM. (1999) **Soil and residue management effects on arable cropping conditions and nitrous oxide fluxes under controlled traffic in Scotland 1. Soil and crop responses.** *Soil & Tillage Research. 52(3-4):177-189.* English. [SAC,Environm Div W Mains Rd Edinburgh EH9 3JG Midlothian Scotland].

Soil compaction can affect crop growth and greenhouse gas emission and information is required of how both these aspects are affected by compaction intensity and weather. In this paper we describe treatments of compaction intensity and their effects on soil physical conditions and crop growth in loam to sandy loam cambisol soils. soil conditions and crop performance were measured over three seasons in a field experiment on soil compacted by wheels on freshly ploughed seedbeds. Ploughing buried the chopped residues of the previous crop. After ploughing,traffic was controlled such that the experimental plots received wheel traffic only as treatments. The overall objective was to discover how the intensity and distribution of soil compaction just before sowing influenced crop performance,soil conditions and emissions of nitrous oxide. Compaction treatments were zero,light compaction by roller (up to 1 Mg m(-1)) and heavy compaction by loaded tractor,(up to 4.2 Mg). The experiment was located at Boghall,near Edinburgh (860 mm average annual rainfall) for the first two seasons under spring and winter barley (Hordeum vulgare L.) and in a drier area at North Berwick (610 mm average annual rainfall) for the third season under winter oil-seed rape (Brassica napus L.). Heavy compaction in dry soil conditions had little effect on crop growth. However,in wet conditions heavy compaction reduced air porosity,air permeability and gas diffusivity,increased cone resistance and Limited winter barley growth and grain yield. Heavy compaction in wet conditions reduced winter barley yields to 7.1 Mg ha(-1),in comparison to 8.8 Mg ha(-1) in the zero compaction treatment. The compaction status of the top 15 cm of soil seemed to be particularly important. Loosening of the top 10 cm of soil immediately after heavy compaction restored soil conditions for crop growth. However,zero seed bed compaction gave patchy and uneven crop emergence in dry conditions. Both zero and light compaction to a target depth of 10 cm gave similar crop productivity. Maintenance of a correct compaction level near the soil surface is particularly important for establishment and overwintering of barley and oil seed rape. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 27].

423 Blanchard,A. (Malteurop,Reims (France)) (1999) **The choices of the variety,the sowing date and the sowing density are the three key factors in "chain integrated agriculture".** *Boissons Bios Conditionnement (France) v. 30(282) p. 84-85.* Orge,malt,biere. English. (AGRIS 2000-000817).

Depuis quelques annees,la production agricole francaise provient d'une agriculture pratiquant des methodes culturales bien adaptees,afin de repondre favorablement aux attentes de la filiere orge - malt - biere. Pour atteindre cet objectif,l'agriculbur doit choisir la variete la mieux adaptee a sa zone de production,et definir l'itineraire technique le plus performant pour s'assurer du meilleur rendement agricole,preserver la qualite des orges et egalement respecter l'environnement. C'est ce que l'on appelle "l'agriculture raisonnee".

424 Brancourt-Hulmel,M.; Lecomte,C.; Meynard,JM. (1999) **A diagnosis of yield-limiting factors on probe genotypes for characterizing environments in winter wheat trials.** *Crop Science. 39(6):1798-1808.* English. [INRA,Unite Genet & Ameliorat Plantes F-80200 Estrees Mons France].

Genotype x environment interaction is Fully analyzed when genotypes and environments are well characterized. Probe genotypes were studied in a simplified crop diagnosis to show how variates of yield components can strengthen characterization of environments by usual indicators of yield-limiting factors. The objective of this study was to determine the main limiting factors of yield and to analyze their effects in wheat (Triticum aestivum L,) trials. Fixed genotypes (Talent,Soissons,Camp-Remy,and Arminda) were studied as probe genotypes at five experimental stations of the Institut National de la Recherche Agronomique (I.N.R.A.) (Rennes,Mons,La Miniere,Dijon,and Ondes) during 1991 and 1992,Two important variates,the reduction of kernel number and the reduction of thousand kernel weight,were analyzed to characterize the environments during the formation of yield,The former described the time-period until flowering and the latter the grain-filling period. In addition,factors that limit yield were determined through indicators such as water deficits,the ratio between nitrogen absorbed and kernel number,radiation,temperature,development of diseases (powdery mildew,strike rust,leaf rust,leaf and glume blotch),and lodging. Our study resulted in providing critical values for grain yield,kernel number,and thousand kernel rr eight for the four probe genotypes. Then reductions of yield components could be determined and analyzed. They provide useful information for characterizing environments subjected to numerous yield-limiting factors. Our study also revealed that the biological variates (essentially susceptibility to powdery mildew and to lodging) affected yield more than the climatic variates. [References: 37].

425 Bulot,S. (1998) **[Spring malting barley: to forecast quality of batches before harvesting].** *Semences et Progres (France) (no 94) p. 134-135.* French. (AGRIS 2000-000818).

La maitrise de la qualite de l'orge brassicole est generalement abordee au niveau de la parcelle. Or les lots fournis aux malteurs resultent d'assemblage de recoltes realisees apres livraison aux organismes collecteurs. Des travaux originaux ont ete menes pour tenter d'ameliorer egalement la qualite a l'echelle du bassin de collecte. L'alimentation azotee,clef de l'elaboration du rendement et du taux de proteines; bien choisir sa parcelle et ses techniques culturales; ecarter les parcelles a risque pour s'assurer des lots homogenes et aux normes.

426 Caekaert,A. (Grandes Malteries Modernes,Marquette lez Lille (France)) (1999) **Towards quality assurance from farmer to brewer.** *Boissons Bios Conditionnement (France) v. 30(282) p. 82-83.* Orge,malt,biere. English. (AGRIS 2000-000839).

Les contraintes qui autrefois se limitaient a la qualite du produit,portent aujourd'hui sur les moyens de production. D'ou le developpement de la contractualisation et la multiplication de cahiers des charges entre les differents acteurs de la filiere. L'objectif etant toujours de pouvoir tracer les produits. La filiere orge malt biere profite ainsi de son organisation pour satisfaire a ces exigences de tracabilite en travaillant sur un guide de bonnes pratiques sur l'entreposage et le transport des orges de brasserie. Elle cree egalement sa propre liste de produits phytosanitaires sur laquelle figurera les produits phytosanitaires ayant subit la methode CEB 185. Parallelement,la collecte orge en France s'organise pour mieux atteindre cet objectif. Ainsi de nombreux organismes stockeurs adherent au GE Infratech. Celui-ci permet de trier efficacement les lots d'orge sur le critere de la proteine des la reception a la moisson. Desormais de nombreux exemples de certification entre l'agriculteur et l'organisme collecteur se developpent: Agri Confiance en est un exemple parmi d'autres.

427 Campariol,L. (1998) **[Triticale,a secondary cereal crop with numerous advantages].** *Semences et Progres (France) (no 95) p. 7-13.* 5 p. p. seulement. French. (AGRIS 2000-000949).

428 Czembor,H.J. (Plant Breeding and Acclimatisation Institute,Radzikow (Poland)) (1999) **Achievements in cereal breeding in Poland and cultivar progress.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 41-55.* 7 tables; 6 ref. Polish. (AGRIS 2000-008612).

The new registred and breeding lines originating from Polish breeding programs represent improvements in yield,disease resistance and resistance for environmental stress. Polish varieties have very good usage value in comparison for foreign varieties,due to their outstanding quality. Especially this is true in the cases of spring wheat,rye and oats. Winter wheat varieties have na average baking quality in contrary to spring wheat varieties which have very good baking quality. It may be consider as a big success maintainance of supremation of Polish varieties of winter triticale.

429 Desiderio,E.; Belocchi,A.; Cecchi,V.; Fornara,M. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)) (1998) **[Results of the experimentation carried out in 1997-98 [Triticum durum Desf. - variety trials]].** *Informatore Agrario (Italy) v. 54(suppl.36) p. 5-20.* 18 tables; 5 graphs. Italian. (AGRIS 2000-000957).

430 Dong Yonghua; Shi Jiping; Shang Zhenqing (Hebei Agricultrual Univ.,Baoding (China). Inst. of Agronomy) (1998) **Effect of IAA and GA3 as foliar spraying agents on physiological characters of wheat seedlings under dry soil conditions.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(3) p. 18-22.* 1 table; 4 ill.,15 ref. Chinese. (AGRIS 2000-008613).

431 Dworakowski,T.; Kuzmicki,J. (Institute of Soil Science and Plant Cultivation,Pulawy (Poland). Dept. of Systems and Economics of Crop Production) (1999) **State and possibilities of cereal production in podlaskie voivodeship.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 73-81.* 5 tables; 12 ref. Polish. (AGRIS 2000-008569). The natural

The natural conditions for cereal cultivation in Podlaskie voivodeship are significantly worse than average for Poland. Morever they are different in dependence on the district. Low level of agricultural practices apart from natural conditions is the main factor that reduces cereal yielding. This low level is seasonally connected with unprofitable price relations and bad financial situation of farmers,especially these ones who farms on the light soils. The results show the existance of significant possibilities for increase cereal yields.

432 Felicio,JC.; Camargo,CEO.; De,Castro,JL.; De,Camargo,MBP. (1999) **Seeding times of triticale in Capao Bonito,SP.** *Pesquisa Agropecuaria Brasileira. 34(12):2193-2202.* Portuguese. [Inst Agron Caixa Postal 28 BR-13001970 Campinas SP Brazil].

Ten triticale and two wheat genotypes were evaluated at three seeding times (21(st) to 31(st) of March,11(th) to 20(th) of April and 21(st) to 31(st) of May) for grain yield,test weight and 1,000 grain weight in experiments carried out at Capao Bonito Experiment Station (SP,Brazil),in the period 1991-95. Soil water availability was obtained by water balances taken at ten days intervals considering 100 mm as the soil retention capacity. The results indicated that the first seeding time was the best for the evaluated parameters. In relation to grain yield genotypes IAC 2 and BGL"S"/CIN"S"//MUS"S" presented good performance at the three seeding times. The genotypes IAC 3,Hare 212,Ardilla"S" and ICT 8803 showed high production at 2(nd) and 3(nd) seeding times and the genotype MERINOS"S"/JLO"S"/3/BGL"S"/CIN"S"//MUS"S" only at the 3(rd) seeding time. The best genotype was IAC 2,independent of the seeding time. Grain yield was associated with 1,000 grain weight. The occurrence of the causal agents of leaf spots was more intense in leaves of the wheat genotype IAC 24 than in triticales except for CEP 15. [References: 17].

433 Filipiak,K.; Kukula,S.; Zarychta,M. (Institute of Soil Science and Plant Cultivation,Pulawy (Poland)) (1999) **Factors**

**determining spring barley production in Poland. 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999.** *Pamietnik Pulawski (Poland) (no.114) p. 83-91.* 2 fig.,4 tables; 6 ref. Polish. (AGRIS 2000-008377).

The effect of some agronomic factors on diversification of spring barley production in Poland was evaluated on the grounds of inquires conducted on private farms within the years 1986-96. It was started that the factors such as soil,mineral fertilization,pesticides and certified seeds influenced spring barley yield to the highest degree. Those factors were found to be closely associated with each other and led to regional diversification of spring barley production in Poland.

434 Fowler,DB. (1999) **CDC Falcon winter wheat.** *Canadian Journal of Plant Science. 79(4):599-601.* English. [Univ Saskatchewan,Ctr Crop Dev 51 Campus Dr Saskatoon SK S7N 5AB Canada].

CDC Falcon is a high-yielding,lodging-resistant,semidwarf winter wheat (Triticum aestivum L.) with good winter hardiness and excellent stem and leaf rust resistance. CDC Falcon is the first winter wheat cultivar with a high level of leaf and stem rust resistance to be registered for production in western Canada. It is especially well adapted to the high-moisture and rust-hazard regions of the western Canadian prairies. CDC Falcon is eligible for grades of the Canada Western Red Winter Wheat class. [References: 4].

435 Fowler,DB. (1999) **CDC Harrier winter wheat.** *Canadian Journal of Plant Science. 79(4):603-605.* English. [Univ Saskatchewan,Ctr Crop Dev 51 Campus Dr Saskatoon SK S7N 5A8 Canada].

CDC Harrier is a winter-hardy,strong-strawed,semidwarf winter wheat (Triticum aestivum L.) with the high grain yield and agronomic performance of CDC Kestrel. CDC Harrier is the first winter wheat cultivar with a high level of stem rust resistance to be registered for production in western Canada. The grain quality characteristics of CDC Harrier are similar to thos of CDC Kestrel. CDC Harrier is eligible for grades of the Canada Western Red Winter Wheat class. [References: 4].

436 Galantini,JA.; Landriscini,MR.; Iglesias,JO.; Miglierina,AM.; Rosell,RA. (2000) **The effects of crop rotation and fertilization on wheat productivity in the Pampean semiarid region of Argentina 2. Nutrient balance,yield and grain quality.** *Soil & Tillage Research. 53(2):137-144.* English. [Univ Nacl Sur,Dept Agron,CIC RA-8000 Bahia Blanca Buenos Aires Argentina].

Wheat (Triticum aestivum L,) in the semiarid region of Argentina has often been grown as a low-input crop. Rainfall scarcity and distribution are the main characteristics of the region. Consequently,a knowledge of the effect of different management practices is the key to sustainable crop production,The objective of this work was to study the effect of 15 years of different wheat management practices on plant nutrition,dry matter production and grain yield and quality. The treatments were: continuous wheat (WW),wheat-grazing natural grasses (WG) and wheat-legume: [vetch (Vicia sativa L,) plus oat (Avena sativa L.) or Triticale (Triticum aestivum L,x Secale cereale L,)] (WL),with and without fertilizer (N + P) application. The WW and WL treatments involved annual tillage and a long fallow period (4-6 months) under stubble mulch,and WG involved annual alternate tillage and a short fallow (1 month). The experiment was started in 1975 and the data presented were obtained in 1989,Wheat yields were higher with the WW than with the WG rotation,but in both rotations fertilization was required to obtain better grain quality (protein content higher than 11 per cent). The wheat-legume rotation resulted in the highest yield,protein content,and better yield components. Fertilizer application did not increase dry matter production but improved nutrient uptake and grain quality. Yield component differences could be attributed to water availability due to different fallow length. The wheat-legume rotation seemed to be the best practice in the semiarid Pampean region. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 25].

437 Gebremedhin,B.; Swinton,SM.; Tilahun,Y. (1999) **Effects of stone terraces on crop yields and farm profitability: Results of on-farm research in Tigray,northern Ethiopia.** *Journal of Soil & Water Conservation. 54(3):568-573.* English. [Int Livestock Res Inst Addis Ababa Ethiopia].

This study was conducted in Tigray,northern Ethiopia,to determine the yield and farm profitability impact of stone terraces. Seventy terrace and 70 non-conserved plots were equally divided between wheat (Triticum aestivum) and fava beans (Vicia faba). Two quadrates each 8 m(2) (86 ft2) were marked on each terraced plot: one just above the terrace (soil accumulation zone) and another one parallel to this but below the next upper terrace (soil loss zone). Only one quadrate (control zone) was marked on each of the non-conserved plots. Results indicate that (1) grain and straw yields for both crops were significantly higher in the soil accumulation zone than in the soil loss zone or in the non-terraced control plots; (2) grain and straw yields from the soil accumulation zone were more stable than those from control zone; (3) over a 30-yr planning horizon,stone terraces yielded a 50% rate of return,roughly equivalent to reported farmer discount rates in Ethiopia. [References: 14].

438 Ghabour,S.K.; Mahfouz,H. (Cairo Univ.,Fayoum (Egypt). Faculty of Agriculture) (1996) **Response of yield and its components of triticale (Triticosecale wittmack) to sowing date,seeding rate and nitrogen fertilizer.** *Fayoum Journal of Agricultural Research and Development (Egypt) v. 10(2) p. 16-26.* 2 tables; 19 ref. English. (AGRIS 2000-000948).

439 Gregorova,H. (Slovenska Polnohospodarska Univ.,Nitra (Slovak Republic). Katedra Krmovinarstva) (1999) **Yield and forage quality of amaranth cultivated after triticale as winter intercrop.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agriculture Sciences v. 45(9-10) p. 627-641.* 5 tables,4 ill.; 21 ref. Slovak. (AGRIS 2000-008185).

In the years 1992-1994 the yield and some qualitative characteristics of amaranth (Amaranthus mantegazzianus L. variety Elbrus) which was cultivated after winter intercrop triticale (variety Dagro),were investigated. There was found highly significant dependence of dry matter yield on atmospherical conditions as well as on row spacing. The herbage yields ranged from 3.79 to 8.54 tons of dry matter per ha in experimental years. At the equal number of plants (400 000 plants per hectar),the higher average yield was obtained with narrower row spacing (6.77 tons of dry matter per ha under row spacing of 0.375 m in comparison to 6.20 tons of dry matter per ha under row spacing of 0.500 m). The highest daily increments both of plant hight and aboveground biomass were found out in the second month of the growing season of amaranth (between the 40th - 60th day). The young plants of amaranth had high content of crude protein and aminoacids. During amaranth ontogenesis their content was being reduced,while the fibre content was increasing at the same time.

440 Gulnaz,A.; Iqbal,J.; Azam,F. (1999) **Seed treatment with growth regulators and crop productivity. II. Response of critical growth stages of wheat (Triticum aestivum L.) under salinity stress.** *Cereal Research Communications. 27(4):419-426.* English. [Nucl Inst Agr & Biol Faisalabad Pakistan].

Laboratory experiments were conducted to study the effect of different concentrations of some plant growth hormones (GA(3),IAA,and IBA) on germination of wheat (Triticum aestivum L.) seeds and seedling vigour under saline conditions. The hormones were administered through seed soaking in aqueous solutions of different concentrations. As expected,germination of seeds decreased with the soil salinity. Negative effects of soil salinity on seed germination were significantly mitigated by hormone treatment. At 200 ppm,GA(3) caused 100% seed germination at an electrical conductivity of 13.11 dSm(-1). Auxins (IAA and IBA) also enhanced the germination at moderate salinity (E.C. 8.44 dSm(-1)) but were unable to cause 100% germination. In normal soil,GA3 and IBA at 100 and 150 ppm,respectively,caused an increase of 10 and 22% in total dry weight of seedling,while IAA treatment had no significant effect. At low (5.41 dSm(-1)) and

moderate (8.44 dSm(-1)) salinity,IAA at 50 and IBA at 10 ppm enhanced the seedling dry matter yield by 17-28%,whereas the increase was only 5-9% with GA(3) at 10 ppm. Seed soaking in 10ppm GA(3) and 50 ppm IAA solutions caused 36 to 43% increase in dry weight at E.C. 13.11 dSm(-1). [References: 28].

441 Juskiw,PE.; Salmon,DF.; Helm,JH. (1999) **Annual forage production from spring-planted winter cereal monocrops and mixtures with spring barley.** *Canadian Journal of Plant Science. 79(4):565-577.* English. [Alberta Agr Crop Res,Field Crop Dev Ctr 5030 50th St Lacombe AB T4L 1W8 Canada].

Spring-planted winter cereals grown as monocrops or in mixture with spring cereals maintain yield and quality into late summer and fall,and can be used to replace or complement perennial pasture. Our objectives were to determine the response to clipping of spring-planted winter cereals,and to determine the effects of seeding rates and ratios of spring to winter cereals on this response. Monocrops of winter triticale (X Triticosecale Wittmack) cv. Pika and winter rye (Secale cereale L.) cv. Musketeer and mixtures of these cereals with the spring barley (Hordeum vulgare L.) cv. Noble were evaluated. Tests were conducted from 1991 to 1993 at Botha and Lacombe,AB. Mixtures of spring:winter cereals were 0:100,25:25,25:75,50:50,75:25,75:75 and 100:100 (Lacombe only),where the ratio of components represented the percentage of the base seeding rate of 250 seeds m(-2). Biomass yields for triticale treatments (5.5 t ha(-1) at Botha and 6.3 t ha(-1) at Lacombe for the May to October growing season) were generally as high as for the rye treatments (5.9 t ha(-1) at Botha and Lacombe); however,at Lacombe,spring regrowth after overwintering for triticale treatments was only 0.6 t ha(-1) compared with 1.0 t ha(-1) for rye treatments (LSD0.05=0.17). As little as 25% spring barley in a mixture ensured good early-season biomass yields,but more than 50% reduced late-season biomass yields. All treatments produced good-quality forage with protein>20%,neutral detergent fibre (NDF)<45% and acid detergent fibre (ADF)<30%. Nitrate contents were frequently >0.5% at both sites in 1991 and 1992,especially for those treatments with spring barley. [References: 19].

442 Karim,MA.; Hamid,A.; Rahman,MS. (1999) **Grain growth and yield performance of wheat under subtropical conditions: I. Effect of sowing dates.** *Cereal Research Communications. 27(4):439-446.* English. [Inst Postgrad Studies Agr PO IPSA Gazipur 1703 Bangladesh].

The optimum sowing time of wheat in subtropical countries like Bangladesh lies between mid-November to mid-December. Wheat is usually sown after transplanted summer rice (aman rice). Due to various reasons summer rice cropping is frequently delayed and so is the wheat. Consequently,farmers are deprived of harvesting potential yield of wheat. However,Kanchan,a high yielding variety (HYV),performs relatively better at late sown conditions than other available wheat varieties. The aim of this study was to elucidate the agronomic reasons for better performance of Kanchan over other varieties. Kanchan ('late variety') and Akbar (a HYV and extensively cultivated) were sown in the field on December 04,1995 and January 04,1996. Their grain growth pattern from anthesis till maturity,and yield and yield components were analyzed. Variety Kanchan outperformed Akbar in terms of number of ear bearing tillers/m(2),individual grain weight and finally grain yield under both sowing conditions. Grain yield was greatly reduced by sowing dates and December sowing plants produced 47% higher yield over the late sowing plants. Grain growth rate and duration for grain growth were affected seriously by sowing times. For December sowing plants the grain growth continued for 39 days in Kanchan and 35 days in Akbar,while the duration was reduced drastically with late sowing to less than 21 days for Kanchan and 19 days for Akbar. Grain growth rate was also higher in Kanchan than in Akbar. Grain growth pattern indicates that both higher growth rate and longer growth duration in Kanchan are responsible for its higher grain yield under late sowing conditions. [References: 19].

443 Kempf,H.; Beutl,F. (1998) **[New trends in wheat breeding are defined by the users].** Saatzucht Schweiger,Feldkirchen (Germany); I.G. Pflanzenzucht GmbH,Munchen (Germany). *Ernaehrungsdienst (Germany) v. (53) p. 15-16.* German. (AGRIS 2000-000976).

Die Entwicklung neuer Weizensorten setzt das fruhzeitige Erkennen von Trends in der landwirtschaftlichen Praxis,der verarbeitenden Industrie und im Umweltschutz voraus. Neue Tendenzen in der Weizenzuchtung bestimmt nicht der Zuchter,sondern der Nutzer. Er muss sich seinerseits wiederum an die haufig wechselnden politischen Vorgaben halten. Es gilt,die Anforderungen,die an eine Sorte im Jahr 2010 gestellt werden,heute zu erkennen und zuchterisch umzusetzen. Die Leistungen,die neue Sorten erbringen mussen,sind vielfaltig. Zum Teil sind sie in aktuellen "Allround-Sorten" jedoch bereits verwirklicht. Der Zuchter muss allerdings Prioritaten setzen und Kompromisse eingehen,um die Anspruche,die oft entgegengesetzte Selektionsrichtungen erfordern,in einer Pflanze zu erfullen. Ohne die klassische Zuchtung ist die Getreide- und Winterweizenzuchtung jedenfalls nicht denkbar. Zu geringe Lizenzen lassen gentechnologische Methoden unrentabel erscheinen. Die Entwicklung einer Sorte dauert von der Kreuzung bis zur EIntragung in die Sortenliste zwolf bis 15 Jahre.

444 Korres,NE.; Froud-Williams,RJ. (1999) **Effects of cultivar and crop density on herbicide sensitivity of winter wheat.** *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :583-584.* English. [Univ Reading,Dept Agr Bot,Sch Plant Sci 2 Earley Gate Reading RG6 6AU Berks England].

The sensitivity of ten winter wheat cultivars at three plant densities to four herbicides was evaluated in two glasshouse experiments. Crop phytotoxicity to diclofop-methyl and fluroxypyr was insignificant but isoproturon and chlorotoluron caused differential damage between cultivars,with isoproturon causing most severe effects. Evidence of reduced herbicide damage with increased plant density is suggested. [References: 3].

445 Lafond,GP.; Gan,YT. (1999) **Row spacing and seeding rate studies in no-till winter wheat for the Northern Great Plains.** *Journal of Production Agriculture. 12(4):624-629.* English. [Agr & Agri Food Canada POB 760 Indian Head SK S0G 2K0 Canada].

The risks of winter kill in winter wheat (Triticum aestivum L.) for the Northern Great Plains of the Canadian prairies san be virtually eliminated when using a no-till production system. Because of the needs for no-till,a re-examination of the effects of row spacing should be conducted. Narrow spacings can cause equipment design and trash clearance problems under heavy residue,The objectives of this study were to determine whether the grain yield of winter wheat could be maintained at wider row spacings by varying seeding rates and P fertilizer and using a fungicide seed treatment,The study consisted of three separate trials that were all conducted at the Indian Head Research Farm in Saskatchewan on an Indian Head heavy clay soil (rego black chernozem Udic Haploboroll). The first trial examined eight seeding rates and the effect of the seed treatment Vitavax Dual Powder. The second trial examined three row spacings and six. seeding rates for three growing seasons. The third trial involved three raw spacings,three seeding rates,and three rates of seed-placed P over 2 yr. Use of the seed treat ment increased grain yield by 4 to 6% in 2 of 3 yr. Optimum seeding rate was about 90 to 120 lb/acre,at which the maximum grain yield writs achieved in 6 out of 8 yr. On average,the 8 and 12 in. row spacing resulted ia an equivalent or higher (8%) grain yield than the 4 in. row spacing,The effect of row spacings was consistent at various seeding rates,with no row spacing x seeding rate interactions. Seed-placed P increased grain yield by 21 to 30%,In the more humid regions of the Northern Great Plains where heavy crop residue may disrupt the seeding operation,wide raw spacing coupled with proper seeding rates,P fertilizer,and a seed treatment,would ensure successful winter wheat production. [References: 25].

446 Liang Juhua (Agricultural Bureau of Changzhi City,Shanxi (China)) (1999) **Yield-increasing effect of wheat straw mulching on winter wheat in southeast Shanxi province.** *Journal of Shanxi*

*Agricultural University (China). Shanxi Nongye Daxue Xuebao (China) v. 19(2) p. 173-175.* 5 tables; 3 ref. Chinese. (AGRIS 2000-008607).

447 Liszewski,M. (Akademia Rolnicza,Wroclaw (Poland). Katedra Szczegolowej Uprawy Roslin) (1998) **Influence of previous crop on spring barley yields.** *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rolnictwo (Poland) (no.347) p. 235-242.* 4 tables; 7 ref. Polish. (AGRIS 2000-008376).

In the years 1990-92 field experiments on the residual effects of 2 faba bean types and oats and different fertilizer rates on spring barley yields were carried out. The site after faba bean of Tibo cultivar was found to be the best,as the yield components of barley were better than after oats,and besides,the grain yield and total protein contents were better by 21 percent and 36 percent,respectively. The most efficient N rates on the site after faba bean were 30 kg/ha for Dino and 90 kg/ha for Tibo cultivar and oats.

448 Macuha,P. (Research Institute of Plant Production,Piestany (Slovak Republic)) (1999) **Comparison of two culture media for testing winter wheat varieties for tolerance to acid environment and toxicity of Al3+ ions.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agriculture Sciences v. 45(9-10) p. 589-596.* 3 tables; 10 ref. Slovak. (AGRIS 2000-008609).

In laboratory conditions were tested some winter wheat varieties (registered in the Slovak Republic) for tolerance to low pH and Al3+ ions in juvenile stage. Experimental plants were cultivated 10 days in air-conditioned chamber in two culture media - in naturally acid soil (pH 4) and in acid nutrient solution with content of 10 ppm Al3+ (pH 4 + Al3+). As standard varieties,the Rumanian tolerant variety Albota and American sensitive variety Scout - 66 were used. The results have shown that these varieties are very suitable for testing of winter wheat varieties for tolerance to low pH and Al3+. From Slovak varieties the most tolerant variety was Rada and the most sensitive Solida. Other varieties rank among medium sensitive and medium tolerant,respectively. Positive correlation between the studied traits suggest that length and weight of roots and leaves can be used equally in testing winter wheat varieties for low pH and Al3+ ions tolerance. Positive correlations between culture media have shown that both media can be used comparably for cultivation and testing for the studied stresses.

449 Macuha,P.; Rychtarik,J. (Vyskumny Ustav Rastlinnej Vyroby,Piestany (Slovak Republic)) (1999) **Reaction of winter wheat and triticale varieties to acid medium.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agriculture Sciences v. 45(7-8) p. 459-470.* 6 tables; 12 ref. Slovak. (AGRIS 2000-008605).

In laboratory conditions the collection of twelve domestic registrated winter wheat varieties and collection of seventeen prevailingly foreign triticale varieties and new-breeding lines for tolerance to acid medium and Al3+ ions was tested. In both collections winter wheat varieties were used as standards. As a tolerant standard was used the Rumanian winter wheat variety Albota and as a sensitive one the American variety Scout-66. Winter wheat varieties were tested after cultivation in natural acid soil (pH 4) and triticale varieties after hydroponic cultivation in acid nutritious solution (pH 4). After ten-days cultivation of plants the length and weight of roots and leaves were evaluated. According to results the most tolerant one was the standard Albota variety. Rada,Livia,Blava and Torysa varieties belong to middle tolerant ones. Other varieties were middle sensitive. The most sensitive variety was the standard Scout-66 variety. In collection triticale the most tolerant were Poland variety Ugo and German new-breeding line LP-5096.4.96. Among sensitive varieties belong Poland varieties Ded-179/91 and Ded-194 and other ones rank among middle tolerant and middle sensitive varieties.

450 Mandal,AK.; De,BK.; Basu,RN. (1999) **Dry-seed treatment for improved germinability and productivity of wheat (Triticum aestivum).** *Indian Journal of Agricultural Sciences. 69(9):627-630.* English. [Univ Calcutta,Coll Agr 35 Ballygunge Circular Rd Calcutta 700019 W Bengal India].

Treatment of harvest-fresh (high-vigour) 'Sonalika' wheat seed (Triticum aestivum L. emend Fiori & Paol.) by dry-dressing with crude plant materials (dried and finely powdered ripe red chilli fruit and turmeric rhizome) 1-2 g/kg of seed and pharmaceutical formulations (aspirin-containing aspro and ascorbic acid-containing Celin) 100 mg/kg of seed and commercial calcium hypochlorite,active ingredient of common bleaching powder 2 g/kg of seed greatly reduced the loss of vigour and viability under accelerated ageing at 100% relative humidity and 40 degrees C and natural ageing under ambient conditions. Mid-storage soaking-drying treatment with water (wet treatment),which was included for the comparison with dry seed treatment,was equally effective in slowing down seed deterioration. The crop raised from the treated and untreated seeds showed that water soaking-drying treatment as:well as dry treatments,especially with Aspro and bleaching powder significantly improve field performance and productivity of the crop over untreated control. Between the wet (soaking-drying) and dry treatments only marginal differences were noted in respect to germinability and crop productivity. [References: 24].

451 Martyniuk,S.; Zieba,S.; Mackowiak Cz. (Instytut Uprawy,Nawozenia i Gleboznawstwa,Pulawy (Poland)) (1998) **Relations between enzymatic activity of soil and yields of spring barley in a long-term field experiment. 31. All-Polish Microbiological Symposium: Biologically-Active Metabolites of Microorganisms in Soil - Advantages and Injuriousness. Sobotka Gorka (Poland) 4-7 Sep 1996.** *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Konferencje (Poland) (no.332) p. 31-38.* 2 fig.,2 tables; 7 ref. Polish. (AGRIS 2000-008375).

The results presented in the article were obtained during a 16-year long-term field experiment on two crop rotations: A - potato-winter wheat-spring barley-maize,and B - potato-winter wheat (green manure)-spring barley-grass-clover mixture. The results show that dehydrogenase and acid phosphatase activities in the soil as well as the number of c.f.u. of bacteria were higher in crop rotation B than those in crop rotation A. The highest and significant correlation coefficients were found between the grain yields of barley and acid phosphatase activity. Dehydrogenase activity and the crop yields were correlated only in the case of samples collected in June,and for alkaline phosphatase no similar relations were found.

452 Mazzola,M.; Gu,YH. (2000) **Impact of wheat cultivation on microbial communities from replant soils and apple growth in greenhouse trials.** *Phytopathology. 90(2):114-119.* English. [USDA ARS,Tree Fruit Res Lab 1104 N Western Ave Wenatchee,WA 98801 USA].

Studies were conducted to assess the impact of short-term rotations of wheat on microbial community composition and growth of apple in soils from replant orchard sites. Soils from two orchards were cultivated with three successive 28-day growth cycles of 'Eltan','Penewawa',or 'Rely' wheat in the greenhouse and subsequently planted to 'Gala' apple seedlings. Cultivation of orchard replant soils with any of the three wheat cultivars enhanced growth of apple relative to that achieved in untreated soils. Improved growth was associated with a marked reduction in apple root infection by species of Rhizoctonia and Pythium. Populations of plant-parasitic nematodes were below damage threshold levels in these orchard soils; however,apple seedlings grown in wheat-cultivated soils had significantly lower root populations of Pratylenchus spp,than did seedlings grown in untreated soils. Growth of apple in 'Penewawa'-cultivated soils often was superior to that observed in soils planted with 'Eltan' or 'Rely'. In untreated orchard soils,fluorescent pseudomonad populations isolated from soil and the apple rhizosphere were dominated by Pseudomonas fluorescens biotype C and Pseudomonas syringae. Cultivation of replant soils with wheat induced a characteristic transformation of the fluorescent pseudomonad population,and Pseudomonas putida dominated the population of this bacterial group recovered from wheat-cultivated replant orchard soils. Results from this study suggest that use of short-term wheat cropping sequences during orchard

renovation could be useful in management of replant disease and that this disease-control option may operate,in part,through modification of the fluorescent pseudomonad community. [References: 33].

453 Merah,O.; Deleens,E.; Monneveux,P. (1999) **Grain yield,carbon isotope discrimination,mineral and silicon content in durum wheat under different precipitation regimes.** *Physiologia Plantarum. 107(4):387-394.* English. [Univ Paris Sud,UMR 8618,Inst Biotechnol Plantes,Ctr Orsay Bat 630 F-91405 Orsay France].

Twenty-one durum wheat genotypes originating from different geographic areas were groan during 3 successive years.,The trials were characterised by different precipitation regimes,Carbon isotope discrimination (Delta),carbon content (CC) and ash content (m(a)) were assessed in the flag leaf during anthesis,then in the kernel at full maturity. Differences between the 3 years,due to mater availability,were noted for Delta,m(a),CC and yield,Genotypic differences were also noted within each year for all the traits studied. Some genotypes from the Middle East exhibited higher flag leaf and kernel Delta than those originating from the West of the Mediterranean basin. The kernel Delta was strongly correlated with grain yield (GY). The leaf Delta correlated with GY only under strong water limitation and with biomass production (BP) in favourable mater conditions. For the flag leaf,ii was correlated with m(a) and with CC. Silicon content was then assessed in the flag leaf and in the kernel on a subset of 10 genotypes differing in their Delta values,Strong positive correlations were noted between silicon content and Delta and m(a) for the flag leaf. However,no clear relationship was found between silicon content and GY,The results obtained in this study confirm the validity of kernel Delta as a predictive criterion for GY under water stress and suggest the possible use of kernel m(a) as an alternative criterion to select genotypes with higher mater stress tolerance. [References: 36].

454 Mersinkov,N.; V"lcheva,D.; Navushchanov,S. (Institut po Echemika,Karnobat) (1998) **Agrobiological characteristics of introduced spring milting barley samples.** Selskostopanska Akademiya,Sofia (Bulgaria). *Rasteniev"dni Nauki (Bulgaria). Plant Science v. 35(10) p. 843-847.* 3 tables; 17 ref. Bulgarian. (AGRIS 2000-000822).

455 Miglierina,AM.; Iglesias,JO.; Landriscini,MR.; Galantini,JA.; Rosell,RA. (2000) **The effects of crop rotation and fertilization on wheat productivity in the Pampean semiarid region of Argentina. 1. Soil physical and chemical properties.** *Soil & Tillage Research. 53(2):129-135.* English. [Univ Nacl Sur,Dept Agron,CONICET RA-8000 Bahia Blanca Buenos Aires Argentina].

Wheat in the semiarid region of Argentina has often been grown as a low-input crop,Rainfall scarcity and distribution are the main characteristics of this region. The knowledge of the combined effects of crop rotation and fertilization on soil physical and chemical properties are the key for a sustainable crop production. Soil properties for an Entic Haplustoll in the semiarid region of Argentina were evaluated,where differ ent crop rotations were used for 15 years. Wheat-wheat (Triticum aestivum L.) (WW),wheat-grazing natural grasses (WG) and wheat-legume [vetch (Vicia sativa L,) plus oat (Avena sativa L.) or Triticale (Triticum aestivum L. x Secale cereale L,)] (WL) rotations with and without fertilizer (64 kg N and 16 kg P ha(-1)) were studied. The annual wheat cropping system (WW) resulted in the lowest soil organic carbon (SOC) and total nitrogen (N-t) levels. Extractable phosphorus (P-ext) values were sufficient for wheat growth with all treatments and decreased with depth. Fertilizer applications significantly increased the proportion of large pores (>8.81 mu m) in the 0-0.07 m depth of the WW and WG system plots. A decrease in the proportion of medium size pores (0.19-8.81 mu m) and in the water holding capacity was observed in the WG rotation plots. The fertilized treatments resulted in the following sequence of available water: WL > WW > WG,Bulk density was similar with all treatments for each depth,except with the fertilized WG treatment that had the lowest value in the 0-0.07 m depth. These results showed the positive influence of legume inclusion (WL) and alternate cable grazing (WG) on SOC and N-t contents,(C) 2000 Elsevier Science B.V. All rights reserved. [References: 31].

456 Minella,E.; Arias,G.; Linhares,AG.; Silva,MSE. (1999) **Barley cultivar BR 2: Malting quality and resistance to net blotch caused by Pyrenophora teres.** *Pesquisa Agropecuaria Brasileira. 34(11):2163-2168.* Portuguese. [EMBRAPA,Ctr Nacl Pesquisa Trigo Caixa Postal 451 BR-99001970 Passo Fundo RS Brazil].

Barley cultivar BR 2 developed by the Embrapa-Centro Nacional de Pesquisa de Trigo (CNPT) was released in 1989. BR 2 traces back to seven plants selected in the F-3 from the cross FM 424/TR 206 made in Passe Fundo,RS,in 1979. BR 2 is a two row spring barley with wide adaptation,earliness and short straw. It is the first Brazilian cultivar resistant to Pyrenophora teres,causal agent of net blotch,a major barley disease in Brazil. In eight years of yield testing in the National Barley Trial in twelve locations of Southern Brazil,BR 2 yielded between 1,621 and 4,014 kg/ha of plump kernels,with 3%,13% and 6% yield increase over the check cultivar Antarctica 05 in the States of Rio Grande do Sul and Santa Catarina,Parana and in the mean of 96 trials,respectively. On the farm fields,BR 2 has yielded over 5,000 kg/ha. Since its approval as a malting barley in 1992,it has been widely used,taking up 30% in 1993 and 90% in 1997 of the area sown. Barley BR 2 represents a cornerstone in the history of barley breeding in Brazil and is making a significant contribution to the competitiveness of the domestic barley production. [References: 12].

457 Muller,K. J. (1999) **[Criteria for the development of high quality wheat on light soils].** 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte". AMS Berlin (Germany). 23-25 Febr 1999. Gesellschaft fuer goetanische Forschung e. V.,Darchau (Germany). . Hoffmann,H.;Muller,S. *Beitrage zur 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte" [Proceedings of the fifth scientific conference on ecological farming "From the periphery to the focus of attention"] p. 165-168. Gesellschaft fuer goetanische Forschung e. V.,Darchau (Germany).* Dr. Koster. German. (AGRIS 2000-000952).

Um auf leichten,okologisch bewirtschafteten Standorten eine zufriedenstellende Bestands- und Ertragsbildung erzielen zu konnen,haben sich Aussaaten in der ersten Septemberhalfte als hilfreich erwiesen. Die VerarbeitungsparameterFeuchtkleber und Sedimentation konnten mit einer Jauchedungung vor dem Ahrenschieben angehoben werden. Mit den im Handel erhaltlichen Qualitatsweizen konnten die minimal erforderlichen Qualitatsparameter aber nur in Einzelfallen naherungsweise erreicht werden. Als Aufgabenstellung fur die zugrundeliegenden Versuche ergab sich die Suche nach morphologischen Typen,die im Fruhjahr rasch die Reihen schliessen,und die Frage danach,wie der Weizen beschaffen sein muss,mit dem bei zufriedenstellendem Ertrag die fur die Verarbeitung geforderten Qualitatsparameter ohne zusatzliche Pflegemassnahmen (Hacken,Striegeln) erreicht werden konnen.

458 O'Donovan,JT.; Newman,JC.; Harker,KN.; Blackshaw,RE.; McAndrew,DW. (1999) **Effect of barley plant density on wild oat interference,shoot biomass and seed yield under zero tillage.** *Canadian Journal of Plant Science. 79(4):655-662.* English. [Agr & Agri Food Canada Box 29 Beaverlodge AB T0H 0C0 Canada].

There has been little research aimed at developing regression models to describe the effects of barley and wild oat plant density on barley yield loss,or wild oat biomass and seed yield. Such models are an important component of integrated weed management systems,and can help determine when weed control with herbicides is economical. Field experiments were conducted over 4 yr at Vegreville,Alberta,to determine the interactive effects of wild oat and barley plant density on barley and wild oat variables in a zero tillage system. A non-linear regression model in most cases provided good descriptions of barley yield loss,wild oat shoot dry weight,and wild oat seed yield as functions of wild oat and barley plant densities. The interactive effect of wild oat and barley plant density on percentage barley yield loss did not differ significantly (P = 0.05) among years. A pooled regression model

describing barley yield loss accounted for 57% of the variation,and provides a means of estimating yield loss due to wild oat in barley grown under zero tillage. Barley yield loss increased as wild oat density increased but the magnitude of the yield loss diminished with increasing barley plant density. Wild oat economic threshold densities varied among years,and were strongly influenced by barley price and expected wild oat-free yield. Economic thresholds were greater at higher barley plant densities. Barley seed weight decreased with increasing barley plant density,and to a lesser extent with increasing wild oat density. The interactive effect of wild oat and barley plant density on wild oat seed yield varied significantly with year,and appeared to be influenced by climatic conditions. The cooler,wetter spring of 1996 favored wild oat seed production (by several orders of magnitude) compared with the relatively warmer and drier spring of 1995. Each year wild oat seed yield and shoot dry weight decreased as barley plant density increased. The results suggest that seeding barley at relatively high rates may reduce the need for wild oat control with herbicides in zero tillage systems. [References: 24].

459 Pandey,AK.; Prasad,K.; Prakash,V.; Singh,RD. (1999) **Planting pattern in wheat (Triticum aestivum) and Indian mustard (Brassica juncea) crop mixture under irrigated conditions in mid-hills of North-Western Himalayas.** *Indian Journal of Agronomy. 44(1):21-25.* English. [Vivekananda Parvatiya Krishi Anusandhan Shala Almora 263601 Uttar Pradesh India].

A field experiment was conducted during the winter season of 1990-91 to 1992-93 to study the effect of planting pattern of wheat (Triticum aestivum L. emend. Fiori & Paol.) and Indian mustard [Brassica juncea (L.) Czernj. & Cosson] under 2 wheat row spacings (22.5 and 15 cm) and as seed mixture under broadcast sowing. Wheat + Indian mustard intercropped in an 8 : 1 row combination under both wheat row spacings and mixed cropping of wheat and Indian mustard under broadcast sowing system did not show significant difference in wheat yield compared to yield of respective,sole crop of wheat. All the inter- and mixed cropping treatments showed higher wheat-equivalent yields,land-equivalent ratio (LER) and benefit :cost ratio over sole crops,and the highest values of these parameters were obtained under planting pattern of wheat and Indian mustard in row ratio of 8 : 1 in both wheat row spacings,but 22.5 cm wheat row spacing proved more remunerative. [References: 4].

460 Petr,J.; Skerik,J. (1999) **Yield response of winter wheat varieties to low inputs.** *Rostlinna Vyroba. 45(12):525-532.* Czech. [Czech Univ Agr Prague 16521 6 Suchdol Czech Republic].

In five-year varietal trial the set of varieties was studied in conditions of ecological cultivation according to IFOAM (International Federation of Organic Agriculture Movements) principles and Methodological Instruction for Ecological Agriculture of Ministry of Agriculture of CR. Trials were a part of national investigation of varieties for the List of Recommended Varieties preparing by the Central Institute for Supervising and Testing in Agriculture,Brno. The trials with wheat varieties are conducted on many Czech places at various cultivation intensity,fertilization and application of pesticides and growth regulators. Our trial was conducted without using of fertilizers,herbicides,fungicides,insecticides and growth regulators. Experimental station of the Czech University of Agriculture is in Praha-Uhrineves in fertile beet-growing region (production capacity of soil 84 points) with a good reserve of nutrients. Average annual air temperature is 8.3 degrees C and annual sum of precipitation is 575 mm. Weather pattern in different years is presented in Tab. I. Different weather pattern in different years participated significantly in obtained yields. In 1994 average yield of all varieties amounted to 7.92 t.ha(-1),in 1995 7.51 t.ha(-1) what were markedly higher yields than in the other years. Significantly lowest yield in 1996 was 4.58 t.ha(-1) likewise in 1998. Average yields of tested varieties in different years are given in Tabs. II to VI. Sets of identical varieties tested for three,four,five years were compiled for statistical evaluation. The varieties Bruta,Samanta and Siria seemed to be the most yielding in these sets. Regarding the good yield,the varieties Astella,Estica and Athlet of new varieties included in the last years in this system of cultivation were well manifested. It was proved that for cultivation procedures with low inputs or directly for ecological cultivation it is not necessary to select older varieties or originall regional as it was recommended earlier. On the contrary,these are mostly very good yielding modern varieties forming the yield rather by productivity of spike than the number of spikes and high weight of caryopses. They should be also the so-called plastic,i.e. suitable into less favourable conditions,with very good health condition. [References: 9].

461 Popova,M.M. (Mykolaiv Regional Agricultural Experimental Station (Ukraine)) (1999) **[The productivity of the winter cereal crops in the crop rotations of the Southern Steppe of Ukraine].** 214 ref.; 2 ill.; 38 tables. 150 p. Ukrainian. (AGRIS 2000-008631).

The place of the winter crops in crop rotation is testified for conditions of the South of Ukraine. The better preceding crops for winter wheat and barley are determined to provide high yields. The increase in the yields by 15 up to 20 % is achieved.

462 Rychtarik,J. (Vyskumny Ustav Rastlinnej Vyroby,Piestany (Slovak Republic)) (1999) **Productivity and technological quality of winter wheat hybrids in early generations after crossing.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agriculture Sciences v. 45(9-10) p. 578-588.* 6 tables; 10 ref. Slovak. (AGRIS 2000-008608).

In the hybrid progenies of F1 and F2 generations from varieties Lutescens 2836473-1 and Obrij,Hana and Selekta arranged according to the system of incomplete diallel crossing,the level,stability,and corellations between the traits were assessed to be used in the breeding for productivity and technological quality. Experiments were carried out at RIPP Pieçœany in 1990 and 1991. Progeny of F1 and F2 generations was sown in the field experiments with parallel inclusion of both maternal and paternal varieties. Field observations were carried out and after the harvest the plant and grain analyses followed (namely the grain number,grain weight in ear,one thousand grains weight,plant height,gluten content,swelling capacity of gluten,protein content,and sedimentation test). The highest level of productivity traits was revealed in the variety Lutescens,and that of technological quality traits in Hana. Successful selection in the combination of productivity and quality traits can be expected especially in the selection from the hybrid progenies of Lutescens/Hana,Hana/Selekta and Obrij/Hana. One thousand grain weight,plant height,wet gluten and protein contents were the most stable traits. Number and weight of grains in ear were negatively correlated. One thousand grain weight and plant height were positively correlated with the traits of bread-making quality.

463 Sandhu,KS.; Arora,VK.; Chand,R.; Sandhu,BS.; Khera,KL. (2000) **Optimizing time distribution of water supply and fertilizer nitrogen rates in relation to targeted wheat yields.** *Experimental Agriculture. 36(1):115-125.* English. [Punjab Agr Univ,Dept Soils Ludhiana 141004 Punjab India].

Long-term field experiments were conducted at sis different sites (representing dryland and irrigated environments) with wheat (Triticum aestivum) on sandy loam soils to generate a database relating available water supply and fertilizer nitrogen (N) rate ro grain yield. Stepwise multiple regression analysis showed that water supply and fertilizer N at more than 53 cm a(-1) and 103 kg ha(-1) a(-1) were unproductive. A method,based on the principle of equi-marginal productivity of water in different periods of crop growth,has been used to estimate the optimum allocation of the variable amounts of water supply over the growing season. The optimized quantities of water in different periods of crop growth were then employed to compute fertilizer N requirement to achieve a given yield target. For medium grain yield targets (4-5 t ha(-1)),the range of substitution between fertilizer N and water for efficient resource use was quite wide. [References: 22].

464 Scheller,E. (1999) **[Protein quality of wheat,dinkel and one-grained wheat].** 5. Wissenschaftstagung zum Okologischen

Landbau "Vom Rand zur Mitte". AMS Berlin (Germany). 23-25 Febr 1999. . Hoffmann,H.;Muller,S. *Beitrage zur 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte" [Proceedings of the fifth scientific conference on ecological farming "From the periphery to the focus of attention"] p. 121-125.* Dr. Koster. German. (AGRIS 2000-000958).

Im Auftrag der Backerei Herzberger wurden konventionelle Backweizen- und Okoweizenproben von der Steinbacher Muhle in Sachsen,Weizen- und Dinkelproben aus dem auf einem biologisch-dynamisch bewirtschafteten Betrieb angebauten Sortenversuch des Beratungsringes Schwabisch-Hall und 6 Einkornproben von K. J. Muller,angebaut auf Gut Schmerwitz,und eine Einkorn-Feldprobe von dem Landwirt Walter Maier auf ihre Aminosaurezusammensetzung untersucht. Ferner wurden ausgewahlte Proben nach Wieser et all (1996) fraktioniert,wobei auf den letzten Schritt der Auftrennung der laugeloslichen Fraktion in lmw- und hmw-Untereinheiten verzichtet wurde.

465 Schillinger,WF.; Cook,RJ.; Papendick,RI. (1999) **Increased dryland cropping intensity with no-till barley.** *Agronomy Journal. 91(5):744-752.* English. [Washington State Univ,Dept Crop & Soil Sci,Dept Plant Pathol 201 Johnson Hall Pullman,WA 99164 USA].

For most of a century,the wide spread practice of growing only one crop every other year in a tillage based wheat (Triticum aestivum L.)-fallow rotation has degraded soils and contributed to environmental problems in low-precipitation (<350 mm annual) dryland regions of the inland Pacific Northwest of the USA. Many growers in this 2-million-ha cropland area are increasing the intensity; of cropping with spring crops,but most use conventional tillage (CT) for seedbed preparation. The agronomic performance of spring barley (Hordeum vulgare L.),sown into CT seedbeds with double-disk drills or into standing stubble with several types of no-fill (NT) drills (hoe,single disk,and notched coulter),was determined in two experiments ron ducted both in 1996 and 1997 where the previous crop was either winter wheat or spring barley. We measured stand establishment,seed-zone temperature,soil Hater,dry biomass accumulation,rhizoctonia root rot,surface residue retention. and grain yield components,Plant stand (r(2) = 0.60). dry biomass accumulation (r(2) = 0.63),and spike density (r(2) = 0.62) as single independent variables,and combined in a multiple regression model (R-2 = 0.81),Here strongly correlated (P < 0.001) to grain yield. Early-season seed-zone temperatures were cooler under NT,but seed-zone water was slightly higher with CT. Low spike density consistently occurred in a wide row spacing (406 mm) NT drill treatment,and the highest overall yields Here obtained with NT drills with rows spaced 255 mm or less,Rhizoctonia root rot was severe on seminal roots in ail treatments in three out of four trials,but did not appear to limit yields,possibly due to healthy crown roots and favorable growing conditions. No-till spring sowing into undisturbed standing stubble (2420-5230 kg ha(-1)) can produce grain yields equal to or exceeding those under CT and ran provide environmental and potential soil quality benefits for low-precipitation dryland farming areas in the inland pacific Northwest. [References: 20].

466 Tadic,L.; Mesi,M.; Popovic,V. (Poljoprivredni fakultet,Novi Sad (Yugoslavia)) (1998) **Appraisal of quality of threshing of the new [Yugoslav] varieties of wheat in 1997.** 6. naucni skup Pravci razvoja poljoprivredne tehnike. Novi Sad (Yugoslavia). 26 Jun 1996. *Savremena poljoprivredna tehnika (Yugoslavia) v. 24(5) p. 147-155.* 1 graph; 3 tables; 6 ref. Serbian. (AGRIS 2000-008606).

In the process of combine harvesting the parameters are found concerning the amount and structure of losses,as well as those pointing to the quality of the grain threshed. In the investigations the following wheat varieties have been included: NS-Rana-5,Evropa-90,Pobeda and Danica. Investigations have shown that the significant differences existed between the varieties studied.

467 Thakur,R.; Verma,UN.; Singh,MK.; Pal,SK. (1999) **Energetics of wheat (Triticum aestivum) production under different levels of irrigation,seed rate and fertilizer.** *Indian Journal of Agricultural Sciences. 69(9):624-626.* English. [Birsa Agr Univ,Dept Agron Ranchi 834006 Bihar India].

A field experiment was conducted during winter season of 1992-94 at Ranchi on sandy-loam soil to estimate the energetics of wheat (Triticum aestivum L. emend Fiori & Paol.) production under different levels of irrigation,seed rate and fertilizer. Wheat cultivation required 92.9% more indirect sources of energy than direct sources of energy input. The crop with 4 irrigations at crown-root initiation,maximum tillering,boot and milk stages produced 4 071 kg grain/ha and consequently gave 33.8 and 32.4% higher energy through grain and total biomass,respectively along with higher grain (3.08) and total biomass(6.55) energy-use efficiency and required less specific energy (4 769 MJ/tonne) than 3 irrigations at maximum tillering,boot and milk stages (44 717 MJ/ha grain and 96 092 MJ/ha biomass energy output). Increasing seed rate beyond 100 kg/ha did not influence the grain as well as energy production and energy-use efficiency. Crop fertilized with N150P32.7K33.2 gave higher grain yield (3 615 kg/ha) as well as energy output through grain (53 141 MJ/ha) and biomass (113 091 MJ/ha) with net energy output of 94 269 MJ/ha than N120P32.7K33.2. However,in respect of grain and biomass energy-use efficiency,crop with N120P26.2K33.2 being similar to N150P32.7K33.2 had lowest specific energy (5 143 MJ/tonne) requirement,a desired production index,established an edge over the highest dose N180P39.3K33.2. Reduction in energy production owing to omission of irrigation at crown-root initiation stage of wheat cannot be mitigated by increasing seed rate and fertilizer. [References: 5].

468 Tothne Lokos,K. (1999) **Effect of plant density for yield stability of wheat varieties with conventional and doubled haploid origins.** *(Novenytermeles) (no.2) p. 125-132.* Hungarian. (AGRIS 2000-000955).

The value of a new variety depends on the achievement of its potential productivity and the stabilization of average yield or other important characters under different conditions. The stability of commercial doubled haploid varieties is of particular interest. The objective of this study was to investigate the effect of different origins (conventional and DH) on the yield stability of winter wheat at three different plant densities.

469 Vida,Gy.; Bedo,Z. (1999) **Use of principal component analysis in correlation studies between kernel hardness and other breadmaking quality traits in winter aestivum and durum wheat genotypes.** *(Novenytermeles) (no. 1) p. 33-42.* Hungarian. (AGRIS 2000-000954).

Varieties and breeding lines of common wheat (Triticum aestivum L.) and durum (T. durum Desf.) wheat included in the Martonvasar breeding programme were examined using a Single Kernel Characterization System 4100 instrument to determine the correlation between the kernel hardness index and other technological quality traits. It can be seen from the results that the majority of common wheat varieties and lines belong to the hard-grained type and only a few have soft grains.

470 Vill,P. (1999) **The differentiated influence on monocultured barley yield,weeds and diesel fuel consumtion [Estonian].** *TRANSACTIONS OF THE ESTONIAN AGRICULTURAL UNIVERSITY,VOL 205 : AGRONOMY. 205:86-92.* Estonian. [Estonian Inst Agr Teaduse 4 EE-75501 Saku Harjumaa Estonia].

471 Wan Luzhang (Shandong Academy of Agricultural Sciences,Jinan (China). Inst. of Plant Protection) (1999) **Relationship between effective accumulated temperature of wheat straw media and productivity of Volvariella volvacea.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 1) p. 12-14.* 3 tables. Chinese. (AGRIS 2000-008666).

472 Wittouck,D.; Boone,K.; Bulcke,S.; Debosschere,S.; Sanders,G.; Vandaele,A.; Vandenbulcke,J.; Calus,A. (Provincie West Vlaanderen,Rumbeke (Belgium). Onderzoeks en Voorlichtingscentrum voor Landen Tuinbouw) (1999) **[Cereal crops. Results of the research performed in 1998 [in Belgium]. Scientific report].** 234 p. Dutch. (AGRIS 2000-000821).

473 Wittouck,D.; Maddens,K.; Denoo,A.; Vanpeteghem,J.; Boone,K.; Vandaele,A.; Calus,A. (Provincie West Vlaanderen,Rumbeke (Belgium). Onderzoeksen Voorlichtingscentrum voor Land en Tuinbouw) (1998) **[Cereal crops. Results of the research performed in 1996 [in Belgium]. Scientific report].** received in 1999. 166 p. Dutch. (AGRIS 2000-000819).

474 Wittouck,D.; Vanpeteghem,J.; Boone,K.; Sanders,G.; Vandaele,A.; Vandenbulcke,J.; Calus,A. (Provincie West Vlaanderen,Rumbeke (Belgium). Onderzoeks en Voorlichtingscentrum voor Land en Tuinbouw) (1999) **[Cereal crops. Results of the research performed in 1997 [in Belgium]. Scientific report].** 240 p. Dutch. (AGRIS 2000-000820).

475 Wojciechowski,W. (1998) **Effect of varying post-harvest and pre-sowing soil tillage and two rates of artificial fertilizer on growth and yields of winter wheat. Pt. 1. Effect on stubble crops yielding and selected soil properties.** Akademia Rolnicza,Wroclaw (Poland). Katedra Ogolnej Uprawy Roli i Roslin. *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rolnictwo (Poland) (no.347) p. 43-62.* 9 tables; 44 ref. Polish. (AGRIS 2000-008610).

The mixture of legumes with non-legumes was a better stuble crop than winter rape in the years with rainfalls above 100 mm,giving nearly 33 percent more dry matter. On the other hand,winter rape as a stubble crop was more certain and profitable in dry years. In the year with 85 mm rainfall it produced 37 percent more dry matter as compared to the mixture during growth of the stubble crops. Pre-sowing ploughing was the better tillage method than disking. The stubble crops yielded less dry matter after disking than after ploughing regardless of the ploughing depth. Physical properties of soil were more affected by stubble crops ploughed under than by tillage depth. The stubble crops increased total and capillary porosity of the soil and decreased soil compaction.

476 Wojciechowski,W. (1998) **Effect of varying post-harvest and pre-sowing soil tillage and two rates of artificial fertilizer on growth and yields of winter wheat. Pt. 2. Effect on winter wheat yields.** Akademia Rolnicza,Wroclaw (Poland). Katedra Ogolnej Uprawy Roli i Roslin. *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rolnictwo (Poland) (no.347) p. 63-77.* 1 fig.,7 tables; 28 ref. Polish. (AGRIS 2000-008611).

The results indicate that stubble crops used as green manure before sowing of winter wheat favourably affected the growth and yield of this cereal,giving,on average 0.34 t/ha (6.4 percent) more grain than the yield obtained from conventional method of wheat cultivation. A legume + non-legume mixture resulted in 12.8 percent increase in grain yield,and rape in the same tillage treatment gave 5.9 percent increase. The stubble crops,however,can fail during years with dry summer/autumn,reducing soil moisture,plant emergence (by 24.7 percent) and as a result decreasing the grain yield (by 4.0 percent) compared to conventional method of winter wheat cultivation.

477 Zhang Boxi; Shan Yongnian (Academia Sinica,Lushan,Jiangxi (China). Lushan Garden of Botany); Ye Xianrong (1999) **Research on the effect of Geniposide on wheat yield.** *Acta Agriculturae Jiangxi (China). Jiangxi Nongye Xuebao (China) v. 11(2) p. 1-5.* 3 tables; 8 ref. Chinese. (AGRIS 2000-000956).

478 Zhou Zhiguo (Shandong Agricultural Univ.,Taian (China)) (1998) **Effect of cultivation methods on cotton boll development of 3-1 model with middle spring cotton variety.** *Acta Gossypii Sinica (China). Mian Hua Xue Bao (China) v. 10(3) p. 146-151.* 5 tables; 1 ill.,9 ref. Chinese. (AGRIS 2000-008349).

## F02 PLANT PROPAGATION

479 Akula,C.; Akula,A.; Henry,R. (1999) **Improved regeneration efficiency from mature embryos of barley cultivars.** *Biologia Plantarum. 42(4):505-513.* English. [So Cross Univ Lismore,CRC Mol Plant Breeding,Ctr Plant Conservat Genet Lismore NSW 2480 Australia].

A reliable protocol for plant regeneration from mature embryo derived calli of nine barley (Hordeum vulgare) cultivars has been developed,The auxins 2,4-dichlorophenoxyacetic acid,picloram and dicamba proved effective in inducing callus from mature embryos of most of the barley cultivars,The induced primary callus was loose,friable and translucent,It ultimately yielded creamy white and compact callus after 2 - 3 transfers on fresh medium of the same composition. Callus induction and regeneration capacity were highly cultivar dependent,Addition of a high concentration of picloram (4 mg. dm(-3)) promoted regeneration in 3 cultivars (Tallon,Grimmett and Sloop),In cv,Arapiles,abscisic acid and betaine were crucial in generating morphogenic callus from the mature embryos,Plants regenerated from these calli were hardy and developed roots readily when transferred to hormone free medium. [References: 26].

480 Harvey,A.; Moisan,L.; Lindup,S.; Lonsdale,D. (1999) **Wheat regenerated from scutellum callus as a source of material for transformation.** *Plant Cell Tissue & Organ Culture. 57(2):153-156.* English. [John Innes Ctr Plant Sci Res,Dept Mol Genet Norwich NR2 7UH Norfolk England].

Reports of wheat transformation efficiencies vary from less than 1% to more than 5% for individual experiments. Rarely are negative experiments reported though we estimate that between one in two and one in three of all experiments fail to produce transformed plants. Consequently if transformation efficiencies were calculated from the total number of scutellum bombarded rather than from only those experiments which produced transformed plants there would be a significant fall in reported efficiencies. The use of scutellum-derived material from plants regenerated from scutellum callus and grown in a controlled environment room significantly reduced the number of experiments failing to produce plants. Though there is a small but significant increase in transformation efficiencies for individual experiments,the recovery of plants,as a direct consequence of the reduction in the number of failed experiments,increases nearly 350%,from 4.8 plants/1000 scutella from seed gown plants bombarded to 17 plants/1000 embryos bombarded from tissue culture regenerated plants. There appears to be no additional gains to be made from plants which are cycled through tissue culture more than one time. [References: 12].

481 Immonen,S.; Robinson,J. (2000) **Stress treatments and ficoll for improving green plant regeneration in triticale anther culture.** *Plant Science. 150(1):77-84.* English. [Agr Res Ctr,Plant Prod Res Crops & Soil Myllytie 10 FIN-31600 Jokioinen Finland].

Anther culture of 10 winter triticale cultivars of diverse origin was studied. Two-week cold pretreatment was applied to all cultivars. In addition,cold pretreatment in combination with heat shock or mannitol starvation and prolonged cold stress of three weeks were tested on some of the genotypes. Field and greenhouse conditions were compared for growing the mother plants. Anthers for stress treatment testing were cultured on solid W14. Ficoll-supplemented induction medium was tested with three cultivars. A total of 378 green regenerants were analysed for DNA-ploidy with flow-cytometry. Morphological observations and seed-set were recorded for 317 plants grown to maturity. Large genotypic differences were noted between the cultivars. Seven out of 10 cultivars exhibited a differential response to the treatments and it was possible to improve green plant production considerably by applying increased stress or by culture on a medium containing ficoll. Cold pretreatment complemented with heat shock improved androgenetic response of the three cultivars tested. Prolonged cold pretreatment increased generally both the proportion of green plants and the proportion of spontaneous doubling. Morphological abnormalities,possibly caused by aneuploidy and associated with loss of fertility,were observed in 23% of the plants. (C) 2000 Elsevier Science Ireland Ltd. All rights reserved. [References: 26].

482 Kondic,A. (Institut za ratarstvo i povrtarstvo,Novi Sad (Yugoslavia)); Sesek,S.; Pekaric Nadj,N. (1998) **Pulsating electromagnetic field (PEMF) stimulation influence on wheat zygotic embryo callus growth in vitro.** *Savremena poljoprivreda (Yugoslavia) (no. 3-4) p. 37-41.* 1 ill.; 1 table; 10 ref. Serbian. (AGRIS 2000-008759).

The objective of this study was to examine the possible influence of the pulsating electromagnetic field (PEMF) on callus formation and growth. Tha calli originated from in vitro wheat (Triticum aestivum L.) zygotic embrio. Mature wheat cv. 'Jugoslavija' embryos were isolated under sterile conditions and cultured on a modified MS (Murashige and Skoog,1962) nutritive medium. Immediately after the isolation the embryos were exposed for 30 minutes to low intensity PEMF of five different frequencies: 8,15,30,50 and 72 Hz. The callus diameters were measured every five days. The lat measurement took place 40 days after the stimulation. The results indicated that electromagnetic field stimulation had influence on callus formation and growth. Electromagnetic field of the lowest examined frequencies (8 and 15 Hz) shown the highest influence on callus growth. However,electromagnetic fields of 30,50 and 72 Hz didn't have significant influence on callus formation and growth.

483 Manninen,OM. (2000) **Associations between anther-culture response and molecular markers on chromosomes 2H,3H and 4H of barley (Hordeum vulgare L.).** *Theoretical & Applied Genetics. 100(1):57-62.* English. [Agr Res Ctr FIN-31600 Jokioinen Finland].

Segregation distortion is a common phenomenon among anther-culture-derived plants and it has been suggested that the distorted areas may contain genes affecting survival in anther-culture. Segregation of 111 markers was checked in an androgenetic barley (Hordeum vulgare L.) progeny and a linkage map was constructed. Thirty one progeny lines were tested for their anther-culture ability and associations between molecular markers and anther-culture traits were established. Two regions on chromosomes 2H and 4H were associated with anther response,three on 2H (two areas) and 3H with plant regeneration rate,and one on 4H with spontaneous diploidization. The chromosomal regions controlling anther-culture response and the regions where distorted segregation was found were not always the same. [References: 34].

484 Marcinska,I.; Biesaga-Koscielniak,J.; Dubert,F.; Kozdoj,J. (1999) **Effect of length and developmental stage of spike on the induction and differentiation efficiency of callus tissue in winter wheat. Evidence for generative development of regenerated plants.** *Acta Physiologiae Plantarum. 21(4):355-363.* English. [Polish Acad Sci,Franciszek Gorski Dept Plant Physiol Podluzna 3 PL-30239 Krakow Poland].

The capability of various immature inflorescence fragments of winter wheat cv. Grana to regenerate via callus was studied. The induction and regeneration efficiency of callus derived from spikes at different developmental stages (2-50 mm in length) was determined. Callus was initiated from the following organs of spike: whole segments of the youngest spikes (pairs of spikelets with a part of rachis),single spikelets and rachis of the middle stage spikes and finally individual flowers within spikelets excised from the oldest spikes. Morphogenic callus,capable to regenerate new plants,was obtained from segments derived from spikes being at early stage of organogenesis (2-10 mm in length) and distal flowers (3rd and 4th order) within spikelets of most advanced spikes (41-50 mm in length). Explants derived from spikes at the middle stage of organogenesis (11-40 mm in length) were not able to regenerate into new plants. No regeneration occurred also from developed rachis and glumes. All regenerants obtained in this study reached heading phase without additional vernalization,they were fertile and produced normally formed grains. It indicates that callus transferred the physiological state of the mother tissue i. e. the readiness to flowering. [References: 19].

485 Mitic,N. (Agricultural Research Institute "Serbia",Zajecar (Yugoslavia). Center for Agricultural and Technological Research); Nikolic,R.; Neskovic,M. (1999) **Somatic embryogenesis and plant regeneration from immature embryos of five wheat cultivars and their reciprocal hybrids.** *Archives of Biological Sciences (Yugoslavia) v. 51(2) p. 99-104.* 6 ill.; 2 tables; 18 ref. English. (AGRIS 2000-008760).

The tissue culture response of immature embryos,evaluated according to callus formation,percentage of regenerative calli and the number of plants per embryos,was investigated in five wheat (Triticum aestivum L.) cultivars and their reciprocal hybrids. Somatic embryogenesis and adventitious bud formation were induced on a medium containing high 2,4-D concentration,followed by the transfer to a growth regulator-free medium. With respect to the percentage of regenerative calli,the five investigated wheat cultivars were classified into three groups. By crossing the cultivar with the highest tissue culture response and the two cultivars with the lowest response,it was demonstrated that the regeneration potential was heritable. The results suggest the presence of a class of extra-nuclear factors (genetic and/or environmental) in the "Vesna" cultivars. They significantly account for a relatively higher regeneration capacity in the hybrids having this cultivar as a pollen recipient (female parent) than in those where the "Vesna" cultivar was the pollen donor (male parent).

486 Moller,M.; Smith,ML. (1999) **The effects of priming treatments using seaweed suspensions on the water sensitivity of barley (Hordeum vulgare L.) caryopses.** *Annals of Applied Biology. 135(2):515-521.* English. [Royal Bot Gardens 20A Inverleith Row Edinburgh EH3 5LR Midlothian Scotland].

Two seaweed suspensions,one prepared from Ascophyllum nodosum (Linnaeus) Le Jolis (ANS),another from Laminaria hyperborea (Gunn.) Foslie (LHS),were evaluated for their effects on the water sensitivity of barley (Hordeum vulgare L.) seeds. Priming in either seaweed suspension did not reduce viability. Priming in ANS was beneficial to seeds germinated in elevated water levels. The suspension of A. nodosum reduced the water sensitivity of barley seeds better than either water or polyethylene glycol (PEG) priming treatments. ANS also reduced the microbial population on the seeds by 86%. The hygroscopic properties and the antibiotic effect of the suspension of A. nodosum resulted in greater oxygen availability to the embryo,enabling more seeds to germinate under oxygen deficient conditions. [References: 39].

487 Sesek,S.; Dencic,S. (Naucni institut za ratarstvo i povrtarstvo,Novi Sad (Yugoslavia)) (1996) **Acclimatization of wheat regenerants produced by in vitro anther culture.** *Selekcija i semenarstvo (Yugoslavia). Plant Breeding and Seed Production v. 3(3-4) p. 19-22.* 2 tables; 5 ref. Serbian. (AGRIS 2000-008758).

An investigation was conducted to assess three methods of acclimatization and vernalization of winter wheat regenerants produced by in vitro anther culture. The first method involved the acclimatization of regenerants in a phytotron,in controlled conditions of relative humidity (95%),temperature (28 deg C) and light (2,00 lx),vernalization in a cold chamber at 4-5 deg C,and subsequent cultivation of regenerants in a greenhouse. The second method involved the acclimatization of regenerants at high humidity (covered with a foil) and the temperature of 26-28 deg C,vernalization in a cold chamber and subsequent cultivation in a greenhouse. The third method involved the acclimatization of regenerants at high humidity and the temperature of 26-28 deg C,vernalization in a cold chamber at 5-10 deg C and subsequent cultivation in natural conditions of the open field. The results showed that the third method produced the largest number of regenerants that reached the stage of physiological maturity - 90%. The plants matured in the first third of July. The second method produced 58% of mature regenerants which reached the stage of physiological maturity in the second or last third of May. Of the regenerants cultivated in the phytotron,72% reached the stage of physiological maturity,in the last third of February or the first third of March.

488 Zhang,L.; Rybczynski,JJ.; Langenberg,WG.; Mitra,A.; French,R. (2000) **An efficient wheat transformation procedure: transformed calli with long-term morphogenic potential for plant**

**regeneration.** *Plant Cell Reports. 19(3):241-250.* English. [Univ Nebraska,USDA ARS 344 Keim Hall Lincoln,NE 68683 USA].

A method for producing large numbers of transgenic wheat plants has been developed. With this approach,an average of 9.7% of immature embryo explants were transformed and generated multiple self-fertile,independently transformed plants. No untransformed plants,or escapes,were regenerated. This transformation procedure uses morphogenic calli derived from scutellum tissue of immature embryos of Triticum aestivum cv. Bobwhite co-bombarded with separate plasmids carrying a selectable marker gene (bar) and a gene of interest,respectively. Transformed wheat calli with a vigorous growth phenotype were obtained by extended culture on media containing 5.0 mg/l bialaphos. These calli retained morphogenic potential and were competent for plant regeneration for as long as 11 months. The bar gene and the gene of interest were co-expressed in T0 progeny plants. This wheat transformation protocol may facilitate quantitative production of multiple transgenic plants and significantly reduce the cost and labor otherwise required for screening out untransformed escapes. [References: 34].

489 Zheng,MY.; Konzak,CF. (1999) **Effect of 2,4-dichlorophenoxyacetic acid on callus induction and plant regeneration in anther culture of wheat (Triticum aestivum L.).** *Plant Cell Reports. 19(1):69-73.* English. [Houghton Coll,Dept Biol 1 Willard Ave Houghton,NY 14744 USA].

Anthers from a doubled-haploid line of spring wheat (Triticum aestivum L.) cv. Pavon 76 were plated in liquid P-4 medium supplemented with 2,4-dichlorophenoxyacetic acid (2,4-D) at four concentrations (0.5,1.0,2.0,4.0 mg/l) for 5,10,15,and 25 days before being transferred to another medium with the same or reduced 2,4-D concentrations for the remainder of the induction phase for a total of 45 days. Incubation with 0.5 mg/l 2,4-D for 45 days produced lower callus yield and plant regeneration,indicative of insufficient auxin for callus induction. Callus yield and regeneration frequencies were higher with 1.0 mg/l 2,4-D. With 2.0 or 4.0 mg/l 2,4-D,an induction period of 10 or 15 days was sufficient for initiation of callus development. The extended presence of 2-4 mg/l 2,4-D in the medium beyond the initiation phase was detrimental to plant regeneration. Thus optimal callus induction and plant regeneration could be obtained through manipulating the 2,4-D concentration and the duration of its presence in the induction medium. [References: 23].

## F03 SEED PRODUCTION

490 Ruza,A.; Obolevica,D. (Latvia Univ. of Agriculture,Jelgava (Latvia). Faculty of Agriculture. Inst. of Crop Sciences. Dept. of Plant Production) (1999) **The hull-less barley and oats germination process and its influence on plant growing.** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization on husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 250-259.* Latvia University of Agriculture. 4 tables; 6 ill.,3 ref. English. (AGRIS 2000-001069).

The germination process of hull-less barley and oats seeds and its influence on the productivity of the crops were investigated at the Latvia University of Agriculture in the period of 1996-1997. The germination power of normal (non-hulled) and mechanically hulled seed samples obtained during harvesting was studied. The investigation results showed that the mechanically and also genetically hulled barley and oats seeds had essentially lower germination power compared to the non-hulled seeds. The hull-less seed material produced weaker sprouts and smaller mass per sprout length unit. Under the field conditions the hull-less grain seeds had a low germination ability.

## F04 FERTILIZING

491 Adhikari,C.; Bronson,KF.; Panuallah,GM.; Regmi,AP.; Saha,PK.; Dobermann,A.; Olk,DC.; Hobbs,PR.; Pasuquin,E. (1999) **On-farm soil N supply and N nutrition in the rice-wheat system of Nepal and Bangladesh.** *Field Crops Research. 64(3):273-286.* English. [Texas A&M Univ,Agr Expt Stn Route 3 Box 219 Lubbock,TX 79401 USA].

On-farm research to evaluate the productivity and nitrogen (N) nutrition of a rice (Oryza sativa L.)-wheat (Triticum aestivum L.) cropping system was conducted with 21 farmers in the piedmont of Nepal and with 21 farmers in northwest Bangladesh. In Nepal,two levels of N-fertilizer (0-22-42 and 100-22-42 kg N-P-K ha(-1)) and farmers' nutrient management practices were tested in the rice season,and three levels of N (0-22-42,70-22-42,and 100-22-42) and farmers' practices were evaluated in the wheat season. The treatments in Bangladesh included a researchers managed minus-N plot (0-22-42) and the farmers' practices. Rice and wheat yields were higher in all treatments than the 0-22-42 control plots,with the exception of rice with the fanners' practices at one location in Bangladesh. The researchers' treatment of 100-22-42 in Nepal resulted in larger yields of both rice and wheat than the farmers' practices,indicating that farmers' rates of N-fertilizer (mean 49 kg N ha(-1)) were too low. Delaying wheat seeding reduced yields in the fertilized plots in both countries,especially as N-fertilizer dose increased. Soil N-supplying capacities (SNSC),measured as total N accumulation from the zero-N plots (0-22-42),and grain yields without N additions were greater for rice than for wheat in both Nepal and Bangladesh. Higher SNSC in rice was probably due to greater mineralization of soil organic N in the warm,moist conditions of the monsoon season than in the cooler,drier wheat season. However,SNSC was not correlated with total soil N,two soil N availability tests (hot KCl-extractable NH4+ or 7-day anaerobic incubation),exchangeable NH4+ or NO3-. Wheat in Nepal had greater N-recovery efficiency,agronomic efficiency of N,and physiological efficiency of N than rice. Nitrogen internal-use efficiency of rice for all treatments in both countries was within published ranges of maximum sufficiency and maximum dilution. In wheat,the relationship between grain yield and N accumulation was linear indicating that mobilization of plant N to the grain was less affected by biotic and abiotic stresses than in rice. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 41].

492 Auti,AK.; Wadile,SC.; Pawar,VS. (1999) **Yield,quality and nutrient removal of wheat (Triticum aestivum) as influenced by levels and sources of fertilizer.** *Indian Journal of Agronomy. 44(1):119-122.* English. [Mahatma Phule Krishi Vidyapeeth Rahuri 413722 Maharashtra India].

Response of 'HD 2189' wheat (Triticum aestivum L. emend. Fiori & Paol.) to different levels and sources of fertilizer was studied during the winter (rabi) season of 1993-94 and 1994-95,to investigate efficiency of 5 sources of fertilizer at 4 levels of fertilizer in relation to yield,quality and uptake of nutrients. The-grain yield,straw yield and protein content were increased significantly with the increase in levels of NPK. The yield of grain was 19.73,30.93,39.03 and 45.62 q/ha due to application of 30,15 and 15; 60,30 and 30; 90,45 and 45 and 120,60 and 60 kg/ha N,P2O5 and K2O respectively. Significant improvement due to increased levels of NPK was also noticed for uptake of nutrients. There were no significant differences between the sources tried in terms of yield,protein content and uptake of nutrient,indicating equal availability of nutrients from all sources. [References: 4].

493 Bulot,S. (1998) **[Hybrid wheat use well late applications of nitrogen].** *Semences et Progres (France) (no 97) p. 216-217.* French. (AGRIS 2000-001227).

Pour permettre a un ble hybride d'exprimer tout son potentiel,les techniques culturales classiques doivent etre modifiees. Quelques adaptations de la fertilisation azotee peuvent deja etre envisagees.

494 Candrakova,E.; Bakula,J.; Kulik,D. (Slovenska Polnohospodarska Univ.,Nitra (Slovak Republic). Katedra Rastlinnej Vyroby) (1999) **The regulation possibilities of spring barley nitrogen nutrition during vegetation season.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for*

*Agricultural Sciences v. 45(11-12) p. 700-713.* 3 tables,1 ill.; 11 ref. Slovak. (AGRIS 2000-008835).

In 1997 and 1998 years the six variants of nitrogen fertilization of spring barley during vegetation season have been observed in field experiments of beet cropping area. The influence of nitrogen application on yield formation have been evaluated and the most convenient way and term of nitrogen application have been searched for. Forecrop have been sugar beet. The four varieties of spring barley (Kompakt,Garant,Atribut and Expres) and three kinds of fertilizers (ammonium nitrate with lime-stone,DAM-390 and Fostim) have been compared. Nitrogen in every form have been applicated in dose 20 kg per hectare and in standard dose calculated on yield of 5 ton grain per hectare (based on content of mineral nitrogen in soil at the growing stage beginning of tillering). The results have shown decisive effect of year on formation all yield components and yield of grain of spring barley. Varieties Garant and Expres have achieved the highest yield of grain. Nitrogen application in form of DAM-390 at the end of tillering have had the highest yield effect.

495 Chaudhry,A.U.; Mehmood,R. (University of Agriculture,Faisalabad (Pakistan). Dept. of Agronomy) (1998) **Determinations of optimum level of fertilizer nitrogen for varieties of wheat (Triticum aestivum L.).** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 351-353.* 4 tables,7 ref. English. (AGRIS 2000-001229).

Investigation to compare the growth,yield and protein percentage in grains of two wheat varieties under varying levels of nitrogen were carried out in sandy loam soil. The nitrogen levels comprised 0,50,100,150,200 and 250 kg ha-1 while the cultivars were Inqualab-91 and Pasban-90. The results showed that the various components of wheat crop such as number of tillers per unit area,spike bearing tillers,grain weight per spike,1000-grain weight,grain yield and straw yield were affected significantly by different levels of nitrogen. Nitrogen application in the range of 150 to 200 kg ha-1 alongwith 118 kg P2O5 ha-1 was found to be an optimum dose. Nitrogen application beyond range of 150 to 200 kg ha-1 will not be profitable. Protein contents of wheat grain increased with increasing level of nitrogen. Inqualab-91 produced significantly more number of fertile tillers per unit area,1000-grain weight,higher harvest index and straw yield than Pasban-90. The average grain yield of Inqualab-91 was 4.35 t ha-1 and Pasban-90 was 3.66 t ha-1.

496 Desiderio,E.; Fornara,M.; D'Egidio,M.G.; Cecchini,C.; Palumbo,M. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)); Ciriciofolo,E. (Perugia Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee); Codoni,D. (Regione Abruzzo,Pescara (Italy). Agenzia per i Servizi di Sviluppo Agricolo); Lendini,M. (Centro Regionale Agrario Sperimentale,Cagliari (Italy)); Porfiri,O. (Centro di Miglioramento Genetico Vegetale N. Strampelli,Abbadia di Fiastra,Macerata (Italy)) (1998) **[Effect of nitrogen fertilization on production and grain quality of durum wheat [Triticum durum Desf. - variety trials - Latium - Marches - Sardinia - Sicily - Umbria]].** *Informatore Agrario (Italy) v. 54(10) p. 31-38.* 8 tables; 3 graphs. Italian. (AGRIS 2000-001233).

497 Djokic,D.; Kostic,M.A. (Institut za istrazivanja u poljoprivredi "Srbija",Kragujevac (Yugoslavia). Centar za strna zita) (1996) **The influence of rate and time of application of nitrogen on concentration,accumulation,distribution and utilization of nitrogen in wheat.** *Savremena poljoprivreda (Yugoslavia) (no. 1-2) p. 5-10.* 1 table; 21 ref. Serbian. (AGRIS 2000-008984).

Investigation was carried out in a pot experiment,on soil-sand mixture,with winter wheat cultivar Srbijanka. Rates of applied nitrogen were 1,2,3,4,and 6 g/pot of KAN (calcium ammonium nitrate,27% N) and time of application in stages of tillering,jointing,heading and flowering. Nitrogen concentration in above-ground part of mature plants,grains and straw increased with increasing of nitrogen rate. The later application of nitrogen caused larger increase of nitrogen concentration in grains,while earlier application increased more nitrogen concentration in straw. The accumulation of nitrogen in plant increase of nitrogen rate,and changed under effect of time of application,too. The highest accumulation was obtained at topdressing in jointing,and the lowest one at nitrogen topdressing in flowering. The nitrogen harvest index was higher at later addition of nitrogen and at medium rates. Physiological efficiency of nitrogen decreased with increase of nitrogen rate,and somewhat at later nitrogen addition. Utilization of nitrogen from fertilizer decreased with increase of nitrogen rate,and at its application at earlier and later dates.

498 Djokic,D.; Kostic,M.; Stojanovic,J. (Institut za istrazivanja u poljoprivredi "Srbija",Kragujevac (Yugoslavia). Centar za strna zita) (1996) **Nitrogen nutrition efficiency of wheat as genotype characteristic.** *Savremena poljoprivreda (Yugoslavia) (no. 1-2) p. 25-30.* 1 table; 9 ref. Serbian. (AGRIS 2000-008986).

In three field and three pot experiments with different wheat cultivars nitrogen nutrition efficiency of wheat was studied. Efficiency of nitrogen nutrition (ENN) was analyzed particularly through indicators of accumulation (EAN) and utilization efficiency of nitrogen in plants (EUN) in yield formation. The results showed that same nitrogen nutrition efficiency i.e. same yield may be received as results of different value of accumulation and utilization of nitrogen in plant. Incorporation of maximal values of these indicators from different cultivars in new genotype provide further yield increase - higher than in parent with maximal yield. It is demonstrate that negative correlations between accumulation and utilization of nitrogen in plant is one of the essential problems of nitrogen nutrition efficiency.

499 El Kady,F.A. (Ministry of Agriculture,Cairo (Egypt). (Field Crops Research Inst.); Zein,F.I. (1997) **Response of wheat to foliar application of urea and some micronutrients [Zn,Fe,Mn].** *Menofiya Journal of Agricultural Research (Egypt) v. 22(6) p. 1697-1700.* 2 fig. 3 tables; 19 ref. English. (AGRIS 2000-001218).

500 Filipov,Kh.; Dachev,Z. (Institut po Introduktsiya i Rastitelni Resursi "K. Malkov",Sadovo (Bulgaria)) (1999) **Varietal differentiation of wheat according to the effect of nitrogenous nutrition of the yield of grain.** Selskostopanska Akademiya,Sofia (Bulgaria). *Rasteniev"dni Nauki (Bulgaria). Plant Science v. 36(1) p. 5-11.* 3 ill.,3 tables; 11 ref. Bulgarian. (AGRIS 2000-001220).

501 Fotyma,E.; Pecio,A. (Institute of Soil and Plant Cultivation,Pulawy (Poland). Dept. of Plant Feeding and Fertilization) (1999) **Relationships between nitrogen content and dry matter accumulation of cereals.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 93-100.* 4 fig.,3 tables; 8 ref. Polish. (AGRIS 2000-008994).

The study was based on the analysis of data obtained from long-term field experiments on nitrogen fertilization conducted in IUNG experimental stations in the nineties. Cereal crops were grown in 4-field crop rotation: winter cereal after rapeseed and spring ones after root crops. The relationship between nitrogen content and dry matter accumulation in winter and spring wheat,winter triticale and spring barley was described by the equation. It was stated that for optimally nutrished with nitrogen winter and spring wheat and winter triticale coefficients were very similar.

502 Fotyma,M.; Jadczyszyn,T.; Zarychta,M. (Institute of Soil Science and Plant Cultivation,Pulawy (Poland). Dept. of Plants Feeding and Fertilization) (1999) **Wheat fertilization in Poland on the base of GUS data and results of surveying.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 101-109.* 3 tables; 14 ref. Polish. (AGRIS 2000-008995).

The state of mineral nutrition of wheat in Poland was analysed on the base of statistical data collected by GUS (State Statistical Office) in 1993-97 and results of surveing. The method of evaluation of mineral fertilizers doses under wheat from data on fertilizers consumption by until area of agricultural land is presented. Mineral Fertilizarion covers approximately 50 percent

of wheat demands for fertilizers. The average effectiveness of wheat fertilization equals 8 kg of grain per 1 kg NPK fertilizers.

503 Gabel,D.; Friedel,J.K.; Stahr,K. (1999) **[Surveying of net nitrogen mineralization in situ under the conditions of ecological farming].** 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte". AMS Berlin (Germany). 23-25 Febr 1999. Hohenheim Univ.,Stuttgart (Germany). Inst. fuer Bodenkunde und Standortlehre. . Hoffmann,H.;Muller,S. *Beitrage zur 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte" [Proceedings of the fifth scientific conference on ecological farming "From the periphery to the focus of attention"] p. 476-479. Hohenheim Univ.,Stuttgart (Germany). Inst. fuer Bodenkunde und Standortlehre.* Dr. Koster. German. (AGRIS 2000-001224).

In der Hauptwachstumsphase von Winterweizen spielt die N-Versorgung eine bedeutende Rolle fur die Ertragsleistung. In der Zeit zwischen Bestockung und spater Stossphase kann eine gute N-Versorgung die Erhaltung und Ausbildung der angelegten Organe unterstutzen. Die Eignung von zwei Methoden zur Abschatzung der Stickstoff-Netto-Mineralisierung (NNM) im Okologischen Landbau sollte fur diesen Zeitraum verglichen werden. Die erwartete Beziehung der N-Netto-Mineralisierung zum mikrobiellen Stickstoff sollte gepruft werden. Gegenstand der Untersuchung waren Ackerschlage auf der Domane Kleinhohenheim (Versuchsstation der Universitat Hohenheim),die seit 3 Jahren okologisch bewirtschaftet werden.

504 Gahoonia,TS.; Nielsen,NE.; Lyshede,OB. (1999) **Phosphorus (P) acquisition of cereal cultivars in the field at three levels of P fertilization.** *Plant & Soil. 211(2):269-281.* English. [Royal Vet & Agr Univ,Dept Agr Sci,Plant Nutr & Soil Fertil Lab Thorvalsensvej 40 DK-1871 Frederiksberg C Denmark].

Low phosphorus (P) availability in soils and diminishing P reserves emphasize the need to create plants that are more efficient P users. Knowledge of P efficient germplasm among the existing cereal varieties may serve as the basis for improving soil P use by selection and breeding. We had identified some cereal cultivars (winter wheat: Kosack and Kraka; winter barley: Hamu and Angora; spring barley: Canut,Alexis,Salka,Zita;) which differed ($p<0.05$) in P depletion from thin slices (0.2 mm) of the rhizosphere soil under controlled conditions. In the present study,the same cultivars were studied under field conditions at three levels of P supply (no-P,10 and 20 kg P ha(-1)) and the differences in P uptake as found in the previous work were confirmed. Under both conditions,the variation between the cultivars was greatest in soil without P fertilizers (no-P) for about 30 years. The variation in P uptake with most cultivars disappeared when 10 kg P ha(-1) was applied. Root development did not differ between the cultivars much,but there was wide,consistent variation in their root hairs,regardless of growth media (solution,soil column and field). Increase in soil P level reduced the length of root hairs. The variation in root hairs between the cultivars was largest in no-P soil. When 10 kg P ha(-1) was applied,the root hair lengths did not differ between the cultivars. Barley cultivars with longer root hairs depleted more P from the rhizosphere soil and also absorbed more P in the field. The relationship between root hairs and phosphorus uptake of the wheat cultivars was less clear. The wide variation in P uptake among the barley cultivars in the field and its relationship to the root hair development confirms that root hair length may be a suitable plant characteristic to use as criterion for selecting barley cultivars for P efficiency,especially in low-P soils. [References: 24].

505 Govedarica,M.; Milosevic,N.; Jarak,M.; Ubavic,M.; Radanovic,Z. (Poljoprivredni fakultet,Novi Sad (Yugoslavia). Institut za ratarstvo i povrtarstvo) (1996) **Effect of green manure on microbiological activity [in soil] under wheat.** *Savremena poljoprivreda (Yugoslavia) (no. 1-2) p. 69-73.* 2 tables; 23 ref. Serbian. (AGRIS 2000-008987).

The investigation included the study of the effect of green manure (15 t/ha) on microbiological activity in soil under wheat. Soil for microbiological analysis was sampled at the beginning,middle and end of the growing period from the depth of 0-30 cm. Green manure incorporation brought to increased total number of microorganisms,oligonitrophilic bacteria,actinomycetes,celulolitic microorganisms and enzymic activity of dehydrogenase in all three sampling periods. The number of ammonifiers,fungi and nitrogen fixing bacteria was higher in the control plot at the beginning of growing period and in the middle and end of growing period it was also higher in the soil with incorporated green manure. The incorporation of green manure reduced the activity of urease in all sampling periods. The highest microbiological activity in soil with incorporated green manure was found at the end of growing period and without green manure at the beginning of the growing period.

506 Grant,CA.; Bailey,LD. (1999) **Effect of seed-placed urea fertilizer and N-(n-butyl)thiophosphoric triamide (NBPT) on emergence and grain yield of barley.** *Canadian Journal of Plant Science. 79(4):491-496.* English. [Agr & Agri Food Canada,Brandon Res Ctr Box 1000A,RR 3 Brandon MB R7A 5Y3 Canada].

Seedling damage from excess seed-placed urea fertilizer can be a major problem in one-pass seeding and fertilizing systems. Field studies were conducted on a clay loam and a fine sandy loam soil over 3 yr to evaluate the impact of seed-placed urea N,with and without the addition of the urease inhibitor N-(n-butyl) thiophosphoric triamide (NBPT) on stand density and growth of barley. Seedling damage,as indicated by reduction in stand density,occurred on both soil types at rates of seed-placed N as low as 40 kg N ha(-1). Addition of NBPT to the urea fertilizer increased stand density at N levels where damage occurred with the untreated urea. Dry matter yield at heading generally was unaffected by N application or use of NBPT; however,final yield was increased by use of NBPT in four of five site-years. Use of NBPT appears promising as a method of reducing the risk of seedling damage from seed-placed urea fertilizer,thus increasing the rate of urea-N that can be safely placed with the seed. [References: 16].

507 Hudec,J. (Slovenska Polnohospodarska Univ.,Nitra (Slovak Republic). Katedra Chemie) (1999) **Effect of the basic organic component of the preparate Avit-35 on the winter wheat yield.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agricultural Sciences v. 45(9-10) p. 565-577.* 4 tables; 8 ref. Slovak. (AGRIS 2000-008990).

In the pot and field trials the effect of the basic organic component of the liquid fertilizer Avit-35,foliary applying at the different doses and growth stages on the yield formation of winter wheat summer form was studied. The tested active ingredience inhibites the growth of wheat at the first phases after short-term application (on 10-14 days) and subsequently stimulate the prolonging growth. The application at the tillering has not positive effect on the number of productive tillers only and does not inhibite the grain number in the ear,but gentle positively effects the weigh of grain,too. The using of tested active ingredient (optimally at the tillering in dose 1.5 kg/ha) is more suitable from the point of the yield formation (non significant) than application of Retacel. On the contrary the Retacel is more applicable from the point of stem strenght. The most optimal term of the tested ingredient application is at the beginning of the ear formation. After this application with the rising dose of the active ingredient (with optimum at the dose 1 kg/ha) the tendency of the growth of the grain weight was registered,which is at possitive correlation with yield of grain. The convenience of the latter application term confirms its antistress effect,because the growth phases following the application (mainly after milk ripeness) could be regarded as phases of a succeeding nature stress of the plant,frequently accompanied by external stress conditions (June=July).

508 Hylander,L. (Uppsala Univ. (Sweden). Inst. of Limnology); Johansson,L.; Renman,G.; Ridderstolpe,P.; Siman,G. (1999) **Phosphorus recycling from waste water by filter media used as fertilisers.** Use of Municipal Organic Waste. Jokioinen (Finland). 23-25 Nov 1998. Use of municipal organic waste; Proceedings of NJF seminar no. 292. Petersen,J.; Petersen,S.O. (Eds.). *DIAS. Report. Plant Production (Denmark); 166 p. p. 139-146. Danmarks*

*Jordbrugsforskning,Foulum (Denmark).* DJF. 5 ill.,16 ref. English. (AGRIS 2000-009011).

509 Jensen,LS.; Pedersen,IS.; Hansen,TB.; Nielsen,NE. (2000) **Turnover and fate of N-15-labelled cattle slurry ammonium-N applied in the autumn to winter wheat.** *European Journal of Agronomy. 12(1):23-35.* English. [Royal Vet & Agr Univ,Dept Agr Sci,Plant Nutr & Soil Fertil Lab Torvaldesnsvej 40 DK-1871 Frederiksberg C Denmark].

The fate of (NH4)-N-15-N labelled cattle slurry applied before sowing in September of a winter wheat crop was studied on a loamy sand soil. The aim was to quantify immobilization of slurry NH4-N into microbial biomass,the speed at which nitrate derived from the slurry NH4-N was transported down the soil profile,and the utilization of slurry NH4-N by the winter wheat crop. Cattle slurry was applied at a rate corresponding to 75 kg NH4-N ha(-1),with very little loss by volatilization (<4%) due to rapid incorporation by ploughing. The slurry amendment resulted in a doubling of soil surface CO,flux,an index of microbial activity,over non-amended soil within the first c. 2 weeks,but ceased again after c. 4 weeks,due to depletion of the easily degradable substances,e.g,volatile fatty acids,in the slurry. Nitrification of the applied NH4-N was fast and complete by 3 weeks from application,and at this time,the maximum immobilization of slurry NH4-N into the microbial biomass (23% of applied (NH4)-N-15-N) was also observed,although no significant increase in total microbial biomass was observed. Rapid turnover of the microbial biomass quickly diluted the assimilated N-15,With only 6% of applied (NH4)-N-15-N remaining in the microbial biomass by next spring. Downwards transport of nitrate was rapid in spite of lower than normal precipitation,and slurry-derived (NO3)-N-15-N appeared in ceramic suction cups installed at 60 cm depth already 2 months after slurry application. Due to the unusually low winter precipitation in the experimental year,wheat yields were high,and the recovery of N in above-ground plant biomass derived from slurry NH4-N at harvest reached 32%. An additional 45% of the applied slurry NH4-N could be found in the soil to a depth of 100 cm (mostly in organic form in the plough layer),indicating that 23% had been lost by leaching or in gaseous form. It was concluded that although significant immobilization of slurry NH4-N did occur,this was not sufficient to prevent leaching of slurry-derived N over the winter and that the relatively high recovery of slurry-derived N in the wheat crop was due partly to lower than normal winter percolation and partly to a relatively high rooting depth on this particular site. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 33].

510 John,A.; Khalid,M. (University of Agriculture,Faisalabad (Pakistan). Dept. of Soil Science); Javed,F. (1998) **Evaluation of compost fertilizer "Zarkhez" in conjunction with chemical fertilizers for rice and wheat production.** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 368-371.* 4 tables,15 ref. English. (AGRIS 2000-001169).

Experiments conducted to evaluate a compost fertilizer "Zarkhez" showed that effect of compost alone (2000 kg/ha and 4000 kg/ha) on number of tillers,1000-grain weight,yield and NPK uptake by rice and wheat was almost similar to control,whereas,significant improvements were observed when combination of compost and chemical fertilizers were applied. Maximum yield of paddy (4.25 t ha-1) and wheat (2.61 t ha-1) were obtained with 4000 kg ha-1 compost + chemical fertilizers (150-75-0 kg ha-1,which were 170.70 and 272.86 percent increased over control,respectively.

511 Kataria,N.; Bassi,K.; Kataria,RK. (1999) **Response of wheat (Triticum aestivum) to nitrogen and mulch application under rainfed conditions.** *Indian Journal of Agronomy. 44(1):115-118.* English. [Himachal Pradesh Krishi Vishvavidyalaya,Dept Agron Palampur 176062 Himachal Prades India].

A field experiment was carried out during winter (rabi) season of 1990-91 and 1991-92 to evaluate the effect of nitrogen and mulch application on wheat (Triticum aestivum L. emend. Fiori & Paol.) under rainfed conditions. Nitrogen 80 kg/ha significantly produced taller plants,more number of effective tillers and higher dry-matter accumulation over 40 kg N/ha. Heading and maturity were delayed by 4 days by increasing N from 40 to 80 kg/ha. Similarly,application of 80 kg N/ha resulted in longer ears,more number of grains/ear,1,000-grain weight and grain and straw yields. Non-significant differences between 80 and 120 kg N/ha were observed on various growth and development parameters,yields and yield attributes of wheat. Application of mulch 30 tonnes/ha on fresh-weight basis resulted in significant improvement in all the above characters. [References: 5].

512 Korschens,M. (1997) **Dependence of soil organic matter (SOM) on location and management,and its influence on yield and soil properties.** Umweltforschungszentrum Leipzig-Halle GmbH,Bad Lauchstaedt (Germany). Sektion Bodenforschung. *Archives of agronomy and soil science (Germany) v. 41(6) p. 435-463.* German. (AGRIS 2000-001089).

513 Kumar,S.; Badiyala,D.; Singh,CM.; Saroch,K. (1999) **Nitrogen and cutting management in winter wheat (Triticum aestivum) under dry temperate high hills.** *Indian Journal of Agronomy. 44(1):112-114.* English. [Himachal Pradesh Krishi Vishvavidyalaya,Dept Agron Palampur 176062 Himachal Prades India].

A field experiment was conducted on sandy-loam soils of Kukumseri (Lahaul valley) of dry temperate high hills of Himachal Pradesh during 1993-94 and 1994-95. Application of nitrogen at 135 and 180 kg/ha gave higher grain,straw and green-fodder yields of wheat (Triticum aestivum L. emend. Fiori & Paol.) though both the rates remained statistically at par with each other. Cutting of winter wheat for green fodder during last week of May or first week of June reduced the grain and straw yields significantly. However,this reduction could be compensated with availability of good-quality green fodder during lean period. [References: 2].

514 Limaux,F.; Recous,S.; Meynard,JM.; Guckert,A. (1999) **Relationship between rate of crop growth at date of fertiliser N application and fate of fertiliser N applied to winter wheat.** *Plant & Soil. 214(1-2):49-59.* English. [INRA,Unite Agron Rue Fernand Christ F-02007 Laon France]. To investigate the relationship

To investigate the relationship between the timing of fertiliser N applications and the N use efficiency of wheat,three field experiments with N-15 were set up on winter wheat,on three different soils in France. Different crop N demands on the day of fertiliser application were obtained by varying either crop densities or date of fertiliser application. Labelled (NH4NO3)-N-15-N-15 was applied at tillering and during stem elongation. The N-15 recovered from plant and soil at different dates after N-15 addition and at maturity of wheat was measured. The fate of fertiliser N was rapidly determined,most of the fertiliser N accumulated in the wheat at maturity having been taken up within a few days of application. N-15 recovery by the crop at final harvest (%) varied greatly (19-55% N applied) according to crop density,soil type and date of application. It was linearly related to the instantaneous crop growth rate calculated at the day of N-15 application. The amount of fertiliser N immobilised in the soil was constant at 20 kg N ha(-1),for all soil types and crop densities. Because residual mineral N-15 in the soil at harvest was negligible and immobilisation was constant,the level of total N-15 measured in the different N pools (soil+plant) reflected the% N-15 uptake by the plant. There was consequently a negative linear relationship between the percentage of N-15 not recovered for measurement,and crop growth rate (i.e. crop N demand) at date of fertiliser application. These results suggest that crop N demand at the time of N application determines the ability of the crop to compete for N with other processes,and may be a major factor determining the division of N between soil and crop. [References: 28].

515 Lozek,O.; Fecenko,J. (Slovak Agricultural Univ.,Nitra (Slovak Republic). Department of Plant Nutrition) (1998) **Exploitation of biohumus extract in fertilization of winter wheat.** Humic Substances in Ecosystems. Rackova Dolina (Slovak Republic). 14-16

Jun 1998. *Humic substances in ecosystems - Proceedings of the international conference. Zaujec,A; Gonet,S.S.; Bielek,P. (Eds.). Vyskumny Ustav Podoznalectva a Ochrany Pody,Bratislava (Slovak Republic); Slovenska Polnohospodarska Univ.,Nitra (Slovak Republic) 195 p. p. 83-86.* Vyskumny Ustav Podoznalectva a Ochrany Pody,Slovenska Polnohospodarska Univ. 4 tables; 5 ref. English. (AGRIS 2000-008991).

Little plot experiments were used for testing of fertilizing efficiency of biohumus extract,isolated from vermicompost,for winter wheat production. Four years results from little plot experiment on loamy degraded chernozem at Breeding Station Sladkovicovo-Novy Dvor confirmed following stimulate effect of foliage application of vermisol together with nitrogenous nutrition of winter wheat,variety Hana. Statisticaly significant effect of foliage application to grain crop of winter wheat was reached at mutual application of vermisol and fertilizer DAM-390 at productive fertilization. In comparison to unfertilized control,addition of crop of grain was 0.83 t/ha (12%) and nitrogenous nutrition was 4.5%. Content of wet gluten in wheat grains was not influenced by vermisol. It was realized tendency of little increasing about 1.1 till 3.2%.

516 Maggiore,T.; Tano,F. (Milan Univ. (Italy). Istituto di Agronomia); Spallacci,P. (Istituto Sperimentale Agronomico,Bari (Italy)) (1998) **Agronomic aspects of animal manures utilization.** *Rivista di Agronomia (Italy) v. 32(4) p. 173-195.* 18 tables; 8 graphs; 83 ref. Italian. (AGRIS 2000-001145).

Animal manures are a valuable source of organic matter and nutrients for crops,but can be a potential source of pollution. In this paper the problem is fully described,through an updated bibliographic study. Both agronomic aspects (nutrients content,crop recovery) and environmental effects (potential impact on water,soil,air,animals and man) are here analyzed. Finally,Italian legislation and methods available for regional scale management of manures are described and critically analyzed I reflui zootecnici costituiscono al tempo stesso un materiale di grande valore fertilizzante e un potenziale problema ambientale. Con la presente relazione,attraverso una aggiornata rassegna bibliografica,si intende fornire un quadro della problematica. Sono analizzati sia gli aspetti agronomici legati al loro utilizzo (contenuto in nutrienti,efficienza di utilizzazione da parte delle colture),sia le problematiche ambientali (impatto sulle risorse idriche,sul suolo,sull'aria,rischi per l'uomo e per gli animali). Gli aspetti legislativi e i metodi disponibili per la gestione territoriale dei reflui sono descritti e analizzati criticamente.

517 Mandal,UK.; Sharma,SN.; Singh,G.; Das,DK. (1999) **Effect of Sesbania green manuring and greengram (Phaseolus radiatus) residue incorporation on physical properties of soil under rice (Oryza sativa)wheat (Triticum aestivum) cropping system.** *Indian Journal of Agricultural Sciences. 69(9):615-620.* English. [Cent Res Inst Dryland Agr Hyderabad 500659 Andhra Pradesh India].

Afield study was conducted during 1993-94 to 1994-95 on the physical properties of soil induced by Sesbania green mauring and greengram (Phaseolus radiatus Roxb.) residue incorporation on a sandy clay loam soil (Typic Ustochrept) under rice (Oryza sativa L.) - wheat (Triticum aestivum L. emend. Fiori & Paol.) cropping system. Sesbania green manuring and greengram residue incorporation resulted in reduction in bulk density and increase in soil aggregation which in turn increased infiltration and percolation rate and hydraulic conductivity of soil. The effect of Sesbania green manuring and greengram residue incorporation for improving the physical condition of soil conducive to better transmission properties was more conspicuous where 120 kg N/ha was applied to rice indicating the beneficial role of increased root biomass production in fertilized plot. [References: 19].

518 Milosev,D. (Poljoprivredni fakultet,Novi Sad (Yugoslavia)) (1996) **Effect of nitrogen and temperatures at grain formation and grain fill on the number of fertile spikelets [in wheat spike].** *Savremena poljoprivreda (Yugoslavia) (no. 1-2) p. 11-18.* 1 ill.; 2 tables; 11 ref. Serbian. (AGRIS 2000-008985).

A two-year trial by means of Mitscherlich's pots was conducted in order to study the effects of different nitrogen rates and temperatures at seed formation and seed fill on the number of fertile spikelets per spike in winter wheat. The results have shown that the number of fertile spikelets in primary spikes is much larger with the plants subjected to nitrogen fertilization than with those to which no nitrogen is added. Among the fertilized treatments,this number began,to drop when nitrogen rates exceeded 1 g per dish,especially in the first year of the study. In the case of secondary spikes,however,the situation was exactly the opposite. The number of fertile spikes showed a constant and highly significant increase all the way up to the maximum dose of 3 g per dish. With regard to temperature,no the other hand,it can be concluded that,on the whole,their effect was neither consistant nor significant,since the variation came at the point when the number of fertile spikelets had already been largely determined.

519 Milosev,D. (Poljoprivredni fakultet,Novi Sad (Yugoslavia)) (1996) **Effects of temperature and nitrogen on the duration of grain formation and grain fill of winter wheat.** *Savremena poljoprivreda (Yugoslavia) (no. 5-6) p. 47-53.* 1 graph; 2 tables; 14 ref. Serbian. (AGRIS 2000-008983).

A two-year trial with Mitscherlich's pots was conducted under semi-controlled and controlled conditions in order to determine the effects of different temperatures at grain formation and grain fill on the duration of this stage and the height of yield in five winter wheat genotypes grown under different nitrogen (N) nutrition conditions. Increasing N rates prolonged the grain formation and grain fill stage and increased the yield averages. This trend continued up to the maximum N rate of 3 g per pot. Different temperatures had a major influence on the length of the grain formation and grain filling stage and hence on the yields themselves. On average,this stage lasted 33 days in the warmer and 47 in the cooler of the two greenhouses. Grain formation and grain fill lasted longer in the earlier-maturing than in the later-maturing varieties.

520 Mishra,SN.; Paikaray,RK.; Mishra,KN. (1999) **Effect of lime,organic and inorganic nutrients on wheat (Triticum aestivum) soybean (Glycine max) cropping system in acidic red soils.** *Indian Journal of Agronomy. 44(1):26-29.* English. [Orissa Univ Agr & Technol,Reg Agr Res Stn Semiliguda Orissa India].

A field experiment was carried out during 1988-89,1989-90 and 1990-92 to study the direct effect of lime,organic and inorgnic nutrients on wheat (Triticum aestivum L. emend. Fiori & Paol.) and its carry-over effect on soybean [Glycine max (L.) Merr.]. Lime (1.25 tonnes/ha),FYM (4 tonnes/ha) and boron (10 kg/ha) in combination with 60 kg N + 30 kg P2O5 + 20 kg K2O/ha resulted in the highest yield of wheat (29.3 q/ha). A significant residual effect was also observed for soybean (23.4 q/ha) with application of 30 kg N + 60 kg P2O5 + 30 kg K2O/ha. The direct and the carry-over effects of lime and organic manure along with inorganic nutrients application significantly increased the uptake of N,P and K by both the crops in the cropping system. [References: 3].

521 Moller,K.; Reents,H.J. (1999) **[Influence of different catch crops after grain peas on the nitrate content in the soil and growth of the following crop (potatoes,wheat)].** 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte". AMS Berlin (Germany). 23-25 Febr 1999. Technische Univ. Muenchen,Freising (Germany). Lehrstuhl fuer Phytopathologie. . Hoffmann,H.;Muller,S. *Beitrage zur 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte" [Proceedings of the fifth scientific conference on ecological farming "From the periphery to the focus of attention"] p. 109-112. Technische Univ. Muenchen,Freising (Germany). Lehrstuhl fuer Phytopathologie.* Dr. Koster. German. (AGRIS 2000-001213).

Die Auswirkungen unterschiedlicher Strategien des Zwischenfruchtanbaus nach Erbsen auf die Nitratauswaschungsgefahr,das N-Angebot und das Wachstum der Folgefruchte Kartoffeln und Winterweizen wurden in Feldversuchen in den okologisch bewirtschafteten

Versuchsbetrieben Klostergut Scheyern und Viehhausen im Zeitraum 1996-1998 untersucht.

522 Narang,RS.; Brar,SS.; Kumar,S. (1999) **Effect of crop-residue incorporation load on nitrogen requirement of succeeding crops and soil productivity in rice (Oryza sativa)-wheat (Triticum aestivum) system.** *Indian Journal of Agronomy. 44(1):8-11.* English. [Punjab Agr Univ,Dept Agron Ludhiana 141004 Punjab India].

A field experiment was conducted during 1992-93 to 1994-95 to investigate the effect of incorporation of variable crop residue loads of combine harvested rice (Oryza sativa L.) and wheat (Triticum aestivum L. emend. Fiori & Paol.) crops on the nitrogen requirement of succeeding crops of wheat and rice grown in sequence and soil productivity. The treatments consisted of 3 levels of residue loads in the main plots and 3 of nitrogen (80,120,160 kg N/ha) in the subplots. The crop sequence of wheat followed by rice was taken for 3 years on the same site. An increasing trend was noted in crop yield and productivity with the increase in the level of residue load incorporated. The incorporation of moderate level of crop residue load in conjunction with the application of recommended level of N (120 kg/ha) not only assisted in increasing the grain yield but also increased the organic matter content,available N and P. [References: 5].

523 Peschke,H.; Mollenhauer,S. (1998) **N(min) content in the soil,N-fertilization and N uptake of winter wheat in the international organic nitrogen long-term fertilization experiment (IOSDV) Berlin-Dahlem.** Humboldt-Universitaet,Berlin (Germany). Landwirtschaftlich-Gaertnerische Fakultaet. Inst. fuer Pflanzenbauwissenschaften. *Zeitschrift fuer Pflanzenernaehrung und Bodenkunde (Germany) v. 161(1) p. 9-15.* German. (AGRIS 2000-001232).

524 Pietola,L.; Tanni,R.; Elonen,P. (1999) **Responses of yield and N use of spying sown crops to N fertilization,with special reference to the use of plant growth regulators.** *Agricultural & Food Science in Finland. 8(4-5 Special Issue SI):423-440.* English. [Univ Helsinki,Dept Appl Chem & Microbiol POB 27 FIN-00014 Helsinki Finland].

The role of plant growth regulators (PGR) in nitrogen (N) fertilization of spring wheat and oats (CCC),fodder barley (etephon/mepiquat) and oilseed rape (etephone) in crop rotation was studied in 1993-1996 on loamy clay soil. Carry over effect of the N fertilization rates (0-180 kg ha(-1)) was evaluated in 1997. N fertilization rate for the best grain/seed yield (120-150 kg ha(-1)) was not affected by PGRs. The seed and N yields of oilseed rape were improved most frequently by recommended use of PGR. The yields of oats were increased in 1995-96. Even though PGR effectively shortened the plant height of spring wheat,the grain yield increased only in 1995. N yield of wheat grains was not increased. Response of fodder barley to PGR was insignificant or even negative in 1995. T he data suggest that PGRs may decrease some N leaching at high N rates by improving N uptake by grain/seeds,if the yield is improved. The carryover study showed that in soils with no N fertilization,as well as in soils of high N rates,N uptake was higher than in soils with moderate N fertilization (60-90 kg ha(-1)),independent of PGRs. According to soil mineral N contents,N leaching risk is significant (15-35 kg ha(-1)) only after dry and warm late seasons. After a favourable season of high yields,the N rates did not significantly affect soil mineral N contents. [References: 29].

525 Saini,JP.; Thakur,SR. (1999) **Response of barley (Hordeum vulgare) varieties to nitrogen under dry temperate conditions.** *Indian Journal of Agronomy. 44(1):123-125.* English. [HPKV,Dept Agron Palampur 176062 Himachal Prades India].

A field experiment was conducted during the summer season of 1990 and 1991 to find out the response of barley (Hordeum vulgare L. s.l.) varieties to N levels. Among the varieties,'Dolma' registered significantly higher number of effective tillers/m row length,harvest index and grain yield than 'HBL 233' and 'Local'. Almost all the yield attributes and grain yield increased significantly with each successive increase in hi levels up to 90 kg/ha. [References: 3].

526 Salim,M.; Rahmatullah; Nabi,G. (National Agricultural Research Centre,Islamabad (Pakistan). Land Resources Research Inst.) (1999) **Differential response of wheat cultivars to phosphorus supply under saline conditions.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 799-800.* 2 tables,11 ref. English. (AGRIS 2000-001228).

Three wheat cultivars (Pak-81,Punjab-85 and Inqalab) were grown in solution supplied with low (10 mew m) and high (100 mew m) levels of P at 0 and 100 mM NaCl salinity. Root medium salinity depressed the growth of all the three cultivars. Phosphorus supply in the root medium altered the growth depressing effects in the three cultivars to variable extent. Root behavior of the three cultivars also differed with P application and salinity. In all the three cultivars,the relative rates of Na uptake were significantly decreased with increasing P supply to roots.

527 Schliephake,W.; Garz,J.; Stumpe,H. (1999) **Fate of N-15 after one single application of labelled N fertilizer in the long-term experiment Eternal Rye Cropping Halle.** *Journal of Plant Nutrition & Soil Science-Zeitschrift fur Pflanzenernahrung und Bodenkunde. 162(4):429-435.* German. [Univ Halle Wittenberg,Inst Pflanzenernahrung & Bodenkunde Adam Kuckhoff Str 17B D-06108 Halle Germany].

To elucidate the fate of N in the long-term field experiment with continuous rye cropping in Halle,Germany (Haplic Phaeozem derived from sandy loess; mean annual precipitation: 466 mm) micro plots (9 m(2)) were established within the NPK main plot in 1993 and 1994 and the routine N dose (60 kg N ha(-1) a(-1)) was once applied as N-15 labelled fertilizer. In the subsequent four years each micro plot was analyzed for the N-15 withdrawn with grain and straw and that remaining in the soil after harvest. Parallel to this,micro plots on the unfertilized main plot received a single dose of 5 kg ha(-1) of high-label N-15 in order to achieve labelling of the annual N input from the air (similar to 40 kg ha(-1) a(-1)) and to follow its fate. - In the NPK treatment about one third of the labelled fertilizer N applied (= *N) was taken up by the rye in the first year,while nearly half of it remained in the soil (0-100 cm),and 10-15% was not recovered (most likely lost via leaching). During the following three years the amount of *N remaining in the soil decreased from 32.7 kg ha(-1) to 21.5 kg ha(-1). However,less than half of the remobilized *N had been taken up by the crop. On the unfertilized plot the uptake of *N was lower at the end of the experiment compared to the NPK plot,while the loss exceeded the comparative figure correspondingly. [References: 24].

528 Shi Yan; Wei Dongbin (Laiyang Agricultural Coll.,Shandong (China). Inst. of Dry Land Crops); Yu Zhenwen (1999) **Effects of plant power 2003 on root senescence after anthesis of dry land wheat.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 35(2) p. 118-119.* 4 ill.,5 ref. Chinese. (AGRIS 2000-001230).

529 Singh,MK.; Verma,UN.; Pal,SK.; Thakur,R. (1999) **Efficacy of slow release nitrogen-fertilizers to rice (Oryza sativa) and their residual effect on wheat (Triticum aestivum).** *Indian Journal of Agronomy. 44(1):102-104.* English. [Birsa Agr Univ,Dept Agron Ranchi 834006 Bihar India].

A field experiment was conducted during 1989-91 on sandy clay loam soil at Ranchi to study the efficiency of forms of urea,viz,prilled (PU),lac-coated (LCU),rock phosphate-coated (RCU),karanj cake-coated (KCU) and neem cake-coated (NCU) at varying N rates (0,40,80,120 kg/ha) on the productivity of rice (Oryza sativa L.) and their residual effect on succeeding wheat ( Triticum aestivum L. emend. Fiori & Paol.). The LCU,NCU,and KCU gave 24,14.2 and 12.7% more grain yield of rice respectively than PU. Each incremental N levels recorded higher grain yield over its preceeding levels. However,nitrogen-use efficiency decreased with increasing N level. Application of LCU,NCU and KCU favourably affected soil-available N after rice which consequently exhibited more residual effect on the productivity of

succeeding wheat. Rice fertilized with 120 kg N/ha also recorded maximum grain yield of succeeding wheat (23.1 q/ha). [References: 4].

530 Tiwana,US.; Narang,RS.; Gosal,KS. (1999) **Nutrient management for yield maximization of rice (Oryza sativa)-wheat (Triticum aestivum) cropping system.** *Indian Journal of Agronomy. 44(1):1-7.* English. [Punjab Agr Univ,Dept Plant Breeding Ludhiana 141004 Punjab India].

A field investigation was carried out during winter 1990 - rainy season 1992 on loamy sand of average fertility status. The grain yield as well as the main crop productivity parameters significantly increased with maximum economic yield fertilizer level (MEYFL) of 180,30 and 30 kg/ha to rice (Oryza sativa L.) and 180,60 and 0 kg/ ha to wheat (Triticum aestivum L. emend. Fiori & Paol.) (grown in sequence) over the recommended fertilizer level (RFL) of 120,30 and 30 kg/ha to rice and 120,60 and 30 kg/ha of N,P2O5 and K2O respectively. The MEYFL was significantly superior to RFL with yield advantages of 16.2% in rice (average grain yield 8.6 tonnes/ha) and 13.5% in wheat (average grain yield 5.8 tonnes/ha). Green-manuring with Sesbania aculeata Pers. (20-25 tonnes/ha green matter) saved 60 kg/ha equivalent of N in rice without any residual effect on wheat. The higher levels of P and K and growth regulators cycocel (1 g/litre at 45 days),followed by cytokinin (50 mg/litre at 80 days) in 500 litres water/ha did not,show any significant influence on rice and wheat. The benefit : cost ratio with additional income over additional expenditure for the rice-wheat rotation at MEYFL was 2.35 with chemical fertilizer and 1.55 with green-manured series compared with 1.47 under RFL. Both crops showed higher uptake of N,P and K with MEYFL over RFL. The total uptake (kg/ha of N,P and K) was respectively 107,18.8 and 94 in rice and 106,18.3 and 97 in wheat at MEYFL; and 99,16.5 and 88 in rice and 92,15.8 and 97 in wheat at RFL. The rice and wheat straw component accounted only for 12 and 17% of N and 15 and 19% of P,though fraction of K retained was quite sizeable (92.1 and 82.1% respectively). [References: 11].

531 Wang Yuefu (Shandong Agricultural Univ.,Taian (China)) (1998) **Exploration of economically reasonable fertilizer and water index for different wheat varieties.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 4) p. 7-10.* 3 tables; 5 ref. Chinese. (AGRIS 2000-008988).

532 Wei Wenxue; Xu Chiming; Duan Mingyuan (Huazhong Agricultural Univ.,Wuhan (China)) (1998) **The effect of molybdenum nutrition on the compositions of protein and amino-acid in wheat seed.** *Journal of Huazhong Agricultural Universtiy (China). Huazhong Nongda Xuebao (China) v. 17(4) p. 364-368.* 3 tables; 2 ill.,6 ref. Chinese. (AGRIS 2000-008989).

533 Xu Qiuming; Zhou Jun; Li Yaxing (Beijing Municiple Academy of Agriculture and Forestry Sciences,Beijing (China). Inst. of Plant Nutrition and Resources) (1998) **Comparison of interractions among N,P and water of wheat in soils of different textures.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(2) p. 69-74.* 7 tables; 2 ill.,7 ref. Chinese. (AGRIS 2000-008996).

534 Zamuner,E.; Culot,J.P. (1999) **Effect of fertilization in phosphorus sorption capacity.** *Investigacion Agraria. Produccion y Proteccion Vegetales (Espana) t. 14(1-2) p. 107-116.* 4 tablas,2 graf.; 34 ref. Spanish. (AGRIS 2000-001219).

Se estudia la variacion en la capacidad de sorcion de P de un suelo agricola argentino despues de agregar un fertilizante fosfatado. Las muestras analizadas corresponden a un Argiudol tipico con monocultivo de trigo. Se compararon los valores obtenidos de un suelo sin fertilizar con los del mismo suelo luego de uno y dos anos de haber sido fertilizado con una dosis unica al inicio del ensayo de 88 myg.g sup(-1) de fosforo (P) como superfosfato triple. Los procesos se cuantificaron mediante isotermas de adsorcion de Langmuir,Freundlich y la determinacion de la capacidad reguladora de P (CRF). Los resultados muestran que el efecto de la fertilizacion sobre el proceso de sorcion se manifiesta solo durante el primer ano posterior a recibirla. En este periodo se incrementa sustancialmente la CRF y la fraccion de P inorganico labil del suelo fertilizado respecto del que no fue tratado. Paralelamente se produce una disminucion significativa de la energia de retencion (k de la I. de Langmuir) y de la capacidad relativa de adsorcion (a de la I. de Freundlich). Al segundo ano de cultivo estas diferencias se desvanecen.

535 Zhang Yuqiong; Dong Zhaorong; Zhang Heying (Anhui Agricultural Univ.,Hefei (China). Dept. of Biotechnology) (1998) **Effects of nitrogen fertilizer rates at the jointing stage on the activities of superoxidase dismutase and peroxidase and grain yield of barley.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 34(6) p. 423-426.* 5 tables; 11 ref. Chinese. (AGRIS 2000-001138).

## F06 IRRIGATION

536 Zhang,H.; Wang,X.; You,M.; Liu,C. (1999) **Water-yield relations and water-use efficiency of winter wheat in the North China Plain.** *Irrigation Science. 19(1):37-45.* English. [Int Ctr Agr Res Dry Areas POB 5466 Aleppo Syria].

Limited precipitation restricts yield of winter wheat (Triticum aestivum L.) grown in the North China Plain. Water stress effects on yield can be avoided or minimized by application of irrigation. We examined the multi-seasonal irrigation experiments in four locations of the piedmont and lowland in the region,and developed crop water-stress sensitivity index,relationship between seasonal evapotranspiration (ET) and yield,and crop water production functions. By relating relative yield to relative ET deficit,we found that the crop was more sensitive to water stress from stem elongation to heading and fi-om heading to milking. For limited irrigation,irrigation is recommended during the stages sensitive to water stress. Grain yield was 258-322 g m(-2) in the piedmont and 260-280 g m(-2) in the lowland under rainfed conditions. The corresponding seasonal ET was 242-264 mm in the piedmont and 247-281 mm in the lowland. Irrigation significantly increased seasonal ET and therefore grain yield as a result of increased kernel numbers per m(-2) and kernels per ear. On average,one irrigation increased grain yield by 21-43% and two to four irrigations by 60-100%. Grain yield was linearly related to seasonal ET with a slope of 1.15 kg m(-3) in the lowland and 1.73 kg m(-3) in the pied mont. Water-use efficiency was 0.98-1.22 kg m(-3) :For rainfed wheat and 1.20-1.40 kg m(-3) for the wheat irrigated 2-4 times. Grain yield response to the amount of irrigation (IRR) was developed using a quadratic function and used to analyze different irrigation scenarios. To achieve the maximum grain yield,IRR was 240 mm in the piedmont and 290 mm in the lowland. When the maximum net profit was achieved,IRR was 195 mm and 250 mm in the piedmont and lowland,respectively. The yield response curve to IRR showed a plateau over a large range of IRR,indicating a great potential in saving IRR while maintaining reasonable high levels of grain yield. [References: 30].

## F07 SOIL CULTIVATION

537 Andersen,A. (1999) **Plant protection in spring cereal production with reduced tillage. II. Pests and beneficial insects.** *Crop Protection. 18(10):651-657.* English. [Norwegian Crop Res Inst,Plant Protect Ctr,Dept Entomol & Nematol Fellesbygget N-1432 As Nlh Norway].

In five field experiments run for four years the infestation of pests and the activity of carabids and staphylinids were compared in autumn ploughed and reduced tillage (no-tillage or spring harrowing) plots. Differences were generally most evident in experiments with no-tillage. Weed cover was denser in reduced tillage,and could explain much of the differences. The agromyzid Chromatomyia fuscula was most common in autumn ploughed plots,probably due to healthier plants. Thrips numbers were correlated with grain quality in no-tillage plots. Field slugs were most common in reduced tillage,and were positively correlated with weed cover. Generally,more carabids and staphylinids were

caught in reduced tillage. This was especially true for Amara-species and Loricera pilicornis,Philonthus cognatus and Tachinus signatus,which also were positively correlated with weed cover. Aloconota gregaria,Bembidion quadrimaculatum,B. lampros,Harpalus rufipes and Trechus quadristriatus were more common in autumn ploughed plots,several of them preferring open soil. (C) 2000 Elsevier Science Ltd. All rights reserved. [References: 23].

538 Buchner,W. (1998) **[How to cope with Nematoda problems in the fruit rotation sugarbeets-patatoes-winter wheat?].** *Zuckerruebe (Germany) v. 47(6) p. 314-317.* German. (AGRIS 2000-001293).

539 Daniel,JA. (1999) **Influence of wheat tillage practices on shallow groundwater recharge.** *Journal of Soil & Water Conservation. 54(3):560-564.* English. [USDA ARS,Grazinglands Res Lab El Reno,OK 73036 USA].

A three-year study (1994 to 1996) using four-ha watersheds was done to determine the impact of no-till,moldboard,and sweeps tillage practices on recharge to a shallow unconfined groundwater system. A native grass watershed was used for central: Each watershed was equipped with three groundwater wells,which allowed monthly monitoring of water levels. Two method of quantifying recharge from fluctuating water table levels (deep percolation) were used: an averaged index and active monthly recharge. Results show native grass with the highest index (0.7) followed by moldboard (0.6),sweeps (0.2),and no-till (.06). Recharge rates under the native grass watershed are larger than the tilled watersheds for years with average and above average rainfall. However,during a year with below average rainfall no active recharge was found. The watersheds with different tillage practices had lesser recharge amounts with mold-board ranging from 10.4 to 20.8 cm,no-till ranging from 3.8 to 11.7 cm,and sweeps ranging from 20 to 10.9 cm. This recharge is attributed to fallow practice during summer and low evapotranspiration during the fall and early winter. [References: 12].

540 Jones,MJ. (2000) **Comparison of conservation tillage systems in barley-based cropping systems in northern Syria.** *Experimental Agriculture. 36(1):15-26.* English. [The Roaches,Nether Compton Sherborne DT9 4RE Dorset England].

Yields of rainfed barley (Hordeum vulgare) for feed and forage in small-ruminant production systems in low-rainfall areas of North Africa and West Asia are limited by low and erratic water availability. Therefore,the testing of conservation farming techniques,effective in dryland systems elsewhere,is often suggested. Seven-pear results from a typical site in northern Syria showed that zero-till (direct-drill) systems with cereal residue retention may marginally enhance soil moisture status,but the yield effect on barley,either monocropped or rotated with vetch (Vicia sativa),was small and non-significant. Tn the vetch-barley rotation,a small and fairly consistent benefit to vetch was observed,amounting to a 20% yield increase in vetch hay. Given smallholders' strong preference for barley and reluctance to grow vetch as an alternate crop,there is little in this result to encourage the promotion of zero-till conservation techniques in these farming systems. [References: 14].

541 Klima,K. (Academy of Agriculture,Cracow (Poland)) (1997) **Impact of varying soil cultivation techniques on water erosion volume in particular hydrologic periods. 14. ISTRO Conference** on Agroecological and Ecological Aspects of Soil Tillage Pulawy (Poland). 27 Jul - 1 Aug 1997. *Fragmenta Agronomica (Poland) v. 2B p. 367-370.* 1 fig.,2 tables; 6 ref. English. (AGRIS 2000-009061).

The results obtained during this study showed that winter plouging reduced the amounts of soil loss by half in time of the winter hydrological half-year compared to the sities-sown with winter crops,and increased it by 500 percent compared to the control meadow. Presowing,crop care and broad-rill sowing of beets increased the soil loss 50 times compared to the control meadow during the summer hydrological half-year. Comparing to all the investigated zones (of slope),in the upper zone there were higher soil losses (increased by en average of 13-18 percent) and lower subsurface sheet runoff.

542 Kuht,J.; Ries,M. (Estonian Agricultural Univ.,Tartu (Estonia)) (1999) **[Influence of night presowing tillage on field weediness].** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 28-34.* Latvian University of Agriculture. 1 table; 4 ill.,8 ref. English. (AGRIS 2000-001306).

In 1997-98 field trials were carried out to investigate the influence of tillage in the dark (at night) on the weediness of barley field. Germination of weeds requires light. During soil tillage at daytime weed seeds are exposed to light and start to germinate. The field trials on presowing tillage at night showed that the number of weeds,their dry mass and their height diminished compared with the tillage in the daytime. The greatest effect was observed in the case of Matricaria inodora (in 1997) and Spergula vulgaris (in 1998).

543 Kus,J.; Jonczyk,K. (Institute of Soil Science and Plant Cultivation,Pulawy (Poland). Dept. of Crop Rotation) (1997) **Effect of tillage systems and soil mulching with intercrops on mineral nitrogen content in soil and plant yield. 14. ISTRO Conference** on Agroecological and Ecological Aspects of Soil Tillage Pulawy (Poland). 27 Jul - 1 Aug 1997. *Fragmenta Agronomica (Poland) v. 2B p. 407-410.* 1 fig.,4 tables; 5 ref. English. (AGRIS 2000-009071).

Simplification of tillage (grubber) under intercrops compared to skimming did not influenced spring barley and corn yields. Soil mulching with intercrop biomass had no significant effect on barley and corn yields. Mineral nitrogen content was lower in the late autumn and a little higher in spring on objects with intercrops. Effect of mulching and grubbering on mineral nitrogen content in soil depended on weather condition.

544 Maiorana,M. (Istituto Sperimentale Agronomico,Bari (Italy)) (1998) **[Soil ploughing of crop residues of durum wheat [Triticum durum Desf. - monoculture - Apulia]].** *Informatore Agrario (Italy) v. 54(18) p. 41-45.* 8 tables; 1 graph. Italian. (AGRIS 2000-001310).

545 Malicki,L.; Ochal,M.; Podstawka Chmielewska,E. (Agricultural Academy,Lublin (Poland). Dept. of Ecology) (1997) **Energetic effectiveness of various soil cultivation systems. 14.** ISTRO Conference on Agroecological and Ecological Aspects of Soil Tillage Pulawy (Poland). 27 Jul - 1 Aug 1997. *Fragmenta Agronomica (Poland) v. 2B p. 445-446.* 1 table; 8 ref. English. (AGRIS 2000-009090).

Direct sowing of spring crops,i.e. horse bean and barley,ensures higher effectiveness of energetic input (expenditure) than traditional cultivation methods or cultivation without ploughing independent of the soil type. The same situation takes place with winter wheat on heavy and medium soils. Whereas,on the medium heavy soil cultivation without ploughing is equally effective; and on the light soil all the cultivation systems compared yield energetic effects that are not significantly differentiated.

546 Malicki,L.; Podstawka Chmielewska,E. (Agricultural Academy,Lublin (Poland). Dept. of Ecology) (1997) **Soil cultivation method and yield of the crop rotation link: horse bean - winter wheat - spring barley. 14. ISTRO Conference** on Agroecological and Ecological Aspects of Soil Tillage Pulawy (Poland). 27 Jul - 1 Aug 1997. *Fragmenta Agronomica (Poland) v. 2B p. 443-444.* 1 table; 4 ref. English. (AGRIS 2000-009089).

Irrespective of the soil type and seasonal conditions the highest yields of crop units can be expected when agrotechnology of crop rotation link: horse bean for seeds-winter wheat-spring barley is based on the traditional (with ploughing) soil cultivation methods. Cultivation without ploughing results in about 7 percent decrease in yields,and direct sowing in 12 percent decrease. However,considering the choice of the cultivation method,should be decided on the basis of economic calculation and sometimes

also on the basis of some considerations outside production issues,and not only on the yield size.

547 Nozdrovicky,L.; Halaj,P. (Slovak Agricultural University,Nitra (Slovak Republic). Dept. of Machines and Production Systems) (1997) **Effect of the two soil tillage systems on infiltration characteristics.** 14. ISTRO Conference on Agroecological and Ecological Aspects of Soil Tillage Pulawy (Poland). 27 Jul - 1 Aug 1997. *Fragmenta Agronomica (Poland) v. 2B p. 487-490.* 3 fig.,2 tables; 4 ref. English. (AGRIS 2000-009072).

The effects of two different soil tillage practices-conventional tillage based on ploughing and no-till based on using of no-till drill related to the growing of spring barley are considered from the point of changes of soil properties. The plot experiments were realized on loamy fine soil. The effects of soil tillage practices were evaluated by using values of soil porosity and infiltration rate. The both values were higher on fields where no-till technology were implemented. Soil infiltration rate was studied by using Horton Mezentsev theoretical equations. Obtained results have confirmed that Horton equation allows better curve fitting of empirical data.

548 Palys,E.; Kuraszkiewicz,R. (Lublin Agricultural University,Lublin (Poland). Dept. of Agricultural Ecology) (1997) **Influence of plant tillage methods on the weight of post-harvest residues in the crop rotation link on the rendzina soil.** 14. ISTRO Conference on Agroecological and Ecological Aspects of Soil Tillage Pulawy (Poland). 27 Jul - 1 Aug 1997. *Fragmenta Agronomica (Poland) v. 2B p. 511-512.* 2 tables; 2 ref. English. (AGRIS 2000-009092).

Zero tillage in comparison to classical and minimum tillage increases root air dry weight of horse been on rendzina soil. Horse been,winter wheat,and spring barley gather a significantly higher mass of root in the surface layer of the soil 0-10 cm than in the deeper layers. Horse been leaves a significantly higher mass of post-harvest residues than spring barley and winter wheat on the rendzina soil.

549 Palys,E.; Podstawka Chmielewska,E.; Kwiatkowska,J. (Lublin Agricultural University,Lublin (Poland). Dept. of Ecology) (1997) **Influence of tillage systems on weed infestation of crop canopy in the crop rotation on rendzina soil.** 14. ISTRO Conference on Agroecological and Ecological Aspects of Soil Tillage Pulawy (Poland). 27 Jul - 1 Aug 1997. *Fragmenta Agronomica (Poland) v. 2B p. 507-510.* 4 tables; 3 ref. English. (AGRIS 2000-009091).

The zero tillage significantly increased the individual number of weeds as total and perennial weeds before harvest,when compared to the minimum and classic tillage on rendzina soil. Zero tillage also increased weed species number. No matter what the cultivation system employed was,higher density and biodiversity of weeds appeared in horse beens and spring barley than in winter wheat. Setaria glauca was the dominant species,among-lived weeds in horse been,Avena fatua and Echinochloa crus-galli - in spring barley and Avena fatua - in winter wheat. Whereas Agropyron repens among perennial,was the most numerous in all studied crops. Air dry weight of weeds was significantly higher in the case of horse beens than in the two other crops of crop rotation.

550 Schlegel,AJ.; Dhuyvetter,KC.; Thompson,CR.; Havlin,JL. (1999) **Agronomic and economic impacts of tillage and rotation on wheat and sorghum.** *Journal of Production Agriculture. 12(4):629-636.* English. [Kansas State Univ,SW Res Ext Ctr Tribune,KS 67879 USA].

The predominant crop in the central Great Plains is winter wheat (Triticum aestivum L.) grown in a wheat-fallow (WF) rotation. However summer crops,such as grain sorghum [Sorghum bicolor (L.) Moench] or corn (Zea mays L.),grown in a wheat-summer crop-fallow rotation are increasingly popular. Tillage is decreasing as reduced tillage (RT) and no-tillage (NT) systems are used more extensively in intensive cropping systems. This field study quantified the effects of increasing cropping intensity and reducing tillage on soil water dynamics,wheat and grain sorghum production and profitability,and the sorghum yield necessary to ensure greater profitability with a wheat-sorghum-fallow (WSF) rotation than with WF. Cropping systems were WF,WSF,and continuous wheat (WW). From 1991 to 1995 all crops were grown under NT,and WF and WSF also were grown under RT. Reduction in tillage had little effect on soil water storage prior to planting of wheat or sorghum. Precipitation capture during fallow tended to be greater with WSF than WF (35 vs. 29%). Wheat yields were similar for WF and WSF (46 vs. 47 bu/acre),with WW yields being about 45% less. Tillage had little impact on wheat yields,but sorghum yields were 23% greater with NT than RT (59 vs. 48 bu/acre). Water use efficiency (WUE) was greater fbr sorghum than wheat,and NT increased sorghum WUE by 25% compared with RT (205 vs. 167 lb/in.). The quantity of wheat straw was similar for WF and WSF,with about 145 lb of straw/bu of wheat yield,which is much greater than the commonly used value of 100 lb of straw/bu. Production costs were $14 to 19/acre greater with NT than RT for wheat,primarily because of higher weed control costs,but production costs were similar for NT and RT sorghum. Economic returns were similar for WF-RT,WSF-RT,and WSF-NT at about $22 to 27/acre compared with $10 to 13/acre for WENT and WW-NT The sorghum yield to make WSF more profitable than wheat depends upon relative grain prices,yield,and production costs; in this study,sorghum yields of 55 to 60 bu/acre were required before WSF was as profitable as WF. [References: 17].

551 Schmidt,O.; Curry,JP. (1999) **Effects of earthworms on biomass production,nitrogen allocation and nitrogen transfer in wheat-clover intercropping model systems.** *Plant & Soil. 214(1-2):187-198.* English. [Univ Coll Dublin,Fac Agr,Dept Environm Resource Management Dublin 4 Ireland].

The effects of earthworms (Lumbricidae) on plant biomass production and N allocation in model intercropping systems of winter wheat and white clover were evaluated in two pot experiments. Wheat and wheat-clover mixtures were grown in a low-organic loam soil,earthworms were added at densities comparable to field population densities and the experiments were terminated 48 and 17 d after earthworm introductions. In both experiments,earthworms significantly increased the biomass and N uptake of wheat while they had generally no effects on clover. As a result,earthworm activity increased the proportion of wheat biomass in the total plant biomass of the mixture. Nitrogen budgets of the experiment lasting 48 d indicated that additional N in the system made available by earthworm activity was primarily taken up by the wheat. Earthworms also affected intra-plant N allocation in wheat which had significantly higher shoot:root N ratios when earthworms were present. When clover was labelled with N-15 in the experiment which lasted 17 d,endogeic earthworms significantly reduced the amounts of N-15 excess transferred from living or decomposing clover roots to accompanying wheat plants. Earthworms assimilated small quantities of N-15 tracer from decomposing clover roots but not from living clover roots. The results of these model experiments suggest that earthworms can affect the balance between intercropped cereals and legumes by altering intra- and inter-plant N allocation. [References: 54].

552 Stancevicius,A.; Spokiene,N.; Jodaugiene,D.; Treciokas,K.; Raudonius,S. (Lithuanian Univ. of Agriculture,Kaunas Akademija (Lithuania)) (1999) **[The influence of reduced tillage on winter wheat yield and agrophysical soil properties].** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,]. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 157-165.* Latvia University of Agriculture. 4 tables; 1 ill.,7 ref. English. (AGRIS 2000-001296).

The possibility to use shallow ploughing (12-14 cm) or chisel loosening (12-14 and 23-25 cm) instead of conventional ploughing (23-25 cm) in the six year crop rotation was investigated at the Experimental Station of Lithuanian University of Agriculture in 1989-1998. The experiment was conducted on light loam soil. Herbicides were used only during the second crop rotation because of high weed infestation. The results of investigation show that ploughing of the depth of 23-25 cm is not necessary to keep

soil loose. Ploughed loose soil naturally settles and becomes dense approximately within one month. After winter wheat sowing soil bulk density was already similar in all treatments. Differences of soil bulk density,total porosity and moisture content between all treatments were not significant during all the vegetation period of winter wheat. According to nine year average experimental data,reduced soil tillage did not decrease winter wheat yield.

## F08 CROPPING PATTERNS AND SYSTEMS

553 Adamiak,E.; Adamiak,J. (University of Agriculture and Technology,Olsztyn (Poland)). Dept. of Agricultural Systems) (1999) **Yield-forming and crop protecting role of oats in cereal crop rotations.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 15-21.* 2 fig.,2 tables; 9 ref. Polish. (AGRIS 2000-009118).

A field experiment was conducted on the heavy brown - wheat soil to determine the yield-forming and yield protecting role of oats in crop rotations with 67 percent proportion of cereals in 1986-92. Comparative objects were crop rotations with the same proportion of cereals in which the field of oats was replaced with spring barley or spring wheat and crop rotation with 50 percent proportion of cereals. In crop rotation with 67 percent proportion of cereals there was better yielding of oats,its lower weed infestation and lower disease infestation than in the other spring cereal.

554 Hu Mengyin (Shandong Cotton Research Center,Jinan (China)) (1998) **Dynamics of moisture change during the synchtonous period in the field of wheat interplanted with spring cotton.** *Journal of Shandong Agricultural Science (China). Shandong Nongye kexue (China) (No. 2) p. 13-16.* 4 ill.,2 ref. Chinese. (AGRIS 2000-009208).

555 Khan,R.U.; Rashid,A.; Khan,A.; Khan,S.G. (Arid Zone Research Inst.,PARC,D.I. Khan (Pakistan)) (1999) **Seed yield and monetary returns as influenced by pure crop and intercrops grown in association with wheat.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 891-893.* 4 tables,12 ref. English. (AGRIS 2000-001341).

Studies were undertaken at Arid Zone Research Institute,D.I. Khan during 1996-97 and 1997-98 to determine the effect of different intercropping combination viz.,wheat + gram,wheat + rapeseed with pure crop of wheat,gram and rapeseed for maximum monetary returns. Data revealed that intercropping of wheat and gram sown in ratio of 1:1 and 3:1 gave significantly maximum seed yield and higher returns over traditionally sown pure crop of wheat,gram and rapeseed both the year respectively. This above intercropping combination of (1:1) and (3:1) increased the monetary returns 65,37 and 95 percent during 1997-98 while 162,12 and 555 percent during 1997-98 over sowing of pure crops of wheat,gram and rapeseed respectively.

556 Li Fangdong (Paulownia Research and Development Center of China,Zhengzhou (China)) (1998) **Light distribution within the intercropping systems of paulownia - wheat and its influences on wheat yield.** *Journal of Beijing Forestry University (China). Beijing Linye Daxue Xuebao (China) v. 20(3) p. 101-107.* 9 ill.,9 ref. Chinese. (AGRIS 2000-009205).

557 Li Fangdong (Paulownia Research and Development Center,Zhengzhou (China)) (1998) **Wheat biomass in the intercropping system of Paulownia - wheat.** *Journal of Beijing Forestry University (China). Beijing Linye Daxue Xuebao (China) v. 20(3) p. 121-127.* 6 tables; 8 ill.,8 ref. Chinese. (AGRIS 2000-009206).

558 Pang Huancheng; Chen Fu (China Agricultural Univ.,Beijing (China). Dept. of Agronomy) (1997) **Research on high yield cropping pattern of wheat intercropping with early and middle maturing cotton.** *Acta Gossypii Sinica (China). Mian Hua Xue Bao (China) v. 9(5) p. 267-272.* 6 tables; 5 ref. Chinese. (AGRIS 2000-009203).

559 Parylak,D. (1998) **Optimization of winter triticale cultivation in short-term monoculture on good rye soil complex.** Akademia Rolnicza,Wroclaw (Poland). Katedra Ogolnej Uprawy Roli i Roslin. *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rozprawy (Poland); (no.326) 94 p.* Wydawnictwo Akademii Rolniczej we Wroclawiu. 18 fig.,21 tables; 226 ref. Polish. (AGRIS 2000-009201).

The response of winter triticale cv. Bolero to cultivation in a 3-year monoculture was examined in the field,microplot and pot experiments conducted in 1991-95. Possibilities of reducing the consequences of this unfavourable crop succesion were also studied.

560 Pei Baohua (Hebei Agricultural Univ.,Baoding (China)) (1998) **Effect of tree shading simulation on wheat growth and output.** *Journal of Agricultural University of Hebei (China). Hebei Nongye Daxue Xuebao (China) v. 21(1) p. 1-5.* 4 tables; 3 ill.,5 ref. Chinese. (AGRIS 2000-009202).

561 Pilipavicius,V. (Lithuanian Univ. of Agriculture,Kaunas Akademija (Lithuania)) (1999) **[Influence of spring barley harvesting time on weed seed fall into the soil and on the crop yield].** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,I. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 142-149.* Latvia University of Agriculture. 2 tables; 3 ill.,18 ref. English. (AGRIS 2000-001315).

The article contains the results of the research on the dynamics of weed seed fall on the soil and the growth of spring barley crop dry overground phytomass. Reaping early spring barley in milky or milky wax ripenning phases,a 37-40 % higher yield was got of overground crop phytomass dry material and 73-95 % weed seeds fall on soil was decreased as compared with the hard ripenning phase of spring barley.

562 Sarno,R.; Gristina,L.; Carrubba,A.; Trapani,P. (Palermo Univ. (Italy). Istituo di Agronomia Generale e Coltivazioni Erbacee) (1998) **Durum wheat - field pea intercropping in the semi-arid Mediterranean environments [Triticum durum Desf. - Pisum sativum L. - Sicily].** *Rivista di Agronomia (Italy) v. 32(1) p. 62-71.* 12 tables; 1 graph; 14 ref. Italian. (AGRIS 2000-001344).

A two-year trial (1992/94) was carried out in a semi-arid Mediterranean environment in order to test the efficiency of intercropping between durum wheat (Triticum durum Desf.) cv. Valbelice and field pea (Pisum sativum L.) cv. Belinda,in relation to seed and biomass yield,LER (Land Equivalent Ratio),CR (Competitive Ratio) and weet biomass. A factorial design with three replications was arranged,comparing: a) the two pure stands (350 and 60 germinable seeds m*[-2) for durum wheat and field pea respectively); b) intercropping with a rate of 25:75,50:50 and 75:25 according to a replacement design; all thesis were combined with two nitrate fertilization levels (0 and 50 kg ha*[-1)). In the trial,as regards both triticum durum and field pea,higher equivalent yields than pure stands were observed; moreover,LER always reached values higher than unit. Field pea showed a lower competitive ability (CR) than durum wheat in all the examined thesis. Fertilization rates did not affect yield and LER. Durum wheat presence in intercropping improved efficiency in weed control Si riportano i risultati di una ricerca di durata biennale (1992/94) condotta per valutare l'efficienza della consociazione tra frumento duro (Triticum durum Desf.) cv. Valbelice e pisello proteico (Pisum sativum L.) cv. Belinda nell'ambiente semi-arido mediterraneo. Utilizzando uno schema fattoriale con tre ripetizioni sono stati posti a confronto: a) le due specie in coltura pura (con una densita' di semina di 350 e di 60 semi germinabili m*[-2),rispettivamente,per il frumento ed il pisello); b) le stesse in consociazione secondo rapporti di sostituzione pari a 25:75,50:50 e 75:25. Le diverse tesi sono state inoltre combinate con due livelli di

concimazione azotata (0 e 50 kg ha*[-1]). Sono stati analizzati i principali parametri della consociazione: produzione totale di biomassa e di granella,LER (Land Equivalent Ratio),CR (Competitive Ratio) e biomassa delle infestanti. In entrambi gli anni di prova nelle consociazioni sono state riscontrate produzioni superiori a quelle delle rispettive colture pure e valori di LER totali sempre superiori all'unita'. In tutte le tesi studiate,il pisello ha messo in evidenza una capacita' competitiva (CR) minore rispetto al frumento; non si e' riscontrata,inoltre,alcuna risposta statisticamente significativa alla concimazione azotata in termini di produzione e di LER. La presenza del frumento nella consociazione e' risultata,infine,efficace ai fini del controllo delle infestanti.

563 Schillinger,WF.; Papendick,RI.; Veseth,RJ.; Young,FL. (1999) **Russian thistle skeletons provide residue in wheat-fallow cropping systems.** *Journal of Soil & Water Conservation. 54(2):506-509.* English. [Washington State Univ,Dept Crop & Soil Sci Lind,WA 99341 USA].

Growers in low-precipitation (< 300 mm annual) dryland areas of the inland Pacific Northwest of the USA practice a wheat (Triticum aestivum L.) -fallow rotation where only one crop is grown every two years. When when wheat yields are low,it is difficult to maintain adequate surface residue for erosion control during the ensuing fallow cycle Russian thistle (Salsola iberica) is a major broadleaf weed in low-crop-production years,and it often produces more dry matter by grain harvest than the wheat crop it infests. In a 4-yr study,the effect of 3 tillage management treatments on retention of above-ground wheat residue and dead Russian thistle plants or "skeletons" during fallow was determined Treatments were: 1) traditional (tillage),2) minimum (herbicides and tillage),and 3) delayed minimum (herbicides and delayed tillage). Russian thistle infestation occurred 2 of the 4 yr when winter wheat failed and was replaced by spring wheat. Russian thistle skeletons were preserved as an important source of surface cover during fallow using minimum tillage,whereas they were wind-blown from the field or buried with traditional tillage. Minimum tillage also increased surface wheat residue compared to traditional tillage an all sampling dates. Results show the value of conserving Russian thistle skeletons for erosion control in low crop residue situations when this weed is likely to be present in large amounts. [References: 19].

564 Sun Benpu (Agricultural Research Inst. of Binzhou District,Shandong (China)) (1997) **Effects of different row space between wheat and cotton on the ecological environment and plant development of cotton sown in spring.** *Acta Gossypii Sinica (China). Mian Hua Xue Bao (China) v. 9(6) p. 318-323.* 3 tables; 3 ill.,3 ref. Chinese. (AGRIS 2000-009204).

565 Velicka,R.; Treciokas,K. (Lithuanian Univ. of Agriculture,Kaunas Akademija (Lithuania)) (1999) **[Weediness of spring rape and barley depending on rape growing area in crop rotation].** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 172-179.* Latvia University of Agriculture. 2 tables; 11 ref. Russian. (AGRIS 2000-001330).

In the period of 1995-1998 experiments were carried out in the Experimental Station of Lithuanian University of Agriculture with the purpose to determine the area under spring rape in crop rotation. Weediness of spring rape and barley was also investigated. It was determined that though weediness in barley sowings was higher than in rape,the increase of rape area in crop rotation did not influence the amount of weeds either in rape or in barley crops. It influenced only weed mass. The average weed mass in spring rape was twice as high as in barley. Weed smothering power of spring rape is significantly weaker than that of barley.

566 Wang Zhifen (Shandong Academy of Agricultural Sciences,Jinan (China). Inst. of Atomic Energy Application) (1998) **Study on the physiological characters of wheat-cotton interplanting system.** *Journal of Shandong Agricultural Science (China). Shandong Nongye kexue (China) (No. 2) p. 7-12.* 9 tables. Chinese. (AGRIS 2000-009207).

## F30 PLANT GENETICS AND BREEDING

567 **[Twenty five years of variety trials of soft wheat [Triticum aestivum L. - Italy]]** (1998) (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)). *Informatore Agrario (Italy) v. 54(34) p. 43-48.* 6 tables; 4 graphs. Italian. (AGRIS 2000-001826).

568 Ahokas,H. (Helsinki Univ. (Finland)) (1999) **Spontaneous tetraploidy in strawberry (Fragaria sp.,Rosaceae).** *Nordic Journal of Botany (Denmark) v. 19(2) p. 227-234.* 7 ill.,84 ref. English. (AGRIS 2000-009307).

569 Ahsan,M. (University of Agriculture,Faisalabad (Pakistan). Dept. of Plant Breeding and Genetics); Wright,D. (1998) **Wheat varietal behavior in hydroponic and soil culture under saline conditions.** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 318-320.* 4 tables,14 ref. English. (AGRIS 2000-001835).

The experiment was conducted to compare two systems (hydroponic and soil culture). Seven wheat varieties differing in salt tolerance were grown under saline conditions (100 mol m3 NaCl) in these two systems. Ion contents (Na+,K+,Cl,Ca2+ and Mg2+) in the fourth leaf were not correlated with ion contents in the flag leaf. There were few significant correlation coefficients between ion contents and grain weight per plant. Which suggests that ion contents in leaf sap may not be good indicators of salt tolerance in wheat. Linear correlation coefficients for grain yield,most of yield components and ion contents of seven wheat varieties between hydroponic and soil culture were non-significant. These results suggest that hydroponic culture system is independent from soil culture system.

570 Ahsan. M. (Wales Univ.,Gwynedd (United Kingdom). School of Agriculture and Forest Sciences) (1998) **Inter-and intra-varietal variations in wheat (Triticum aestivum L.) under saline conditions.** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 339-341.* 2 tables,20 ref. English. (AGRIS 2000-001836).

Three wheat varieties (Kharchia-65,KRL 1-4 and Alexandria) were tested for their salt tolerance at 125 mol m3 NaCl salinity. Inter and intra-varietal variations in these wheat varieties were also investigated for ion contents (Na+,K+,Cl),K+/Na+ ratio,yield and yield components under saline conditions. Although environmental conditions were uniform,but variability within varieties was found to higher than the variability between varieties. KRL 1-4 was found salt tolerant than Kharchia-65 and Alexandria under saline conditions. These inter and intra-varietal variations suggested that improvement for salt tolerance might be achieved through selection from within already existing varieties and,or by crossing salt tolerant and salt sensitive wheat genotypes.

571 Al Shabi,J.H.M.S. (1998) **Biochemical genetic fingerprint for some wheat cultivars.** Ain-Shams Univ.,Cairo (Egypt). Faculty of Agriculture. 26 fig. 37 tables; Bibliography: p. 133-159. 162 p. English. (AGRIS 2000-001819).

572 Anamthawat-Jonsson,K. (1999) **Variable genome composition in TriticumxLeymus amphiploids.** *Theoretical & Applied Genetics. 99(7-8):1087-1093.* English. [Univ Iceland,Dept Biol Grensasvegi 12 IS-108 Reykjavik Iceland].

Three different amphiploid lines originated from crosses between wheat (Triticum L.) and lymegrass (Leymus Hochst.) were analysed by fluorescence in situ hybridization (FISH) using total genomic DNA and 18S.26S ribosomal genes (rDNA). Based on the genomic probes,these lines were the same in that they all were allohexaploids (2n=6x=42) containing 30 wheat and 12 lymegrass

chromosomes. The ribosomal gene mapping further identified species origin of the chromosomes,whereby the lymegrass parent was undoubtedly L. mollis and the wheat was likely to be a Triticum species having the AB genomes. This rDNA mapping was also able to reveal differences in the genome composition among these lines,and such differences were mainly in the wheat nucleolar organizing regions (Nor). The first line (M) had two Nor-B1 (1BS),the second line (G) had one Nor-B1 (1BS),two Nor-B2 (6BS) and two Nor-A1 (1AS),whereas the third line (U) had the same Nor loci as the second line but two sites each. The wheat ribosomal genes were variably expressed depending on the lines,but the lymegrass loci appeared inactive. All three lines had the same Nor loci belonging to L. mollis! two Nor-m1 and two Nor-m2. Analysis of restriction fragment length polymorphism (RFLP) of the rDNA confirmed the identity of L. mollis parent in all three lines and verified the differences in the wheat ribosomal genes among them. These amphiploids were,however,similar in their restriction profiles,therefore indicating common origin. The molecular and cytogenetic evidence here suggested that these annual,fully fertile amphiploids that originated from the same crosses 40 years ago became genetically differentiated and fixed in stable forms. [References: 31].

573 Anon. (1998) **[Cultivars of autumn cereal crops in France].** *Semences et Progres (France) (no 96) p. 16-30.* 16 tableaux. French. (AGRIS 2000-001416).

Ce dossier comprend: les descriptions precises des nouvelles varietes de cereales qui sont en cours de lancement et qui soulevent toujours de nombreuses questions. Des tableaux comparatifs regroupant la plupart des varietes de cereales d'hiver actuellement cultivee,avec leurs principales caracteristiques; en plus des varietes inscrites au Catalogue officiel francais,ces tableaux comprennet aussi les principales varietes du Catalogue europeen commercialisees en France.

574 Anon. (1998) **[National variety trials of barley [Hordeum vulgare L. - Italy]].** *Informatore Agrario (Italy) v. 54(33) p. 33-38.* 10 tables. Italian. (AGRIS 2000-001538).

575 Anon. (1998) **[Productive responses of brewer's barley varieties [Hordeum vulgare L. - Italy]].** *Informatore Agrario (Italy) v. 54(33) p. 41-44.* 8 tables. Italian. (AGRIS 2000-001539).

576 Anon. (1999) **[Seed and cultivars of autumn cereals].** *Semences et Progres (France) (no 100) p. 28-72.* Tableaux. French. (AGRIS 2000-001417).

Ce dossier rassemble les informations sur les varietes de cereales d'automne: descriptions precises des nouvelles varietes qui sont en cours de lancement et qui soulevent toujours de nombreuses questions,des tableaux comparatifs regroupant la plupart des varietes de cereales d'hiver actuellement cultivees; en plus dse varietes inscrites au Catalogue officiel francais,ces tableaux comportent aussi les principales varietes du Catalogue europeen commercialisees en France. On trouve egalement un tableau synthetique complet,classant les ble tendres d'hiver en fonction de leur precocite et de leur alternativite.

577 Aragona,M.; Porta-Puglia,A. (1999) **Identification of resistance to barley leaf stripe using a Pyrenophora graminea transformant expressing beta-glucuronidase.** *European Journal of Plant Pathology. 105(8):831-834.* English. [Ist Sperimentale Patol Vegetale Via CG Bertero 22 I-00156 Rome Italy].

A Pyrenophora graminea strain expressing the beta-glucuronidase gene (GUS) was obtained via genetic transformation,and used to follow the penetration of the pathogen inside barley germinating seeds and the colonization of host tissues. Significant differences between resistant and susceptible barley cultivars were observed in the colonization of artificially-infected embryos by the fungus. These results suggest that the GUS transgenic strain of P. graminea will be useful for the early screening of barley cultivars for resistance to leaf stripe disease. [References: 20].

578 Asif,M.; Khaliq,I.; Chowdhry,M.A.; Salam,A. (University of Agriculture,Faisalabad (Pakistan). Dept. of Plant Breeding and Genetics) (1999) **Genetic mechanism for some spike characteristics and grain yield in bread wheat.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 948-951.* 6 ills.,1 table,11 ref. English. (AGRIS 2000-001831).

Five wheat varieties/lines viz; HABA-4,HABA-12,Pitic-62 Pak - 81 and LU-26 S were crossed in a diallel fashion to determine the mode of inheritance of some important spike characteristics. Number of spikes per plant,number of grains per spike and grain yield per plant were governed by over dominance type of gene action. Number of spikelets per spike,spike length and 1000-grain weight were ruled by partial dominance with additive type of gene action except spike length in which non additive type of gene action was observed. Epistasis was absent for all the traits studied.

579 Assad,MT.; Ravary,Z.; Pourhadji,A.; Ahmadi,AA.; Emam,Y. (1999) **Evaluation and inheritance of resistance to Russian wheat aphid in barley.** *Journal of Agricultural Science. 133(Part 3):297-301.* English. [Shiraz Univ,Coll Agr,Dept Agron Shiraz Iran].

Russian wheat aphid (RWA): Diuraphis noxia is a serious pest of cereals in various regions of the world. Seventy-six barley genotypes collected from different areas in Iran were subjected to an initial mass screening test and six susceptible and 17 apparently resistant genotypes were identified. To determine resistance mechanisms,antixenosis,antibiosis and tolerance tests were conducted and selected genotypes were ranked according to their plant resistance indices. Four crosses were made between the two most resistant lines (Shz.B-106,and Shz.B-108) and two most susceptible lines (Shz.B-105 and Shz.B-107). F-1,F-2 and BCF1 (backcross to the resistant parent) seedlings were screened for RWA resistance in the greenhouse by artificial infection. Resistance in Shz.B-106 was apparently controlled by a semi-dominant gene,whereas resistance in Shz.B-108 was controlled by a dominant one. [References: 20].

580 Bahrman,N.; Le,Gouis,J.; Hariri,D.; Guilbaud,L.; Jestin,L. (1999) **Genetic diversity of old French six-rowed winter barley varieties assessed with molecular,biochemical and morphological markers and its relation to BaMMV resistance.** *Heredity. 83(Part 5):568-574.* English. [INRA,Lab Genet & Ameliorat Plantes Domaine Brunehaut F-80200 Estrees Mons France].

Twenty-six old French six-rowed winter barley (Hordeum vulgare L.) varieties were characterized for their reaction against barley mild mosaic virus (BaMMV). The genetic diversity of these varieties and two recent barley varieties was assessed using molecular,biochemical and morphological data. Seven old varieties were fully resistant to BaMMV. A higher differentiation level between varieties was observed by using DNA molecular markers compared to biochemical and morphological ones. Correspondence analysis using all markers showed that DNA molecular data could fully discriminate between ail varieties,whereas biochemical and morphological markers were not able to achieve a complete discrimination. The dendrogram clustering computed with the DNA marker dissimilarity index showed two main groups. The first group included the seven varieties resistant to the BaMMV,whereas the second contained susceptible varieties. The relationships between these varieties,their diversity level,and their characterization are discussed. We infer that the seven BaMMV-resistant varieties have a common origin. [References: 29].

581 Bai,GH.; Shaner,G.; Ohm,H. (2000) **Inheritance of resistance to Fusarium graminearum in wheat.** *Theoretical & Applied Genetics. 100(1):1-8.* English. [USDA ARS,Natl Ctr Agr Utilizat Res,Mycotoxin Res Unit 1815 N Univ St Peoria,IL 61604 USA].

To study the inheritance of resistance in wheat to Fusarium graminearum,six resistant cultivars from China were crossed to two susceptible cultivars. The parents and their progenies were evaluated in the greenhouse for resistance to the spread of scab within a spike. A central floret was inoculated by injecting a droplet of inoculum at the time of anthesis. Inoculated plants were

kept in a moist chamber for three subsequent nights. The proportion of scabbed spikelets was recorded six-times from 3-days to 21-days after inoculation,and the area under the disease progress curve (AUDPC) was calculated from these proportions. One to three genes,depending on the cultivar,conditioned resistance to scab as reflected by the AUDPC. A simple additive-dominance effect model fitted the segregation data for 8 of the 11 crosses. Dominance and epistatic effects were significant in a few crosses. These effects increased resistance in some crosses but decreased resistance in others. However,relative to additive effects,dominant and epistatic effects accounted for only a small portion of the genetic effects in the populations evaluated. The importance of additive effects means that it should be possible to accumulate different genes to enhance resistance to scab in wheat. [References: 22].

582 Balalic,I.; Kobiljski,B. (Naucni institut za ratarstvo i povrtarstvo,Novi Sad (Yugoslavia)) (1996) **Variability and correlation between stem height,harvest index and grain yield in wheat.** *Selekcija i semenarstvo (Yugoslavia). Plant Breeding and Seed Production v. 3(3-4) p. 7-12.* 6 tables; 16 ref. Serbian. (AGRIS 2000-009526).

The aim of this oaoer was to examine variability and correlation between stem height,harvest index and grain yield in different wheat genotypes originated from four regions: region 1 (Japan,China and Korea),region 2 (Russia and Ukraine),region 3 (Middle and East Europe) and region 4 (North America).

583 Barcellos,AL.; Roelfs,AP.; de,Moraes-Fernandes,MIB. (2000) **Inheritance of adult plant leaf rust resistance in the Brazilian wheat cultivar Toropi.** *Plant Disease. 84(1):90-93.* English. [Univ Minnesota,Dept Plant Pathol,Cereal Dis Lab 1551 Lindig St St Paul,MN 55108 USA].

Adult plant resistance to leaf rust in the Brazilian wheat cultivar Toropi (Triticum aestivum) was studied in crosses with the susceptible cultivar IAC 13. Cvs. Toropi and IAC 13 are susceptible at the seedling stage to race LCG-RS of Puccinia triticina Erikss.,and to all other known Brazilian leaf-rust races. Thus,the resistance observed in Toropi in the field was due to adult plant-resistance genes. In the greenhouse at the adult plant stage,resistance segregated in a 7:9 ratio for two complementary recessive genes. Additionally,two recessive genes for leaf-tip necrosis were identified in the greenhouse environment. Necrosis was expressed when the two homozygous recessive genes occurred together in the Fz,independently of the response to leaf rust. The resistance and leaf-necrosis genes differ from those previously reported in wheat. Segregation for leaf-rust resistance in the field at Passe Fundo,Brazil,fit a 1:3 ratio for a single recessive gene. With a different pathogen race,and in crosses of cvs. Toropi and ThatcherLr34,two recessive genes and a dominant gene for resistance were detected in the field in Mexico. The dominant gene was likely Lr34 from cv. ThatcherLr34 and the two recessive genes were likely those detected in the greenhouse adult plants tests at Passe Fundo. [References: 15].

584 Barriga B,Patricio; Fuentealba A,Juan; Manquian T,Nimia (1998) **Phosphorus uptake and utilization efficiency in wheat genotypes.** *Agro Sur (Chile) v. 26(1) p. 1-10.* 30 ref. Spanish. (AGRIS 2000-001839).

Se evaluo la variabilidad genetica de la eficiencia de absorcion y utilizacion de fosforo en genotipos de trigo primaverales en condiciones de campo con dos nivele de fertilizacion fosforada,uno deficiente y otro no limitado. La eficiencia de fosforo se estimo por los parametros relacion de eficiencia de fosforo (PE),relacion de eficiencia radical (RE) y eficiencia de absorcion de fosforo (PUE). Los genotipos de mayor rendimiento fueron aquellos que presentaron el mayor contenido de P en sus tejidos a la madurez de cosecha. Existieron marcadas diferencias genotipicas en cuanto a la utilizacion del P por las plantas (PE) en niveles de baja fertilizacion fosforada; ademas esta relacion de eficiencia no se correlaciono con el rendimiento de grano. Por otra parte,los genotipos fueron mas eficientes al inicio de macolla que a la antesis y a la madurez de cosecha estimada a traves de la relacion de eficiencia radical (RE). En cuanto a la capacidad de las plantas de obtener el P del suelo (PUE),los genotipos difirieron en su estrategia y presentaron una mayor eficiencia entre macolla y antesis; la fertilizacion fosforada no afecto este parametro. Los resultados sugieren que la habilidad de las plantas para remover el fosforo del suelo dependeria del PUE,de ellas,es decir,de su habilidad para localizar y obtener el P del suelo como tambien por la absorcion temporal del P del suelo por el genotipo. Seleccion para eficiencia de absorcion de fosforo (PUE) podria tener algun beneficio.

585 Belicka,I. (Latvia Univ. of Agriculture,Jelgava (Latvia). Faculty of Agriculture. Inst. of Crop Sciences. Dept. of Plant Production) (1999) **The investigation of barley breeding lines with increased protein content.** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 197-206.* Latvia University of Agriculture. 4 tables; 1 ill.,13 ref. English. (AGRIS 2000-001384).

For the improvement of the nutritional value of barley,hull-less mutant X-4 by Hiproly was used as a donor of high protein content in hybridization. Hulled and hull-less barley lines with increased protein content were developed. During 1996-1998 with changing meteorological conditions the new lines exceeded by 2.4-6.9 % the protein content of standard variety "Abava" (10.3-13.3 %). The grain yields of hulled and hull-less barley lines were 65.2-89.5 % and 60.6-78.7 % respectively in comparison with standard variety "Abava" (4.31-4.71 t haE-1). The protein yields of the best lines were 90.8-108.9 % compared to "Abava". The content of essential amino acids was higher than that of hulled parents.

586 Bonciarelli,U. (Perugia Univ. (Italy). Istituto di Agronomia e Coltivazioni Erbacee) (1998) **[Barley in Umbria. Cultivars for feed and malt production [Hordeum vulgare L. - variety trials]].** *Informatore Agrario (Italy) v. 54(33) p. 59-63.* 1 table; 5 graphs. Italian. (AGRIS 2000-001541).

587 Brabant,P. (Institut National de la Recherche Agronomique,Gif sur Yvette (France). Centre de Versailles Grignon Ferme du Moulon,Genetique Vegetale); David,J.; Enjalbert,J.; Goldringer,I.; Paillard,S. (1999) **[Interest of dynamic management of genetic resources for plant breeding: the example of soft wheat].** Journee de l'ASF. Paris (France). 4 Fev 1999. *Selectionneur Francais (France) (no 50) p. 33-44.* 9 ref.,8 graph. French. (AGRIS 2000-001821).

588 Branlard,G. (Institut National de la Recherche Agronomique,Clermont Ferrand (France). Centre de Clermont Ferrand Theix,Amelioration des Plantes); Dardevet,M.; Gateau,I.; Marcoz,C.; Martini,B. (1999) **[Genetical basis of the quality of tomorrow wheats].** *Industries des Cereales (France) (no 114) p. 5-8.* 14 ref. French. (AGRIS 2000-001822).

589 Brennan,JP.; Godden,D.; Smale,M.; Meng,E. (1999) **Breeder demand for and utilisation of wheat genetic resources in Australia.** *Plant Varieties & Seeds. 12(2):113-127.* English. [NSW Agr,Waga Waga Agr Inst Wagga Wagga NSW 2650 Australia].

As part of a study of genetic diversity in wheat,Australian wheat breeders were surveyed to assess the importance of genetic diversity to breeders. This paper reports the findings of that survey,and identifies the key issues that concern wheat breeders. The issues addressed include the breeders' attitude to diversity and the diversity available in their current gene pool. The sources of materials that breeders use to maintain and/or enhance diversity in their programmes are identified and ways in which diversity influences breeding decisions are also examined. More importantly from the policy view point,survey responses identify changes over time in the environment in which breeders operate that affect the extent to which they can enhance diversity. Funding constraints,in particular,are shown to influence th extent to which breeders can utilise genetic diversity. The paper raises some important issues concerning the future genetic diversity of Australia's wheat

industry,and the extent to which economic problems related to genetic diversity may arise in the future. [References: 8].

590 Brook,R. von (1999) **Biotechnology and grain breeding.** Lochow-Petkus GmbH,Bergen (Germany). *Getreide Mehl und Brot (Germany) v. 53(4) p. 195-196.* German. (AGRIS 2000-001418).

Die Ziele und Probleme der Getreidezuchtung werden dargestellt. Der Einsatz von Biotechniken bzw. Gentechnik in der Getreidezuchtung ist zur Zeit noch problematisch,weil die Technik noch nicht routinemassig eingesetzt werden kann,wirklich attraktive Merkmale noch nicht zur Verfugung stehen,die geringe Wertschopfung bei Getreidesaatgut den Einsatz dieser teuren Technik einschrankt und die Akzeptanz in der offentlichen Meinung noch sehr gering ist. Es wird ein Uberblick uber verschiedene in der Praxis genutzte Techniken gegeben. Bei fast allen Zuchtern von Gerstensorten werden z.B. doppelt haploide Pflanzen aus Kreuzungsnachkommen erzeugt. Uber diese zellbiologische Methode hinaus stehen molekulare gentechnische Methoden zurBestimmung von Merkmalen direkt an der Erbsubstanz am Beginn der praktischen Anwendung. Gentechnik im gebrauchlichen Sinn findet an Getreide derzeit nur in den Laboratorien von wissenschaftlichen Einrichtungen statt. Es wird noch einige Jahre dauern,bis das erste gentechnisch veranderte Getreide auf den Markt kommt. Es wird eine Zusammenstellung uber gentechnische Verbesserungen fur Getreide,an denen gearbeitet oder geforscht wird,gegeben.

591 Brunell,MS.; Lukaszewski,AJ.; Whitkus,R. (1999) **Development of arm specific RAPD markers for rye chromosome 2R in wheat.** *Crop Science. 39(6):1702-1706.* English. [Lamar Univ,Dept Biol POB 10037 Beaumont,TX 77710 USA].

Rye (Secale cereale L.) chromosome 2R carries several genes for resistance to biotic and abiotic stresses,which could be used in wheat (Triticum aestivum L,) improvement. To make these genes accessible in breeding,translocations of 2R to wheat chromosome 2B have been generated. To compensate for the lack of clearly identifiable cytological markers on chromosome 2R,random amplified polymorphic DNAs (RAPDs) were employed as markers. Wheat lines homozygous for centric translocations 2RS.2BL and 2BS.2RL were screened with 489 primers,resulting in 65 clear and reproducible RAPD polymorphisms. To assign the polymorphisms to individual arms of chromosomes 2R and 2B,the arms of the translocations were separated by centric misdivision and the resulting progeny with desired chromosome constructs were rescreened,As a result,17 markers were assigned to chromosome arm 2RS,15 to 2RL,and the remaining 33 most likely located on 2B,Preliminary mapping studies (not shown here) have indicated that some of these markers are evenly distributed along the chromosome arms. These markers should be useful for the localization of translocation breakpoints in recombinant wheat-rye chromosomes. [References: 35].

592 Cai Shibing; Cao Yang; Fang Xianwen (Jiangsu Provincial Academy of Agricultural Sciences,Nanjing (China). Inst. of Food Crops) (1999) **A study on the resistance to preharvest sprouting in white-grained wheat land races originated from Jiangsu Province [China].** *Jiangsu Journal of Agricultural Sciences (China). Jiangsu Nongye Xuebao (China) v. 15(1) p. 7-11.* 3 tables; 2 ill.,11 ref. Chinese. (AGRIS 2000-001841).

593 Ceccarelli,S.; Grando,S.; Tutwiler,R.; Baha,J.; Martini,AM.; Salahieh,H.; Goodchild,A.; Michael,M. (2000) **A methodological study on participatory barley breeding - I. Selection phase.** *Euphytica. 111(2):91-104.* English. [Int Ctr Agr Res Dry Areas POB 5466 Aleppo Syria].

Decentralized selection,defined as selection in the target environment,has been used to emphasize favorable interactions when significant genotype by environment interactions exist. However,crop breeding based on decentralized selection can still miss its objectives if it does not utilize the farmers' knowledge of the crops and the environment,and it may fail to fit crops to the specific needs and uses of farmers' communities unless it becomes participatory. One cycle of decentralized participatory selection was conducted in eleven locations in Syria. 208 barley entries (fixed lines and segregating populations) were planted unreplicated in two research stations and in the fields of nine Syrian (host) farmers,where they were managed (except planting) by the farmers themselves. Visual selection was conducted by a breeder at all locations and by the host farmers on their own fields and on both stations. In five farm locations,there was also a one-time group selection by neighboring farmers. Host farmers were able to handle the large number of entries making observations during the cropping season using different scoring methods. They did not use the performance of entries on station for their final selection and used a higher selection pressure than the breeder. In their own fields,they selected about one tenth the number of entries selected by the breeder,while on station the farmers selected,on average,about half the number of lines selected by the breeder. For some broad attributes,such as modern germplasm versus landraces,selection was mostly driven by environmental effects. Selection for other attributes was partly environmentally driven and partly based on individual farmers preferences. Selection preferences were similar for fixed or segregating populations. There was wider diversity among farmers' selections in their own fields than among farmers' selections on research stations and among breeder's selections,irrespective of where the selection was conducted. Larger kernels,higher grain yield and biomass,and taller plants (particularly in environmentally stressed locations) were the characteristics most frequently used as selection criteria by both breeder and farmers. Entries selected by the farmers yielded as much,and in one case significantly more,than those selected by the breeder. Decentralized-participatory selection was significantly more efficient in identifying the highest yielding entries in farmers' fields than any other type of selection. There was also evidence suggesting that the breeder was more efficient in selecting higher yielding entries in the research station in a high rainfall area,while the farmers were more efficient in selecting under stress conditions. The results suggest that farmers can handle selection choices among a large number of lines,and because farmers' selections are at least as high yielding as breeder's selections,it is possible to transfer the responsibility of selection to farmers in their fields. [References: 24].

594 Chague,V.; Fahima,T.; Dahan,A.; Sun,GL.; Korol,AB.; Ronin,YI.; Grama,A.; Roder,MS.; Nevo,E. (1999) **Isolation of microsatellite and RAPD markers flanking the Yr15 gene of wheat using NILs and bulked segregant analysis.** *Genome. 42(6):1050-1056.* English. [Univ Haifa,Inst Evolut Mt Carmel IL-31905 Haifa Israel].

Microsatellite and random amplified polymorphic DNA (RAPD) primers were used to identify molecular markers linked to the Yr15 gene which confer resistance to stripe rust (Puccina striiformis Westend) in wheat. By using near isogenic lines (NILs) for the Yr15 gene and a F-2 mapping population derived from crosses of these lines and phenotyped for resistance,we identified one microsatellite marker (GWM33) and one RAPD marker (OPA19(800)) linked to Yr15. Then,bulked segregant analysis was used in addition to the NILs to identify RAPD markers linked to the target gene. Using this approach,two RAPD markers linked to Yr15 were identified,one in coupling (UBC199(700)) and one in repulsion phase (UBC212(1200)). After Mapmaker linkage analysis on the F-2 population,the two closest markers were shown to be linked to Yr15 within a distance of about 12 cM. The recombination rates were recalculated using the maximum likelihood technique to take into account putative escaped individuals from the stripe rust resistance test and obtain unbiased distance estimates. As a result of this study,the stripe rust resistance gene Yr15 is surrounded by two flanking PCR markers,UBC199(700) and GWM33,at about 5 cM from each side. [References: 50].

595 Chen,Q.; Conner,RL.; Laroche,A.; Ji,WQ.; Armstrong,KC.; Fedak,G. (1999) **Genomic in situ hybridization analysis of Thinopyrum chromatin in a wheat - Th. intermedium partial amphiploid and six derived chromosome addition lines.** *Genome. 42(6):1217-1223.* English. [Agr & Agri Food Canada,Res Ctr POB 3000 Lethbridge AB T1J 4B1 Canada].

The genomic origin of alien chromosomes present in a wheat - Thinopyrum intermedium partial amphiploid TAF46 (2n = 8x = 56) and six derived chromosome addition lines were analyzed by genomic in situ hybridization (GISH) using S genomic DNA from Pseudoroegneria strigosa (2n = 2x = 14,SS) as a probe. The GISH analysis clearly showed that the chromosome complement of the partial amphiploid TAF46 consists of an entire wheat genome plus one synthetic genome consisting of a mixture of six S genome chromosomes and eight J (=E) genome chromosomes derived from Th. intermedium (2n = 6x = 42,JJJ(s)J(s)SS). There were no J(s) genome chromosomes present in TAF46. The J genome chromosomes present in TAF46 displayed a unique GISH hybridization pattern with the S genomic DNA probe,in which S genome DNA strongly hybridized at the terminal regions and weakly hybridized over the remaining parts of the chromosomes. This provides a diagnostic marker for distinguishing J genome chromosomes from J(s) or S genome or wheat ABD genome chromosomes. The genomic origin of the alien chromosomes present in the six derived chromosome addition lines were identified by their characteristic GISH hybridization patterns with S genomic DNA probe. GISH analysis showed that addition lines L1,L2,L3,and L5 carried one pair of J genome chromosomes,while addition lines L4 and L7 each carried one pair of S genome chromosomes. GISH patterns detected by the S genome probe on addition line of L1 were identical to those of the J genome chromosomes present in the partial amphiploid TAF46,suggesting that these chromosomes were not structurally altered when they were transferred from TAF46 to addition lines. [References: 33].

596 Codianni,P.; Troccoli,A.; Di Fonzo,N.; Galterio,G.; Pogna,N.E. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)) (1998) **[Davide. The first variety of emmer obtained by plant breeding [Triticum dicoccum Schubler - Italy]].** *Informatore Agrario (Italy) v. 54(25) p. 46-48.* 2 tables. Italian. (AGRIS 2000-001850).

597 Czembor,JH.; Czembor,HJ. (2000) **Powdery mildew resistance in selections from Moroccan barley landraces.** *Phytoparasitica. 28(1):65-78.* English. [Plant Breeding & Acclimatizat Inst,Dept Genet & Plant Breeding PL-05870 Blonie Poland].

Thirty bailey landraces collected from Morocco in 1985 and 1989,and held in the Polish Gene Bank,IHAR,Radzikow,Poland,were screened for resistance to powdery mildew. Fifteen tested landraces (50%) showed powdery mildew resistance reactions and 24 single plant lines were selected. Eighteen lines originating from 13 landraces were tested with 17 isolates of powdery mildew and another six lines originating from six landraces were tested with 23; the isolates were chosen according to their virulence spectra observed on the 'Pallas' isolines differential set. Three lines (E 1090-2-2,E 1110-3-2 and E 1077-1-1) showed resistance to all powdery mildew virulence genes prevalent in Europe. In 21 lines,unknown genes alone or in combination with specific ones were detected. Five different resistance alleles (Mlat,Mla1,Mla3,Mlg and Ml(CP)) were postulated to be present in the tested lines,alone or in combination: Mlat was postulated to be present in nine (similar to 38%) lines; Mlg and Ml(CP) in two lines,and Mla1 and Mla3 in one tested line each. The use of newly identified sources of resistance in barley breeding as a means of controlling powdery mildew is discussed. [References: 68].

598 Czembor,JH.; Johnston,MR. (1999) **Resistance to powdery mildew in selections from Tunisian landraces of barley.** *Plant Breeding. 118(6):503-509.* English. [Plant Breeding & Acclimat Inst,Dept Plant Pathol Radzikow PL-05870 Blonie Poland].

Two-hundred and thirty-two accessions of barley landraces collected from Tunisia were screened for resistance to powdery mildew. A number of race-specific genes were detected using the detached leaf technique. Among the 232 accessions tested,169 were susceptible to powdery mildew,20 were resistant and 43 showed differential reactions to the three isolates of powdery mildew used. An attempt was made to determine the number of genes,the types of gene,the types of gene action and the gene loci in 20 resistant accessions. Three types of cross were made: (1) the accessions were crossed to the susceptible variety 'Pallas',(2) the accessions were crossed with 'Pallas' isolines,and (3) accessions with identical powdery mildew reaction patterns were intercrossed. Three isolates of Erysiphe graminis f. sp. hordei were used: Bzm-1,KM 18-75,R13C. A number of different resistance genes were detected among the 20 resistant accessions. Surprisingly,segregation indicating single genes only were detected with the isolates used. Some of these genes could be associated with loci already known. In 19 cases a dominant and in one a recessive mode of inheritance was detected. The recessive gene was not located at the mlo locus. This investigation represents the first systematic study of race-specific genes for powdery mildew resistance in Tunisian landraces. The newly identified sources of resistance may be used in many strategies of breeding for disease resistance. [References: 52].

599 D'Antuono,L.F.; Minelli,M. (Bologna Univ. (Italy). Dipartimento di Agronomia); Colonna,M. (Ente Regionale di Sviluppo Agricolo per il Molise (ERSAM),Campobasso (Italy)); Porfiri,O. (Centro di Miglioramento Genetico Vegetale N. Strampelli,Abbadia Fiastra,Macerata (Italy)) (1998) **[Spelt. Variety comparison [Triticum spelta L. - Italy]].** *Informatore Agrario (Italy) v. 54(37) p. 48-50.* 5 tables. Italian. (AGRIS 2000-001854).

600 Dell'Aquila,A.; Di,Turi,M. (1999) **Amplification of ageing symptoms in two differently thermal-sensitive wheat (Triticum durum L.) genotypes by heat-shock: relationships between germination response and embryo protein patterns.** *Seed Science & Technology. 27(2):467-476.* English. [CNR,Germplasm Inst Via Amendola 165-A I-70126 Bari Italy].

The ability to survive under non-optimal conditions of storage and imbibitional heat-shock stress in two differently thermal-tolerant wheat (Triticum durum L.) genotypes was examined. Heat-shock treatment,given before radicle emergence,can amplify the ageing symptoms in the thermal-sensitive genotype by decreasing viability and increasing mean germination time,while in the thermal-resistant genotype the treatment effect is limited only to an increase in mean germination time. Thermal-resistant seeds also show a higher capacity to incorporate [S-35]-methionine into heat-shock untreated and treated embryos. In these embryos,an analysis of newly synthesized proteins by SDS-PAGE,showed a higher production of HSPs with low molecular weight (MW < 30kDa) and a lower decrease of 'normal' germination proteins than in the corresponding embryos of thermal-sensitive seeds. The hypothesis that low molecular weight HSPS are involved in the expression of seed vigour and its preservation during storage is discussed. [References: 18].

601 Dimitrijevic,M. (Poljoprivredni fakultet,Novi Sad (Yugoslavia). Institut za ratarstvo i povrtarstvo); Kraljevic Balalic,M.; Petrovic,S.; Ivezic,J. (1996) **The phenotypic variability of yield components and phenotypic distances in wheat varieties (Triticum aestivum ssp. vulgare).** *Savremena poljoprivreda (Yugoslavia) (no. 1-2) p. 47-60.* 2 graphs; 10 tables; 11 ref. Serbian. (AGRIS 2000-009549).

Twelve varieties of common wheat originated from all over the World were evaluated in two years for five yield components (plant height,productive tillering,spike length,number of spikelets per spike and plant weight). The components of phenotypic variability were calculated using two factorial ANOVA and equation after Mather. Clustr single linkage hierarchical joining by Eculidian distances was used for phenotypic grouping. There were significant differences among the genotypes regarding all five studied traits. Screening the phenotypic variance components it could be stated that genotype contributed to total phenotypic variability somewhere in the neighborhood of 50% for all the traits except the productive tillering (10%),and the plant weight (36%). The highest contribution of genotype to phenotype variance was noticed for plant height (66%). Grouping,at different hierarchical levels,according to phenotypic distances by clustering was obvious for all the characters.

602 Ellis,RP.; Forster,BP.; Robinson,D.; Handley,LL.; Gordon,DC.; Russell,JR.; Powell,W. (2000) **Wild barley: a source of genes for crop improvement in the 21st century?** *Journal of Experimental Botany. 51(342):9-17.* English. [Scottish Crop Res Inst Dundee DD2 5DA Scotland].

The development of new barleys tolerant of abiotic and biotic stresses is an essential part of the continued improvement of the crop. The domestication of barley,as in many crops,resulted in a marked truncation of the genetical variation present in wild populations. This process is significant to agronomists and scientists because a lack of allelic variation will prevent the development of adapted cultivars and hinder the investigation of the genetic mechanisms underlying performance. Wild barley would be a useful source of new genetic variation for abiotic stress tolerance if surveys identify appropriate genetic variation and the development of marker-assisted selection allows efficient manipulation in cultivar development. There are many wild barley collections from all areas of its natural distribution,but the largest are derived from the Mediterranean region. The results of a range of assays designed to explore abiotic stress tolerance in barley are reported in this paper. The assays included; sodium chloride uptake in wild barley and a mapping population,effects for delta(13)C and plant dry weight in wheat aneuploids,effects of photoperiod and vernalization in wild barley,and measurements of root length in wild barley given drought and nitrogen starvation treatments in hydroponic culture. There are examples of the use of wild barley in breeding programmes,for example,as a source of new disease resistance genes,but the further exploration of the differences between wild barley and cultivars is hampered by the lack of good genetic maps. In parallel to the need for genetic studies there is also a need for the development of good physiological models of crop responses to the environment. Given these tools,wild barley offers the prospect of a 'goldmine' of untapped genetic reserves. [References: 34].

603 Faccioli,P.; Bellini,L.; Terzi,V.; Baldi,P.; Stanca,A.M. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)) (1998) **[Barley - malt - hops - beer. Which future with biotechnologies? [Hordeum vulgare L. - plant breeding]].** *Informatore Agrario (Italy) v. 54(33) p. 47-50.* Italian. (AGRIS 2000-001540).

604 Faris,JD.; Haen,KM.; Gill,BS. (2000) **Saturation mapping of a gene-rich recombination hot spot region in wheat.** *Genetics. 154(2):823-835.* English. [Kansas State Univ,Throckmorton Plant Sci Ctr 4307,Dept Plant Pathol Manhattan,KS 66506 USA].

Physical mapping of wheat chromosomes has revealed small chromosome segments of high gene density and frequent recombination interspersed with relatively large: regions of low gene density and infrequent recombination. We constructed a detailed genetic and physical map of one highly recombinant region on the long aim of chromosome 5B. This distally located region accounts for 4% of the physical size of the long arm and at least 30% of the recombination along the entire chromosome. Multiple crossovers occurred within this region,and the degree of recombination is at least 11-fold greater than the genomic average. Characteristics of the region such as gene order and frequency of recombination appear to be conserved throughout the evolution of the Triticeae. The region is more prone to chromosome breakage by gametocidal gene action than gene-poor regions,and evidence for genomic instability was implied by loss of gene collinearity for six loci among the homeologous regions. These data suggest that a unique level of chromatin organization exists within gene-rich recombination hot spots. The many agronomically important genes in this region should be accessible by positional cloning. [References: 92].

605 Fath,A.; Bethke,PC.; Jones,RL. (1999) **Barley aleurone cell death is not apoptotic: characterization of nuclease activities and DNA degradation.** *Plant Journal. 20(3):305-315.* English. [Univ Calif Berkeley,Dept Plant & Microbial Biol 111 Koshland Hall Berkeley,CA 94720 USA].

Barley aleurone cells undergo programmed cell death (PCD) when exposed to gibberellic acid (GA),but incubation in abscisic acid (ABA) prevents PCD. We tested the hypothesis that PCD in aleurone cells occurs by apoptosis,and show that the hallmarks of apoptosis,namely DNA cleavage into 180 bp fragments,plasma membrane blebbing,and the formation of apoptotic bodies do not occur when aleurone cells die. We show that endogenous barley aleurone nucleases and nucleases present in enzymes used for protoplast preparation degrade aleurone DNA and that DNA degradation by these nucleases is rapid and can result in the formation of 180 bp DNA ladders. Methods are described that prevent DNA degradation during isolation from aleurone layers or protoplasts. Barley aleurone cells contain three nucleases whose activities are regulated by GA and ABA. GA induction and ABA repression of nuclease activities correlate with PCD in aleurone cells. Cells incubated in ABA remain alive and do not degrade their DNA,but living aleurone cells treated with GA accumulate nucleases and hydrolyze their nuclear DNA. We propose that barley nucleases play a role in DNA cleavage during aleurone PCD. [References: 43].

606 Forster,BP.; Ellis,RP.; Thomas,WTB.; Newton,AC.; Tuberosa,R.; This,D.; El-Enein,RA.; Bahri,MH.; Ben,Salem,M. (2000) **The development and application of molecular markers for abiotic stress tolerance in barley.** *Journal of Experimental Botany. 51(342):19-27.* English. [Scottish Crop Res Inst Dundee DD2 5DA Scotland].

This article represents some current thinking and objectives in the use of molecular markers to abiotic stress tolerance. Barley has been chosen for study as it is an important crop species,as well as a model for genetic and physiological studies. It is an important crop and,because of its well-studied genetics and physiology,is an excellent candidate in which to devise more efficient breeding methods. Abiotic stress work on cultivated gene pools of small grain cereals frequently shows that adaptive and developmental genes are strongly associated with responses. Developmental genes have strong pleiotropic effects on a number of performance traits,not just abiotic stresses. One concern is that much of the genetic variation for improving abiotic stress tolerance has been lost during domestication,selection and modern breeding,leaving pleiotropic effects of the selected genes for development and adaptation. Such genes are critical in matching cultivars to their target agronomic environment,and since there is little leverage in changing these,other sources of variation may be required. In barley,and many other crops,greater variation to abiotic stresses exists in primitive landraces and related wild species gene pools. Wild barley,Hordeum spontaneum C. Koch is the progenitor of cultivated barley,Hordeum vulgare L. and is easily hybridized to H,vulgare. Genetic fingerprinting of H. spontaneum has revealed genetic marker associations with site-of-origin ecogeographic factors and also experimentally imposed stresses. Genotypes and collection sites have been identified which show the desired variation for particular stresses. Doubled haploid and other segregating populations,including landrace derivatives have been used to map genetically the loci involved. These data can be used in molecular breeding approaches to improve the drought tolerance of barley. One strategy involves screening for genetic markers and physiological traits for drought tolerance,and the associated problem of drought relief-induced mildew susceptibility in naturally droughted fields of North Africa. [References: 64].

607 Friebe,B.; Kynast,RG.; Hatchett,JH.; Sears,RG.; Wilson,DL.; Gill,BS. (1999) **Transfer of wheat-rye translocation chromosomes conferring resistance to Hessian fly from bread wheat into durum wheat.** *Crop Science. 39(6):1692-1696.* English. [Kansas State Univ,Wheat Genet Resource Ctr,Dept Plant Pathol Plant Sci Bldg,Throckmorton Hall Manhattan,KS 66506 USA].

The Hessian fly,Mayetiola destructor (Say),is a damaging pest of bread wheat,Triticum aestivum L.,and durum wheat,T. turgidum L,ssp. durum Desf. Husn,,in many wheat production areas of the world. Breeding for host plant resistance is the most agronomically desirable way to control this pest. Twenty-seven major genes conferring resistance to Hessian fly hale been identified and used in wheat improvement. These genes confer resistance to specific biotypes of the Hessian fly,Recently,new sources of Hessian fly

resistance derived from cultivated rye,Secale cereale L.,have been reported that confer resistance to all known biotypes of the Hessian fly,The resistance gene H21 is present on the wheat-rye whole arm translocation T2BS . 2R#2L.H25 is present on an interstitial rye segment in the 4AL arm of the wheat-rye translocation chromosome Ti4AS . 4AL-6R#1L-4AL. The objective of the present study was to transfer H21 and H25 to tetraploid durum wheat,thereby making these genes available for the improvement of durum wheat. Homozygous T2BS . 2R#2L and Ti4AS . 4AL-6R#1L-4AL translocation durum lines were recovered that expressed the H21 and H25 resistance,The H25 durum translocation line was vigorous and set seeds similar to the durum wheat parental cultivar,Thus,the H25 transfer can be used directly in durum wheat improvement. Plant vigor and seed set of the H21 durum translocation line was drastically reduced,indicating that the missing 2BL arm in this translocation has genes that are essential for normal plant vigor and fertility. Further chromosome engineering is required to shorten the rye segment in this translocation before H21 can be used in durum breeding. [References: 30].

608 Fritz,AK.; Caldwell,S.; Worrall,WD. (1999) **Molecular mapping of Russian wheat aphid resistance from triticale accession PI 386156.** *Crop Science. 39(6):1707-1710.* English. [Texas A&M Univ,So Crop Improvement Facil College Stn,TX 77843 USA].

The Russian wheat aphid (RWA),Diuraphis noxia Mordvilko,is an economic pest of wheat (Triticum aestivum L.) in some western growing regions. Sources of resistance occur within the wheat gene pool,but there are also high levels of resistance in wheat relatives,including rye (Secale cereale L.). An F-2 population between PI 386156,a Russian wheat aphid-resistant triticale (x Triticosecale Wittmack) from Russia and NE88T222,a susceptible triticale,was used to examine the inheritance of resistance. Five distinct classes of reaction to the RWA were observed,suggesting this trait is not controlled by a single dominant gene in this population. Bulked segregant analysis was performed with DNA from plants representing the most resistant ('R') and most susceptible ('S') classes. A co-dominant marker amplified by primer OP-M09 explained more than 55% of the variation observed for resistance. Sequencing results revealed a deletion in the 'S' parent relative to the 'R' parent. Using a set of wheat-rye addition lines,we mapped the target fragment to chromosome 4R,which has previously been identified as the critical chromosome for RWA resistance from PI 386156 and other Russian triticales. [References: 20].

609 Furusho,M.; Baba,T.; Yamaguchi,O.; Yoshida,T.; Hamachi,Y.; Yoshikawa,R.; Mizuta,K.; Yoshino,M. (1999) **Breeding of a new malting barley cultivar Houshun by the Bulbosum method.** *Breeding Science. 49(4):281-284.* English. [Fukuoka Agr Res Ctr 587 Yoshiki Fukuoka 8188549 Japan].

610 Gallo,G. (Stazione Sperimentale di Granicoltura per la Sicilia,Caltagirone,Catania (Italy)); Di prima,G. (Palermo Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee); Spina,A.; Minoia,C.; Pasquini,M.; Sereni,L. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)); Liotta,C. (Regione Siciliana,Aragona,Agrigento (Italy)); Invernizzi,C. (Apsov Sementi S.r.l.,Voghera,Pavia (Italy)); Padovan,S. (Istituto di Genetica e Sperimentazione Agraria N. Strampelli,Lonigo,Vicenza (Italy)); Casulli,F. (Bari Univ. (Italy). Dipartimento di Protezione delle Piante dalle Malattie); Siniscalco,A. (Bari Univ. (Italy). Dipartimento di Patologia Vegetale); Mameli,L. (Centro Regionale Agrario Sperimentale,Cagliari (Italy)) (1998) **[Behaviour of hard and soft wheats against some fungal diseases [Triticum durum Desf. - Triticum aestivum L. - Italy]].** *Informatore Agrario (Italy) v. 54(38) p. 63-73.* 11 tables. Italian. (AGRIS 2000-001851).

611 Garello,G.; Le,Page-Degivry,MT. (1999) **Evidence for the role of abscisic acid in the genetic and environmental control of dormancy in wheat (Triticum aestivum L.).** *Seed Science Research. 9(3):219-226.* English. [Univ Nice Sophia Antipolis,Lab Physiol Vegetale F-06108 Nice 2 France].

Grain production of two wheat cultivars (Triticum aestivum L. cv Recital and Scipion),known for their different germination behaviour,was studied at two different temperatures. The study of dormancy onset during grain development showed that in both cultivars,dormancy developed on the mother plant. In Recital grain,after a period of high germinability,dormancy developed for a transient period. However,full germination was obtained on medium supplemented with fluridone,showing that dormancy was associated with abscisic acid (ABA) biosynthesis inside the grain. Dormancy progressively disappeared during natural drying,at a slower rate for grains developing at 15 degrees C than for grains developing at 25 degrees C. However,at both temperatures,the release from dormancy was complete at maturity. In Scipion grain,dormancy was almost total throughout grain development irrespective of the temperature. However,grains could germinate in the presence of fluridone: changes in sensitivity to fluridone were observed during grain development,showing an increase in dormancy during the first half of development,followed by a progressive decrease during the second half. This decrease occurred later for grains developing at 15 degrees C than for those developing at 25 degrees C. In Scipion grain,unlike the cultivar Recital,release from dormancy was not completed before the end of development on the mother plant. An additional dry storage period was necessary which was shorter for grains developed at 25 degrees C than for grains produced at 15 degrees C. A comparison of embryo ABA levels after a 24-h culture in the presence or absence of fluridone,allowed the ABA synthesis to be estimated. It appears that the depth of dormancy was related to the estimated ABA synthesis capacity of the embryos. [References: 27].

612 Gonzalez,MJ.; Cabrera,A. (1999) **Identification of wheat and tritordeum chromosomes by genomic in situ hybridization using total Hordeum chilense DNA as probe.** *Genome. 42(6):1194-1200.* English. [Univ Cordoba,ETSIAM,Dept Genet Apdo 3048 E-14080 Cordoba Spain].

Total genomic Hordeum chilense DNA probe was hybridized to somatic chromosome spreads of Triticum aestivum 'Chinese Spring' and to four advanced tritordeum lines,the latter being the fertile amphiploid between H. chilense and durum wheat (2n = 6x = 42,AABBH(ch)H(ch)). The probe hybridized strongly to the B-genome chromosomes and to one or two bands on the A-genome chromosomes present in both wheat and tritordeum alloploids. Bands on chromosomes 1D,2D,and 7D from hexaploid wheat were also detected. Genomic H. chilense DNA probe identified 16 chromosome pairs of the chromosome complement of hexaploid wheat and all A- and B-genome chromosomes present in the tritordeum amphiploids. The in situ hybridization patterns observed correspond to those previously reported in wheat by both N-banding and in situ hybridization with the GAA-satellite sequence (Pedersen and Langridge 1997),allowing the identification of these chromosomes. Variation among the tritordeum amphiploids for hybridization sites on chromosomes 2A,4A,6A,7A,4B,5B,and 7B was observed. Despite of this polymorphism,all lines shared the general banding pattern. When used as probe,total H. chilense genomic DNA labeled the H. chilense chromosomes over their lengths allowing the identification of 14 H. chilense chromosomes present in the tritordeum amphiploids. In addition,chromosome-specific telomeric,interstial,and centromeric hybridization sites were observed. These hybridization sites coincide with N-banded regions in H. chilense allowing the identification of the individual H. chilense chromosomes in one of the amphiploid. The N-banded karyotypes of H. chilense (accessions H1 and H7) are presented. [References: 25].

613 Gorny,AG. (1999) **Inheritance of nitrogen and phosphorus utilization efficiency in spring barley at the vegetative growth stages under high and low nutrition.** *Plant Breeding. 118(6):511-516.* English. [Polish Acad Sci,Inst Plant Genet Strzeszynska 34 PL-60479 Poznan Poland].

Inheritance of the nitrogen and phosphorus utilization efficiencies (NUE and PUE,respectively) and that of the tolerance (T) to limited NP nutrition was investigated in spring barley crosses at the vegetative growth stages. Plants were grown in sand-vermiculite cultures under high and low NP nutrition. In a diallel set (Ps and F(2)s),both general combining ability (GCA) and specific combining ability (SCA) effects were significant for the variation in NUE and PUE,while the variation in T was mainly associated with GCA effects. The contribution of nonadditive genes for the utilization efficiencies was found to increase under nutrient shortages. Overdominance of genes was detected. The characters exhibited low heritabilities (0.1-0.42). Generation means analysis in two cross-combinations revealed significant effects of epistatic gene interactions. It was assumed that the involvement of both the dominance effects and epistatic interactions would not facilitate selection efforts to improve the characters in spring barley at its vegetative growth. Such selection should be performed among families of later generations. The genotype-nutrition interactions observed suggest that selection under diverse nutrition rates would be necessary for the more precise evaluation of barley efficiency under less favourable soil fertility. [References: 34].

614 Grewal,TS.; Dhaliwal,HS.; Harjit-Singh.; Datta,R.; Pannu,PPS. (1999) **Identification and transfer of powdery mildew resistance from related species into cultivated wheats (Triticum aestivum).** *Indian Journal of Agricultural Sciences. 69(10):707-711.* English. [Punjab Agr Univ,Ctr Biotechnol Ludhiana 141004 Punjab India].

A study was conducted during 1990-98 to identify new sources of powdery mildew (Erysiphe graminis DC f sp tritici E. Marchel) resistance among 4 wild and 1 related species of wheat (Triticum aestivum L. emend. Fiori & Paol.). Testing at adult plant stage under natural conditions as well as at Seedling stage using single spore isolates identified 26 sources of resistance among Triticum araraticum (9),;T: boeoticum (1),Aegilops speltoides (14),A. squarrosa ( 1) and T. dicoccum (1). This resistance of two accessions of T: araraticum (Accessions 4697 & 4698) has been transferred into I: durum Desf and 'NP 200' T. dicoccum into 'HD 2329' T. aestivum through interspecific hybridization. One backcross derivative carrying resistance from T araraticum (Accession 4698) showed multiple resistance to powdery mildew,leaf rust,stripe rust and stem rust under natural conditions at Wellington (Tamil Nadu). [References: 12].

615 Gupta,PK.; Varshney,RK.; Sharma,PC.; Ramesh,B. (1999) **Molecular markers and their applications in wheat breeding** [Review]. *Plant Breeding. 118(5):369-390.* English. [CH Charan Singh Univ,Dept Agr Bot,Mol Biol Lab Meerut 250004 Uttar Pradesh India].

In recent years,considerable emphasis has been placed on the development of molecular markers to be used for a variety of objectives. This review attempts to give an account of different molecular markers-restriction fragment length polymorphisms (RFLPs),random amplified polymorphic DNAs (RAPDs),sequence-tagged sites (STS),DNA amplification fingerprinting (DAF),amplified fragment length polymorphisms (AFLPs) and microsatellites (STMS) - currently available for genome mapping and for tagging different traits in wheat. Other markers,including microsatellite-primed polymerase chain reaction (MP-PCR),expressed sequence tags (ESTs) and single nucleotide polymorphisms (SNPs) are also discussed. Recent information on synteny in cereal genomes,marker-assisted selection,marker validation and their relevance to cereal breeding in general and wheat breeding in particular are also examined. [References: 243].

616 Gupta,SK.; Singh,D. (1999) **Hybrid performance for yield and malt quality in barley using cytoplasmic male sterile lines.** *Cereal Research Communications. 27(4):389-394.* English. [CCS HAU,Dept Plant Breeding Hisar 125004 Haryana India].

1A,2A and msm2 cytoplasmic genic male sterile lines of barley were crossed with restorers to generate 26 hybrids to know the extent of heterosis for grain-yield,malt content and their components. The best heterotic hybrids with Iq 2A and msm2 exhibited 67,73 and 25 per cent heterosis respectively for grain yield over the standard variety BH-75. Heterosis for grain yield was attributed to 1000-grain weight and tillers/plant in most of the hybrids. Six-hybrids showed significantly higher heterosis for malt extract over the standard variety Alfa-93. The heterosis for malt-extract was mainly due to high grain yield,low protein-content and plumy kernels (>2.5mm). Most of the hybrids showed negative heterosis for diastatic power,positive heterosis for grain-protein and husk content. Five hybrids namely 1Ax BH75,1A x Alfa-93,2A x BH331,2A x DL88 and msm2 x BH75 showed significant higher heterosis for both grain yield and malt extract. [References: 16].

617 Haji,HM.; Hunt,LA. (1999) **Genotype x environment interactions and underlying environmental factors for winter wheat in Ontario.** *Canadian Journal of Plant Science. 79(4):497-505.* English. [Univ Guelph,Dept Plant Agr Guelph ON N1G 2W1 Canada].

Many studies have dealt with the problem of varying genotype performance in different environments (GE interaction). Little is known,however,of the underlying causes of GE interaction. This study was undertaken to identify some of the environmental factors that are associated with GE interactions in winter wheat in Ontario,Canada. Grain yields were obtained from the 1992/1993 and 1993/1994 winter wheat (Triticum aestivum L. em. Thell.) recommendation trials in Ontario. In each year,trials were grown at nine sites. Variance components for the second-order interaction between genotypes x sites x years were considerably larger (22% of the phenotypic variance) than the first-order interactions between genotypes x years and genotypes x sites,which,respectively,accounted for only 5% of the total variation,suggesting that the genotypes were responding differentially to environmental factors at the various sites. Both linear and non-linear components of the regression of genotype grain yields on site mean grain yield were significant. Grain yield of many genotypes was associated with both the lowest and the mean minimum temperature in January and with precipitation during the vegetative stage (May) in 1992/1993 and during the grain-filling period (July) in 1993/1994. Interaction principal component analysis scores for the environment were associated with January minimum temperature in both years although winter survival differences were only apparent in 1992/1993. The results indicate that January temperatures,together with moisture supply before anthesis,are associated with some of the GE interaction noted with winter wheat in Ontario. Both of these aspects,but in particular January temperatures,should thus be taken into account when evaluating cultivar performance trials. Cultivars should be exposed to low January temperatures at some sites during the evaluation process,and weather records from evaluation sites should be examined to ensure that this has occurred. [References: 29].

618 Han,F.; Kilian,A.; Chen,JP.; Kudrna,D.; Steffenson,B.; Yamamoto,K.; Matsumoto,T.; Sasaki,T.; Kleinhofs,A. (1999) **Sequence analysis of a rice BAC covering the syntenous barley Rpg1 region.** *Genome. 42(6):1071-1076.* English. [Washington State Univ,Dept Crop & Soil Sci Pullman,WA 99164 USA].

In the course of map-based cloning of the barley stem rust resistance gene Rpg1,we identified a rice bacterial artificial chromosome (BAC) containing the Rpg1 flanking markers. Based on the excellent gene order colinearity between barley and rice in this region,we expected that this rice BAC would contain the barley Rpg1 homologue. In order to identify the putative rice homologue,we sequenced ca. 35 kb of the rice BAC at random and then an additional 33 kb of contiguous sequence between the two most closely spaced Rpg1 flanking markers. Sequence analysis revealed a total of 15 putative genes,5 within the 33-kb contiguous region. A rice Rpg1 homologue was not identified,although a gene encoding a hypothetical polypeptide with similarity to a membrane protein could not be eliminated as a candidate. Surprisingly,four of the genes identified in the 33-kb contiguous rice sequence showed a high degree of similarity with genes on Arabidopsis chromosome 4. The genome regions harboring these genes showed some relatedness,but many rearrangements were also evident. These data suggest that some genes have remained

linked even over the long evolutionary separation of Arabidopsis and rice,as has also been reported for mammals and invertebrates. [References: 15].

619 Hanif,M. (Government Coll.,Faisalabad (Pakistan)); Davies,M.S. (1998) **Effects of salt on seed germination in contrasting cereal cultivars.** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 280-282.* 4 ills.,11 ref. English. (AGRIS 2000-001833).

This study was to compare the relative salt tolerance of differentially salt-tolerant cultivars of wheat,rye and barley grown at varying concentrations of NaCl in solution culture during germination. Increasing concentration of NaCl (60-150 mM) reduced the percentage of seed germinating. The lines of Hordeum sativum were generally less sensitive to the NaCl-induced reduction in respect of the character than Triticum aestivum) or Secale cereale. Germination is not a good discriminating character for salt tolerance in this study.

620 Harwood,WA.; Ross,SM.; Cilento,P.; Snape,JW. (2000) **The effect of DNA/gold particle preparation technique,and particle bombardment device,on the transformation of barley (Hordeum vulgare).** *Euphytica. 111(1):67-76.* English. [John Innes Ctr Plant Sci Res Norwich Res Pk Norwich NR4 7UH Norfolk England].

Immature embryos of the spring barley variety Golden Promise,were bombarded with three different particle delivery systems and both transient and stable transformation examined. In addition,a range of techniques for the preparation of the DNA coated gold particles was examined. Fertile transgenic barley plants were obtained using three particle preparation techniques which differed in the amount of gold and DNA used for each bombardment. However,only one of the particle delivery systems,the PDS 1000/He device,appeared to be effective in yielding transformed barley plants. [References: 24].

621 Hussein,T.S.T. (1998) **The phylogenetic relations of some barley species and varieties.** Ain-Shams Univ.,Cairo (Egypt). Faculty of Agriculture. 17 fig. 21 tables; Bibliography: p. 91-107. 110 p. English. (AGRIS 2000-001536).

622 Igartua,E.; Casas,AM.; Ciudad,F.; Montoya,JL.; Romagosa,I. (1999) **RFLP markers associated with major genes controlling heading date evaluated in a barley germ plasm pool.** *Heredity. 83(Part 5):551-559.* English. [CSIC,Dept Genet & Plant Prod,Estac Expt Aula Dei POB 202 E-50080 Zaragoza Spain].

Adjustment of crop phenology to resources and constraints of the production environment is crucial for barley adaptation to dry-land environments. The aims of this study were to characterize (under field and under controlled conditions) the diverse heading responses of barley cultivars grown in Spain,and to identify phenotypic trait-molecular marker associations with restriction fragment length polymorphism (RFLP) probes which are linked to major loci controlling vernalization (Sh and Sh(2)) and photoperiod (Ppd-H1 and Ppd-H2) sensitivities in barley. Thirty-two cultivars were sown in held trials for 3 years in four locations in northern Spain (10 autumn and nine winter sowings),and for 1 year in southern Spain (autumn sowing),and 2 years in Scotland (spring sowings); they were also studied under four glasshouse treatments,combining presence/absence of vernalization and short/long photoperiod. These cultivars were examined for the presence of RFLP polymorphisms with four probes and three restriction enzymes. Analyses of variance detected a number of associations which were quite consistent with expectations,suggesting that marker-loci associations found in mapping populations are,to some extent,maintained in a germ plasm pool,and may be useful for germ plasm characterization and marker-assisted selection in breeding programmes. Two possible epistatic interactions among the probes were detected,one of them possibly related to a short-day vernalization response. [References: 20].

623 Islam,AKMR.; Shepherd,KW. (2000) **Isolation of a fertile wheat-barley addition line carrying the entire barley chromosome 1H.** *Euphytica. 111(2):145-149.* English. [Univ Adelaide,Dept Plant Sci Waite Campus Glen Osmond SA 5064 Australia].

The isolation of six of the seven possible additions of barley chromosomes to the wheat genome reported 18 years ago has made an important contribution to gene mapping in barley,first with genes controlling isozymes and more recently DNA (molecular) markers. A fertile addition line involving barley chromosome 1H,which carries genes controlling several characters of economic importance,could not be isolated at that time because it caused extreme meiotic abnormalities leading to complete sterility when added to wheat. Later the short arm of barley chromosome 1H was added to wheat as a fertile ditelosomic addition,but the non-availability of the entire barley chromosome 1H addition line has hampered the location of barley genes to the long arm of this chromosome. This problem has now been overcome cytogenetically as described herein. The resultant self-fertile disomic-monotelodisomic addition line carrying a pair of barley chromosome 6H and a heteromorphic 1H/1HS pair is more stable,and makes the wheat-barley addition line series complete for gene mapping work and will provide a vehicle for the possible transfer of useful genes from this barley chromosome to wheat. [References: 16].

624 Ivanovski,M. (Institut za poljoprivredu,Skopje (The Formar Yugoslav Republic of Macedonia)); Knezevic,D.; Menkovska,M. (1996) **Inheritance of some kernel quality characteristics of hybrids at F4 generations in wheat.** *Savremena poljoprivreda (Yugoslavia) (no. 1-2) p. 19-23.* 1 table; 12 ref. Serbian. (AGRIS 2000-009548).

In this study mass of 1000 grain,hectoliter weight,protein content and sedimentation volume of ten hybrid lines at F4 generation obtained by interspecies hybridization of soft wheat varieties (Triticum aestivum ssp. vulgare) have been analyzed. The experiment was carried out on experimental field of the Agricultural Institute in Skopje region (The Former Yugoslav Republic of Macedonia). The inheritance of mass 1000 grain on eight hybrid lines showed positive heterosis,and in two lines partial dominant. The inheritance of hectoliter weight showed intermediary,partial dominant and positive heterosis. Protein content showed in eight lines negative heterosis and in two lines partial dominant. The inheritance of the sedimentation value showed partial dominant in five lines,intermediary in one line,and super dominant in four lines where positive heterosis was in two lines and negative in other two lines.

625 Iwaki,K.; Nakagawa,K.; Kuno,H.; Kato,K. (2000) **Ecogeographical differentiation in east Asian wheat,revealed from the geographical variation of growth habit and Vrn genotype.** *Euphytica. 111(2):137-143.* English. [Okayama Univ,Fac Agr 2-5-1 Shikata Cho Okayama 7008530 Japan].

Growth habit,heading date and Vrn genotype were examined for wheat landraces cultivated in China,Korea and Japan,to study their ecogeographical differentiation in east Asia. Spring type landraces accounted for 43.6% of the whole,and the frequency varied between the localities,being closely related to the degree of winter coldness. Spring type landraces mainly adapted to north and south China where average January temperature is under -7 degrees C and over 4 degrees C,respectively. On the contrary,winter type adapted to areas of average January temperature from -7 degrees C to 4 degrees C. As to heading date,significant difference was not observed between spring and winter type landraces but between localities,and those cultivated in north China were significantly later in heading. It is therefore indicated that spring type mainly adapts to areas where wheat is sown in spring to avoid frost injury,and where winter temperature is not low enough to vernalize winter type wheat. Genetic analysis for spring type landraces showed that the relative frequency of four Vrn genes was different with each other. Vrn3 was most widely and frequently found among the four genes,followed by Vrn1 and Vrn2. Only seven landraces proved to be the carrier of Vrn4. The frequency was also different between localities. Genotype with Vrn1 plus other dominant gene(s) adapted to

spring sowing to avoid severely cold winter in north China,while genotype with only Vrn3 adapted to winter sowing in south China and southwest Japan. It is therefore concluded that at least three ecotypes,differing in growth habit and Vrn genotype,are allopatrically distributed in east Asia,as a result of adaptation to winter coldness in each locality. [References: 29].

626 Jaaskelainen,M.; Mykkanen,AH.; Arna,T.; Vicient,CM.; Suoniemi,A.; Kalendar,R.; Savilahti,H.; Schulman,AH. (1999) **Retrotransposon BARE-1: expression of encoded proteins and formation of virus-like particles in barley cells.** *Plant Journal. 20(4):413-422.* English. [Univ Helsinki,Viikki Bioctr,Inst Biotechnol POB 56 FIN-00014 Helsinki Finland].

Retrotransposons are ubiquitous and major components of plant genomes,and are characteristically retroviral-like in their genomic structure and in the major proteins encoded. Nevertheless,few have been directly demonstrated to be transcribed or reverse transcribed. The BARE-1 retrotransposon family of barley (Hordeum vulgare) is highly prevalent,actively transcribed,and contains well conserved functional regions. Insertion sites for BARE-1 are highly polymorphic in the barley genome. Here we show that BARE-1 is translated and the capsid protein (GAG) and integrase (IN) components of the predicted polyprotein are processed into polypeptides of expected size. Some of the GAG sediments as virus-like particles together with IN and with BARE-1 cDNA. Reverse transcriptase activity is also present in gradient fractions containing BARE-1 translation products. Virus-like particles have also been visualized in fractions containing BARE-1 components. Thus BARE-1 components necessary for carrying out the life cycle of an active retrotransposon appear to be present in vivo,and to assemble. This would suggest that post-translational mechanisms may be at work to prevent rapid genome inflation through unrestricted integration. [References: 50].

627 Jimenez,M.; Dubcovsky,J. (1999) **Chromosome location of genes affecting polyphenol oxidase activity in seeds of common and durum wheat.** *Plant Breeding. 118(5):395-398.* English. [Univ Calif Davis,Dept Agron & Range Sci 1 Sheilds Ave Davis,CA 95616 USA].

This study used cytogenetic stocks to investigate the chromosomal location of genes responsible for polyphenol oxidase (PPO) activity in common and durum wheat seeds. Substitution lines of chromosome 2A of hexaploid Varieties 'Cheyenne','Thatcher' and 'Timstein' in 'Chinese Spring' showed significantly higher PPO activity than all other substitution lines of the same variety,with the exception of substitutions of 'Cheyenne' chromosome 3A and 'Thatcher' chromosome 4B. Substitution lines of chromosome 2A of Triticum turgidum var,dicoccoides and of chromosome 2D of 'Chinese Spring' into the tetraploid variety 'Langdon' showed a significant increase in PPO activity relative to all other substitution lines in Langdon. The gene(s) responsible for high PPO activity in chromosome 2D from 'Chinese Spring' was mapped on the long arm within a deletion that represents 24% of the distal part of the arm. This study shows that genes located in homoeologous group 2 play a major role in the activity of PPO in wheat. [References: 16].

628 Kato,K.; Miura,H.; Sawada,S. (1999) **Detection of an earliness per se quantitative trait locus in the proximal region of wheat chromosome 5AL.** *Plant Breeding. 118(5):391-394.* English. [Obihiro Univ Agr & Vet Med,Dept Crop Sci Obihiro Hokkaido 0808555 Japan].

A homoeologous quantitative trait locus to that of eps5L. on barley chromosome 5H was identified in a syntenic region of wheat chromosome 5A. Wheat single chromosome recombinant lines (SCRs) were developed from a cross between 'Chinese Spring' ('Cappelle-Desprez' 5A) and 'Chinese Spring' (Triticum spelta SA),these were grown together with the parental controls under different vernalization and photoperiod regimes. The variation for ear emergence time accelerated heading induced by the T. spelta segment indicated an effect associated with the Xcdo412-Xbcd9 interval. Since no differences between the SCRs and controls in responses to vernalization and photoperiod treatments were detected,this effect was identified as an earliness per se gene,QEet.ocs-5A.2,which may be homoeologous to the eps5L quantitative trait locus of barley. Xbcd926 has been found to be closely linked to the rice flowering time quantitative trait loci,QHd9a or FLTQ2,on chromosome 9,suggesting possible relationships among the quantitative trait loci across wheat,barley and rice genomes. [References: 24].

629 Kato,K.; Wada,T. (1999) **Genetic analysis and selection experiment for narrow-sense earliness in wheat by using segregating hybrid progenies.** *Breeding Science. 49(4):233-238.* English. [Okayama Univ,Fac Agr 1-1-1 Tsushima Naka Okayama 7008530 Japan].

Genetic analysis of narrow-sense earliness in wheat was carried out,by using four segregating populations derived from the crosses between five cultivars with a large variation in narrow-sense earliness. Narrow-sense earliness measured at 15 degrees C,exhibited a large variation among five parental cultivars ranging from 29.8 to 51.2 days. It was earlier in F-1 hybrids than in the mid-parent and later by a few days than in the early parent in all cross combinations,indicating the partial dominance of earliness. The polygenic nature of narrow-sense earliness was indicated by continuous variation in F-2 populations,and heritability in a broad sense ranged from 0.90 to 0.99 among four F-2 populations. In randomly selected progenies,the parent-offspring correlation coefficient between parents (F-2 plants) and F-3 lines proved to be statistically significant ($r = 0.608-0.742, P < 0.01$). These results indicated that narrow-sense earliness is a highly heritable character,inspite of its quantitative nature. Artificial selection in F-2 populations resulted in significant improvement in early and late selections as compared with randomly selected F-3 lines,indicating the effectiveness of artificial selection for optimizing narrow- sense earliness. [References: 25].

630 Kazemekas,O.; Becus,V.; Kazemekiene,B. (Lithuanian Univ. of Agriculture,Kaunas Akademija (Lithuania)) (1999) **[Suitability of non-dropping pea varieties in mixtures with barley].** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies . Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 124-127.* Latvia University of Agriculture. 1 table; 7 ref. Russian. (AGRIS 2000-001654).

In the period of 1996-98 field trials were carried out at the Research Station of the Lithuanian University of Agriculture to investigate the suitability of three non-dropping pea varieties (Tomiai,Kibukai,Greitieji) in mixture with the barley variety "Roland". The investigation results showed that the highest grain yield was obtained by mixing the barley variety "Roland" with the pea variety "Kibukai". The seedings were less weedy and the protein content in grain was higher than in the mixtures with the other two pea varieties.

631 Khaliq,I.; Shah,S.A.H.; Ahsan,M. (University of Agriculture,Faisalabad (Pakistan). Dept. of Plant Breeding and Genetics); Khalid,M. (1999) **Evaluation of spring wheat (Triticum aestivum L.) for drought field conditions: A morpho-physiological study.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 1006-1009.* 2 tables,11 ref. English. (AGRIS 2000-001832).

Twenty wheat (Triticum aestivum L.) genotypes were compared for different morpho-physiological traits under drought stress to know the type and extent to their contribution to yield. There was significant variation found among wheat genotypes for indicated traits. Wheat genotypes 8252,Rohtas-90,8274 and 8244 were found high yielding under drought field conditions. However it concluded these can be selected to grow under drought stress conditions or may be useful for further cross breeding programme. Inter- relationships and path coefficient analysis revealed that stomatal frequency and osmotic pressure along with their indirect causal effects may be useful selection criteria for increasing grain yield of wheat because to their direct positive effects on grain yield in wheat under drought field conditions.

632 Khan,A.S.; Malik,M.A. (National Agricultural Research Centre,Islamabad (Pakistan)) (1999) **Effect of gamma irradiation on some morphological characters of three wheat varieties.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 903-905.* 1 table,19 ref. English. (AGRIS 2000-001829).

The effect of gamma irradiation (0,15,25,35 and 45 kR) was studied on three varieties of wheat viz; Pak-81,LU-26 and SS-5. Significant differences were observed due to varieties and different doses of gamma irradiation. A trend of reduction was observed in seedling emergence percentage and plant height in response to doses. Significant reduction in seedling emergence percentage (79%) and plant height (19.9%) were observed due to 45 kR as compared to control. On application of various doses,the parameters of days taken to earning started,days taken to earning completion,number of tillers,number of leaves per plant and spike length increased gradually as compared to control.

633 Khan,A.S.; Sher,A. (University of Agriculture,Faisalabad (Pakistan). Dept. of Plant Breeding and Genetics) (1999) **Estimation of heterotic effects for yield and its components in bread wheat (Triticum aestivum L.).** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 928-930.* 2 tables,11 ref. English. (AGRIS 2000-001830).

Heterosis was estimated over mid and better parents,for yield and some important yield components in 20 crosses of wheat involving one local variety viz. Inq. 91 and four promising lines viz. 6039-4,8284,4943 and 4770. Grain yield per plant showed maximum heterosis over the mid parent (44.30%) followed by 1000- grain weight (28.65%),plant height (13.40%) and number of tillers per plant (12.23%). The maximum heterobeltiosis was recorded for grain yield per plant (34.54%),1000-grain weight (23.52%),number of tillers per plant (11.20%) and plant height (6.60%).

634 Khan,IA. (1999) **Detection of wheat-alien recombinant chromosomes using co-dominant DNA markers.** *Annals of Applied Biology. 135(3):579-583.* English. [Univ Calif Davis,Dept Agron & Range Sci Davis,CA 95616 USA].

A study of homoeologous recombination along almost the complete genetic length of two homoeologous chromosomes in the Triticeae was conducted. Sears' ph1b mutant was used to induce homoeologous pairing between chromosomes 7A of common wheat and 7Ai-1 of Agropyron intermedium. 390 ph1b ph1b homozygous F-3 progeny were screened using six co-dominant DNA markers (RFLP loci). 63 of the progeny (16%) were putative recombinants,showing dissociation of RFLP markers within the arm(s). Progeny tests of self-fertile putative recombinants confirmed the dissociation phenotypes observed in the F-3 progeny. No recombination could be confirmed in 117 F-3 progeny plants having the Ph1-allele (control population). Frequencies and distribution of chiasmata along the chromosome arm 7AS were analysed using additional RFLP markers. The patterns of recombination between the two homoeologous chromosomes were found similar to those reported for homologous recombination between the same markers on short arms of group 7 chromosomes of Triticeae. [References: 30].

635 Kihara,M.; Kaneko,T.; Ito,K.; Aida,Y.; Takeda,K. (1999) **Geographical variation of beta-amylase thermostability among varieties of barley (Hordeum vulgare) and beta-amylase deficiency.** *Plant Breeding. 118(5):453-455.* English. [Sapporo Breweries Ltd,Plant Bioengn Res Labs 37-1 Kizaki Nitta Gunma 3700393 Japan].

Investigations onto the thermostability of beta-amylase in 274 Varieties of barley (Hordeum vulgare L.) indicated that all varieties except one were distributed into three types of high (type A),intermediate (type B),and low (type C) thermostability,respectively. One variety (TB29) from China showed no beta-amylase activity. Geographical variation was observed in the thermostability of beta-amylase. Type C varieties were not observed in East Asia (Japan,the Korean Peninsula,China and Nepal),although 36 out of 37 varieties in Ethiopia were type C. Most of the varieties were Type A in Japan,the Korean Peninsula and China,whereas the frequency of type A and type B were nearly equal in Nepal. Varieties in the other five areas (North America,North Africa,Southwest Asia,Turkey and Europe) consisted of types A; B and C. These results support the fact that East Asian cultivars are genetically different from those of the western regions,as previously reported. [References: 10].

636 Kobiljski,B. (Naucni institut za ratarstvo i povrtarstvo,Novi Sad (Yugoslavia)); Dencic,S.; Kraljevic Balalic,M. (1998) **Variability and stability of harvest index and spike index and their value in wheat breeding.** *Savremena poljoprivreda (Yugoslavia) (no. 3-4) p. 29-36.* 7 tables; 25 ref. Serbian. (AGRIS 2000-009530).

Phenotypic variability and stability of harvest index and spike index in 40 wheat genotypes,originated from four different regions in 35-50 belt of World north hemisphere (Russia and Ukraine,Far East,North America,Cemtral and South Europe) were investigated. Based on the results of phenotypic variability and stability of analysed characters,the genotypes were detected which could serve as parents in future wheat breeding.

637 Kobiljski,B.; Dencic,S.; Khairallah,S. (Naucni institut za ratarstvo i povrtarstvo,Novi Sad (Yugoslavia)) (1996) **Effect of spike size on yield components and grain yield in wheat.** *Selekcija i semenarstvo (Yugoslavia). Plant Breeding and Seed Production v. 3(3-4) p. 27-31.* 2 tables; 13 ref. Serbian. (AGRIS 2000-009528).

In this paper,the effect of spike size on yield components and grain yielding wheat was observed in four different groups of genotypes: 1) foreing high-yielding genotypes,2) old NS cultivars (developed at Institute of Field and Vegetable Crops,Novi Sad,Yugoslavia,and recognized between 1970 and 1989),3) new NS cultivars (recognized between 1992 and 1996) and 4) most promising NS lines.

638 Kocsy,G.; Szalai,G.; Vagujfalvi,A.; Stehli,L.; Orosz,G.; Galiba,G. (2000) **Genetic study of glutathione accumulation during cold hardening in wheat.** *Planta. 210(2):295-301.* English. [Hungarian Acad Sci,Agr Res Inst POB 19 H-2462 Martonvasar Hungary].

The effect of cold hardening on the accumulation of glutathione (GSH) and its precursors was studied in the shoots and roots of wheat (Triticum aestivum L.) cv. Cheyenne (Ch,frost-tolerant) and cv. Chinese Spring (CS,moderately frost-sensitive),in a T. spelta L. accession (Tsp,frost-sensitive) and in chromosome substitution lines CS (Ch 5A) and CS (Tsp 5A). The fast induction of total glutathione accumulation was detected during the first 3 d of hardening in the shoots,especially in the frost-tolerant Ch and CS (Ch 5A). This observation was corroborated by the study of de novo GSH synthesis using [S-35]sulfate. In Ch and CS (Ch 5A) the total cysteine,gamma-glutamylcysteine (precursors of GSH),hydroxymethylglutathione and GSH contents were greater during the 51-d treatment than in the sensitive genotypes. After 35 d hardening,when the maximum frost tolerance was observed,greater ratios of reduced to oxidised hydroxymethylglutathione and glutathione were detected in Ch and CS (Ch 5A) compared to the sensitive genotypes. A correspondingly greater glutathione reductase (EC 1.6.4.2) activity was also found in Ch and CS (Ch 5A). It can be assumed that chromosome 5A of wheat has an influence on GSH accumulation and on the ratio of reduced to oxidised glutathione as part of a complex regulatory function during hardening. Consequently,GSH may contribute to the enhancement of frost tolerance in wheat. [References: 41].

639 Korzun,V.; Borner,A.; Siebert,R.; Malyshev,S.; Hilpert,M.; Kunze,R.; Puchta,H. (1999) **Chromosomal location and genetic mapping of the mismatch repair gene homologs MSH2,MSH3,and MSH6 in rye and wheat.** *Genome. 42(6):1255-1257.* English. [Lochow Petkus GmbH Bollersener Weg 5 D-29303 Bergen Germany].

The efficiency of homeologous recombination is influenced by mismatch repair genes in bacteria,yeast,and mammals. To elucidate a possible role of these genes in homeologous pairing

and cross-compatibility in plants,gene probes of wheat (Triticum aestivum) specific for the mismatch repair gene homologues MSH2,MSH3,and MSH6 were used to map them to their genomic positions in rye (Secale cereale). Whereas MSH2 was mapped to the short arm of chromosome 1R,MSH3 was mapped to the long arm of chromosome 2R and MSH6 to the long arm of chromosome 5R. Southern blots with nullisomic-tetrasomic (NT) lines of wheat indicated the presence of the sequences on the respective homeologous group of wheat chromosomes. Additionally,an MSH6-specific homologue could also be detected on homoeologous group 3 of wheat. However,in the well-known,highly homoeologous pairing wheat mutant ph1b the MSH6-specific sequence is not within the deleted part of chromosome 5BL,indicating that the pairing phenotype is not due to a loss of one of the mismatch repair genes tested. [References: 16].

640 Kuburovic,M.; Pavlovic,M.; Knezevic,D.; Zecevic,V.; Milovanovic,M.; Kovacevic,B. (Institut za istrazivanja u poljoprivredi Srbija,Kragujevac (Yugoslavia). Centar za strna zita) (1998) **Characteristics of new winter wheat cultivars created in Kragujevac [Yugoslavia].** *Savremena poljoprivreda (Yugoslavia) (no. 3-4) p. 49-54.* 7 tables; 7 ref. Serbian. (AGRIS 2000-009532).

During the period 1990-1995 in the Center for Small Grains in Kragujevac,Serbia (Yugoslavia) 8 new winter wheat cultivars were created. At the Yugoslav Federal Commission for Varietal Approvement new Kragujevac's winter wheat cultivars: Studenica,Takovcanka,Jasenica,Ravanica,Levcanka,Gruza,KG-56 S and Bistrica were registered. The cultivars have good resistance to lodging,and very good resistance to low temperatures. The cultivars Studenica,Takovcanka,Jasenica,Ravanica and Levcanka have potential productivity for grain yield about 11 t/ha,and cultivar Gruza and KG-56 S 10 t/ha. These cultivars characterized by very good yield of flour and bread yield as well as high yield of flour and bread per hectare,which are in majority of cultivars significantly higher than standard cultivars (Partizanka and Super Zlatna). Studenica,Jasenica,Ravanica,Takovcanka,Levcanka and Gruza are very good bread cultivars,they belongs mostly to B1 quality group and the 2nd quality class. KG-56 S cultivar has excellent parameters of breadmaking quality and it is similarly to standard cultivar (Partizanka).

641 Kumar,PK.; Subrahmanyam,NC. (1999) **Molecular changes at Rrn loci in barley (Hordeum vulgare L.) hybrids with H-bulbosum (L.).** *Genome. 42(6):1127-1133.* English. [Univ Hyderabad,Sch Life Sci Hyderabad 500046 Andhra Pradesh India].

Southern blots of restriction fragments of genomic DNAs from Hordeum vulgare (L.),H. bulbosum (L.),and interspecific hybrids and their derivatives were hybridized with rDNA probe to identify locus-specific modifications at Rrn loci. H. bulbosum rDNA revealed a single EcoRV site per repeat compared with two sites in H. vulgare rDNA repeats. H. bulbosum accessions possessed at least two rDNA repeat lengths,indicating heterozygosity at the Rrn locus. Hybrids possessed both H. vulgare and H. bulbosum rDNA repeats. Two of the hybrid derivatives possessed bulbosum-specific Sau3AI and HaeIII rDNA fragments,while amphiploid and doubled haploid derivatives lacked H. bulbosum rDNA repeat units and (or) fragments. Two hybrid derivatives,one amphiploid and a doubled haploid derived from the same parental combination,lacked the vulgare Rrn(2)-specific 9.0-kb rDNA repeat. This is the first conclusive evidence for the elimination of vulgare genetic material in vulgare-bulbosum hybrids. The ratios of 9.0- to 9.9-kb vulgare repeats and H. vulgare to H. bulbosum rDNA repeats indicate partial loss of the vulgare-specific 9.0-kb rDNA repeat among the hybrids. Differences in MboI and Sau3AI fragments and the ratios of 9.0 to 9.9 kb vulgare rDNA repeats revealed differential methylation at Rrn(1) and Rrn(2) loci. Hybrids and derivatives showed differential distribution of methylation of EcoRI,Bg/II,and SacI sites at the Rrn(1) locus. Two of the hybrid derivatives exhibited extensive CpG-biased methylation. Data presented here are indicative of the differences in the onset of events triggered by the interaction of the component genomes and enabled detection of differential methylation among Rrn loci,loss of H. vulgare genetic material,and development of doubled haploids with the Rrn(1) locus. [References: 32].

642 Kunzel,G.; Korzun,L.; Meister,A. (2000) **Cytologically integrated physical restriction fragment length polymorphism maps for the barley genome based on translocation breakpoints.** *Genetics. 154(1):397-412.* English. [Inst Pflanzengnet & Kulturpflanzenforsch,IPK Correnssstr 3 D-06466 Gatersleben Germany].

We have developed a new technique for the physical mapping of barley chromosomes using microdissected translocation chromosomes for PCR with sequence-tagged site primers derived from >300 genetically mapped RFLP probes. The positions of 240 translocation breakpoints were integrated as physical landmarks into linkage maps of the seven barley chromosomes. This strategy proved to be highly efficient in relating physical to genetic distances. A very heterogeneous distribution of recombination rates was found along individual chromosomes. Recombination is mainly confined to a few relatively small areas spaced by large segments in which recombination is severely suppressed. The regions of highest recombination frequency (less than or equal to 1 Mb/cM) correspond to only 4.9% of the total barley genome and harbor 47.3% of the 429 markers of the studied RFLP map. The results for barley correspond well with those obtained by deletion mapping in wheat. This indicates that chromosomal regions characterized by similar recombination frequencies and marker densities are highly conserved between cell the genomes of barley and wheat. The findings for barley support the conclusions drawn from deletion mapping in wheat that for all plant genomes,notwithstanding their size,the marker-rich regions are all of similar gene density and recombination activity and,therefore,should be equally accessible to map-based cloning. [References: 75].

643 Li Haobing; Yao Jingxia (Jiangsu Provincial Academy of Agricultural Sciences,Nanjing (China). Inst. of Agrobiological Genetics and Physiology) (1999) **A change in chromosome number due to cytomixis in an interspecific hybrid of tritical crops.** *Jiangsu Agricultural Research (China). Jiangsu Nongye Yanjiu (China) v. 20(2) p. 23-26.* 6 ill.,18 ref. Chinese. (AGRIS 2000-001817).

644 Li Haobing; Yao Jingxia (Jiangsu Provincial Academy of Agricultural Sciences,Nanjing (China). Inst. of Agrobiological Genetics and Physiology) (1999) **Cytomixis in pollen mother cells of an interspecific hybrid of tritical crops.** *Jiangsu Agricultural Research (China). Jiangsu Nongye Yanjiu (China) v. 20(1) p. 12-14.* 6 ill.,12 ref. Chinese. (AGRIS 2000-001816).

645 Li Suoping; Yuan Junshui (Henan Univ.,Kaifeng (China). Dept. of Biology) (1999) **Tissue culture of hybrid embryos of distant hybridization in Triticum tauschii.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 25(1) p. 13-14.* 2 tables; 6 ref. Chinese. (AGRIS 2000-001815).

646 Li Xingpu; Pang Chunming; Jiang Chunzhi (Hebei Academy of Agricultural and Forestry Sciences,Shijiazhuang (China). Inst. of Cereal and Oil Crops) (1998) **Effects of different dwarfing genes on development of spring wheat plant and its indirect effect on grain yield.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(4) p. 1-7.* 5 ill.,13 ref. Chinese. (AGRIS 2000-009519).

647 Li Xinhua (Shandong Academy of Agricultural Sciences,Jinan (China). Inst. of Atomic Energy Application) (1998) **Wheat breeding by pollen irradiation in combination with sexual hybridization.** *Journal of Shandong Agricultural science (China). Shandong Nongye Kexue (China) (No. 1) p. 5-8.* 2 tables; 5 ref. Chinese. (AGRIS 2000-009536).

648 Li Yuqin; Hu Fushun; Ma Junyong (Hebei Acadmey of Agricultural and Forestry Sciences,Hengshui (China). Inst. of Dryland Farming) (1998) **A study on the identification and**

**selection methods of high-yield and drought resistant new winter wheat varieties.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(suppl.) p. 45-49.* 4 tables; 8 ref. Chinese. (AGRIS 2000-009542).

649 Li,CD.; Zhang,XQ.; Eckstein,P.; Rossnagel,BG.; Scoles,GJ. (1999) **A polymorphic microsatellite in the limit dextrinase gene of barley (Hordeum vulgare L.).** *Molecular Breeding. 5(6):569-577.* English. [Univ Saskatchewan,Dept Plant Sci Crop Dev Ctr 51 Campus Dr Saskatoon SK S7N 5A8 Canada].

A DNA fragment containing the exons 16,17 and intron 16 of the limit dextrinase gene was cloned using a 654 bp cDNA as probe. Intron 16 contained a simple sequence repeat (microsatellite). PCR primers were designed to amplify that microsatellite. Using these primers,the limit dextrinase gene was mapped to the short arm of chromosome 1 (7H) using 150 DH lines from the Steptoe x Morex mapping population. This gene co-segregated with the RFLP marker ABC154A. QTLs for malt extract,alpha-amylase activity,diastatic power and fine-coarse difference previously mapped in the North American Barley Genome Mapping Project have been located in this chromosome region. Five limit dextrinase alleles were detected in 31 barley cultivars with a PIC of 0.75. Ten different alleles/genes were identified in 23 uncultivated Hordeum species or subspecies using these microsatellite primers. The primers also amplified one fragment from wheat and two from oat. This microsatellite should be useful for marker-assisted selection for malting quality. [References: 41].

650 Lijavetzky,D.; Muzzi,G.; Wicker,T.; Keller,B.; Wing,R.; Dubcovsky,J. (1999) **Construction and characterization of a bacterial artificial chromosome (BAC) library for the A genome of wheat.** *Genome. 42(6):1176-1182.* English. [Univ Calif Davis,Dept Agron & Range Sci Davis,CA 95616 USA].

A genomic bacterial artificial chromosome (BAC) library of the A genome of wheat has been constructed. Triticum monococcum accession DV92 was selected for this purpose because it is a cultivated diploid wheat and one of the parental lines used in the construction of a saturated genetic map. Leaves from this accession were used to isolate high-molecular-weight DNA from nuclei. This DNA was partially digested with restriction enzyme Hind III,subjected to double size selection,electroeluted and cloned into the pINDIGO451 BAC vector. The library consists of 276 480 clones with an average insert size of 115 kb. Excluding the 1.33% of empty clones and 0.14% of clones with chloroplast DNA,the coverage of this library is 5.6 genome equivalents. With this genome coverage the probability of having any DNA sequence represented in this library is higher than 99.6%. Clones were sorted in 720 384-well plates and blotted onto 15 high-density filters. High-density filters were screened with several single or low-copy clones and five positive BAC clones were selected for further analysis. Since most of the T. monococcum BAC ends included repetitive sequences,a modification was introduced into the classical end-isolation procedure to select low copy sequences for chromosome walking. [References: 37].

651 Liu Chaohui; Chen Peidu (Nanjing Agricultural Univ. (China). Key Lab. of Crop Cytogenetics) (1999) **Study on the effectiveness of genetic system controlling homoeologous chromosome pairing in common wheat.** *Journal of Nanjing Agricultural University (China). Nanjing Nongye Daxue Xuebao (China) v. 22(1) p. 1-5.* 2 tables; 1 ill.,16 ref. Chinese. (AGRIS 2000-001845).

652 Lu Menggu; Wei Jingfang; Ge Yaxin (Hebei Academy of Agricultural and Forestry Sciences,Shijiazhuang (China). Inst. of Agro physics,Plant Physiology and Biochemistry) (1998) **Genetic variance of regeneration plant progeny of wheat protoplast.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(supple.) p. 12-16.* 1 table; 3 ill.,6 ref. Chinese. (AGRIS 2000-009541).

653 Luo Hongbin; He Juemin; Dai Junti (Hunan Centre of Hybrid Wheat,Changsha (China)) (1998) **Studies on the characteristics of seed production of two ecological male sterile lines in wheat.** *Journal of Hunan Agricultural Universtiy (China). Hunan Nongda Xuebao (China) v. 24(2) p. 83-89.* 7 tables; 6 ref. Chinese. (AGRIS 2000-009558).

654 Luthar,Z. (Ljubljana Univ. (Slovenia). Biotechnical Fac.,Agronomy Dept.) (1999) **Transformation of barley microspores by electroporation.** *Zbornik Biotehniske fakultete Univerze v Ljubljani (Slovenia). Kmetijstvo v. 73(1) p. 15-21.* 2 ill.,21 ref. English. (AGRIS 2000-009362).

655 Ma Chuanxi (Anhui Agricultural Univ.,Hefei (China). Dept. of Agronomy) (1999) **Effect of selection in early generation and backcross on yield and quality of bread wheat.** *Journal of Anhui Agricultural University (China). Anhui Nongye Daxue Xuebao (China) v. 26(1) p. 85-88.* 1 table; 1 ill.,7 ref. Chinese. (AGRIS 2000-001846).

656 Ma,JX.; Zhou,RH.; Dong,YS.; Jia,JZ. (2000) **Control and inheritance of resistance to yellow rust in Triticum aestivum-Lophopyrum elongatum chromosome substitution lines.** *Euphytica. 111(1):57-60.* English. [Chinese Acad Agr Sci,Inst Crop Germplasm Resources Beijing 100081 Peoples R China].

A set of T. aestivum-L. elongatum chromosome substitution lines was tested for yellow rust resistance at the seedling stage. Inheritance of the resistance and esterase-5 (Est-5) variation were studied. The results demonstrated that L. elongatum carried a new gene(s) conferring yellow rust resistance. This gene was dominant and located on chromosome 3E of L. elongatum. The biochemical locus encoding Est-5 was also located on chromosome 3E,and co-segregated with the Yr gene(s) in the wheat background. The transmission frequencies of chromosome 3E in 3E(3A) x CS,3E(3B) x CS and 3E(3D) x CS hybrids were scored. None of the hybrids transmitted the alien chromosome at the theoretical maximum rate,but the transmission frequencies of chromosome 3E in F-2 populations of 3E(3A) x CS and 3E(3D) x CS were significantly higher than in that of 3E(3B) x CS. [References: 20].

657 Mahmood,N.; Chowdhry,M.A. (University of Agriculture,Faisalabad (Pakistan). Dept. of Plant Breeding and Genetics) (1999) **Inheritance of some growth parameters in bread wheat.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 781-790.* 6 ills.,3 tables,23 ref. English. (AGRIS 2000-001828).

A full diallel cross involving six bread wheat genotypes was evaluated for the inheritance of some growth parameters. Mean values displayed significant reduction of 17.50,20.60,17.67,15.54,15.25 and 28.04 percent for days to heading,plant height,fertile tillers,days to maturity,grain filling period (GFP) and grain yield per plant under late planting,respectively,as compared to normal planting. Genetic analysis revealed that additive gene action for days to heading and maturity and grain filling period under normal planting changed to dominant under late planting,while over-dominant gene action for plant height changed to additive and additive gene action for fertile tillers per plant and grain yield per plant remained unchanged. Dominant genes were responsible for early heading,fertile tillers per plant and GFP under both plantings while dominant gene control for plant height and days to maturity under normal planting changed to recessive under late planting. Similarly,gene control for grain yield per plant changed from recessive to dominant under late planting.

658 Mastari,J.; Lapierre,H. (1999) **Sequences of the 3 ' halves of the genomes of barley yellow dwarf Virus-PAV cpA isolates that vary in symptom severity.** *European Journal of Plant Pathology. 105(8):801-811.* English. [INRA,Unite Pathol Vegetale Route St Cyr F-78026 Versailles France].

Barley yellow dwarf virus (BYDV)-PAV isolates from USA have been separated into two distinct clusters (Chay et al. (1996) Virology 219: 57-65; Chay et al. (1996) Phytopathology 86: 370-377). Following this finding we have shown that BYDV-PAV is divided into two groups cpA and cpB based on their coat protein gene sequence,and distinct host preferences (Mastari et al. (1998) Phytopathology 88: 818-821). We have sequenced the complete 3' half of the genomes of two lethal and two mild cpA isolates and

compared them with those of several known PAV cpA isolates to assess variability and locate potential determinants of severity. Open reading frames (ORFs) 3,4,5,6 and the 3' untranslated regions had different percent homologies between isolates: ORF5 (92-97%),ORF3 (88-98%) 3'-translational enhancer (87-100%) ORF4 (85-99%),3' untranslated region (72-97%) and ORF6 (61-99%). In contrast to the mild isolates,the field-lethal isolates (FHv1 and FHv2) fell into the same cluster,regardless of the genomic region analysed. The isolates FHv1 and FHv2 differed from mild isolates by eight amino acid substitutions in ORFs 3 and 4,and insertions in ORF5. Four amino acid substitutions in the 17-kDa protein encoded by ORF4 caused a change in local net charge in the field-lethal isolates. Two insertions of four amino acids were identified in the C-terminal half of ORF5 of the field-lethal isolates,but were not present systematically in all lethal isolates analysed. The potential relationships of these differences in predicted amino acid sequences to disease severity are discussed. [References: 34].

659 McCaig,TN.; Fenn,DYK.; Knox,RE.; DePauw,RM.; Clarke,JM.; McLeod,JG. (1999) **Measuring polyphenol oxidase activity in a wheat breeding program.** *Canadian Journal of Plant Science. 79(4):507-514.* English. [Agr & Agri Food Canada,Semiarid Prairie Agr Res Ctr POB 1030 Swift Current SK S9H 3X2 Canada].

High levels of polyphenol oxidase (PPO) have been associated with discoloration of end-use products of wheat,especially certain noodle types. Two whole-seed methods of measuring PPO,one based on 10 mM tyrosine as substrate and the other on 90 mM catechol,were examined and modified to determine their potential as screening tools in large-scale breeding programs. Thirteen spring wheat and two spring triticale genotypes were used to compare the methods. Both methods could measure PPO on individual seeds. All genotypes displayed large seed-to-seed variation for PPO with both substrates. The mean coefficient of variation for the PPO values of individual seeds within genotypes was 39% with tyrosine and 34% with catechol. Furthermore,the PPO values of individual seeds within genotypes were not normally distributed for most genotypes. Identifying genotypes with incremental improvements in PPO would probably require measurement of 70-100 seeds. Approximately 50% of the catecholase activity was associated with the water extract after soaking seeds for 16 h,while all of the tyrosinase activity was still associated with the seed,suggesting that different enzymes are responsible for oxidizing tyrosine and catechol in wheat. While the 10 mM tyrosine assay was nondestructive and allowed plants to be generated from seeds low in PPO,90 mM catechol reduced germination to less than 20%. Reducing the catechol to 30 mM improved germination to 85%,did not substrate-limit the reaction,and reduced the health risk associated with the assay. Spectral and kinetic differences between the assays were also considered. [References: 21].

660 Mujeeb-Kazi,A.; Cortes,A.; Rosas,V.; William,MDHM.; Delgado,R. (1999) **Some Triticum turgidum L. cultivars possessing the chromosome T1BL.1RS substitution.** *Cereal Research Communications. 27(4):373-376.* English. [CIMMYT Lisboa 27,Apartado Postal 6-641 Mexico City 06600 DF Mexico].

Six durum wheat (Triticum turgidum L.) cultivars were pollinated by Cando/Veery to produce chromosome 1B,T1BL.1RS F-1 heterozygotes. Each F-1 combination was pollinated by its respective durum maternal parent to yield the first backcross (BC1) derivatives. Heterozygous 1B,T1BL.1RS plants were identified by glucose phosphate isomerase (GPI) electrophoresis and Giemsa C-banding. These BC1F1 heterozygotes were backcrossed further to their durum parents to yield BC2 derivatives,which were similarly advanced to BC7 and then self-pollinated. From the selfed progeny,plants homozygous for chromosome 1B and T1BL.1RS were identified biochemically and cytologically. We discuss here the utility and uniqueness of this germplasm to elucidate the contributions of the 1RS translocated chromosome arm in different durum genotypes. [References: 13].

661 Mullarkey,M.; Jones,P. (2000) **Isolation and analysis of thermotolerant mutants of wheat.** *Journal of Experimental Botany. 51(342):139-146.* English. [Univ Coll,Dept Plant Sci Cork Ireland].

Thermotolerant mutants of wheat cv,Guardian were isolated by selecting survivors from 5-d-old seedlings of M2 populations exposed to 47 degrees C for 90 min,Progeny testing,using triphenyl tetrazolium chloride reduction as a measure of tissue viability,following heat stress treatment for 120 min at each of three temperatures (32,38 and 50 degrees C),confirmed the thermotolerant nature of seedlings of 13 mutants. Mutants were isolated at frequencies of 0.1% and 0.2% following the use of sodium azide and ethyl methanesulphonate,respectively. The relative thermotolerance of ten of the mutants and 'Guardian' was then tested by exposing plants to heat stresses of 38 degrees C for 6 h in every 24 h for five successive days at one of four growth stages between seedling and anthesis. P-max (light-saturated net photosynthetic rate) and chlorophyll content were compared in stressed and unstressed plants. The P-max of 'Guardian' was depressed by at least 23% by heat stress at each stage; this inhibition was least at ear emergence and greatest at anthesis,the latter being associated with reduced sink size as a result of lowered seed set. The stress-induced inhibition of P-max in 'Guardian' plants at anthesis had not recovered 3 d after removal of the stress,Mutant lines exhibited different developmental profiles of P-max thermostability,Mutant tht (thermotolerant) 10,for example,exhibited partial thermostability at each growth stage tested while the P-max of mutant tht 2 was completely unaffected by heat stress at second node and ear emergence,but was as inhibited as that of 'Guardian' at anthesis; heat stress applied at anthesis in tht 2,but not tht 10,was associated with reduced seed set. Generally,the inhibitory effect of heat stress on P-max in the mutants was reflected in declines in chlorophyll content. The ten mutants were grouped into nine categories,on the basis of thermotolerance characteristics. [References: 30].

662 Munns,R.; Hare,RA.; James,RA.; Rebetzke,GJ. (1999) **Genetic variation for improving the salt tolerance of durum wheat.** *Australian Journal of Agricultural Research. 51(1):69-74.* English. [CSIRO Plant Ind GPO Box 1600 Canberra ACT 2601 Australia].

Durum wheat (AB genomes) is more salt-sensitive than bread wheat (ABD genomes),a feature that restricts its expansion into areas with sodic or saline soils. Salt tolerance in bread wheat is linked with a locus on the D genome that results in low Na+ uptake and enhanced K+/Na+ discrimination. In order to introduce salt tolerance into current durum wheats from sources other than the D genome,a search for genetic variation in salt tolerance was made across a wide range of tetraploids representing 5 Triticum turgidum sub-species (durum,carthlicum,turgidum,turanicum,polonicum). Selections were screened for low Na+ uptake and enhanced K+/Na+ discrimination. This was assessed in seedlings grown in 150 mM NaCl with supplemental Ca2+,by measuring the Na+ and K+ accumulated in the blade of a given leaf over 10 days. Large and repeatable genetic variation was found. Low Na+ accumulation and high K+/Na+ discrimination of similar magnitude to that of bread wheat was found in the subspecies durum. These selections have the potential for improving salt tolerance in durum wheat breeding programs. [References: 23].

663 Nabi,T.G.; Chowdhry,M.A.; Aziz,K.; Bhutta,W.M. (University of Agriculture,Faisalabad (Pakistan). Dept. of Plant Breeding and Genetics) (1998) **Interrelationship among some polygenic traits in hexaploid spring wheat (Triticum aestivum L.).** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 299-302.* 2 tables,21 ref. English. (AGRIS 2000-001834).

Sixteen wheat varieties/lines were sown under normal field conditions. Phenotypic and genotypic correlations among various morphological characters were estimated. Direct and indirect effects of these traits on grain yield were determined through path-coefficient analysis. Flag leaf area,grains per spike and tillers per meter length had positive significant genotypic correlation but highly positive significant phenotypic correlation with grain yield whereas spike length,spikelets per spike and spike density

exhibited positive significant genotypic and phenotypic correlation with grain yield per meter length. Path- coefficient determined that tillers per meter length and grains per spike are the characters which contribute largely to grain yield.

664 Nakamura,H. (1999) **Identification of alleles for complex gene loci Glu-A1,Glu-B1,and Glu-D1,which code for nigh molecular weight subunits of glutenin in Japanese hexaploid wheat varieties.** *Journal of Agricultural & Food Chemistry. 47(12):5273-5277.* English. [Tohoku Natl Agr Expt Stn Morioka Iwate 0200198 Japan].

Seed storage proteins of Japanese wheat (Triticum aestivum) varieties were fractionated by sodium dodecyl sulfate-polyacrylamide gel electrophoresis to identify the alleles for complex gene loci,Glu-A1,Glu-B1,and Glu-D1,which code for high molecular weight (HMW) subunits of glutenin in Japanese hexaploid wheat varieties. These were identified by comparison of subunit mobility with. those previously found in hexaploid wheat. Twenty-four different,major glutenin HMW subunits were identified,and each variety contained three to five subunits. Seventeen different glutenin subunit patterns were observed for 14 alleles in Japanese varieties. A catalog of alleles for the complex gene loci,Glu-A1,Glu-B1,and Glu-D1,that code for HMW subunits of glutenin in hexaploid wheat was compiled. Japanese varieties showed some special allelic variation in glutenin HMW subunits that was different from those in hexaploid wheats of other countries. [References: 24].

665 Nawaz,S.; Qureshi,R.H.; Aslam,M.; Akhtar,J.; Parveen,S. (University of Agriculture,Faisalabad (Pakistan). Dept. of Soil Sciences) (1998) **Comparative performance of different wheat varieties under salinity and waterlogging II: Ionic relations.** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 357-359.* 1 ill.,1 table,10 ref. English. (AGRIS 2000-001837).

A pot study was conducted to find out the wheat variety which can restrict the uptake of Na+ and CT and prefer K+ under the dual stress of salinity and hypoxia. Matrix culture techniques were used to simulate the field conditions. Five wheat varieties were grown and salts (150 mol m3 NaCl+ 15 mol m raise to the power is 3 CaCl2) were added to saline and saline-hypoxic treatments Plants were harvested after a stress of four week and leaf sap was extracted from the youngest fully expanded leaf for Na+,K+,and Cl determination. An increase in Na+ and Cl concentration was observed in saline and saline-hypoxic treatments,while K+ concentration increased in saline and decreased in saline-hypoxic. Among the varieties,Blue silver and Chinese Spring showed a better control over ionic uptake compared with others.

666 Nayar,SK.; Bhardwaj,SC.; Prashar,M. (1999) **Characterization of Lr34 and Sr2 in Indian wheat (Triticum aestivum) germplasm.** *Indian Journal of Agricultural Sciences. 69(10):718-721.* English. [Directorate Wheat Res,Reg Stn Shimal 171002 Himachal Prades India].

667 Noaman,M.M.; Asaad,F.A.; El Sayed,A.A.; El Bawab,A.M.O. (Ministry of Agriculture,Cairo (Egypt). Field Crops Research Inst.) (1997) **Drought tolerant barley genotypes for rainfed areas in Egypt.** *Egyptian Journal of Agricultural Research (Egypt) v. 75(4) p. 1019-1036.* 8 tables; 7 ref. English. (AGRIS 2000-001535).

668 Nomura,T.; Sue,M.; Horikoshi,R.; Tebayashi,S.; Ishihara,A.; Endo,TR.; Iwamura,H. (1999) **Occurrence of hordatines,the barley antifungal compounds,in a wheat-barley chromosome addition line.** *Genes & Genetic Systems. 74(3):99-103.* English. [Kyoto Univ,Grad Sch Agr,Div Appl Life Sci Kyoto 6068502 Japan].

Hordatines A and B,strong antifungal components in shoots of barley seedlings,were found to occur in a barley chromosome 2H addition line to wheat,but not in a wheat line carrying the long arm of chromosome 2H,These results showed that some genes that encode hordatine biosynthetic enzymes are located on the short arm of chromosome 2H. The total content of the hordatines was about six fold less than that in the parental barley,but was still at a concentration more than 20-fold higher than that required for inhibition of spore germination of pathogenic fungi. [References: 19].

669 Ohnishi,Y.; Tajiri,H.; Matsuoka,Y.; Tsunewaki,K. (1999) **Molecular analysis of a 21.1-kb fragment of wheat chloroplast DNA bearing RNA polymerase subunit (rpo) genes.** *Genome. 42(6):1042-1049.* English. [Fukui Prefectural Univ,Dept Biosci 4-1-1 Kenjyojima Matsuoka Fukui 9101195 Japan].

The entire nucleotide sequence of a 21.1-kb fragment of wheat chloroplast (ct) DNA was determined. This fragment carries 18 intact genes and parts of two additional genes,including the three RNA polymerase genes rpoB,rpoC1,and rpoC2. The gene arrangement of this region is conserved in wheat,rice,and maize,but not in non-grass species. Comparison of these 20 genes in wheat,rice,and maize showed that tRNA genes evolved more slowly than protein-coding genes in the chloroplast genome. Intergenic regions evolved much faster than both types of genes. Although the 19 genes of wheat,except for orf42,showed high identity to those of other plants,there were three novel structural features in the wheat rpoC2 gene; a deletion of 81 bp in the middle region,a variable insertion (408 bp),and a nonsense mutation in the 3' terminal region,resulting in truncation of a sequence of ca. 10 amino acids. An intermolecular recombination between the stretches of CTTAT and CTTTT was suggested as the mechanism of the 81-bp deletion in the wheat rpoC2 gene. Evolutionary distance between the chloroplast genomes of wheat and maize was larger than those between wheat and rice and between rice and maize. [References: 29].

670 Oury,FX.; Brabant,P.; Berard,P.; Pluchard,P. (2000) **Predicting hybrid value in bread wheat: biometric modelling based on a "top-cross" design.** *Theoretical & Applied Genetics. 100(1):96-104.* English. [INRA,Stn Ameliorat Plantes Domaine Crouelle F-63000 Clermont Ferrand France].

Multi-environmental experimentation made it possible to compare 311 hybrids and their 59 parental lines for five characters: yield,two yield components (number of grains per m(2) and 1000-grain weight),height and date of heading. At all three sites,average high-parent heterosis exceeded 6%,and our results confirm that hybrids in general head as early as the earlier parent does and are as high as the taller parent. For the five characters studied ecovalences were significantly lower in the Fl than in the parents,indicating a higher level of homeostasis for hybrids. The experimental model,based on a "top-cross" design comprised of 55 lines used as females and four testers,made it possible to implement different hybrid-value prediction models. For yield,by far the most important character to predict,the predictor based on the general combining ability and the per se value of the parents,appears to be the most interesting. The prediction remains,however,imperfect as specific combining ability (SCA) has a strong impact for this character. Attempting to take account of SCA in the prediction,by using a multiplicative model for "malexfemale" interaction modelling,did not prove convincing. [References: 20].

671 Paldi,E.; Szalai,G.; Janda,T. (1999) **Molecular biological test for determining the frost tolerance of wheat and barley varieties.** *(Novenytermeles) (no. 1) p. 25-32.* Hungarian. (AGRIS 2000-001825).

A molecular biological test was elaborated to determine the frost resistance of wheat and barley varieties. The method was based on detailed examinations on the effect of low temperature on the maturing process of cytoplasmic ribosomal ribonucleic acids (crRNA) in wheat and barley genotypes with different degrees of frost resistance.

672 Parker,GD.; Chalmers,KJ.; Rathjen,AJ.; Langridge,P. (1999) **Mapping loci associated with milling yield in wheat (Triticum aestivum L.).** *Molecular Breeding. 5(6):561-568.* English. [Univ Adelaide,Dept Plant Sci,CRC Waite Campus Glen Osmond SA 5064 Australia].

A partial genetic linkage map constructed using 150 single seed descent (SSD) lines generated from a cross between the hexaploid wheat varieties 'Schomburgk' and 'Yarralinka' was used to identify

loci controlling milling yield. Milling yield data were obtained using seed collected from field trials conducted at different sites over two seasons. The estimated broad-sense heritability of milling yield in this population was calculated as 0.48. In the preliminary analysis,two regions were identified on chromosomes 3A and 7D,which were significantly associated with milling yield and accounted for 22% and 19% of the genetic variation,respectively. Bulked segregant analysis in combination with AFLP identified other markers linked to these loci,as well as an additional region on chromosome 5A,which accounted for 19% of the genetic variation. The applicability of these markers as selection tools for breeding purposes is discussed. [References: 44].

673 Pavlovic,M. (Institut za istrazivanja u poljoprivredi Srbija,Kragujevac (Yugoslavia). Centar za strna zita); Kuburovic,M.; Knezevic,D.; Zecevic,V. (1998) **The characteristics of the new winter wheat cultivar Tara.** *Savremena poljoprivreda (Yugoslavia) (no. 3-4) p. 43-47.* 3 tables; 12 ref. Serbian. (AGRIS 2000-009531).

The Tara winter wheat cultivar developed from the cross combination Una x KG-56 and approved by Yugoslav Federal Commission of Cultivar Approvement in 1997. The Tara cultivar is medium early. The resistance to low temperature is good,the resistance to lodging is excellent. The height of plant is about 95 cm. The Tara cultivar has good resistance to leaf rust,and thigtly less to stem rust and powdery mildew. The potential of grain yield is more than 10 t/ha. The mass of 1000 grains is about 34.0 g,the hectoliter mass of grain is 83.0 kg. The grain quality is very good,belongs to subclass A2 and 2nd quality group estimated by protein content and sedimentatition volume. This cultivar has good milling and almost very good baking quality,it is very good bread variety.

674 Petrovic,S. (Poljoprivredni fakultet,Novi Sad (Yugoslavia). Institut za ratarstvo i povrtarstvo); Dencic,S.; Kobiljski,B.; Iveges,M. (1998) **Height reducing genes present in [Yugoslav] NS wheat varieties and lines.** *Savremena poljoprivreda (Yugoslavia) (no. 3-4) p. 23-27.* 3 tables; 7 ref. Serbian. (AGRIS 2000-009529).

The presence of Rht genes has been done for most of NS winter and spring wheat varieties and lines. Among winter wheat varieties or lines,usually GA R genes are present. In contrary,among the spring ones,GA I genes were mostly determined. It is necessary to determine the type of the Rht genes present in wheat varieties,while it might be important in seed production.

675 Petrovic,S. (Poljoprivredni fakultet,Novi Sad (Yugoslavia). Institut za ratarstvo i povrtarstvo); Worland,A.J.; Mihaljev,I.; Iveges,M. (1996) **Interaction effect of alien cytoplasm and hexaploid wheat nucleus,1: number of spikelets per spike.** *Selekcija i semenarstvo (Yugoslavia). Plant Breeding and Seed Production v. 3(3-4) p. 13-15.* 3 tables; 8 ref. Serbian. (AGRIS 2000-009545).

Varieties Bersee,Cappelle - Desprez and Dwarf A with normal Triticum aestivum cytoplasm and in three different cytoplasms - Aegilops mutica,Aegilops variabilis and Aegilops squarrosa were tested in space planted experiment in four replicates for five years. The results showed significant differences between three tested varieties in studied character. In three varieties values are decreased in Aegilops mutica cytoplasm,while in Aegilops variabilis or Aegilops squarrosa cytoplasm the values are on the level of those in Triticum aestivum cytoplasm. All values for number of spikelets per spike are highly significant,except the ABC interaction value,that is significant. The differences between F values are significant or highly significant,due to rather small error,or due to rather small number for the degrees of freedom.

676 Petrovic,S. (Poljoprivredni fakultet,Novi Sad (Yugoslavia). Institut za ratarstvo i povrtarstvo); Worland,A.J.; Mihaljev,I.; Iveges,M. (1996) **Interaction effect of alien cytoplasm and hexaploid wheat nucleus,2: spike length.** *Selekcija i semenarstvo (Yugoslavia). Plant Breeding and Seed Production v. 3(3-4) p. 16-18.* 3 tables; 8 ref. Serbian. (AGRIS 2000-009546).

Varieties Bersee,Cappele - Desprez and Dwarf A with normal Triticum aestivum cytoplasm and in three different cytoplasm - Aegilops mutica,Aegilops variabilis and Aegilops squarrosa were tested in space planted experiment in four replicates for five years. The results showed significant differences between three tested varieties in studied character. In three varieties values are decreased in Aegilops mutica cytoplasm,while in Aegilops variabilis or Aegilops squarrosa cytoplasm the values are on the level of those in Triticum aestivum cytoplasm. All values for lenght of spike are highly significant,except the ABC interaction values,that is significant. The differences between F values are significant or highly significant,due to rather small error,or due to rather small number for the degrees of freedom.

677 Peusha,H.; Enno,T. (Estonian Agricultural Univ.,Tartu (Estonia). Inst. of Experimental Biology) (1998) **Improvement of wheat resistance by using alien gene transfer from related species.** *Proceedings of the Latvian Academy of Sciences. Section B: Natural,Exact and Applied Sciences (Latvia). Latvijas Zinatnu Akademijas Vestis. B dala: dabaszinatnes v. 52(6) p. 305-309.* 6 tables; 19 ref. English. (AGRIS 2000-009551).

The genetic analysis of introgressive wheat lines,selected in the progeny of crosses between common wheat and tetraploid species Triticum timopheevii and Triticum militinae revealed monogenic cotrol of resistance to leaf rust. It was ascertained that some of the introgressive lines had effective resistance genes. Some of these lines contain the Lr 23 gene or some other one closely connected to it. Some possible gene combinations have been found that determine the introgressive line resistance to powdery mildew.

678 Pickering,RA.; Malyshev,S.; Kunzel,G.; Johnston,PA.; Korzun,V.; Menke,M.; Schubert,I. (2000) **Locating introgressions of Hordeum bulbosum chromatin within the H-vulgare genome.** *Theoretical & Applied Genetics. 100(1):27-31.* English. [New Zealand Inst Crop & Food Res Ltd Private Bag 4704 Christchurch New Zealand].

Several disease-resistant recombinants between barley (Hordeum vulgare) and bulbous barley grass (H. bulbosum) have been obtained in recent years,but the process of characterization is often laborious and time-consuming. In order to improve the identification and chromosomal location of introgressed chromatin from H,bulbosum into the barley genome,we employed sequential genomic in situ hybridization (GISH) and fluorescence in situ hybridization (FISH). GISH enabled us to establish that an introgression was present in the disease-resistant recombinant line,and the subsequent use of FISH,with a short oligonucleotide sequence as probe,allowed us to locate the introgression on the long arm of barley chromosome 2H. These data were confirmed using RFLP probes that hybridize to barley chromosome 2HL. [References: 21].

679 Ponya,Z.; Finy,P.; Feher,A.; Mityko,J.; Dudits,D.; Baranbas,B. (1999) **Optimisation of introducing foreign genes into egg cells and zygotes of wheat (Triticum aestivum L.) via microinjection.** *Protoplasma. 208(1-4):163-172.* English. [Hungarian Acad Sci,Agr Res Inst POB 19 H-2462 Martonvasar Hungary].

An expeditious and highly efficient technique of microinjection has been developed with the aim of introducing exogenous DNA into egg cells and zygotes of wheat. Using a mechanical-dissection method and a novel immobilisation approach enabled us to microinject around 15 egg cells of wheat per hour. Exposing the protoplasts to a high-frequency alternating-current field for immobilisation,a significantly higher transient expression rate of the injected genes (46% and 52% for egg cells and zygotes,respectively) could be achieved than reported thus far for plant protoplasts. Whether this high transformation efficiency is due to the high-frequency electrical field applied for immobilising the protoplasts is not known. The transformation rate appeared to be a factor depending upon the time of egg cell isolation. According to the ultrastructural observations this seems to reflect a variation in competence of the egg cells during in situ development. In order to conduct studies directed towards establishing the optimal time-window for DNA delivery into the

fertilised egg cell,the time course of DNA dynamics during zygotic development has been quantified via quantitative microspectrofluorometry. [References: 46].

680 Przulj,N.; Mladenov,N. (1999) **Inheritance of grain filling duration in spring wheat.** *Plant Breeding. 118(6):517-521.* English. [Inst Field & Vegetable Crops Maksima Gorkog 30 YU-21000 Novi Sad Yugoslavia].

The genetic basis of grain-filling duration (GFD,days from anthesis to maturity) in six spring wheat hybrids involving nine varieties ('Sonaiika'/'Bobwhite','Sonalika'/'Glennson 81','Lelija'/'Bobwhite','Lelija'/'Mitacore','Buckbuck'/'Dugoklasa',and 'Vesna'/'Radusa') and their F-1,F-2,BC1,and BC2 generations was studied in the field near Sarajevo,Yugoslavia. Parental means differed in four of the six crosses. Generation mean analyses of genetic effects indicated that an additive-dominance model was sufficient for only two crosses: Lel/Bow and Lel/Mco. One or more types of epistasis were significant in the remaining crosses. The F-1 and F-2 means were either intermediate,closer to the mean of the parent with the longer GFD,or closer to the mean of the parent with the shorter GFD. Even though different modes of gene action controlled GFD among the six crosses,the heritabilities were reasonably high (narrow sense,40-60% range for six crosses),indicating that progress could be made from selection in these crosses for either long or short GFD. The parents were selected to have a range in days from planting to anthesis and to maturity. The relationship between dates of anthesis or maturity and GFD was not consistent,but the two latest-maturing varieties had the longest GFD,indicating that anthesis or maturity dates are not a good criteria for choosing parents for modifying GFD. Additive genetic effects predominated in the crosses studied here,but epistasis involving dominance gene action was sufficiently important. Tb eliminate confounding epistatic dominance effects and to take advantage of favourable additive x additive effects during selection for GFD,a breeding strategy involving rapid approach to homozygosity followed by selection after the achievement of homozygosity was suggested. [References: 31].

681 Przulj,N.; Momcilovic,V.; Mladenov,N. (Naucni institut za ratarstvo i povrtarstvo,Novi Sad (Yugoslavia)) (1998) **[Phenotypic stability of some in malting barley].** *Savremena poljoprivreda (Yugoslavia) (no. 3-4) p. 55-60.* 4 tables; 17 ref. Serbian. (AGRIS 2000-009364).

Yield,lodging,1000-kernel weight,hectoliter mass,grain protein content,and malt fine extract content in 10 spring malting barley genotypes have been analyzed. The importance of the variety x year interaction for the grain protein and malt fine extract contents has been additionally determined by means of the regression coefficient and the deviation from regression as parameters of stability. The interrelationship between the traits under investigation and the regression coefficients was determined using the coelficient of corellation. Grain yield,1000-kernel weight,hectoliter mass,and grain protein content were for the most part dependent on the genotype,while lodging and malt fine extract content dependent the most on the year. Using the coefficient of regression,genotypes have divided into three groups: (I) those that had the highest protein and malt fine extract contents under highly favourable conditions; (II) those that proved adaptable to less favourable growing conditions,and (III) those whose traits were shown to be stable under different growing conditions. A significant correlation was found between yield and the coefficient of regression for malt fine extract content.

682 Qi,LL.; Chen,PD.; Liu,DJ.; Gill,BS. (1999) **Homoeologous relationships of Haynaldia villosa chromosomes with those of Triticum aestivum as revealed by RFLP analysis.** *Genes & Genetic Systems. 74(3):77-82.* English. [Kansas State Univ,Dept Plant Pathol,Wheat Genet Resource Ctr Throckmorton Hall Manhattan,KS 66506 USA].

Homoeologous relationships between Haynaldia villosa chromosomes and bread wheat (Triticum aestivum) were studied in two sets of wheat-H. villosa addition lines and five substitution lines by restriction fragment length polymorphism (RFLP) analysis. H. villosa chromosomes 1V to 7V are homoeologous with group 1 to 7 chromosomes of wheat. In wheat-H. villosa substitution lines,the wheat chromosomes 3D,4D,5D,and 6A were replaced by homoeologous H. villosa chromosomes. The addition lines for chromosome 4V and 5V from three different accessions were analyzed by C-banding,and characterized by RFLP markers. Group 4 and 5 translocations were detected on chromosomes 4V#1 and 5V#1 (produced by Sears,unpublished),and 4V#3 and 5V#3 (produced by Lukaszewski,personal communication). The translocation breakpoints were located between Xpsr1051 and Xpsr115 on 4VL and between Xpsr370 and Xcdo1312 on 5VL. The similarities of the breakpoints within the Triticeae indicates that the specific chromosome regions of the homoeologous groups 4 and 5 are "hot spots" for chromosome breaks. The group-5 homoeologous loci,Xpsr115,Xpsr580,and Xcdo484,also were detected on the chromosome 4V#2 (produced by Liu et al.,1988) with a similar breakpoint between Xpsr1051 and Xpsr115. However,no reciprocal translocation was detected on the chromosome 5V#2. Possible reasons for difference of 4/5 translocation in this species are discussed. [References: 22].

683 Qiao,CG.; Basford,KE.; DeLacy,IH.; Cooper,M. (2000) **Evaluation of experimental designs and spatial analyses in wheat breeding trials.** *Theoretical & Applied Genetics. 100(1):9-16.* English. [Univ Queensland,Sch Land & Food Brisbane Qld 4072 Australia].

Thirty-three wheat breeding trials were conducted from 1994 to 1996 in the Northern Grains Region (QLD and Northern NSW) of Australia to evaluate the influence of experimental designs and spatial analyses on the estimation of genotype effects for yield and their impact on selection decisions. The relative efficiency of the alternative designs and analyses was best measured by the average standard error of difference between line means. Both more effective designs and spatial analyses significantly improved the efficiency relative to the randomised complete block model,with the preferred model (which combined the design information and spatial trends) giving an average relative efficiency of 138% over all 33 trials. When the Czekanowski similarity coefficient was used,none of the studied models were in full agreement with the randomised complete block model in the selection of the top lines. The agreement was influenced by selection proportions. Hence,the use of these methodologies can impact on the selection decisions in plant breeding. [References: 28].

684 Rachovska,G. (Institut po Introduktsiya i Rastitelni Resursi "K. Malkov",Sadovo (Bulgaria)) (1998) **Sodium azide possibilities for enriching genetic diversity of hexaploid wheat.** Selskostopanska Akademiya,Sofia (Bulgaria). *Rastenievˇdni Nauki (Bulgaria). Plant Science v. 35(10) p. 814-817.* 2 ill.,2 tables; 14 ref. Bulgarian. (AGRIS 2000-001838).

685 Ran Yili; Zou Wanhe; Wang Hui (Zhejiang Provincial Academy of Agricultural Sciences,Hangzhou (China). Lab. of Virology) (1998) **Evaluation of barley cultivars for resistance to Polymyxa graminis Lend.** *Acta Agriculturae Zhejiangensis (China). Zhejiang Nongye Xuebao (China) v. 10(6) p. 295-297.* 2 tables; 7 ref. Chinese. (AGRIS 2000-001542).

686 Rasco-Gaunt,S.; Riley,A.; Barcelo,P.; Lazzeri,PA. (1999) **Analysis of particle bombardment parameters to optimise DNA delivery into wheat tissues.** *Plant Cell Reports. 19(2):118-127.* English. [IACR Rothasted,Dept Biochem & Physiol Harpenden AL5 2JQ Herts England].

The objective of this study was to identify the major parameters controlling DNA delivery by particle bombardment to wheat (Triticum aestivum L.) scutellum and inflorescence tissue. The main factors studied were the DNA/gold precipitation process,bombardment parameters and tissue culture variables. Efficiency of DNA (uidA gene) delivery was assessed by scoring transient GUS expression in bombarded tissues. Of the parameters analysed,amount of plasmid DNA,spermidine concentration,presence of Catt ions,calcium chloride concentration,amount of gold particles,gold particle

size,acceleration pressure,chamber vacuum pressure,bombardment distance,osmotic conditioning of tissues and type of auxin had a clear influence on transient gene expression. A bombardment procedure suitable for elite wheat varieties was developed which allowed high-efficiency DNA delivery combined with reduced damage to target tissues. [References: 23].

687 Remmelg,H. (Estonian Agricultural Univ.,Tartu (Estonia)) (1999) **Wheat-rye crossability and characterization of the alloplasmic rye obtained.** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 81-85.* Latvia University of Agriculture. 3 tables; 9 ref. English. (AGRIS 2000-001827).

Triticum aestivum L. lines LT and L-430 of good crossability with Secale cereale L. and cv. Starke were crossed with the short-strawed Dm rye mutant to create an alloplasmic rye. Seed set was highest in the case of line L-430 (82.3 %),intermediate in LT (42.5 %) and zero in "Starke",not any seed was obtained with this variety. Seed set was extremely low in the two subsequent backcrosses,in BC1 and BC2. Only one plant (line L-430) survived from BC2 and gave rise to BC3. From BC3 on seed set became more and more normal. The sterility was expressed in the lack of stamens,empty anthers and reduced production of pollen grains. Alloplasmic plants were shorter,their grains were smaller and their flowering began nine days later than that of the normal rye. All this makes the use of male sterility of allo-rye for the hybrid rye breeding problematic.

688 Reynolds,MP.; Rajaram,S.; Sayre,KD. (1999) **Physiological and genetic changes of irrigated wheat in the post-green revolution period and approaches for meeting projected global demand.** *Crop Science. 39(6):1611-1621.* English. [Apartado 370,POB 60326 Houston,TX 77205 USA].

Global demand for wheat (Triticum aestivum L.) is growing faster than gains in genetic yield potential are being realized,currently a little under 1% per year in most regions. Improvement in yield of semidwarf wheat has generally been associated with increased harvest index (HI) and grain per square meter. For CIMMYT (International Maize and Wheat Improvement Center) varieties released between 1962 and 1988,yield increase was also associated with higher flag-leaf photosynthetic rate and related traits,but not higher biomass,Nevertheless,significantly higher biomass has been reported in more recent CIMMYT lines. Improved HI is associated with higher N use efficiency (yield per unit of available N) and improved yield of semidwarf lines is expressed at high and low levels of N input. Where interplant competition for light and soil factors are manipulated,yield improvement is associated with adaptation to high plant density. Studies have confirmed that the juvenile spike growth phase is critical in determining both grain number and kernel weight (sink) potential. Improving assimilate availability during this stage,perhaps by lengthening its relative duration,may be one way to improve yield potential. Traits that could potentially be exploited for improving assimilate (source) capacity include early vigor,stay-green,leaf-angle,and remobilization of stem reserves. Use of alien chromatin is a successful approach for introducing yield-enhancing genes into elite genetic backgrounds. Examples include the 1B/1R chromosome translocation from rye (Secale cereale L.),and more recently the LR19 segment from tall wheatgrass [Agropyron elongatum (Host) P,Beauv,] Improving the efficiency of early-generation selection may be another strategy for raising yield potential by increasing the probability of identifying physiologically superior lines by techniques such as infrared thermometry and spectral reflectance. [References: 68].

689 Richter,K.; Thiele,M. (1998) **[Breeding of wheat with baking quality and resistance against Pseudocercosporella herpotrichoides].** Saatzucht Hadmersleben GmbH,Hadmersleben (Germany). *Ernaehrungsdienst (Germany) v. (53) p. 13.* German. (AGRIS 2000-001723).

Der zunehmende Getreideanbau fuhrt zur Verengung der Fruchtfolgen und damit zu einer Zunahme der Halmbasiserkrankungen. Eine der wichtigsten Fusskrankheiten ist die Halmbruchkrankheit,die von dem Pilz Pseudocercosporella herpotrichoides verursacht wird. Da der Pilz auf Stoppelresten zwei bis drei Jahre uberleben kann,ist eine standige Infektionsquelle fur das Getreide vorhanden.

690 Roberts,MA.; Reader,SM.; Dalgliesh,C.; Miller,TE.; Foote,TN.; Fish,LJ.; Snape,JW.; Moore,G. (1999) **Induction and characterization of Ph1 wheat mutants.** *Genetics. 153(4):1909-1918.* English. [John Innes Ctr Plant Sci Res Norwich Res Pk Norwich NR4 7UH Norfolk England].

The cloning of genes for complex traits in polyploid plants that possess large genomes,such as hexaploid wheat,requires an efficient strategy. We present here one such strategy focusing on the homeologous pairing suppressor (Ph1) locus of wheat. This locus has been shown to affect both premeiotic and meiotic processes,possibly suggesting a complex control. The strategy combined the identification of lines carrying specific deletions using multiplex PCR screening of fast-neutron irradiated wheat populations with the approach of physically mapping the region in the rice genome equivalent to the deletion to reveal its gene content. As a result,we have located the Phl factor controlling the euploid-like level of homologous chromosome pairing to the region between two loci (Xrgc846 and Xpsr150A). These loci are located within 400 kb of each other in the rice genome. By sequencing this region of the rice genome,it should now be possible to define the nature of this factor. [References: 34].

691 Robinson,D.; Handley,LL.; Scrimgeour,CM.; Gordon,DC.; Forster,BP.; Ellis,RP. (2000) **Using stable isotope natural abundances (delta N-15 and delta C-13) to integrate the stress responses of wild barley (Hordeum spontaneum C. Koch.) genotypes.** *Journal of Experimental Botany. 51(342):41-50.* English. [Scottish Crop Res Inst Dundee DD2 5DA Scotland].

To integrate the complex physiological responses of plants to stress,natural abundances (delta) of the stable isotope pairs N-15/N-14 and C-13/C-12 were measured in 30 genotypes of wild barley (Hordeum spontaneum C,Koch,),These accessions,originating from ecologically diverse sites,were grown in a controlled environment and subjected to mild,short-term drought or N-starvation,Increases in total dry weight were paralleled by less negative delta(13)C in shoots and,in unstressed and droughted plants,by less negative whole-plant delta(13)C. Root delta(15)N was correlated negatively with total dry weight,whereas shoot and whole-plant delta(15)N were not correlated with dry weight. The difference in delta(15)N between shoot and root varied with stress in all genotypes,Shoot-root delta(15)N may be a more sensitive indicator of stress response than shoot,root or whole-plant delta(15)N alone. Among the potentially most productive genotypes,the most stress-tolerant had the most negative whole-plant delta(15)N,whether the stress was drought or N-starvation. In common,controlled experiments,genotypic differences in whole-plant delta(15)N may reflect the extent to which N can be retained within plants when stressed. [References: 36].

692 Rychtarik,J.; Masar,S. (Vyskumny Ustav Rastlinnej Vyroby,Piestany (Slovak Republic)) (1999) **Triticale x wheat hybridization in wheat breeding.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agricultural Sciences v. 45(11-12) p. 738-748.* 5 tables; 15 ref. Slovak. (AGRIS 2000-009544).

In the triticale x wheat hybrid program,intensive varieties were crossed,mutually differing especially in height,spike length,resistance,fertility,grain quality and other economic characteristics. In hybrids,the grain setting after the crossing and backcrossing with wheat was studied. From the results follows that winter hexaploid triticale can be crossed with winter wheat relatively easily. Percentage of the success in our experiments reached 20.11% in average. For F1 generation of triticale x wheat

hybrids the triticale plants,uniformity of morphological characters of the spike and plant,and a low level of spike fertility are characteristic. Backcrossing with wheat (Bo),as compared to Fo generation,increased the grain setting to 10.17%. The progeny was split up to wheat,triticale and transient types,therefore selection can be oriented according to the way of utilization. Selected wheat genotypes had 41 or 42 (2n) chromosomes and were characterized by a high homogeneity,stable uniformity of morphological characteristics,yields,and one thousand grain weight.

693 Sarma,RN.; Fish,L.; Gill,BS.; Snape,JW. (2000) **Physical characterization of the homoeologous Group 5 chromosomes of wheat in terms of rice linkage blocks,and physical mapping of some important genes.** *Genome. 43(1):191-198.* English. [John Innes Ctr Norwich Res Pk,Colney Lane Norwich NR4 7UH Norfolk England].

The wheat homoeologous Group 5 chromosomes were characterized physically in terms of rice linkage blocks using a deletion mapping approach. All three chromosomes,5A,5B,and 5D,were shown to have a similar structure,apart from the 4A-5A translocation on the distal end of chromosome arm 5AL. The physical mapping of rice markers on the deletion lines revealed that the whole of rice chromosome 9 is syntenous to a large block,proximal to the centromere,on the long arm. Likewise,a small segment of the distal end of the long arm showed conserved synteny with the distal one-third end of the long arm of rice chromosome 3. In between those conserved regions,there is a region on the long arm of the Group 5 chromosomes which shows broken synteny. The proximal part of the short arms of the Group 5 chromosomes showed conserved synteny with a segment of the short arm of rice chromosome 11 and the distal ends showed conserved synteny with a segment of rice chromosome 12. The physical locations of flowering time genes (Vrn and earliness per se) and the gene for grain hardness (Ha) on the Group 5 chromosomes were determined. These results indicate that comparative mapping using the deletion mapping approach is useful in the study of genome relationships,the physical location of genes,and can determine the appropriate gene cloning strategy. [References: 31].

694 Schweizer,P.; Christoffel,A.; Dudler,R. (1999) **Transient expression of members of the germin-like gene family in epidermal cells of wheat confers disease resistance.** *Plant Journal. 20(5):540-552.* English. [Univ Zurich,Inst Plant Biol Zollikerstr 107 CH-8008 Zurich Switzerland].

The wheat genome encodes a family of germin-like proteins that differ with respect to regulation and tissue specificity of expression of the corresponding genes. While germin exhibits oxalate oxidase (E.C. 1.2.3.4.) activity,the germin-like proteins (GLPs) have no known enzymatic activity. A role of oxalate oxidase in plant defence has been proposed,based on the capacity of the enzyme to produce H2O2. a reactive oxygen species. The role in defence of germin and other members of the germin-like gene family was functionally assessed in a transient assay system based on particle bombardment of wheat leaves. Transient expression of the pathogen-induced germin gf-2.8 gene,but not of the constitutively expressed HvGLP1 gene,reduced the penetration efficiency of Blumeria (syn. Erysiphe) graminis f.sp. tritici. the causal agent of wheat powdery mildew,on transformed cells. Two engineered germin-gf-2.8 genes and the TaGLP2a gene,which all encoded proteins without oxalate oxidase activity,also reduced the penetration efficiency of the fungus,demonstrating that oxalate oxidase activity is not required for conferring enhanced resistance. Instead. activity tagging experiments showed that in cells transiently expressing the germin gf-2.8 gene,the transgene product became insolubilised at sites of attempted fungal penetration where localised production of H2O2 was observed. Thus. germin and GLPs may play a structural role in cell-wall re-enforcement during pathogen attack. [References: 47].

695 Selbach,A.; Cavalli-Molina,S. (2000) **RAPD characterization of Brazilian barley (Hordeum vulgare ssp vulgare) varieties.** *Euphytica. 111(2):127-135.* English. [Univ Fed Rio Grande Sul,Inst Biociencias,Dept Genet Cx Postal 15053 BR-91501970 Porto Alegre RS Brazil].

Thirteen varieties of Brazilian barley selected for malting qualities were analysed by RAPD (Random Amplified Polymorphic DNA). Amplification with 18 random primers generated 221 reproducible bands,of which 206 bands were polymorphic (93%): of this number,137 fragments (62%) detected diversity among varieties and 56 bands (25.34%) allowed the distinction of varieties or groups of them. Variation was detected in all Brazilian varieties studied. Within-variety similarities estimated by Jaccard Similarity Coefficient ranged from 0.28 to 0.94,with averages ranging from 0.57 to 0.83,and an overall average of 0.72. Nevertheless,in the cluster analysis representatives of the same variety always fell into the same group and only later joined the other varieties. The average intervarietal similarities estimated by Jaccard Similarity Coefficient ranged from 0.45 to 0.62,with an overall average of 0.52. Many bands or combinations of bands which were responsible for the differentiation of all varieties were detected. Nevertheless,the majority of these bands cannot be considered as diagnostic markers because a great number of them did not occur in many representatives of the variety or had low intensity or even because they were not easily identified in the total pattern of bands. [References: 36].

696 Sesek,S.; Kondic,A. (Institut za ratarstvo i povrtarstvo,Novi Sad (Yugoslavia)) (1996) **Genotypic specificity regarding green plants regeneration in in vitro wheat anther culture.** *Selekcija i semenarstvo (Yugoslavia). Plant Breeding and Seed Production v. 3(3-4) p. 23-26.* 1 table; 17 ref. Serbian. (AGRIS 2000-009527).

The objectives of the investigation were to assess randomly selected heterozygous wheat genotypes,F1 hybrids and their homozygous parents for the capacity to regenerate green plants and to establish the mode of inheritance for the capacity for androgenesis. The investigation indicated that the capacity to regenerate green plants is inherited intermediately,in the case of the combination SO-14-56 x Partizanka niska,or dominantly,in the case of the combinations Veery-4 x Jarka and Veery-4 x Novosadska jara.

697 Shah,MM.; Gill,KS.; Baenziger,PS.; Yen,Y.; Kaeppler,SM.; Ariyarathne,HM. (1999) **Molecular mapping of loci for agronomic traits on chromosome 3A of bread wheat.** *Crop Science. 39(6):1728-1732.* English. [Univ Nebraska,Dept Agron Lincoln,NE 68583 USA].

\Chromosome 3A of bread wheat (Triticum aestivum L,) cultivar 'Wichita' (WI) was previously found to differ from that of 'Cheyenne' (CNN) for genes affecting a number of agronomically important traits such as grain yield (GYLD),kernel number spike(-1) (KPS),1000-kernel weight (TKWT),spike number m(-1) (SPSM),grain,volume weight (GVWT),plant height (PHT),and anthesis date (influenced by Eps locus). This study was designed to map the Eps locus and to identify regions of chromosome 3A of wheat associated with agronomic traits,A population of 3A recombinant inbred chromosome lines (RICLs-3A) was previously evaluated in replicated field trials,Thirteen RFLPs and one morphological marker locus,Eps,were used to develop a genetic linkage map and to identify QTLs associated with agronomic traits,Individual loci explained from 8.9 to 38.2% of the total phenotypic variation for the measured traits. The major locus Eps was mapped distal to an RFLP marker locus Xcdo549 on the short arm of chromosome 3A and explained 38.2% of the total phenotypic variation for PHT,and 17.4% for both KPS and TKWT. Additional QTLs for PHT,TKWT,and KPS were identified on the chromosome. A QTL for SPSM on the long arm of chromosome 3A was tightly linked to QTL for PHT and KPS,QTLs fur GYLD were identified only in a few individual environments whereas no QTL was detected for GVWT,No epistasis was detected between markers associated with QTLs,The QTLs identified across environments were consistent in all or most environments,hence should be useful in future marker assisted selection programs for breeding wheat cultivars. [References: 31].

698 Shahid,MA.; Kabir,G. (1999) **Quantitative karyotype analysis of six promising wheat (Triticum aestivum L.) genotypes.** *Bangladesh Journal of Botany. 28(2):151-157.* English. [Rajshahi Govt Coll,Dept Bot Rajshahi Bangladesh].

A quantitative approach in karyotypic analysis of six promising genotypes of Triticum aestivum L,revealed the followings : (i) The total chromatin length was highest (130.00 mu m) in Ananda and lowest (108.82 mu m) in FM-139,(ii) all the genotypes differed significantly from their mean (118.99 +/- 3.7 mu m) except FM-32 in respect of the total haploid chromatin length,(iii) the karyotypic formula is derived as 7L(m) + 6M(m) + (6S(1)(m) + 2S(1)(sm)) in Aghrani,(5L(m) + 2L(sm)) + (3M(m) + 5M(m)) + (3S(1)(m) + 3S(1)(sm)) in Akbar,5Lm,+ (7M(m) + 3M(sm)) + 5S(1)(m) + 1S(1)(sm)) in Ananda,(9M(m) + 1M(sm)) + (7S(1)(m) + 4S(1)(sm)) in Kanchan,4L(m) + (6Mm + 3M(sm)) + (5S(1)(m) + 2S(1)(sm))+ 1S(2)(m) in FM-32 and (1L(m) + 1L(sm)) + (5Mm + 3M(sm)) + (7S(1)(m) + 3S(1)(sm)) + 1S(2)(m) in FM-139,and (iv) there was no indication of aneuploidy in this study. So,the difference in karyotypic composition of these genotypes might be considered to have an important role in their morpho-developmental diversity. [References: 13].

699 Shahin,S.I.M. (1998) **Studies on the complementary effect of the resistance genes to leaf rust of wheat.** Monoufyia Univ.,Shebin-El-Kom (Egypt). Faculty of Agriculture. 38 tables; Bibliography: p. 124-136. 141 p. English. (AGRIS 2000-001820).

700 Sodkiewicz,T. (1999) **Response of barley lines with structural rearrangements in chromosomes 5,6 and 7 to limited nitrogen nutrition.** *Biologia Plantarum. 42(4):625-629.* English. [Polish Acad Sci,Inst Plant Genet Strzeszynska 34 PL-60479 Poznan Poland].

The responses of barley (Hordeum vulgare L.) lines with rebuilt chromosomes 5,6 and 7 to reduced nitrogen nutrition were evaluated in juvenile growth stages,The material included two series of duplications (D) produced in the short arm of chromosome 6 and of chromosome 7,and in the long an of chromosome 5 and of chromosome 6; their parental translocation lines (T) - from which analyzed duplications were derived and a standard karyotype cv,Bonus as a control,The translocation lines have break points located in 6(S) and 7(S),or 5(L) and 6(L). Only the lines with duplicated segments of the short arms of satellited (6 and 7) chromosomes exhibited an improved tolerance to reduced nitrogen supply,No changes relative to cv,Bonus were observed in the T-lines,More tolerant D-lines showed lower stimulation of the root development,Obtained results suggests that the adaptability factors for the low N tolerance at the vegetative growth stage of barley are located in the short arms of 6 and 7 chromosomes. [References: 15].

701 Stankova,P.; Stankov,I. (Institut po Introduktsiya i Rastitelni Resursi "K. Malkov",Sadovo (Bulgaria)) (1998) **New common wheat genotypes of higher tolerance to soil drought.** Selskostopanska Akademiya,Sofia (Bulgaria). *Rasteniev"dni Nauki (Bulgaria). Plant Science v. 35(10) p. 818- 821.* 2 tables; 25 ref. Bulgarian. (AGRIS 2000-001814).

702 Steyer,S.; Leal,C.; Gregoire,D.; de,Froidmont,D. (1999) **Evaluation of Barley yellow dwarf virus tolerance: a controlled field system compared with a molecular marker test.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 106(5):553-555.* English. [Ctr Rech Agron,Dept Lutte Biol & Ressources Phytogenet Chemin Liroux B-5030 Gembloux Belgium].

For the evaluation of BYDV tolerance,a controlled field system was developed to test lines from our breeding program. ELISA tests confirmed the presence of virus in the plants. Visual assessments were made during the spring to select the tolerant F4 generations. At the same time,an Australian team (FORD et al. 1998) has developed a PCR marker to discriminate between Yd2 and non-Yd2 barley plants. In parallel trials,we analyzed plants for the presence of the Yd2 gene. Results obtained with the controlled field systems were compared with the PCR test. The cost and time consumed were evaluated for each method and the breeding possibilities offered with the combined methods are discussed. [References: 3].

703 Sun Dongfa (Huazhong Agricultural Univ.,Wuhan (China)) (1998) **Inheritance of super-early heading of A super-early maturing line 5199 in barley.** *Journal of Huazhong Agricultural Universtiy (China). Huazhong Nongda Xuebao (China) v. 17(5) p. 418-424.* 3 tables; 7 ref. Chinese. (AGRIS 2000-009367).

704 Svec,M.; Miklovicova,M.; Bernathova,T. (Komenskeho Univ.,Bratislava (Slovak Republic). Prirodovedecka Fakulta); Tisova,V. (1999) **Identifying powdery mildew resistance genes in wheat varieties registered in the Slovak Republic in 1994-1997.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agriculture Sciences v. 45(5-6) p. 379-387.* 3 tables; 16 ref. Slovak. (AGRIS 2000-009575).

Thirteen wheat cultivars registered in the Slovak Republic in 1994-1997 have been analyzed on race-specific resistance to powdery mildew isolates. Only four of the cultivars possessed at least one of the known major resistance genes. Cultivar Astella has been considered to be a cultivar without any specific resistance gene,but we have detected specific resistance gene pm5 in its genotype. Cultivar Alka is suggested to possess both specific resistance gene pm5 and an unknown resistance gene. Resistance genes Pm4b and Pm8 have been detected in wheat cultivar Malvina. Combined resistance of Pm2 + 6 + 8 genes was characteristic for cultivar Sana. Cultivars Alana,Brea,Klea,Rada,Regia,Solara and Solida were susceptible to all powdery mildew isolates used. Achieved results were discussed with information on parental pedigrees.

705 Takumi,S.; Murai,K.; Mori,N.; Nakamura,C. (1999) **Variations in the maize Ac transposase transcript level and the Ds excision frequency in transgenic wheat callus lines.** *Genome. 42(6):1234-1241.* English. [Kobe Univ,Fac Agr,Dept Biol & Environm Sci,Lab Plant Genet,Nada Ku Kobe Hyogo 6578501 Japan].

To investigate the excision of a maize transposable element in wheat cells,plasmid DNAs containing a Dissociation (Ds) element located between a rice actin 1 gene promoter and a beta-glucuronidase (GUS) gene (gus) were introduced into wheat callus lines by microprojectile bombardment,and transient GUS expression was assayed. The gus-expressing cells after Ds excision were detected only when the Activator (Ac) transposase gene was co-transformed. To further examine a relationship between the amount of Ac mRNA and the Ds excision frequency,the Ds-containing plasmids were introduced into 15 independent transgenic callus lines transformed with the Ac transposase gene. Ten lines expressed the Ac transposase gene under the control of either the cauliflower mosaic virus 35S promoter or the Ac native promoter. The gus gene expression that indicated the Ds excision was observed only in the transgenic callus lines stably expressing the Ac transposase gene. The number of blue spots reflecting the frequency of Ds excision was variable among them. Northern-blot analysis also showed a large variability in the amount of Ac transposase transcripts among the lines. It was however noted that the excision frequency was decreased at a high level of the Ac transposase transcripts,supporting the hypothesis that Ds excision is inhibited above a certain level of the Ac transposase as observed in maize and transgenic tobacco. [References: 33].

706 Tothne Lokos,K.; Ahmad,M.; Ahmad,S. (1999) **Genetic study of androgenetic parameters by diallel analyses in wheat populations.** *(Novenytermeles) (no. 1) p. 1-12.* Hungarian. (AGRIS 2000-001824).

The results of a semidiallel cross on seven pure parental lines were used to study the genetic control and medium effect of haploid regeneration in the anther culture of wheat. The seven genotypes,which oroginated from a composite population,were: IBPT 19,IBPT 25,IBPT 31,IPBT 40,IBPT 45,IPBT 74 and IBPT 78. The composite cross population (IBPT) is a genetic pool developed by INRA(Institut National de la Recherche Agronomique,France).

707 Turner,M.; Mukai,Y.; Leroy,P.; Charef,B.; Appels,R.; Rahman,S. (1999) **The Ha locus of wheat: Identification of a polymorphic region for tracing grain hardness in crosses.** *Genome. 42(6):1242-1250.* English. [CSIRO Canberra ACT Australia].

The grain softness proteins or friabilins are known to be composed of three main components: puroindoline a,puroindoline b,and GSP-1. cDNAs for GSP-1 have previously been mapped to group-5 chromosomes and their location on chromosome 5D is closely linked to the grain hardness (Ha) locus of hexaploid wheat. A genomic DNA clone containing the GSP-1 gene (wGSP1-A1) from hexaploid wheat has been identified by fluorescent in situ hybridization as having originated from the distal end of the short arm of chromosome 5A. A genomic clone containing the gene (wGSP1-D1) was also isolated from Aegilops tauschii,the donor of the D genome to bread wheat. There are no introns in the GSP-1 genes,and there is high sequence identity between wGSP1-A1 and wGSP1-D1 up to 1 kb 5' and 300 bp 3' to wGSP1-D1. However,regions further upstream and downstream of wGSP1-D1 share no significant sequence identity to corresponding sequences in wGSP1-A1. These regions therefore identified potentially valuable sequences for tracing the Ha locus through assaying polymorphic DNA sequences. The sequence from 300 to 500 bp 3' to wGSP1-D1 (wGSP1-D13) was mapped to the Ha locus in a mapping population. wGSP1-D13 was also tightly linked to genes for puroindoline a and puroindoline b which have been previously mapped to be at the Ha locus. In addition wGSP1-D13 was used to detect RFLPs between near isogenic soft and hard Falcon lines and in a random selection of soft and hard wheats. [References: 41].

708 Turpeinen,T.; Kulmala,J.; Nevo,E. (1999) **Genome size variation in Hordeum spontaneum populations.** *Genome. 42(6):1094-1099.* English. [Agr Res Ctr Finland FIN-31600 Jokioinen Finland].

Populations of wild barley,Hordeum spontaneum (C. Koch),originating from 10 ecologically and geographically different sites in Israel,were assessed for genome size. Measurements were obtained by flow cytometry using propidium iodide staining. Genome sizes ranged from 9.35 to 9.81 pg. Variance analysis indicated a significant difference between populations. Genome sizes were positively correlated with mean January temperature. Our results corroborate previous findings of intraspecific variation in genome size from different plant species. The positive correlations between climate and genome size suggest that the latter is adaptive and determined by natural selection. [References: 37].

709 Uzik,M.; Zofajova,A. (Vyskumny Ustav Rastlinnej Vyroby,Piestany (Slovak Republic)) (1999) **Formation of spring barley populations for recurrent selection programme.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agriculture Sciences v. 45(7-8) p. 445-458.* 7 tables; 8 ref. Slovak. (AGRIS 2000-009228).

In long-term programme of recurrent selection of spring barley was from ten combinations after crossing of ten varieties (Novum,Jubilant,Galan,Rubin,HE-4886,Birka,CF-79502,Heran,Salka a Candice) selected ten spikes from forty lines of F5 generation. Those were sawn as line (400) in P1992 experiment,where also parents varieties were included. The experiment was established in ten replications,while replication had forty lines according to F5 generation and nine parental varieties,so together there were forty nine rows. A lot of examined lines were more yielding than parental varieties,however high grain yield was combine with agronomic undesirable plant height (r sub(G) = 0.740). Choosing of lines into another cycle of recurrent selection was done by the index selection. On the base of F2 generation results were from more combinations selected two of them,which were examined as a ramsch-population in F3 and F4 generation together with the parental lines and varieties. Both ramsch-populations of R1 and R2 had in comparison to parents higher weight of one thousand grain yield and lower plant height at the average level to parents. In grain yield only R2 matched to parents. Lower relations between grain yield and plant height in F4 generation (in 1997) than in origin line populations in the experiment P1992 indicate higher frequency of favourable recombinations between plant height and grain yield.

710 Vaccino,P.; Empilli,S.; Brandolini,A. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)) (1998) **[Quality characterization of some einkorn populations [Triticum monococcum L.]].** *Informatore Agrario (Italy) v. 54(39) p. 39-40.* 3 graphs. Italian. (AGRIS 2000-001853).

711 Verma,V.; Bains,NS.; Mangat,GS.; Nanda,GS.; Gosal,SS.; Singh,K. (1999) **Maize genotypes show striking differences for induction and regeneration of haploid wheat embryos in the wheat x maize system.** *Crop Science. 39(6):1722-1727.* English. [Punjab Agr Univ,Dept Plant Breeding Ludhiana 141004 Punjab India].

A number of maize (Zea mays L.) genotypes were tested for their influence on induction and regeneration of haploid wheat (Triticum aestivum L.) embryos to improve further the efficiency of the wheat x maize system of haploid production. Fifteen maize genotypes were crossed to five diverse wheat F-1 hybrids in a line x tester fashion in three replications. Two efficiency parameters,caryopses formation frequency (CFF-number of caryopses/100 pollinated florets) and embryo formation frequency (EFF-number of embryo-carrying caryopses/100 pollinated florets),were estimated. Analysis of variance revealed that lines (wheat genotypes),testers (maize genotypes),and their interaction showed significant effects on both efficiency parameters,but the effect of maize genotypes was greater than that of wheat genotypes. The EFF of individual maize genotypes ranged from 1.1 to 23.4% and the EFF of individual wheat genotypes ranged from 8.4 to 10.2%. Maize genotypes also showed significant differences for general combining ability estimates. In addition to EFF,maize genotypes had a striking effect on haploid embryo regeneration as analyzed using one of the wheat genotypes. The values ranged front 0.0 to 87.8%. For maize genotypes producing the highest EFFs,the regeneration frequency was not necessarily higher. Hence,ne suggest a new index,haploid formation efficiency (HFE-number of haploid plants formed /100 pollinated florets),be used for identification of efficient pollinators. The HFE ranged from 0.0 to 9.9%. In this study,a pop corn cultivar,Pearl Pop Corn,was identified as the best pollinator with an average EFF of 15.1% across five wheat genotypes and an HFE of 9.9% with the one wheat genotype tested. [References: 31].

712 Vrinten,PL.; Nakamura,T. (2000) **Wheat granule-bound starch synthase I and II are encoded by separate genes that are expressed in different tissues.** *Plant Physiology. 122(1):255-263.* English. [Tohoku Natl Agr Expt Stn Ahahira 4 Morioka Iwate 0200198 Japan].

Studies of waxy mutations in wheat and other cereals have shown that null mutations in genes encoding granule-bound starch synthase I (GBSSI) result in amylose-free starch in endosperm and pollen grains,whereas starch in other tissues may contain amylose. We have isolated a cDNA from waxy wheat that encodes GBSSII,which is thought to be responsible for the elongation of amylose chains in non-storage tissues. The deduced amino acid sequences of wheat GBSSI and GBSSII were almost 66% identical,while those of wheat GBSSII and potato GBSSI were 72% identical. GBSSII was expressed in leaf,culm,and pericarp tissue,but transcripts were not detected in endosperm tissue. In contrast,GBSSI expression was high in endosperm tissue. The expression of GBSSII mRNA in pericarp tissue was similar at the midpoints of the day and night periods. The GBSSII genes were mapped to chromosomes 2AL,2B,and 2D,whereas GBSSI genes are located on group 7 chromosomes. Gel-blot analysis indicated that genes related to GBSSII also occur in barley,rice,and maize. The possible role of GBSSII in starch synthesis is discussed. [References: 60].

713 Vrinten,PL.; Nakamura,T.; Kasha,KJ. (1999) **Characterization of cDNAs expressed in the early stages of microspore embryogenesis in barley (Hordeum vulgare) L.** *Plant Molecular*

*Biology. 41(4):455-463.* English. [Tohoku Natl Agr Expt Stn Akahira 4 Morioka Iwate 0200123 Japan].

To gain insight into the molecular events occurring in the very early stages of barley microspore embryogenesis,cDNA clones corresponding to genes differentially expressed during the early stages of microspore culture were isolated and characterized. A cDNA library established from barley microspores cultured for three days was differentially screened against probes generated from freshly isolated microspores. Three cDNAs representing genes not previously identified in barley were isolated. ECA1 (early culture abundant 1) lacked significant homology to known genes or proteins,and the transcript was only expressed during the early stages of culture. Expression was also reduced in low-density control cultures,therefore this gene may play a role in the early stages of barley microspore embryogenesis. ECGST (early culture glutathione S-transferase) had homology to parA-like genes,which are members of a newly discovered group of glutathione S-transferases (GSTs). The protein corresponding to ECGST may be important in protecting cells from oxidative stress during the culture process. ECLTP (early culture lipid transfer protein) had homology to lipid transfer proteins (LTPs),and had an expression pattern similar to that of an LTP known to be a marker of the early stages of embryogenesis in the carrot somatic embryogenesis system. The identification and characterization of the clones isolated in this study provides new information on the events involved in barley microspore embryogenesis. [References: 39].

714 Wan Ping; Qi Lili; Chen Peidu (Nanjing Agricultural Univ. (China). Key Lab. of Crop Cytogenetics); Zhao Yinhuai (1999) **Genetics studies on gibberellin acid insensitivity gene Gai 3 in wheat (Triticum aestivum L.).** *Journal of Nanjing Agricultural University (China). Nanjing Nongye Daxue Xuebao (China) v. 22(2) p. 1-5.* 4 tables; 6 ill.,13 ref. Chinese. (AGRIS 2000-001848).

715 Wang Huanzhong (Hebei Agricultural Univ.,Baoding (China). Dept. of Agronomy) (1998) **Preliminary study on photosynthetic performances of wheat cultivars with different maturing dates.** *Journal of Agricultural University of Hebei (China). Hebei Nongye Daxue Xuebao (China) v. 21(2) p. 1-5.* 1 table; 3 ill.,12 ref. Chinese. (AGRIS 2000-009535).

716 Wang Pei; Che Yurong; Wang Feng (Hebei Academy of Agricultural and Forestry Sciences,Shijiazhuang (China). Inst. of Cereal and Oil Crops) (1998) **Studies on wheat breeding program through cell engineering of anther culture.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(suppl.) p. 1-6.* 15 ref. Chinese. (AGRIS 2000-009540).

717 Wei Yunzong; Zhang Jiuganng; Qiao Ruiqing (Shanxi Academy of Agricultural Sciences,Linfen (China). Inst. of Wheat) (1998) **A study on heterotic effects in F1 hybrids of winter wheat under different environment.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(3) p. 23-29.* 5 tables; 5 ref. Chinese. (AGRIS 2000-009543).

718 Wei,FS.; Gobelman-Werner,K.; Morroll,SM.; Kurth,J.; Mao,L.; Wing,R.; Leister,D.; Schulze-Lefert,P.; Wise,RP. (1999) **The Mla (powdery mildew) resistance cluster is associated with three NBS-LRR gene families and suppressed recombination within a 240-kb DNA interval on chromosome 5S (1HS) of barley.** *Genetics. 153(4):1929-1948.* English. [Iowa State Univ,USDA ARS,Corn Insects & Crop Genet Res Unit,Dept Plant Pathol 409 Bessey Hall Ames,IA 50011 USA].

Powdery mildew of barley,caused by Erysiphe graminis f. sp. hordei,is a model system for investigating the mechanism of gene-for-gene interaction between large-genome cereals and obligate-fungal pathogens. A large number of loci that confer resistance to this disease are located on the short arm of chromosome 5(1H). The Mla resistance-gene cluster is positioned near the telomeric end of this chromosome arm. AFLP-,RAPD-,and RFLP-derived markers were used to saturate the Mla region in a high-resolution recombinant population segregating for the (Mla6 + Mla14) and (Mla13 + Ml-Ru3) resistance specificities. These tightly linked genetic markers were used to identify and develop a physical contig of YAC and BAC clones spanning the Mla cluster. Three distinct NBS-LRR resistance-gene homologue (RGH) families were revealed via computational analysis of low-pass and BAC-end sequence data derived from Mla-spanning clones. Genetic and physical mapping delimited the Mla-associated,NBS-LRR gene families to a 240-kb interval. Recombination within the RGH families was at least 10-fold less frequent than between markers directly adjacent to the Mla cluster. [References: 90].

719 Wicki,W.; Messmer,M.; Winzeler,M.; Stamp,P.; Schmid,JE. (1999) **In vitro screening for resistance against Septoria nodorum blotch in wheat.** *Theoretical & Applied Genetics. 99(7-8):1273-1280.* English. [Swiss Fed Inst Technol,Dept Plant Sci,ETH Zentrum CH-8092 Zurich Switzerland].

This study was carried out to develop an in vitro test for the identification of genotypes resistant to Septoria nodorum blotch. The basis for this project was a previous study in which a crude extract of S. nodorum was used as a selective agent (Keller et al. 1994). It was possible to distinguish resistant and susceptible cultivars in an in vitro test with zygotic embryos. In our project we wanted to test whether this in vitro test can also be used to detect resistant and susceptible genotypes in early segregating populations. Specific crosses between eight winter wheat lines showing contrasting resistance reaction for S. nodorum blotch on leaves and ears were made. The resistance level of both leaf and ear was evaluated after artificial inoculation in the field for the parental lines,the F-1 progenies,as well as for segregating F-3 and F-4 populations. In addition,this plant material was tested in vitro using methods similar to those described by Keller et al. (1994),i.e. culturing immature zygotic embryos and mature seeds on selective media. A good agreement between in vitro screening and field resistance on the ear was found for the parental lines,the F-3 and F-4 generation but not for the F-3 generations. This leads to the conclusion that the in vitro screening might be integrated into wheat breeding programs. Populations showing a high susceptibility to the pathogen metabolites in vitro could be discarded. Another promising implementation for wheat breeding would be the screening of advanced breeding material or candidate partners in a crossing program for resistance on the ear. However,the in vitro screening is not precise enough to select single plants in early segregating populations. [References: 16].

720 Wicki,W.; Winzeler,M.; Schmid,JE.; Stamp,P.; Messmer,M. (1999) **Inheritance of resistance to leaf and glume blotch caused by Septoria nodorum Berk. in winter wheat.** *Theoretical & Applied Genetics. 99(7-8):1265-1272.* English. [ETH Zentrum,Swiss Fed Inst Technol,Inst Plant Sci CH-8092 Zurich Switzerland].

Sixteen crosses between eight winter wheat cultivars were screened for resistance to Septoria nodorum leaf and glume blotch in the F-1 and F-4 generations using artificial inoculation in the field. The F-1 of most crosses showed dominance for susceptibility on both ear and leaf. The effects of general combining ability were of similar magnitude as the effects for specific combining ability. On the basis of the phenotypic difference of the parents,no prediction was possible about the amount and the direction of genetic variance in the segregating populations. The variation observed in this study both within and among the segregating populations suggests a quantitative inheritance pattern influencing the expression of the two traits. The components of variance between F-2 families within a population were as high as (for S. nodorum blotch on the ear) or higher (for S. noderum blotch on the leaf) than those between populations. Therefore,strong selection within a few populations may be as effective to obtain new resistant genotypes as selection in a large number of populations. In almost all crosses,progenies were found that were more resistant than the better parent. Thus transgression breeding may be a tool to breed for higher levels of resistance to S. nodorum blotch. Highly resistant genotypes were found even in combination with two susceptible parents. The genetic source for Septoria resistance is probably broader than is generally assumed and could be used to improve S. nodorum resistance by combination breeding followed by strong selection in large populations. [References: 24].

721 Woo,SH.; Adachi,T.; Jong,SK.; Campbell,CG. (1999) **Isolation of protoplasts from viable egg cells of common buckwheat (Fagopyrum esculentum Moench.).** *Canadian Journal of Plant Science. 79(4):593-595.* English. [Agr & Agri Food Canada,Crop Diversificat Ctr Morden MB R6M 1Y5 Canada].

In vitro fertilization could be useful to overcome the problem of self-incompatibility of common buckwheat. Therefore,experiments were conducted to isolate viable protoplasts from egg cells for use in vitro fertilization. Protoplasts from viable egg cells of common buckwheat were isolated by enzyme treatment followed by mechanical isolation. Incubation of ovules for up to 4 h allowed the boundary wall of the egg cells to become partially digested and the protoplasts of the egg cells came out of the micropylar or chalazal end after squashing with a mean isolation frequency of approximately 30% (6 out of 20 ovules). The egg cell protoplasts were larger than those of the synergids. [References: 11].

722 Xia Guangmin; He Chenxia; Chen Huimin (Shandong Univ.,Jinan (China). Coll. of Life Science); Li Zhongyi (1999) **Transgenic plant regeneration from wheat (Triticum aestivum L.) mediated by Agrobacterium tumefaciens.** *Acta Phytophysiologica Sinica (China). Zhiwu Shengli Xuebao (China) v. 25(1) p. 22-28.* 1 table; 2 ill.,15 ref. English. (AGRIS 2000-001844).

723 Xiao Jianfu; Ding Shouren (Zhejiang Univ.,Hangzhou (China). Dept. of Agronomy) (1999) **An attempt to synthesize a new vulgare wheat by the recombination of genomes between Aegilops ventricosa (DDMM,2n=28).** *Acta Agriculturae Zhejiangensis (China). Zhejiang Nongye Xuebao (China) v. 11(1) p. 1-4.* 2 tables; 1 ill.,11 ref. Chinese. (AGRIS 2000-001852).

724 Xiao Jianfu; Ding Shouren (Zhejiang Agricultural Univ.,Hangzhou (China). Dept. of Agronomy) (1998) **Fertility and cytological observation on hybrid between Aegilops ventricosa (DDMM,2n=28) and Triticum durum (AABB,2n=28).** *Acta Agriculturae Zhejiangensis (China). Zhejiang Nongye Xuebao (China) v. 10(6) p. 290-294.* 1 table; 1 ill.,13 ref. Chinese. (AGRIS 2000-001359).

725 Xie Lingqin; Chang Wensuo (Hebei Agricultural Univ.,Baoding (China). Biological Technology Centre) (1999) **Heredity study on harvest index of wheat cultivars with different maturing dates.** *Journal of Agricultural University of Hebei (China). Hebei Nongye Daxue Xuebao (China) v. 22(4) p. 15-18.* 6 tables; 8 ref. Chinese. (AGRIS 2000-009539).

726 Yamamori,M.; Quynh,NT. (2000) **Differential effects of Wx-A1,-B1 and-D1 protein deficiencies on apparent amylose content and starch pasting properties in common wheat.** *Theoretical & Applied Genetics. 100(1):32-38.* English. [Natl Inst Agrobiol Resources Tsukuba Ibaraki 3058602 Japan].

Waxy (Wx) protein is a granule-bound starch synthase (GBSS) responsible for amylose production in cereal endosperm. Eight isolines of wheat (Triticum aestivum L.) having different combinations of presence and absence of three Wx proteins,Wx-A1,-B1,and -D1,were produced in order to elucidate the effect of Wx protein deficiencies on the apparent amylose content and starch-pasting properties. An improved SDS gel electrophoresis showed that 'Bai Hue' (a parental wheat) carried a variant Wx-B1 protein from an allele,Wx-B1e. Thus,wheat lines of types 1,2,4,and 6 examined in this study contained a variant Wx-B1 allele and not the standard allele,Wx-B1a. The results from 3 years of experiments using 176 lines derived from two cross-combinations showed that apparent amylose content increased the least in type 8 (waxy) having no Wx proteins and,in ascending order,increased in type 5 (only the Wx-A1 protein is present) <type 7 (Wx-D1) <type 6 (Wx-B1) <type 3 (Wx-A1 and -D1) <type 4 (Wx-A1 and -B1) <type 2 (Wx-B1 and -D1) <type 1 (three Wx proteins). However,Tukey's studentized range test did not detect significant differences in some cases. Densitometric analysis suggested that the amylose content was related to the amount of the Wx protein in the eight types. Parameters in the Rapid Visco-Analyzer test and swelling power were correlated to amylose content. Consequently,amylose content and pasting properties of starch were determined to be influenced the most by the lack of the Wx-B1 protein,followed by a lack of Wx-D1,and leastly by the Wx-A1 deficiency,which indicated the presence of differential effects of the three null alleles for the Wx protein. [References: 34].

727 Yang Sijun; Zhang Henggan (Jiangsu Provincial Academy of Agricultural Sciences,Nanjing (China). Inst. of Agricultural Modernization); li Demin (1999) **Present status of wheat quality and progress in research on high quality wheat varieties in Jiangsu Province [China].** *Jiansu Agricultural Sciences (China). Jiansu Nongye Kexue (China) (no. 1) p. 2-5.* 3 tablesl; 6 ref. Chinese. (AGRIS 2000-001843).

728 Yang Wannian; He Zhichang; Zhang Jingyu (Wuhan Univ. (China). Coll. of Life Sciences); Yu Huazhong (1998) **Changes in activity of NAD kinase and NADP phosphatase during fertility transformation-period in leaves of photoperiod-sensitive cytoplasmic male-sterile wheat.** *Acta Phytophysiologica Sinica (China). Zhiwu Shengli Xuebao (China) v. 24(4) p. 385-391.* 4 ill.,24 ref. Chinese. (AGRIS 2000-001840).

729 Younis,R.A.A. (1998) **Phylogenetic relationships among cultivated wheat and wild relatives.** Ain-Shams Univ.,Cairo (Egypt). Faculty of Agriculture. 18 fig. 4 tables; Bibliography: p. 129-150. 153 p. English. (AGRIS 2000-001818).

730 Yu Hongxin (Shandong Inst. of Managerial Cadres of Agriculture,Jinan (China)) (1999) **Study on introduction of vermin-resistant gene(CpTI) into wheat through pollen-tube pathway method.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 1) p. 5-8.* 2 tables; 2 ill.,9 ref. Chinese. (AGRIS 2000-009537).

731 Yuan Hongxia; Li Honglian; Wang Shouzheng (Henan Agricultrual Univ.,Zhengzhou (China). Dept. of Plant Protection) (1998) **Identification of resistance to wheat sharp eyespot in wheat relatives.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(4) p. 26-29.* 2 tables; 8 ref. Chinese. (AGRIS 2000-009557).

732 Zhang Zhisheng; Zhang Leqing (South China Agricultural Univ.,Guangzhou (China). Dept. of Agronomy) (1999) **Breeding of new wheat varieties Huanan T2003 and T531 with resistance to scab [Gibberella zeae (Schw) petch].** *Journal of South China Agricultural University (China). Huanan Nongye Daxue Xuebao (China) v. 20(4) p. 44-48.* 2 tables; 1 ill.,13 ref. Chinese. (AGRIS 2000-009538).

733 Zhou Miaoping; Shen Xiaorong; Zhang Jingjuan (Jiangsu Provincial Academy of Agricultural Sciences,Nanjing (China). Inst. of Agrobiological Genetics and Physiology) (1999) **Improvement of wheat gene transformation by particle bombardment.** *Jiangsu Journal of Agricultural Sciences (China). Jiangsu Nongye Xuebao (China) v. 15(1) p. 62-64.* 4 tables; 7 ref. Chinese. (AGRIS 2000-001842).

734 Zhou Wenchun; Wang Shuwen; Zhao Yinhuai (Jiangsu Academy of Agricultural Sciences,Nanjiang (China). Inst. of Food Crops) (1998) **Expression and genetic analysis of grain weight heterosis in F1 of dwarfing lines with Rht 3 gene in wheat.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(4) p. 14-19.* 4 tables; 4 ref. Chinese. (AGRIS 2000-009556).

735 Zhu,H.; Gilchrist,L.; Hayes,P.; Kleinhofs,A.; Kudrna,D.; Liu,Z.; Prom,L.; Steffenson,B.; Toojinda,T.; Vivar,H. (1999) **Does function follow form? Principal QTLs for Fusarium head blight (FHB) resistance are coincident with QTLs for inflorescence traits and plant height in a doubled-haploid population of barley.** *Theoretical & Applied Genetics. 99(7-8):1221-1232.* English. [Oregon State Univ,Dept Crop & Soil Sci Corvallis,OR 97331 USA].

Fusarium head blight (FHB),an important disease of barley in many areas of the world,causes losses in grain yield and quality. Deoxynivalenol (DON) mycotoxin residues,produced by the primary pathogen Fusarium graminearum,pose potential health risks. Barley producers may not be able to profitably market FHB-infected barley,even though it has a low DON level. Three types of FHB resistance have been described in wheat: Type I (penetration),Type II (spread),and Type III (mycotoxin degradation). We describe putative measures of these three types of resistance in barley. In wheat,the three resistance mechanisms show quantitative inheritance. Accordingly,to study FHB resistance in barley: we used quantitative trait locus (QTL) mapping to determine the number,genome location,and effects of QTLs associated with Type-I and -II resistance and the concentration of DON in the grain. We also mapped QTLs for plant height,heading date,and morphological attributes of the inflorescence (seeds per inflorescence,inflorescence density,and lateral floret size). QTL analyses were based on a mapping population of F-1-derived doubled-haploid (DH) lines from the cross of the two-rowed genotypes Gobernadora and CMB643,a linkage map constructed with RFLP marker loci,and field evaluations of the three types of FHB resistance performed in China,Mexico,and two environments in North Dakota,USA. Resistance QTLs were detected in six of the seven linkage groups. Alternate favorable alleles were found at the same loci when different inoculation techniques were used to measure Type-I resistance. The largest-effect resistance QTL (for Type-II resistance) was mapped in the centromeric region of chromosome 2. All but two of the resistance QTLs coincided with QTLs determining morphological attributes of the inflorescence and/or plant height,Additional experiments are needed to determine if these coincident QTLs are due to linkage or pleiotropy and to more clearly define the biological basis of the FHB resistance QTLs. Plant architecture should be considered in FHB resistance breeding efforts,particularly those directed at resistance QTL introgression and/or pyramiding. [References: 42].

## F40 PLANT ECOLOGY

736 Gorski,T. (Institute of Soil Science and Plant Cultivation,Pulawy (Poland). Dept. of Agrometeorology); Krasowicz,S.; Kus,J. (Institute of Soil Sience and Plant Cultivation,Pulawy (Poland). Dept. of Systems and Economics of Crop Production) (1999) **Soil and climatic potential of Poland in cereal grain production.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 127-142.* 2 fig.,6 tables; 21 ref. Polish. (AGRIS 2000-009623).

The aim of this paper was the influence of soil and climatic potential on cereal production in Poland. It was noted that rational use of agricultural area in Poland makes possible to increase cereal yields and global cereal grain production. In agricultural practice cereal yields on the level of 3 tons per ha are achieved. They are about 50 percent smaller than in EU countries. The big share of the light soils is a factor that reduces yields and makes difficult value - wheat and barley.

## F50 PLANT STRUCTURE

737 Feng Chaonian; Guo Wenshan; He Jianhua (Agricultural Coll. of Yangzhou Univ.,Jiangsu (China). Dept. of Agronomy) (1998) **The characteristics of plant type of high yield in wheat.** *Journal of Yangzhou University (Natural Science Edition) (China). Yangzhou Daxue Xiuebao (Ziran Kexue Ban) (China) v. 1(4) p. 24-30.* 10 tables; 3 ill.,7 ref. Chinese. (AGRIS 2000-001950).

738 Kussovska,VN.; Bochev,BV. (1999) **Cytological study of euploid and monosomic wheat-rye hybrids.** *Cereal Research Communications. 27(4):377-381.* English. [Bulgarian Acad Sci,Inst Genet BU-1113 Sofia Bulgaria].

The influence of 1D,3D,4D and 5B wheat chromosomes and their parental genotypes on the number and character of the bivalent and polyvalent association as well as chiasma frequency in PMCs was studied. F-1 hybrids were obtained by crosses between four hexaploid cultivars Triticum aestivum L.2n=42: Chinese Spring (CS),Mironovka 808 (M808),Zlatka (Zl),Novostepnyachka (N),as well as their monosomic lines by 1D,3D,4D and 5B chromosomes with two inbred lines Secale Cereale L.2n=14: Bulgarian Low Stem Rye(BLSR) and Lozen 14(L14). It was established that 5B chromosome had the strongest influence on the homoeologous chromosome pairing,followed by 3D. The strength of the systems,located on 5B and 3D chromosomes was different for the different wheat cultivars.5B and 3D systems in CS and M808 cvs. are with a definitely strong effects and they are significantly weaker in N and Zl. The strength of the suppressors of the homoeologous chromosome pairing does not depend on the male genotypes. [References: 21].

## F60 PLANT PHYSIOLOGY AND BIOCHEMISTRY

739 Abdellaoui,A.; Larhnim,A.; Talouizte,A. (1999) **Nitrate accumulation,adsorption and assimilation in different varieties of Moroccan tender wheat.** *Canadian Journal of Botany-Revue Canadienne de Botanique. 77(10):1485-1489.* French. [Univ Med Ben Abdellah,Fac Sci Dhar Elmehraz,Dept Biol,Lab Physiol Vegetale BP 1796 Atlas Fes Morocco].

The absorption,the exsorption,and the reduction of NO3- ions were examined in light and in darkness in relation to the prior accumulated nitrates in various seedling parts of four Moroccan tender wheat genotypes: Marchouch,Jouda,Khair,and Sais. The genotype Sais has the highest quantity of accumulated nitrates,and the genotype Khair has the lowest. Distribution of nitrates between the roots and shoots of these wheat varieties showed that,for each variety,the shoot accumulates three to five times more NO3- than the roots. Seedlings of the different varieties exposed to light showed a higher absorption and reduction of nitrates than seedlings exposed to darkness. The exsorption of nitrates of plants that are subjected to light was significantly lower than that of the seedlings exposed to darkness. This suggested that the stimulation of NO3- absorption,observed in plants that were exposed to light in comparaison with darkness,could be partly explained by the diminution of nitrate exsorption. The quantitative examination of N-nitrate in roots of plants that were exposed to light showed the presence of quantities of NO3- similar to those of the seedling roots maintained in darkness. These results suggest,that by stimulating the reduction of nitrates,light contributes to a substantial increase of nitrate ion absorption by means of a diminution of ion exsorption out of root cells. [References: 37].

740 Ahlandsberg,S.; Sathish,P.; Sun,CX.; Jansson,C. (1999) **Green fluorescent protein as a reporter system in the transformation of barley cultivars.** *Physiologia Plantarum. 107(2):194-200.* English. [Swedish Univ Agr Sci,Dept Plant Biol,Genet Ctr POB 7080 S-75007 Uppsala Sweden].

A cereal transformation vector,pN1473,containing the strong constitutive rice actin promoter Act-1,a multiple cloning site,and the nos terminator,was constructed. Fusion of a plant-optimized gfp gene to Act-1 in pN1473 resulted in the vector pN1473GFP. To assess the suitability of pN1473,and GFP as a reporter system in barley transformation,two barley cultivars (Baronesse and Golden Promise) were transformed by microprojectile bombardment. Transient gfp expression in transformed embryogenic callus material was detectable by fluorescence microscopy less than 12 h after transformation. The presence of the gfp gene in callus and regenerated plantlets was confirmed by PCR amplification and DNA gel-blot analysis. [References: 27].

741 Ahmed,M.h.A. (1997) **Effect of saline water on the chemical composition of wheat plant grown under desert soil conditions.** Ain-Shams Univ.,Cairo (Egypt). Faculty of Agriculture. 44 fig. 34 tables; Bibliography: p. 173-190. 196 p. English. (AGRIS 2000-002055).

742 Cao Xuecheng; Cheng Bingsong; Zou Qi (Shandong Agricultural Univ.,Taian (China). Dept. of Basic Courses) (1998) **Studies on the physiological effects of pulsed magnetic field treatment on wheat.** *Journal of Shandong Agricultural University (China). Shandong Nongda Xuebao (China) v. 29(3) p. 345-350.* 6 tables; 13 ref. Chinese. (AGRIS 2000-009824).

743 Chen Qin; Liu Youliang (Nanjing Agricultural Univ. (China). Dept. of Agronomy) (1999) **Effects of H2O2,OH and their scavengers on the activities of H+-transport in the tonoplast vesicles isolated from barley leaves.** *Acta Phytophysiologica Sinica (China). Zhiwu Shengli Xuebao (China) v. 25(3) p. 281-286.* 5 ill.,12 ref. Chinese. (AGRIS 2000-002001).

744 Chen,Q.; Zhang,WH.; Liu,YL. (1999) **Effect of NaCl,glutathione and ascorbic acid on function of tonoplast vesicles isolated from barley leaves.** *Journal of Plant Physiology. 155(6):685-690.* English. [Nanjing Agr Univ,Dept Agron Nanjing 210095 Peoples R China].

The seedlings of two barley cultivars differing in salt sensitivity were treated with 300 mmol/L NaCl for 0,2,4,6,and 8 days. The activities of H+-ATPase (EC 3.6.1.35) and H+-PPase (EC 3.6.1.1) associated with tonoplast vesicles isolated from leaves were assayed. H+-ATPase activity increased in the salt-tolerant cultivar during the first 4 days of NaCl stress,and decreased later. In the salt-sensitive cultivar,however,H+-ATPase activity decreased after NaCl treatment. Both GSH content and APX activity of barley seedling leaves in the two cultivars showed the same trends as H+-ATPase activity. There was a significantly positive correlation between H+-ATPase activity and APX activity and between H+-ATPase activity and GSH content,respectively Under salt stress,exogenous GSH or AsA stimulated the activities of H+-ATPase and H+-PPase in two cultivars,and diminished MDA content and electrolyte leakage in leaves of two cultivars. [References: 21].

745 Davy,A.; Sorensen,MB.; Svendsen,I.; Cameron-Mills,V.; Simpson,DJ. (2000) **Prediction of protein cleavage sites by the barley cysteine endoproteases EP-A and EP-B based on the kinetics of synthetic peptide hydrolysis.** *Plant Physiology. 122(1):137-145.* English. [Carlsberg Res Lab,Dept Chem Gamle Carlsberg Vej 10 DK-2500 Copenhagen Denmark].

Hordeins,the natural substrates of barley (Hordeum vulgare) cysteine endoproteases (EPs),were isolated as protein bodies and degraded by purified EP-B from green barley malt. Cleavage specificity was determined by synthesizing internally quenched,fluorogenic tetrapeptide substrates of the general formula 2-aminobenzoyl-P-2-P-1-P-1'-P-2' 1-tyrosine(NO2)-aspartate. The barley EPs preferred neutral amino acids with large aliphatic and nonpolar (leucine,valine,isoleucine,and methionine) or aromatic (phenylalanine,tyrosine,and tryptophan) side chains at P-2,and showed less specificity at P-1,although asparagine,aspartate,valine,and isoleucine were particularly unfavorable. Peptides with proline at P-1 or P-1' were extremely poor substrates. Cleavage sites with EP-A and EP-B preferred substrate sequences are found in hordeins,their natural substrates. The substrate specificity of EP-B with synthetic peptides was used successfully to predict the cleavage sites in the C-terminal extension of barley beta-amylase. When all of the primary cleavage sites in C hordein,which occur mainly in the N- and C-terminal domains,were removed by site-directed mutagenesis,the resulting protein was degraded 112 times more slowly than wild-type C hordein. We suggest that removal of the C hordein terminal domains is necessary for unfolding of the beta-reverse turn helix of the central repeat domain,which then becomes more susceptible to proteolytic attack by EP-B. [References: 31].

746 Duan Yuanlin; Li Hesheng (Central China Agricultural Univ.,Wuhan (China). Dept. of Agronomy) (1999) **Effect of different quality of light and calcium on nitrate reductase and glutamine synthetase activity of wheat seedlings.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 35(2) p. 122-125.* 4 tables; 12 ref. Chinese. (AGRIS 2000-002058).

747 Facchiano,AM.; Colonna,G.; Chiosi,E.; Illiano,G.; Spina,A.; Lafiandra,D.; Buonocore,F. (1999) **In vitro phosphorylation of high molecular weight glutenin subunits from wheat endosperm.** *Plant Physiology & Biochemistry. 37(12):931-938.* English. [Univ Naples 2,CRISCEB,Res Ctr Computat & Biotechnol Sci Via Costantinopoli 16 I-80138 Naples Italy].

We have investigated the in vitro phosphorylation of high molecular weight glutenin subunits (HMW-GS),a group of non-soluble proteins present in wheat endosperm. Computer aided searches of potential biological sites in the known sequences of these proteins have evidenced the presence of sequence motifs specific for protein kinase C (PKC),calcium-dependent protein kinase from wheat,casein kinase II,tyrosine protein kinase and glycosylation. We have demonstrated that subunit 1Bx7 is a substrate of a partially purified PKC from rat brain. Further experiments have shown that this subunit is phosphorylated by an endogenous protein kinase activity found in wheat flour. These preliminary results are important for the possible implications on the structure-function relationships of these proteins and could probably suggest,for the first time,a potential physiological role in particular situations for some HMW-GS. (C) 1999 Editions scientifiques et medicales Elsevier SAS. [References: 41].

748 Fan Jun (Anhui Agricultural Univ.,Hefei (China). Center of Biotechnology); Zhao Peng (1998) **The characteristics assay by electrophoresis of porphobilinogen deaminase from wheat.** *Journal of Anhui Agricultural University (China). Anhui Nongye Daxue Xuebao (China) v. 25(4) p. 429-432.* 4 ill.,10 ref. Chinese. (AGRIS 2000-002057).

749 Guera,A.; de,Nova,PG.; Sabater,B. (2000) **Identification of the Ndh (NAD(P)H-plastoquinone-oxidoreductase) complex in etioplast membranes of barley: Changes during photomorphogenesis of chloroplasts.** *Plant & Cell Physiology. 41(1):49-59.* English. [Univ Alcala de Henares,Dept Biol Vegetal Madrid 28871 Spain].

In the last few years the presence in thylakoid membranes of chloroplasts of a NAD(P)H-plastoquinone oxidoreductase complex (Ndh complex) homologous to mitochondrial complex I has been well established. Herein,we report the identification of the Ndh complex in barley etioplast membranes. Two plastid DNA-encoded polypeptides of the Ndh complex (NDH-A and NDH-F) were relatively more abundant in etioplast membranes than in thylakoids from greening chloroplasts,Conversion of etioplast into chloroplast,after light exposure of barley seedlings grown in the dark,was accompanied by a decrease in the NADH dehydrogenase activity associated to plastid membranes,Using native-PAGE and immunolabelling techniques we have determined that a NADH specific dehydrogenase activity associated with plastid membranes,which was more active in etioplasts than in greening chloroplasts,contained the NDH-A and NDH-F polypeptides. These results complemented by those obtained through blue-native-PAGE indicated that NDH-A and NDH-F polypeptides are part of a 580 kDa NADH dependent dehydrogenase complex present in etioplast membranes,This finding proves that accumulation of the Ndh complex is independent of light. The decrease in the relative levels and specific activity of this complex during the transition from etioplast to chloroplasts was accompanied by a parallel decrease in the specific activity of peroxidase associated to plastid membranes,Based on the mentioned observations it is proposed that an electron transport chain from NADH to H2O2 could be active in barley etioplasts. [References: 48].

750 Hebbar,KB.; Sinha,SK. (2000) **Surface electrical potential changes of saline tolerant and sensitive wheat varieties differ with sodium chloride treatment.** *Current Science. 78(1):76-78.* English. [Cent Inst Cotton Res,Plant Physiol & Biochem Sect POB 2 Nagpur 440010 Maharashtra India].

Surface electrical potential (EP) of wheat varieties was measured by a conventional microelectrode method,wheat seedlings had a surface EP of -7 to -10 mV at,the shoot apex,Addition of NaCl to the root zone suddenly changed the EP at the shoot apex. The change in EP depended on the concentration of NaCl added to the root zone,i.e. 1000 mM NaCl changed the EP with a greater amplitude (6.8 mV); within a few seconds whereas 100 mM NaCl changed the EP with a smaller amplitude (3 mV) gradually. Interestingly,salinity-tolerant variety 'kharchia' produced less noticeable change in EP at the shoot apex,while In salinity sensitive variety 'moti' the amplitude of EP rose sharply and then gradually levelled off to the addition of NaCl in the root zone,The change in EP of kharchia was accompanied by an increase in shoot potassium and calcium content whereas moti showed a larger increase in sodium content. [References: 12].

751 Jaama,E.; Kasearu,P.; Laur,U.; Alaru,M.; Vijand,M. (Estonian Agricultural Univ.,Tartu (Estonia)) (1999) **Chemical composition and baking qualities of winter triticale in Estonia.** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 11-19.* Latvia University of Agriculture. 1 table; 2 ill.,6 ref. English. (AGRIS 2000-002052).

There are no quality data on winter triticale grown in Estonia. Since 1995 a research to investigate winter tritical grown in Estonian conditions (58 deg 23'N,26 deg 44'E) has been underway at the Department of Field Crop Husbandry,Estonian Agricultural University. The chemical composition of the triticale varieties "Modus" and "Dato" was determined and compared with the winter wheat "Sirvinta" and the winter rye "Vambo". The material for the analysis comes from the sowing time field experiments of the years 1996 and 1997. The raw protein content decreases with increasing grain yields. The protein content of triticale is lower than that of wheat and higher or equal to that of rye. The protein differs in different varieties ("Dato's" protein content is higher). The crude fibre and crude ash content does not significantly differ in the species. The baking test was also performed to evaluate the baking properties of triticale flour.

752 Kristensen,B.K. (1998) **Physiological and molecular characterisation of Prx7 and Prx8,two defence-related peroxidases from barley.** Kongelige Veterinaer- og Landbohoejskole,Copenhagen (Denmark); Risoe National Lab.,Roskilde (Denmark). *Risoe-R (Denmark); no. 1089 124 p.* RNL. 17 ill.,6 tables; 33 ref. English. (AGRIS 2000-009762).

753 Li Fangdong (Paulownia Research and Development Center,Zhongzhou (China)) (1998) **Changes of transpiration rates and water use efficiency of wheat in the intercropping system of Paulownia - wheat.** *Journal of Beijing Forestry University (China). Beijing Linye Daxue Xuebao (China) v. 20(3) p. 115-120.* 1 table; 5 ill.,9 ref. Chinese. (AGRIS 2000-009818).

754 Lin Qi; Shi Yan; Wei Dongbin (Laiyang Agricultural Coll.,Shandong (China). Inst. of Dry Land Crop) (1998) **Relations between soil water and yield formation and determination of water-saving irrigation scheme in winter wheat.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(3) p. 1-4.* 4 tables; 6 ref. Chinese. (AGRIS 2000-009820).

755 Liu Jiandong (Shanxi Agricultural Univ.,Taigu (China). Dept. of Agronomy) (1999) **Characterization of clear-day radiation spectrum in winter wheat canopy.** *Journal of Shanxi Agricultural University (China). Shanxi Nongye Daxue Xuebao (China) v. 19(2) p. 93-96.* 1 table; 4 ill.,6 ref. Chinese. (AGRIS 2000-009819).

756 Roy,S.; Gennadios,A.; Weller,CL.; Testin,RF. (2000) **Water vapor transport parameters of a cast wheat gluten film.** *Industrial Crops & Products. 11(1):43-50.* English. [Banner Pharmacaps Inc,Mat Sci Grp,Res & Dev 4125 Premier Dr High Point,NC 27265 USA].

Understanding the mode of transport of water vapor through the film is important for improving the moisture barrier properties of wheat gluten (WG) films. Effective permeability (P-eff),solubility (S-eff),and diffusion (D-eff) coefficients of a hydrophilic cast WG film were determined at 25 degrees C within the relative humidity (RH) range of 0-84% (with a 9-13% RH gradient between upstream and downstream water vapor flux). P-eff,S-eff,and D-eff increased substantially as the RH gradient moved upwards in the RH spectrum. P-eff increased by four orders of magnitude from the lowest RH condition of 0-11% (3.8 x 10(-11) g.m/m(2).s.Pa) to the highest RH condition of 75-54% (4.1 x 10(-7) g.m/m(2).s.Pa). A moisture sorption isotherm of the film at 25 degrees C was constructed. Both the Guggenheim-Anderson-DeBoer (GAB) and the Kuhn moisture sorption isotherm models showed a good fit to the experimental adsorption data. Testing of WG films at the expected conditions of actual use is necessary to quantify the water vapor permeation through the films. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 33].

757 Ruza,A.; Karele,I. (Latvia Univ. of Agriculture,Jelgava (Latvia). Faculty of Agriculture. Inst. of Crop Sciences. Dept. of Plant Production) (1999) **Chlorophyll content dynamics of winter wheat.** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 229-239.* Latvia University of Agriculture. 5 tables; 2 ill.,5 ref. English. (AGRIS 2000-002053).

Field trials were carried out at the Research Station of the Latvia University of Agriculture. Four winter wheat varieties were investigated with the aim to determine the dynamics of chlorophyll accumulation in the whole plant and in its parts during the vegetation period as well as to establish the possible correlation of winter wheat yields with the chlorophyll content in its sowings. It was established that chlorophyll concentration depended on the rate of nitrogen fertilizers. The chlorophyll content in the whole plant and its parts of early wheat varieties was higher than that of the late ones. There was a positive correlation of wheat grain yields with the chlorophyll content in wheat plants.

758 Sakaguchi,T.; Nishizawa,NK.; Nakanishi,H.; Yoshimura,E.; Mori,S. (1999) **The role of potassium in the secretion of mugineic acids family phytosiderophores from iron-deficient barley roots.** *Plant & Soil. 215(2):221-227.* English. [Univ Tokyo,Dept Appl Biol Chem,Lab Plant Mol Physiol,Bunkyo Ku Yayoi 1-1-1 Tokyo 1138657 Japan].

Mugineic acid family phytosiderophores (MAs) are secreted from iron-deficient barley roots with high equimolar correlation of potassium. To determine the form of MAs when it is secreted,we investigated the effect of anion channel blockers and valinomycin on the secretion of MAs. Among the anion channel blockers,anthracene-9-carboxylic acid and phenylglyoxal drastically reduced the amount of secreted MAs,while 4,4-diisothiocyano-2,2- stilbene disulfonate slightly inhibited the MAs secretion. Trifluoromethyl-3-phenylamino-2-nicotinic acid reduced the secreted amount to the half of non-treated. This result suggested that MAs are secreted in the form of anion through an anion channel. The elimination of potassium gradient between the cytoplasm and the cell exterior by treatment with valinomycin reduced the amount of secreted MAs. Analysis of potassium distribution in root by LV-SEM-XMA indicated that potassium in the cortex cells of iron-deficient roots is released with MAs secretion and the amount of potassium in the cortex cells decreases after secretion. These results suggested that MAs are secreted in the form of a monovalent anion via anion channels using the potassium gradient between the cytoplasm and the cell exterior. [References: 31].

759 Scebba,F.; Sebastiani,L.; Vitagliano,C. (1999) **Protective enzymes against activated oxygen species in wheat (Triticum aestivum L.) seedlings: Responses to cold acclimation.** *Journal of Plant Physiology. 155(6):762-768.* English. [Univ Pisa,Scuola Super Studi Via Carducci 40 I-56127 Pisa Italy].

When plants are exposed to low temperatures,they undergo changes in the activities of some of the enzymes that belong to important metabolic pathways. In order to understand if and how the enzymes of the antioxidant systems are involved in the cold acclimation process and during recovery from freezing,superoxide dismutase (SOD),catalase (CAT) and peroxidase (POX) activities were analysed. Triticum aestivum L. (c. vs. Brasilia and Eridano) seedlings were grown at 24/22 degrees C (day/night temperatures) for control treatment and at 12/5 degrees C to induce cold acclimation,while freezing treatment was performed at -4 degrees C. Significant differences in activity between control and acclimated seedlings were observed for all of the enzymes studied except for catalase in leaves. No clear differences were found when comparing the two genotypes. After being exposed to freezing temperatures,the activities of enzymes were compared with those before treatment and the results were expressed as percentage of activation. Superoxide dismutase and catalase enzymes were found to be activated more in cold acclimated than ill control leaves,while the opposite was observed for roots. Peroxidases proved to be activated more both in leaves and roots of control seedlings. Interesting differences after exposure to freezing temperatures were also found between the two cultivars analysed. [References: 31].

760 Shah,N.A.; Khan,R.; Tariq,M.; Mabood,S.F. (Peshawar Univ. (Pakistan). Dept. of Chemistry) (1998) **Isolation and characterization of acid phosphatase from wheat (Pirsabak-85) grain (Triticum aestivum).** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 366-367.* 5 ills.,1 table,8 ref. English. (AGRIS 2000-002056).

Acid phosphatase (Acp.,3.1,3.2) from wheat grain powder was extracted with acetate buffer. Maximum extraction was carried out at pH 5.5. The activity of the extract stored in vitro at 4 degree centigrade was quite stable for upto one week. The enzyme had optimum ph 5.5 and optimum temperature of 30 degree centigrade. The K base m value was found to be 10 Mew M for P-introphenyl phosphate as a substrate.

761 Sueyoshi,K.; Mitsuyama,T.; Sugimoto,T.; Kleinhofs,A.; Warner,RL.; Oji,Y. (1999) **Effects of inhibitors for signaling components on the expression of the genes for nitrate reductase and nitrite reductase in excised barley leaves.** *Soil Science & Plant Nutrition. 45(4):1015-1019.* English. [Niigata Univ,Fac Agr Niigata 9502181 Japan].

Nitrate-induced accumulation of mRNAs for nitrate reductase and nitrite reductase was strongly inhibited by treatment with inhibitors of Ca2+ channels,protein phosphatases,and tyrosine protein kinases in excised barley leaves. It was shown that these components may be involved in the nitrate-response signaling pathways for the expression of nitrate and nitrite reductase genes in barley leaves. [References: 16].

762 Wang Wenzheng; Lu Xiao; Li Xiuqing (Shandong Academy of Agricultrual Sciences,Jinan (China). Central Lab.) (1998) **Study on the effect of ecological factors on the protein content of barley varieties in China.** *Journal of Shandong Agricultural University (China). Shandong Nongda Xuebao (China) v. 29(2) p. 207-210.* 4 tables; 5 ref. Chinese. (AGRIS 2000-009765).

763 Xu,CC.; Jeon,YA.; Lee,CH. (1999) **Relative contributions of photochemical and non-photochemical routes to excitation energy dissipation in rice and barley illuminated at a chilling temperature.** *Physiologia Plantarum. 107(4):447-453.* English. [Pusan Natl Univ,Dept Mol Biol,Keumjung Ku Pusan 609735 South Korea].

The mechanistic basis for differential sensitivities to chilling-induced photoinhibition among two rice (Oryza sativa L.) cultivars (an Indica and a Japonica type) and one barley cultivar (Hordeum vulgare L. cv. Albori) was examined. When leaf segments were exposed to moderate illumination at 4 degrees C,a sustained decrease in the photochemical efficiency of photosystem (PS) II measured as the ratio of variable to maximal fluorescence (F-v/F-m) was observed for several hours,An analysis of fluorescence quenching revealed a sudden drop in PSII-driven electron transport rate (ETR) and a rapid rise in the reduction state of the primary electron acceptor Q(A) upon exposure to chilling in moderate light,There was no appreciable difference in the level of non-photochemical quenching (NPQ) nor in the xanthophyll cycle activity between Japonica rice and barley,However,barley was capable of sustaining a higher ET,thereby keeping a lower reduction state of Q(A) throughout the chilling for 6 h,The Indica rice was characterized by the lowest ability to develop the xanthophyll cycle-associated NPQ,particularly the fast relaxing NPQ component (qf),accompanied by the highest reduction state of Q(A) and photoinhibitory quenching (qI),It is concluded that the lower susceptibility of barley to chilling-induced photoinhibition than Japonica rice is attributable to its higher potential to dissipate excess light energy via a photochemical mechanism,whereas Indica rice is more sensitive to photoinhibition at a chilling temperature than Japonica rice,due primarily to its lower capacity to develop an efficient NPQ pathway. [References: 39].

764 Yu Hanshou; Zhang Yimin; Chen Yongxuan (Nanjing Agricultural Univ. (China). Dept. of Natural Resources and Environmental Sciences); Wu Hanzhang (1999) **Induction of chitinase in rape and wheat by water-soluble chitosan.** *Jiangsu Journal of Agricultural Sciences (China). Jiangsu Nongye Xuebao (China) v. 15(2) p. 67-70.* 2 tables; 3 ill.,8 ref. Chinese. (AGRIS 2000-001973).

765 Zalewski,K.; Lahuta,LB.; Socha,A.; Login,A. (1999) **The effect of water stress on the composition and biosynthesis of phospholipids in yellow lupin seeds and triticale kernels.** *Seed Science & Technology. 27(2):543-551.* English. [Agr Tech Acad,Dept Plant Physiol & Biotechnol PL-10718 Olsztyn Poland].

An analysis has been made of yellow lupin seeds (cv. June) and triticale kernels (cv. Dagro),produced by plants exposed to water stress for 21 days after the initial flowering of the first node of lupin and initial earing of triticale. Seed embryos of triticale as well as embryonic axes and cotyledons of lupin contained phosphatidylinositol (PI),phosphatidylcholine (PC),phosphatidylethanolamine (PE),phosphatidic acid (PA),phosphatidylglycerol (PG),and two unidentified phospholipids (PX1,PX2). Water stress had a stimulating effect on the PC and PE contents of triticale embryos and lupin cotyledons. Cotyledons also contained detectable amounts of phosphatidylserine (PS),the levels of which decreased due to drought. During two - four hours' incubation of embryos,axes and cotyledons at 25 degrees C,the synthesis of the phospholipids varied. Drought during seed development stimulated the biosynthesis of PG and PX2,but lowered that of PA and PX1,recorded as the amount of C-14-sodium acetate bound into the phospholipids. [References: 36].

766 Zhao Degang; Meng Fanjin (China Agricultural Univ.,Beijing (China). Coll. of Biological Science) (1999) **Involvement of zearalenone in short-day vernalization in winter wheat.** *Acta Phytophysiologica Sinica (China). Zhiwu Shengli Xuebao (China) v. 25(1) p. 66-72.* 1 table; 8 ill.,19 ref. Chinese. (AGRIS 2000-002054).

## F61 PLANT PHYSIOLOGY-NUTRITION

767 Blum,A.; Zhang,JX.; Nguyen,HT. (1999) **Consistent differences among wheat cultivars in osmotic adjustment and their relationship to plant production.** *Field Crops Research. 64(3):287-291.* English. [Volcani Ctr,Inst Field Crops POB 6 Bet Dagan Israel].

Osmotic adjustment (OA) is generally considered an important component of drought resistance. Several reports by J.M. Morgan

[Morgan,J.M.,1983. Osmoregulation as a selection criterion for drought tolerance in wheat,Aust,J,Agric,Res. 34,607-614; 1992,Osmotic components and properties associated with genotypic differences in osmoregulation in wheat,Aust. J. Plant Physiol. 19,67-76; 1995. Growth and yield of wheat lines with differing osmoregulative capacity at high soil water deficit in seasons of varying evaporative demand. Field Crops Res. 40,143-152; Morgan,J.M,,Condon,A.G.,1986. Water-use,grain yield and osmoregulation in wheat. Aust. J. Plans Physiol,13,523-532] from Australia concluded that consistent genetic differences in OA existed among wheat cultivars and that high OA cultivars tended to yield better than low OA cultivars under drought stress. Our study was performed to assess his results with his and other genetic materials. Two of Morgan's spring wheat lines with high OA ('H.Osm-134') and low OA ('L.Osm-136') capacity in addition to eight other diverse spring wheat cultivars were tested for OA and plant production when grown in small plots under a rain exclusion shelter at Bet Dagan,Israel in 1996. OA of five of these cultivars (including Morgan's lines) was also measured in two independent greenhouse tests in 1997 (Israel) and 1998 (Texas). The five cultivars differed significantly and ranked consistently for OA in all tests. No significant cultivar by test interaction for OA was revealed. OA was well correlated across cultivars between tests. The significantly higher OA capacity of H.Osm-134 as compared with L.Osm-136 was repeated in all tests. OA of all ten cultivars was positively correlated with biomass ($r = 0.73$; $p = 0.02$) and yield ($r = 0.55$; $p = 0.09$) under pre-flowering drought stress in the rain exclusion shelter. H.Osm-134 line performed significantly (p less than or equal to 0.05) better than L.Osm-136 line for both biomass and yield under drought stress. We therefore support Morgan's results and conclude that consistent differences in OA exist among wheat cultivars and that these differences can be associated with plant production under pre-flowering drought stress. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 9].

768 Bollons,HM.; Barraclough,PB. (1999) **Assessing the phosphorus status of winter wheat crops: inorganic orthophosphate in whole shoots.** *Journal of Agricultural Science. 133(Part 3):285-295.* English. [ICAR Rothamsted,Crop & Dis Management Dept Harpenden AL5 2JQ Herts England].

Winter wheat (Triticum aestivum L.,cv Mercia) was grown at Rothamsted over three seasons (1992/94/95) with plant-available soil P (Olsen-P) ranging from very deficient to superoptimal(1-52 mg P/kg; ADAS soil P Index 0-4). Critical Olsen-P for 95% maximum grain yield changed little between years and averaged 9 mg P/kg. Total-P and inorganic-P (Pi) were measured in whole shoots several times between late tillering and anthesis to see if Pi was a better indicator than total-P of the adequacy of P supply for maximum grain yield. Inorganic-P accumulated in shoot tissue water with increasing Olsen-P to a maximum concentration of c. 15 mM. Inorganic-P was a better indicator of crop P status as there was less variation in critical values between seasons and with crop growth stage. Expressing Pi concentrations on a tissue water basis (Piw) reduced the effect of differences in soil water supply and also offers the prospect of in situ testing. Over the three seasons,critical shoot Piw for 95% maximum grain yield averaged 4.7 mM (range 4.3-5.8 mM) during stem elongation. [References: 30].

769 Bottner,P.; Pansu,M.; Sallih,Z. (1999) **Modelling the effect of active roots on soil organic matter turnover.** *Plant & Soil. 216(1-2):15-25.* English. [CNRS,CEFE 1919 Route Mende F-34293 Montpellier 5 France].

The aim of this experiment was to study the effect of living roots on soil carbon metabolism at different decomposition stages during a long-term incubation. Plant material labelled with C-14 and N-15 was incubated in two contrasting soils under controlled laboratory conditions,over two years. Half the samples were cropped with wheat (Triticum aestivum) 11 times in succession. At earing time the wheat was harvested,the roots were extracted from the soil and a new crop was started. Thus the soils were continuously occupied by active root systems. The other half of the samples was maintained bare,without plants under the same conditions. Over the 2 years,pairs of cropped and bare soils were analysed at eight sampling occasions (total-,plant debris-,and microbial biomass-C and -C-14). A five compartment (labile and recalcitrant plant residues,labile microbial metabolites,microbial biomass and stabilised humified compounds) decomposition model was fitted to the labelled and soil native organic matter data of the bare and cropped soils. Two different phases in the decomposition processes showed a different plant effect. (1) During the initial fast decomposition stage,labile C-14-material stimulated microbial activities and N immobilisation,increasing the C-14-microbial biomass. In the presence of living roots,competition between micro-organisms and plants for inorganic N weakly lowered the measured and predicted total-C-14 mineralisation and resulted in a lower plant productivity compared to subsequent growths. (2) In contrast,beyond 3-6 months,when the labile material was exhausted,during the slow decomposition stage,the presence of living roots stimulated the mineralisation of the recalcitrant plant residue-C-14 in the sandy soil and of the humified-C-14 in the clay soil. In the sandy soil,the presence of roots also substantially stimulated decomposition of old soil native humus compounds. During this slow decomposition stage,the measured and predicted plant induced decrease in total-C-14 and -C was essentially explained by the predicted decrease in humus-C-14 and -C. The C-14-microbial biomass (MB) partly decayed or became inactive in the bare soils,whereas in the rooted soils,the labelled MB turnover was accelerated: the MB-C-14 was replaced by unlabelled-C from C derived from living roots. At the end of experiment,the MB-C in the cropped soils was 2.5-3 times higher than in the bare soils. To sustain this biomass and activity,the model predicted a daily root derived C input (rhizodeposition),amounting to 5.4 and 3.2% of the plant biomass-C or estimated at 46 and 41% of the daily net assimilated C (shoot + root + rhizodeposition C) in the clay and sandy soil,respectively. [References: 24].

770 Cakmak,I.; Cakmak,O.; Eker,S.; Ozdemir,A.; Watanabe,N.; Braun,HJ. (1999) **Expression of high zinc efficiency of Aegilops tauschii and Triticum monococcum in synthetic hexaploid wheats.** *Plant & Soil. 215(2):203-209.* English. [Cukurova Univ,Dept Soil Sci & Plant Nutr TR-01330 Adana Turkey].

The effect of varied zinc (Zn) supply on shoot and root dry matter production,severity of Zn deficiency symptoms and Zn tissue concentrations was studied in two Triticum turgidum (BBAA) genotypes and three synthetic hexaploid wheat genotypes by growing plants in a Zn-deficient calcareous soil under greenhouse conditions with (+Zn=5 mg kg(-1) soil) and without (-Zn) Zn supply. Two synthetic wheats (BBAADD) were derived from two different Aegilops tauschii (DD) accessions using same Triticum turgidum (BBAA),while one synthetic wheat (BBAAAA) was derived from Triticum turgidum (BBAA) and Triticum monococcum (AA). Visible symptoms of Zn deficiency,such as occurrence of necrotic patches on leaves and reduction in shoot elongation developed more rapidly and severely in tetraploid wheats than in synthetic hexaploid wheats. Correspondingly,decreases in shoot and root dry matter production due to Zn deficiency were higher in tetraploid wheats than in synthetic hexaploid wheats. Transfer of the DD genome from Aegilops tauschii or the AA genome from Triticum monococcum to tetraploid wheat greatly improved root and particularly shoot growth under Zn-deficient,but not under Zn-sufficient conditions. Better growth and lesser Zn deficiency symptoms in synthetic hexaploid wheats than in tetraploid wheats were not accompanied by increases in Zn concentration per unit dry weight,but related more to the total amount of Zn per shoot,especially in the case of synthetic wheats derived from Aegilops tauschii. This result indicates higher Zn uptake capacity of synthetic wheats. The results demonstrated that the genes for high Zn efficiency from Aegilops tauschii (DD) and Triticum monococcum (AA) are expressed in the synthetic hexaploid wheats. These wheat relatives can be used as valuable sources of genes for improvement of Zn efficiency in wheat. [References: 29].

771 Cakmakci,R.; Kantar,F.; Algur,OF. (1999) **Sugar beet and barley yields in relation to Bacillus polymyxa and Bacillus**

**megaterium var. phosphaticum inoculation.** *Journal of Plant Nutrition & Soil Science-Zeitschrift fur Pflanzenernahrung und Bodenkunde. 162(4):437-442.* English. [Ataturk Univ,Fac Agr,Dept Agron TR-25240 Erzurum Turkey].

Microbiological fertilizers are an important part of environment friendly sustainable agricultural practices. A study was conducted in order to investigate seed inoculation of sugar beet (cv. Sonja) and barley (cv. Tokak),with nitrogen fixing (Bacillus polymyxa) and phosphate dissolving (Bacillus megaterium var. phosphaticum) bacteria in comparison to control and mineral fertilizer application in the green house and in the field at two sites in 1996 and 1997 in Erzurum (29 degrees 55' N and 41 degrees 16' E with an altitude of 1950 m),Turkey. In the green house trial bacterial inoculation of seeds increased sugar beet root and barley seed yields compared with control. II. polymyxa was more effective,but dual inoculations gave increases of 19.0 and 25.9% respectively. In the field as an average of sites and years sugar beet root yields were increased by 12.0%,7.5% and 16.5% while barley seed yields were increased by 15.0%,8.4% and 18.2% respectively with B. polymyxa,B. megaterium var phosphaticum and dual applications over control treatment. Other yield and yield components were also enhanced especially by dual applications. However,increases in yield and yield components were lower than or comparable to mineral fertilizer application. The beneficial effect of bacterial inoculation was higher in well irrigated pot trials and at the site of rich clayey soils. In conclusion,microbial inoculation of seeds with Bacillus polymyxa and B. megaterium var. phosphaticum,alone or in dual combinations,may substitute costly NP fertilizers in sugar beet and barley production even in cold highland areas such as in Erzurum. [References: 29].

772 Delwiche,SR.; Hruschka,WR. (2000) **Protein content of bulk wheat from near-infrared reflectance of individual kernels.** *Cereal Chemistry. 77(1):86-88.* English. [USDA ARS,Beltsville Agr Res Ctr Beltsville,MD 20705 USA].

Protein content of wheat by near-infrared (NIR) reflectance of bulk samples is routinely practiced. New instrumentation that permits automated NIR analysis of individual kernels is now available,with the potential for rapid NIR-based determinations of color,disease,and protein content,all on a single kernel (sk) basis. In the event that the protein content of the bulk sample is needed rather than that of the individual kernels,the present study examines the feasibility of estimating bulk sample protein from sk spectral readings. On the basis of 318 wheat samples of 10 kernels per sample,encompassing five U.S. wheat classes,the study demonstrates that with as few as 300 kernels bulk sample protein content may be estimated by sk NIR reflectance spectra at an accuracy equivalent to conventional bulk kernel NIR instrumentation. [References: 13].

773 Demotes-Mainard,S.; Jeuffroy,MH.; Robin,S. (1999) **Spike dry matter and nitrogen accumulation before anthesis in wheat as affected by nitrogen fertilizer: relationship to kernels per spike.** *Field Crops Research. 64(3):249-259.* English. [INRA,INA PG,Unite Agron BP 01 F-78850 Thiverval Grignon France].

In wheat crops subjected to nitrogen deficiency before anthesis,kernel number is reduced and is controlled by dry matter (DM) or nitrogen (N) accumulation in spikes. We investigated spike DM and N accumulation before anthesis under various N nutrition conditions,and the relationships between kernel number per spike with spike DM and N content at anthesis and earlier in spike growth period. The winter wheat cultivar Soissons was grown in fields near Paris for 2 years and was subjected to 18 treatments varying N supply. The spike DM and N content were determined twice weekly during the spike growth period,and kernel number was counted before maturity. All determinations were for main shoots only. The dynamics of DM and N accumulation differed greatly between treatments. The shape of the curves of spike DM and N content,expressed as a percentage of the DM and N content at anthesis,were similar,but N began to accumulate before DM,whatever the treatment. The linear relationship between kernel number per spike and spike DM at anthesis was strong and went through the origin. The relationship between kernel number and spike N content at anthesis was equally strong but with a positive intercept. These relationships with kernel number were also significant if spike DM and N content were measured in the middle or at the beginnings of the spike growth period. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 22].

774 Dreccer,M.F. (1999) **Radiation and nitrogen use in wheat and oilseed rape crops.** Wageningen Univ. (Netherlands). Wageningen Univ. Bibliography (15 p.). 135 p. English. (AGRIS 2000-009868).

775 Ercoli,L. (Scuola Superiore di Studi Universitari e di Perfezionamento S. Anna,Pisa (Italy)); Mariotti,M.; Masoni,A. (Pisa Univ. (Italy). Dipartimento di Agronomia e Gestione dell'Agroecosistema) (1998) **Nitrogen and phosphorus translocation in wheat as affected by nitrogen fertilization [Triticum aestivum L. - Tuscany].** *Rivista di Agronomia (Italy) v. 32(3) p. 134-140.* 7 tables; 22 ref. Italian. (AGRIS 2000-002121).

Nitrogen and phosphorus utilization efficiency of wheat depends on uptake of nutrients during the biological cycle and on traslocation to spikes during grain filling. Uptake and translocation have been extensively studied,but the effects of physiological and environmental parameters on these processes is still unknown. The research was carried out aiming at analyzing the effect of nitrogen fertilization on N and P partitioning among the different plant parts and on translocation of N and P from leaves and culms to grain. In a two year field study,six nitrogen rates,corresponding to 0,50,100,150,200 e 250 kg N ha*[-1),were compared. Nitrogen and P uptake and translocation were analyzed determining N and P content of leaves,culms and spikes in the phases of highest N and P content of leaves (phase LH),of culms (heading) and of spikes (physiological maturity). Nitrogen and P content of leaves,culms and spikes in all the three phases increased with the increase of nitrogen rate. Uptake from soil in the period from heading to physiological maturuty and translocation from leaves and culms in the period from LH to physiological maturity were positively affected by the increase of N rate. Nutrients translocation ability of leaves and culms decreased with the increase of nitrogen rate and with the increase of N and P content of leaves and culms L'efficienza di utilizzazione dell'azoto e del fosforo da parte del frumento deriva dalla capacita' della pianta di assorbire gli elementi nutritivi presenti nel terreno nei diversi momenti del ciclo biologico e di traslocarli nelle spighe. Nonostante che i processi di assorbimento e di traslocazione siano stati diffusamente studiati,le cause ambientali e fisiologiche che influenzano questi fenomeni non sono state ancora completamente chiarite. La presente ricerca e' stata condotta al fine di analizzare l'effetto della concimazione azotata sulla ripartizione e sulla traslocazione dell'azoto e del fosforo nel frumento tenero. Sono stati posti a confronto per due anni livelli di concimazione azotata pari a 0,50,100,150,200 e 250 kg ha*[-1) di N. L'entita' dell'assorbimento e della traslocazione dell'azoto e del fosforo e' stata analizzata prendendo in esame i contenuti di azoto e di fosforo delle foglie,dei culmi e delle spighe registrati in tre diversi momenti del ciclo biologico e precisamente nelle fasi di massimo assorbimento delle foglie (fase LH),dei culmi (fase di spigatura) e delle spighe (fase di maturazione fisiologica). Le quantita' di N e P contenute nelle foglie,nei culmi e nelle spighe in ciascuna delle tre fasi sono aumentate con l'aumentare del livello di azoto somministrato. L'assorbimento dal terreno verificatasi nel periodo spigatura-maturazione fisiologica e la traslocazione dalle foglie e dai culmi verificatosi nel periodo LHN-maturazione fisiologica sono stati positivamente influenzati dall'aumento della concimazione azotata. La capacita' specifica di traslocazione dei nutrienti da parte delle foglie e dei culmi e' diminuita con l'aumentare del livello di azoto distribuito e con l'aumentare del loro contenuto di azoto e di fosforo.

776 Espinosa H,Rodrigo Mauricio (1997) **[Effect of UV-B radiation and its interaction with light and temperature on the photosynthesis of seven wheat cultivars].** Chile Univ.,Santiago (Chile). Esc. de Agronomia. 51 ref. 51 p. Spanish. (AGRIS 2000-002122).

En la temporada primavera-verano 1996-97,se cultivaron,bajo invernadero y utilizando sistema hidropenico,siete variedades de trigo (Triticum aestivum L.) del Instituto de Investigaciones Agropecuarias (INIA). Las variedades usadas fueron Millaleu,Lil,n,Nobo,un ensayo de rendimiento (E.R.P.),Talhu,n,Huay£n y Reihue. Un grupo de plantas se desarrolle bajo una dosis suplementaria de radiacien UV-B (4.7 mu W CM-2),mientras que otro grupo crecie en ausencia de ,sta. El objetivo de este estudio fue aportar antecedentes relacionados a posibles cambios inducidos por una dosis elevada de radiacien UV-B,en los umbrales a los cuales las plantas sufren daoo irreversibles por altas temperaturas y cambios en la resistencia a la fotoinhibicien. Ambos estr,s presumiblemente actuarjan primariamente sobre el fotosistema II. Distintos par metros fueron evaluados sobre la quinta hoja en todas las variedades,observ ndose variacien en sus respuestas por efecto del tratamiento. Para la determinacien de los umbrales de daoo irreversible a altas temperaturas,se analize el valor de la fluorescencia inicial (Fo) a distintas temperaturas (curva Fo v/s T grado),observ ndose en las variedades Talhu,n y Nobo tratadas con UV-B,un significativo aumento en sus umbrales de resistencia,que en promedio alcanzaron a 1,6 grados C. El par metro Fv/Fm (fluorescencia variable/fluorescencia m xima) fue utilizado para determinar el grado de fotoinhibicien de la actividad fotosint,tica,pudiendo observar a 8 grados C y 1500 mu mol quanta m-2 s-1 en las variedades Lil,n,Nobo,Talhu,n,Huay£n y Reihue,crecidas bajo radiacien UV-B suplementaria,valores de Fv/Fm m s altos que en aquellas plantas no tratadas. Por otra parte,se midie el efecto de la radiacien UV-B sobre el contenido de materia seca y clorofila,determin ndose para todas las variedades crecidas bajo radiacien UV-B una disminucien significativa del contenido de clorofila total y para Millaleu,E.R.P. y Reihue valores de la relacien clorofila a/b mayores en aquellas plantas tratadas con UV-B,sin embargo s€lo para Millaleu se observe variacien en el peso seco total.

777 Fraignier,MP.; Michaux-Ferriere,N.; Kobrehel,K. (2000) **Distribution of peroxidases in durum wheat (Triticum durum).** *Cereal Chemistry. 77(1):11-17.* English. [INRA,Unite Biochim & Biol Mol Cereales 2 Pl Viala F-34060 Montpellier 01 France].

A biochemical study of the main durum wheat milling fractions (bran,embryo,and semolina) showed that peroxidases (POD) were present in multiple forms in the kernel and appeared to be tissue specific: one form for the embryo,one for the endosperm,one for the subaleuronic layer,and one for the outer layers. Large varietal differences were found regarding both the composition and the POD activity. POD activity,detected by diaminobenzidine,was found mainly in the cell wall of the subaleurone layer and inside some specific,differentiated cells of the embryo. Immunolocalization with antibodies of durum wheat POD showed the presence of POD in several layers of the pericarp (epidermis) and the seed coat (testa),in the embryo,and also in the endosperm. In this latter tissue,the staining intensity decreased gradually from the outer layers toward the center of the kernel. The localization of POD in durum wheat kernel suggests specific functions for different forms. [References: 44].

778 Genc,Y.; McDonald,GK.; Graham,RD. (1999) **Effect of seed zinc content on early growth of barley (Hordeum vulgare L.) under low and adequate soil zinc supply.** *Australian Journal of Agricultural Research. 51(1):37-45.* English. [Univ Adnan Menderes,Dept Agron TR-09100 Aydin Turkey].

Worldwide,barley is often grown on zinc (Zn) deficient soils. Screening for varieties tolerant of low soil Zn (Zn-efficient varieties) generally involves assessing growth or yield of plants grown at different levels of Zn supply. Seed nutrient reserves can influence the growth of the plant; however,there have been no reports on the effect of seed Zn content on the growth of barley. In 2 experiments,we studied the effect of seed Zn content on early growth of barley in 2 genotypes,Amagi Nijo and Tantangara. In Expt 1,the amounts of Zn in the seed ranged from 0.4 to 0.7 mu g/seed,whereas in Expt 2,seed Zn ranged from 0.7 to 5.0 mu g/seed. The plants were grown in a Zn-deficient siliceous sand with Zn added at 0,0.04,0.2,0.8,and 3.2 mg Zn/kg soil in Expt 1 and at 0,0.04,and 0.8 mg Zn/kg soil in Expt 2,and harvested at tillering. Growth and expression of visual symptoms were measured. Plants grown from seed with low Zn content developed symptoms of Zn deficiency by the 2-leaf stage in soil with no soil-applied Zn. Symptoms were reduced markedly as seed Zn content increased. Shoot and root growth increased as the amount of Zn in seed increased,but the effect was most evident when soil Zn supply was limiting plant growth (less than or equal to 0.04 mg Zn/kg soil). For instance,when no Zn was added to the soil,shoot dry weight of plants grown from high-Zn seed was 108% greater than that of plants grown from low-Zn seed,whereas at 0.04 and 0.8 mg Zn/kg soil,the increases were only 52% and 18%,respectively. Soil Zn application significantly increased tissue Zn concentrations. However,the effect of seed Zn content on tissue Zn concentrations was significant only at very high levels of seed Zn. The results presented showed that seed Zn improves vegetative growth in barley,especially when Zn supply is deficient for plant growth. Seed Zn content also affected the determination of Zn efficiency of genotypes,and comparisons of dry matter production of seedlings grown from seed with a wide range in Zn content may alter their rankings for Zn efficiency as determined in this pot assay. The results indicate that seed of similar Zn content needs to be used when comparing genotypes for determination of Zn efficiency. [References: 30].

779 Hong,SS.; Hong,T.; Jiang,H.; Xu,DQ. (1999) **Changes in the non-photochemical quenching of chlorophyll fluorescence during aging of wheat flag leaves.** *Photosynthetica. 36(4):621-625.* English. [Chinese Acad Sci,Shanghai Inst Plant Physiol 300 Fenglin Rd Shanghai 200032 Peoples R China].

Non-photochemical quenching of chlorophyll fluorescence (q(N)) and its three components (q(Nf),q(Nm),and q(Ns)) in the flag leaves of wheat grown in the field were studied by a fluorometer PAM-2000 on clear days. The diurnal variation patterns of q(N) in just fully extended (JFEL) and aging leaves (AL) were similar,but q(N),declined markedly in JFEL while it remained at a relatively high level in AL under strong sunlight at noon. Furthermore,at midday q(Nf) was higher than q(Ns) in JFEL,but much lower in AL. The results show the relative contributions of different mechanisms in:preventing the photosynthetic apparatus from photodamage change during leaf development. [References: 15].

780 Hudec,J. (Slovenska Polnohospodarska Univ.,Nitra (Slovak Republic). Katedra Chemie) (1999) **Hormonal changes in the winter wheat grain after the application of the liquid fertilizer Avit-35.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agricultural Sciences v. 45(11-12) p. 714-726.* 1 table,3 ill.; 12 ref. English. (AGRIS 2000-009867).

With the aim of a partial understanding of the positive effect of preparate Avit-35 to the grain yield of winter wheat in the years 1994/1995 and 1995/1996 a pot experiments with variety Vala were realised. At the phase in the beginning of winter wheat ear formation Avit-35 (treatment designed Avit-35) was applied,respectively the basic organic component of this preparate (treatment designed boc). On the stand of the control treatment the same dose of water was applied. At the single phases of the wheat growth and the ripening of seed,the weight of ear,the dry matter content in ear,releasing of ethylene by ears and the content of endogenous hormones (indolylacetic acid,abscisic acid and zeatin) in ear and seed was analyzed. It follows from the results that organomineral complexes in the liguid fertilizer Avit-35 influenced significantly the level of all of the analyzed endogenous hormones. The most important differences among control and the other variants were in the content of zeatin in the term between the beginning of milk ripeness and wax ripeness. With the increase of zeatin content at the beginning of milk ripeness a relatively expressive decrease of the content of indolylacetic acid in ear is connected.

781 Kawai,S.; Kuwajima,K. (1999) **Incorporation of C-14 into methionine as an intermediate for phytosiderophore**

**biosynthesis in barley.** *Soil Science & Plant Nutrition. 45(4):973-979.* English. [Iwate Univ Morioka Iwate 0208550 Japan].

In order to verify the precursory role of methionine (Met) in the biosynthesis of the mugineic acid family of phytosiderophores (MAs),feeding experiments of C-14-labeled compounds to barley (Hordeum vulgare L. cv. Minorimugi) roots grown hydroponically were conducted. When both C-14-Glucose (Glc) and unlabeled Met were fed to segmented roots,C-14 was incorporated into Met and MAs in the roots. Molar-radioactivity of Met was higher than that of the amino-butanoic-acid unit in MAs in the roots. When C-14-Glc and unlabeled homoserine (Hse) were fed to decapitated roots,C-14 was incorporated into Met but not into Hse. Therefore,it was considered that Hse might not be a major precursor of MAs. In addition,C-14 was incorporated into Met and MAs in the roots when both C-14-glycerol (Gol) and unlabeled Met were fed to segmented roots. It is suggested that MAs may be synthesized from Glc via Met,bypassing Hse,and that the MAs biosynthesis may involve an unknown pathway associated with Gol and leading to Met. [References: 21].

782 Klimov,SV.; Astakhova,NV.; Trunova,TI. (1999) **Changes in photosynthesis,dark respiration rates and photosynthetic carbon partitioning in winter rye and wheat seedlings during cold hardening.** *Journal of Plant Physiology. 155(6):734-739.* English. [Russian Acad Sci,KA Timiryazev Inst Plant Physiol Botanicheskaya 35 Moscow 127276 Russia].

In order to elucidate whether there is any correlation between freezing tolerance of plants and some parameters characterizing their source-sink relations at: different levels of plant structural organization,a number of certain responses of winter rye and wheat seedlings to cold hardening was determined. It has been found that in both crops the ratio of light-saturated photosynthesis rate to that of dark respiration increased about 2-3-fold after hardening while the initial difference in the value of this parameter (it was higher by about 40 % in rye seedlings as compared with that in wheat seedlings) was kept. In addition,cold hardening of both crops resulted in a marked increase in the contents of sugars,lipids and cytoplasmic proteins in leaf tissues,in the ratios of high-mol.-wr. polypeptide content to that of low-mol.-wt. ones,of membrane lipid content to that of membrane proteins,of phospholipid content to that of sterols,of unsaturated fatty acid content to that of saturated ones,of relative cross-section area of chloroplasts to that of a single cell and of the same area of plastoglobules to that of a single chloroplast. These results suggest that the changes observed in the above parameters reflect the development of additional assimilate sinks at various levels of plant structural organization to maintain a sufficiently high rate of photosynthesis at low temperature. According to the data obtained,under these conditions rye seedlings develop a higher sink capacity than wheat seedlings and for this reason likely exhibit more effective frost adaptation as compared with that of the latter crop. [References: 23].

783 Li Fangdong (Paulownia Research and Development Center of China,Zhengzhou (China)) (1998) **Changes of wheat photosynthetic characteristics in the intercropping system of Paulownia- wheat.** *Journal of Beijing Forestry University (China). Beijing Linye Daxue Xuebao (China) v. 20(3) p. 93-100.* 2 tables; 6 ill.,11 ref. Chinese. (AGRIS 2000-009864).

784 Liu Jianling (Hebei Agricultural Univ.,Baoding (China)) (1999) **The transformation of phosphorus in the rhizosphere of crops and effect of VA mycorrhizae on phosphorus transformation.** *Journal of Agricultural University of Hebei (China). Hebei Nongye Daxue Xuebao (China) v. 22(4) p. 4-9.* 2 tables; 2 ill.,15 ref. Chinese. (AGRIS 2000-009866).

785 Mariotti,M.; Masoni,A. (Pisa Univ. (Italy). Dipartimento di Agronomia e Gestione dell'Agroecosistema); Ercoli,L. (Scuola Superiore di Studi Universitari e di Perfezionamento S. Anna,Pisa (Italy)) (1998) **Wheat nitrogen and phosphorus uptake as affected by nitrogen fertilizer [Triticum aestivum L. - Tuscany].** *Rivista di Agronomia (Italy) v. 32(2) p. 73-81.* 1 table; 7 graphs; 9 ref. Italian. (AGRIS 2000-002120).

The research was undertaken to develop a mathematical model to simulate the effect of nitrogen fertilization on wheat growth and N and P uptake. The model was developed utilizing the logistic and monomolecular equations and the sum of photothermal units as climatic variable. Results demonstrated a close relationship between nitrogen rate and coefficients of the equations representing growth and nitrogen concentration of plants parts. The lenght of the biological cycle and of the phases whithin it were related to the amount of photothermal units of the environment and were not affected by nitrogen availability. Nitrogen fertilization increased dry weight and N and P content of leaves and culms during all the biological cycle and increased the lenght of time during which the leaves could absorb nitrogen and phosphorus. The effect of nitrogen fertilization on leaves and culms growth was different. In condition of reduced nitrogen availability,the plant favours growth of leaves and consequently nitrogen is limiting for culms up to the onset of growth and for leaves after a period of normal growth La ricerca e' stata condotta con lo scopo di ottenere un modello matematico per la simulazione dell'effetto della concimazione azotata sull'accrescimento delle piante e sulla asportazione di azoto e di fosforo del frumento tenero. Il modello si basa sulla integrazione delle equazioni logistica e monomolecolare ed utilizza come variabile climatica la sommatoria delle unita' fototermiche. I risultati ottenuti hanno evidenziato l'esistenza di una stretta relazione tra dose di concime azotato distribuita e i coefficienti delle equazioni che rappresentano l'accrescimento e la concentrazione di azoto dei singoli organi della pianta. La lunghezza sia dell'intero ciclo biologico del frumento sia delle singole fasi che lo compongono e' risultata legata alla quantita' di unita' fototermiche dell'ambiente di coltivazione e non e' stata influenzata dalla diversa disponibilita' di azoto. La concimazione azotata,invece,ha provocato incrementi del peso e del contenuto di azoto e di fosforo delle foglie e dei culmi delle piante di frumento in ogni momento del ciclo biologico ed un prolungamento del periodo utile per l'assorbimento dei due elementi da parte delle foglie. L'effetto della concimazione azotata sull'accrescimento dei culmi e delle foglie e' risultato diverso. In condizioni di ridotta disponibilita' di azoto,la pianta di frumento privilegia l'accrescimento delle foglie a scapito di quello dei culmi,cosicche' per i secondi l'azoto e' risultato limitante fin dall'inizio dell'accrescimento e per le prime e' diventato limitante solo dopo un periodo di crescita normale.

786 Muller,B.; Eichacker,LA. (1999) **Assembly of the D1 precursor in monomeric photosystem II reaction center precomplexes precedes chlorophyll a-triggered accumulation of reaction center II in barley etioplasts.** *Plant Cell. 11(12):2365-2377.* English. [Univ Munich,Inst Bot Menzingerstr 67 D-80638 Munich Germany].

Assembly of plastid-encoded chlorophyll binding proteins of photosystem II (PSII) was studied in etiolated barley seedlings and isolated etioplasts and either the absence or presence of de novo chlorophyll synthesis. De novo assembly of reaction center complexes in etioplasts was characterized by immunological analysis of protein complexes solubilized from inner etioplast membranes and separated in sucrose density gradients. Previously characterized membrane protein complexes from chloroplasts were utilized as molecular mass standards for sucrose density gradient separation analysis. In etiolated seedlings,induction of chlorophyll a synthesis resulted in the accumulation of D1 in a dimeric PSII reaction center (RCII) complex. In isolated etioplasts,de novo chlorophyll a synthesis directed accumulation of D1 precursor in a monomeric RCII precomplex that also included D2 and cytochrome b(559). Chlorophyll a synthesis that was chemically prolonged in darkness neither increased the yield of RCII monomers nor directed assembly of RCII dimers in etioplasts. We therefore conclude that in etioplasts,assembly of the D1 precursor in monomeric RCII precomplexes precedes chlorophyll a-triggered accumulation of reaction center monomers. [References: 54].

787 Rafi,MM.; Epstein,E. (1999) **Silicon absorption by wheat (Triticum aestivum L.).** *Plant & Soil. 211(2):223-230.* English.

[Univ Calif Davis,Dept Land Air & Water Resources Soils & Biogeoche 1 Shields Ave Davis,CA 95616 USA].

Although silicon (Si) is a quantitatively major inorganic constituent of higher plants the element is not considered generally essential for them. Therefore it is not included in the formulation of any of the solution cultures widely used in plant physiological research. One consequence of this state of affairs is that the absorption and transport of Si have not been investigated nearly as much as those of the elements accorded 'essential' status. In this paper we report experiments showing that Si is rapidly absorbed by wheat (Triticum aestivum L.) plants from solution cultures initially containing Si at 0.5 mM,a concentration realistic in terms of the concentrations of the element in soil solutions. Nearly mature plants (headed out) 'preloaded' with Si absorbed it at virtually the same rate as did plants grown previously in solutions to which Si had not been added. The rate of Si absorption increased by more than an order of magnitude between the 2-leaf and the 7-8 leaf stage,with little change thereafter. [References: 12].

788 Ranieri,A.; Pieruccetti,F.; Panicucci,A.; Castagna,A.; Lorenzini,G.; Soldatini,GF. (1999) **SO2-induced decrease in photosynthetic activity in two barley cultivars. Evidence against specific damage at the protein-pigment complex level.** *Plant Physiology & Biochemistry. 37(12):919-929.* English. [Univ Pisa,Dipartimento Chim & Biotecnol Agrarie Via Borghetto 80 I-56124 Pisa Italy].

This research investigated the SO2-induced effects on photosynthetic apparatus in two barley (Hordeum vulgare I,.) cultivars (cv),Panda and Express. Following a chronic treatment with SO2 (80 ppb,75 d) neither cv showed any visible signs of injury or chlorosis on leaf surfaces,while a significant reduction in A(max) and G(w) was detected in both cvs,although to different extents. Thylakoids of SO2-treated plants showed a decrease in the electron transport activity at the whole chain,photosystem II (PSII) and photosystem I (PSI) level in both cvs. The high performance liquid chromatography (HPLC) analysis of leaf pigments revealed a significant decrease in both cvs,more pronounced in Panda than in Express. Deriphat-polyacrilamide gel electrophoresis (Deriphat-PAGE) and two dimensional (2-D) electrophoretic analyses of the pigment-protein complexes did not show differences in SO2-treated samples of either cv. HPLC analysis of the green bands also showed no differences in the pigment content of fumigated samples of either cv,except for a decrease in beta-carotene content and xanthophyll cycle pigment (VAZ) content respectively at band 1 (PSI) and band 5 (minor light-harvesting polypeptides of PSII) level in cv Panda,where the de-epoxidation index (DEP) significantly increased,while in Express,an increase in VAZ content and DEP value of band 5 was observed. These results suggest that the decrease in the photosynthetic activity can be ascribed,in addition to stomata closure induced by SO2,to a generalised,rather than specific,pollutant effect on photosynthetic apparatus,which could be interpreted as an adaptation to the adverse environment. (C) 1999 Editions scientifiques et medicales Elsevier SAS. [References: 40].

789 Rengel,Z. (1999) **Physiological responses of wheat genotypes grown in chelator-buffered nutrient solutions with increasing concentrations of excess HEDTA.** *Plant & Soil. 215(2):193-202.* English. [Univ Western Australia,Fac Agr Nedlands WA 6907 Australia].

The chelator-buffered nutrient solutions containing excess chelator have been used frequently in the micronutrient research,but potential toxicity of the excess chelator has not been ascertained. The present study was conducted to test effects of four concentrations of excess HEDTA [ N-(2-hydroxyethyl)ethylenedinitrilotriacetic acid] and two levels of total Zn on growth,root exudation,and nutrient uptake and transport by Triticum aestivum L. (cv. Aroona) and Triticum turgidum L. conv. durum (Desf.) MacKey (cv. Durati) genotypes differing in tolerance to Zn deficiency. Excess HEDTA at 50 mu M reduced root and shoot growth and caused visual toxicity symptoms (necrotic lesions) on leaves; these effects were generally absent at lower concentrations of excess HEDTA. Root exudation of phytosiderophores increased with increasing concentrations of excess HEDTA at deficient and sufficient Zn levels,and was higher in Zn-deficiency-tolerant Aroona than in Zn-deficiency-sensitive Durati wheat. Shoot and root Zn concentrations showed a saturable response to increasing Zn2+ activities in solution. Excess HEDTA at 50 mu M caused an increase in shoot concentrations of Fe and a decrease in concentrations of Mn and Cu. An average rate of Zn uptake increased with an increase in Zn2+ ionic activity in solution,with Zn-deficiency-tolerant Aroona having a higher rate of Zn uptake than Zn-deficiency-sensitive Durati in the deficiency range of Zn2+ activities. Average uptake rates of Mn and Cu decreased with an increase in concentration of excess HEDTA. Similar observations were noted for transport of Mn and Cu to shoots,while Zn transport to shoots was proportional to Zn2+ activities in solution. It was concluded that excess HEDTA at 50 mu M adversely affects wheat growth and physiology,while excess of 25 mu M or less does not cause measurable toxicity. [References: 33].

790 Ruggiero,C.; Pascale,S. de; Fagnano,M. (Naples Univ.,Portici (Italy). Dipartimento di Scienze Agronomiche e Genetica Vegetale) (1998) **Water resistance trends in plant and soil during the biological cycle of barley [Hordeum vulgare L.].** *Rivista di Agronomia (Italy) v. 32(1) p. 17-27.* 4 tables; 15 graphs; 47 ref. Italian. (AGRIS 2000-002092).

791 Ruza,A. (Latvia Univ. of Agriculture,Jelgava (Latvia). Faculty of Agriculture. Inst. of Crop Sciences. Dept. of Plant Production) (1999) **[Phytometric indices of barley yield formation].** International scientific conference: Agronomy. Jelgava (Latvia). 8-10 Jul 1999. *[Agroecological optimization of husbandry technologies. Proceedings of the International scientific conference on Agronomy of the Baltic States Agricultural Universities]. Rubenis,J. (Ed.). Latvia Univ. of Agriculture,Jelgava (Latvia) 262 p. p. 240-249.* Latvia University of Agriculture. 1 table; 4 ill.,5 ref. English. (AGRIS 2000-002075).

Field trials were conducted with the standard local spring barley variety "Abava" on the brown lessive medium loam soil at the Research Farm of Latvia University of Agriculture. The aim of the research was to study the photosynthetic potential of spring barley sowings. During the period of four years the dynamics of leaf area development,dry matter accumulation and distribution among plant fractions was studied,the dynamics of chlorophyll accumulation and content was determined. The photosynthetic potential and the net photosynthesis productivity were calculated. On the ground of the obtained results the correlative relationships were found. The results of the research have been analysed,are discussed and shown graphically.

792 Song Jianming (Shandong Provincial Academy of Agricultural Sciences,Jinan (China). Inst. of Crop Science); Tian Jichun (1999) **Photosynthetic characteristics in flag leaves of high protein wheat cultivars under strong irradiance stress around noon.** *Acta Phytophysiologica Sinica (China). Zhiwu Shengli Xuebao (China) v. 25(3) p. 209-213.* 1 table; 4 ill.,17 ref. Chinese. (AGRIS 2000-002123).

793 Thorgeirsson,H.; Soegaard,H. (1999) **Simulated carbon dioxide exchange of leaves of barley scaled to the canopy and compared to measured fluxes.** *Agricultural & Forest Meteorology. 98-9(Special Issue SI):479-489.* English. [Agr Res Inst Keldnaholt IS-112 Reykjavik Iceland].

Information on the exchange of carbon dioxide between the earth's surface and the atmosphere is critical for successful prediction of future climate. In the present study a model of leaf photosynthesis and stomatal conductance was parameterised based on field measurements of leaf photosynthesis and stomatal conductance. The simulated leaf gas exchange was scaled to the canopy level using the big leaf approach based on estimated radiation capture by the canopy and coupled to calculations of atmospheric resistance and soil carbon dioxide efflux to simulate the fluxes of carbon dioxide over a barley field. The model was found to be applicable for the conditions and simulated values agree well with canopy fluxes measured using the eddy covariance

technique for a four-week period during the second field campaign of the Northern Hemisphere Climate processes Land-surface Experiment (NOPEX) in the region around Uppsala,Sweden,during June and July 1995. The rate of canopy development was high during the period and the leaf area index (LAI) changed from 0.7 to 3.5. Evaluation of the sensitivity of the model to driving variables and key canopy parameters showed high sensitivity to information on development and physiological characteristics of the canopy. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 32].

794 Wieneke,J.; Roeb,G.W. (1998) **Effect of methionine sulphoximine on (13)N-ammonium fluxes in the roots of barley and squash seedlings.** Forschungszentrum Juelich GmbH (Germany). Inst. fuer Radioagronomie. *Zeitschrift fuer Pflanzenernaehrung und Bodenkunde (Germany) v. 161(1) p. 1-7.* English. (AGRIS 2000-002094).

795 Yang,CH.; Crowley,DE. (2000) **Rhizosphere microbial community structure in relation to root location and plant iron nutritional status.** *Applied & Environmental Microbiology. 66(1):345-351.* English. [Univ Calif Riverside,Dept Environm Sci Riverside,CA 92521 USA].

Root exudate composition and quantity vary in relation to plant nutritional status,but the impact of the differences on rhizosphere microbial communities is not known,To examine this question,we performed an experiment with barley (Hordeum vulgare) plants under iron-limiting and iron-sufficient growth conditions. Plants were grown in an iron-limiting soil in root box microcosms. One-half of the plants were treated with foliar iron every day to inhibit phytosiderophore production and to alter root exudate composition. After 30 days,the bacterial communities associated with different root zones,including the primary root tips,nonelongating secondary root tips,sites of lateral root emergence,and older roots distal from the tip,were characterized by using 16S ribosomal DNA (rDNA) fingerprints generated by PCR-denaturing gradient gel electrophoresis (DGGE),Our results showed that the microbial communities associated with the different root locations produced many common 16S rDNA bands but that the communities could be distinguished by using correspondence analysis. Approximately 40% of the variation between communities could be attributed to plant iron nutritional status. A sequence analysis of clones generated from a single 16S rDNA band obtained at all of the root locations revealed that there were taxonomically different species in the same band,suggesting that the resolving power of DGGE for characterization of community structure at the species level is limited. Our results suggest that the bacterial communities in the rhizosphere are substantially different in different root zones and that a rhizosphere community may be altered by changes in root exudate composition caused by changes in plant iron nutritional status. [References: 37].

796 Zawieja,J.; Sniady,R.; Wojciechowski,W. (Akademia Rolnicza,Wroclaw (Poland). Katedra Ogolnej Uprawy Roli i Roslin) (1998) **Effect of varying soil moisture on nutrient uptake and fertilizer efficiency by winter triticale.** *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rolnictwo (Poland) (no.347) p. 125-141.* 8 fig.,3 tables; 19 ref. Polish. (AGRIS 2000-009862).

A pot experiment was conducted in three series in: 1991/92 and 1993/94 in a greenhouse to determine the effects of changing soil moisture contents during the growing season and 2 rates of mineral fertilizer on: NPK content in winter triticale dry matter,nutrient uptake with the yield and efficiency of application. It was found that mineral fertilizers increased nitrogen contents of grain,straw and roots. The highest values at maximum soil moisture content were 19.5 g and 34.9 g respectively.

797 Zhang Cuizhen (Binzhou Prefectural Research Inst. of Agricultural Sciences,Shandong (China)) (1998) **Characteristics of silicon absorption in wheat and its application effects.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 4) p. 29-30.* 4 tables. Chinese. (AGRIS 2000-009865).

798 Zsoldos,F.; Vashegyi,A.; Pecsvaradi,A.; Haunold,E.; Herger,P. (1999) **Nitrate and nitrite transport into cereals affected by low pH and different temperatures.** *Cereal Research Communications. 27(4):403-409.* English. [Attila Jozsef Univ,Dept Plant Physiol POB 654 H-6701 Szeged Hungary].

The effects of pH and temperature on the uptake of nitrate (NO3-) and nitrite (NO2-) of wheat (Triticum aestivum L. cv. GK Othalom) and rice (Oryza sativa L. cv. Oryzella) seedlings were studied in hydroponic cultures in short-term (3-4 h) and long-term (12-24 h) experiments with use of stable (N-15) isotope labelled compounds. In short-term experiments the nitrate uptake of the roots of wheat was lower at pH 6.5 than at pH 4. However,in the long-term tests this changed for the opposite,the uptake of nitrate was definitely higher at pH 6.5. The nitrite uptake at pH 4 hardly increased with time. At pH 6.5 its amount was comparable to nitrate. Nitrate and nitrite was translocated towards the shoot. Tn long-term. experiments this value for nitrite was definitely higher than that of nitrate at pH 6. NO3- and NO2- uptake data show that K+,the accompanying ion,compared to Na+,increased the absorption and translocation of NO3- and NO2- in seedlings. The growth of seedlings,under the same experimental conditions,show the same tendency. The temperature coefficient (Q(10)) for nitrite confirmed the active character of its uptake,and its toxic effect at pH 4. Our results clearly show,that at least in a limited range of concentration (<1mM),at non-acidic pH,plants can utilise the nitrite taken up by roots. However,at low pH HNO2 is formed,generally considered as strong oxidant and toxic substance. [References: 25].

## F62 PLANT PHYSIOLOGY-GROWTH AND DEVELOPMENT

799 Barazani,O.; Friedman,J. (1999) **Allelopathic bacteria and their impact on higher plants [Review].** *Critical Reviews in Plant Sciences. 18(6):741-755.* English. [Tel Aviv Univ,George S Wise Fac Life Sci,Dept Plant Sci IL-69978 Tel Aviv Israel].

The impact of allelopathic,nonpathogenic bacteria on plant growth in natural and agricultural ecosystems is discussed. In some natural ecosystems,evidence supports the view that in the vicinity of some allelopathically active perennials (e.g.,Adenostoma fasciculatum,California),in addition to allelochemicals leached from the shrub's canopy,accumulation of phytotoxic bacteria or other allelopathic microorganisms amplify retardation of annuals. In agricultural ecosystems allelopathic bacteria may evolve in areas where a single crop is grown successively,and the resulting yield decline cannot be restored by application of minerals. Transfer of soils from areas where crop suppression had been recorded into an unaffected area induced crop retardation without readily apparent symptoms of plant disease. Susceptibility of higher plants to deleterious rhizobacteria is often manifested in sandy or so-called skeletal soils. Evaluation of phytotoxic activity under controlled conditions,as well as ways to apply allelopathic bacteria in the field,is approached. The allelopathic effect may occur directly through the release of allelochemicals by a bacterium that affects susceptible plant(s) or indirectly through the suppression of an essential symbiont. The process is affected by nutritional and other environmental conditions,some may control bacterial density and the rate of production of allelochemicals. Allelopathic nonpathogenic bacteria include a wide range of genera and secrete a diverse group of plant growth-mediating allelochemicals. Although a limited number of plant growth-promoting bacterial allelochemicals have been identified,a considerable number of highly diversified growth-inhibiting allelochemicals have been isolated and characterized. Some species may produce more than one allelochemical; for example,three different phyotoxins,geldanamycin,nigericin,and hydanthocidin,were isolated from Streptomyces hygroscopicus. Efforts to introduce naturally produced allelochemicals as plant growth-regulating agents in agriculture have yielded two commercial herbicides,phosphinothricin,a product of Streptomyces viridochromogenes,and bialaphos from S. hygroscopicus. Many species of allelopathic bacteria that affect growth of higher plants

are not plant specific,but some do exhibit specificity; for example,dicotyledonous plants were more susceptible to Pseudomonas putida than were monocotyledons. Differential susceptibility of higher plants to allelopathic bacteria was noted also in much lower taxonomical categories,at the subspecies level,in different cultivars of wheat,or of lettuce. Therefore,when test plants are employed to evaluate bacterial allelopathy,final evaluation must include those species that are assumed to be suppressed in nature. The release of allelochemicals from plant residues in plots of 'continuous crop cultivation' or from allelopathic living plants may induce the development of specific allelopathic bacteria. Both the rate by which a bacterium gains from its allelopathic activity through utilizing plant excretions,and the reasons for the developing of allelopathic bacteria in such habitats,are important goals for further research. [References: 68].

800 Bhaglal,P.; Singh,P.; Bhullar,SS. (1999) **Drought-induced increase in wheat germ agglutinin (WGA) accumulation in developing wheat embryos appears to be independent of ABA.** *Australian Journal of Plant Physiology. 26(8):787-791.* English. [Guru Nanak Dev Univ,Dept Biotechnol Amritsar 143005 Punjab India].

Accumulation of wheat germ agglutinin (WGA) in the developing embryos of three different wheat (Triticum aestivum L.) cultivars,PBW-138,PBW-299 and C-306,was studied in relation to abscisic acid (ABA) accumulation under water stress conditions at 18,24 and 30 days post anthesis (DPA) under natural conditions. Imposition of water stress in all three cultivars resulted in enhanced ABA levels in the embryos at all stages of grain development. On the contrary,the increase in WGA accumulation in the embryos in response to drought was stage- and cultivar-dependent. Our results suggest that apart from ABA,other factors that are temporally expressed may be involved in drought-induced regulation of the WGA gene. [References: 28].

801 Briggs,KG.; Kiplagat,OK.; Johnson-Flanagan,AM. (1999) **Effects of pre-anthesis moisture stress on floret sterility in some semi-dwarf and conventional height spring wheat cultivars.** *Canadian Journal of Plant Science. 79(4):515-520.* English. [Univ Alberta,Dept Agr Food & Nutr Sci Edmonton AB T6G 2P5 Canada].

This study was conducted to investigate the response of some semi-dwarf Canada Prairie Spring wheat (Triticum aestivum) and conventional height (tall) cultivars of Canada Western Red Spring wheat to moisture stress at the booting stage. The effect on the frequency of sterile florets was determined in the two height groups. Drought tolerance was investigated using the electrolyte leakage test. The association of floret sterility with pollen viability under moisture stress conditions was also investigated. When fully watered,several of the semidwarf cultivars had a lower frequency of sterile florets compared with the tall cultivars. Moisture stress increased the frequency of sterile florets in both semi-dwarf and tall wheat cultivars. As moisture stress increased,the resulting sterility was significantly higher in semidwarf cultivars,relative to the tall cultivars (P less than or equal to 0.01). Comparisons between floret sterility and desiccation injury (estimated by electrolyte leakage tests) suggest that a high degree of floret sterility was not associated with lower levels of desiccation tolerance. Cultivar differences in pollen fertility and for electrolyte leakage in response to moisture stress were evident,but were distributed independently of height class. [References: 31].

802 Caredda,S.; Devaux,P.; Sangwan,RS.; Clement,C. (1999) **Differential development of plastids during microspore embryogenesis in barley.** *Protoplasma. 208(1-4):248-256.* English. [Univ Reims,Unite Format & Rech Sci Biol & Physiol Vegetales BP 1039 F-51687 Reims 2 France].

In order to understand and limit albino plantlet formation during pollen embryogenesis in barley (Hordeum vulgare L,cv. Igri),plastid feature was followed during pollen embryogenesis under two anther culture conditions and compared to plastid development in the zygotic embryo. The first condition was characterized by cold pretreatment and maltose in the induction medium. Both embryos and calli were then obtained. During pollen embryo development,up to 30% of plastids had abnormal features. Disruptions mainly affected the plastid size,the feature of plastid envelopes,thylakoid and granum organization,as well as starch accumulation. In pollen calli,superficial cells had meristematic features. Up to 50% of plastids exhibited the above mentioned abnormalities. Internal cells were highly vacuolated with amyloplast-like plastids; envelopes had normal features but no internal membrane was detected. Pollen embryo-derived plantlets had a green-to-albino ratio (G/A) bring equal to 1.0,whereas calli-derived embryos only formed albino plantlets. The second condition was characterized by mannitol pretreatment and the presence of both maltose and mannitol in the induction medium. No callus was formed but most of microspore-derived structures developed haploid embryos and then the green plantlets (200 plantlets per 100 responding anthers,G/A = 9.4). In this case,plastid development in zygotic and pollen embryos were similar and almost no albino plantlets were formed. [References: 38].

803 Combettes,B.; Grienenberger,JM. (1999) **Analysis of wheat mitochondrially encoded polypeptides by in organello labelling.** *Plant Cell Reports. 19(2):161-165.* English. [Univ Strasbourg 1,Inst Biol Mol Plantes,CNRS 12 Rue Gen Zimmer F-67084 Strasbourg France].

The in organello labeling pattern in wheat (Triticum aestivum) mitochondria isolated from imbibed embryos were compared with those from the commonly used starting material,etiolated seedlings. Mitochondria from imbibed embryos proved to be metabolically more active than those from etiolated seedlings and produced a large number of strongly in organello-labeled polypeptides. Immunoprecipitation of the labeled proteins enabled the identification of mitochondrially encoded subunits of the respiratory chain complex I,some of which could not be detected by conventional Western blotting due to their high hydrophobicity. A method for mass isolation of wheat embryos is also presented which allows easy preparation of large amounts of intact and highly active mitochondria suitable for biochemical studies. [References: 19].

804 Cvetkovic,T.V. (Visa poljoprivredna skola,Pozarevac (Yugoslavia)); Milovanovic,M.S.; Ognjanovic,R.; Djokic,D.; Lomovic,S. (1996) **Influence of winter wheat seed treatment by laser on vegetation period duration and harvest index of grain.** *Selekcija i semenarstvo (Yugoslavia). Plant Breeding and Seed Production v. 3(3-4) p. 105-109.* v. 3(3-4) p. 105-109. Serbian. (AGRIS 2000-009953).

Influence of winter wheat seed stimulation by laser (cv. Radika) on the stages of development,duration of vegetation period and harvest index of grain was investigated. For dates of development stages advancing to heading,between cv. Radika and it's laser treatment weren't noticed significant differences. Noticable differences appear in stages of kernel filling and for duration of vegetation period. Treatments by laser were earlier in maturing from standard for 2-6 days depending of treatment and year. The harvest index of grain at laser treatments was significantly higher and depended from the conditions of year,too.

805 Feng Guanglong (China Agricultural Univ.,Beijing (China). Coll. of Resources and Environment) (1998) **Effect of soil water on growth and development of primary and adventitious root in winter wheat.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(3) p. 11-17.* 3 tables; 2 ill.,9 ref. Chinese. (AGRIS 2000-009955).

806 Feng Qing (Shanghai Normal Univ. (China). Dept. of Biology); Xu Langlai (1999) **Changes of the optimum pH and temperature of three protective enzymes during wheat leaf senescence.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 25(1) p. 8-10.* 2 ill.,9 ref. Chinese. (AGRIS 2000-002206).

807 Huang,L.; Millet,E.; Rong,JK.; Wendel,JF.; Anikster,Y.; Feldman,M. (1999) **Restriction fragment length polymorphism in wild and cultivated tetraploid wheat.** *Israel Journal of Plant*

*Sciences. 47(4):213-224.* English. [Weizmann Inst Sci,Dept Plant Sci IL-76100 Rehovot Israel].

RFLP diversity in the nuclear genome was estimated within and among Israeli populations of wild emmer wheat (Triticum turgidum var. dicoccoides) from a longterm study site at Ammiad (NE Israel),and from several other geographical locations. Using 55 enzyme-probe combinations,high levels of genetic diversity were revealed in wild emmer in general and within the Ammiad site. In spite of high diversity,observed heterozygosity was low and populations consisted of a patchwork of alternate multilocus homozygotes,consistent with the reproductive biology of a predominant self-fertilizing species. Retention of genetic diversity in wild emmer may be promoted by large population sizes,microhabitat diversity,and occasional gene flow through both pollen and seed. Population genetic structure in wild emmer appears to have been influenced by historical founder events as well as selective factors. Multivariate analyses indicated that individuals tend to cluster together according to their population of origin,and that there is little geographical differentiation among populations. Sampling of 12 domesticated land-races and both primitive and modern cultivars of T. turgidum revealed high levels of diversity and a large number of alleles that were not detected in the wild emmer populations. This may reflect a long-term domestication process in which wild,semi-domesticated,and domesticated types grew sympatrically,continuing introgression from wild populations,and perhaps also gene flow from trans-specific sources. [References: 37].

808 Hussain,A.; Black,CR.; Taylor,IB.; Mulholland,BJ.; Roberts,JA. (1999) **Novel approaches for examining the effects of differential soil compaction on xylem sap abscisic acid concentration,stomatal conductance and growth in barley (Hordeum vulgare L.).** *Plant,Cell & Environment. 22(11):1377-1388.* English. [Univ Nottingham,Sch Biol Sci Sutton Bonington Campus Loughborough LE12 5RD Leics England].

Novel techniques were devised to explore the mechanisms mediating the adverse effects of compacted soil on plants. These included growing plants in: (i) profiles containing horizons differing in their degree of compaction and; (ii) split-pots in which. the roots were divided between compartments containing moderately (1.4 g cm(-3)) and severely compacted (1.7 g cm(-3)) soil,Wild-type and ABA-deficient genotypes of barley were used to examine the role of abscisic acid (ABA) as a root-to-shoot signal. Shoot dry weight and leaf area were reduced and root : shoot ratio was increased relative to 1.4 g cm(-3) control plants whenever plants of both genotypes encountered severely compacted horizons. In bartey cultivar Steptoe,stomatal conductance decreased within 4 d of the first roots encountering 1.7 g cm(-3) soil and increased over a similar period when roots penetrated from 1.7 g cm(-3) into 1.4 g cm(-3) soil. Conductance was again reduced by a second 1.7 g cm(-3) horizon,These responses were inversely correlated,vith xylem sap ABA concentration. No equivalent stomatal responses occurred in Az34 (ABA deficient genotype),in which the changes in xylem sap ABA were much smaller. When plants were grown in 1.7.

809 Jaskulski,D. (Akademia Techniczno Rolnicza,Bydgoszcz (Poland). Wydzial Rolniczy) (1999) **Allelopathic effects of water extracts from aerial parts of weeds on germination of spring barley and spring wheat.** *Zeszyty Naukowe Akademii Techniczno-Rolniczej w Bydgoszczy. Rolnictwo (Poland) (no.47) p. 7-15.* 2 fig.,2 tables; 18 ref. Polish. (AGRIS 2000-009904).

Shoots collected at the flowering phase were dried and extracted with water to obtain two different concentrations,i.e. 0.5 g,1 g and 2 g d.m. per 100 ml of distilled water. Cereal grains were treated with these extracts in Szmal germinators. Even at the lower concentration water extracts from weed shoots significantly decreased the germination energy of barley and wheat. Higher concentrations (1 g and 2 g d.m. per 100 ml water) also limited the ability of grains of both species to germinate. Low concentration of extracts from weed shoots enhanced the initial growth of barley seedlings while it was neutral to wheat. The extracts of higher concentrations inhibited the growth of both cereal species. In case of wheat the most active was the extract from wild mustard while the growth of barley was limited by field bedstraw.

810 Karsai,I.; Meszaros,K.; Szucs,P.; Hayes,PM.; Lang,L.; Bedo,Z. (1999) **Effects of loci determining photoperiod sensitivity (Ppd-H1) and vernalization response (Sh2) on agronomic traits in the 'Dicktoo' x 'Morex' barley mapping population.** *Plant Breeding. 118(5):399-403.* English. [Hungarian Acad Sci,Agr Res Inst H-2462 Martonvasar Hungary].

The objectives of this research were to determine the individual and interaction effects of the Ppd-H1 and Sh2 loci on agronomic traits under short- and long-photoperiod regimes. Nineteen doubled haploid (DH) lines from the 'Dicktoo' x 'Morex' mapping population,which represented the four genotypes at the Ppd-H1 and Sh2 loci,were phenotyped in controlled environment photoperiods. Both Ppd-H1 and Sh2 had significant effects on several agronomic traits,in addition to their role in determining first node appearance and flowering time. The magnitude of these effects depended on daylight. Under long-day conditions (18 h) Ppd-H1,and under short-day conditions (12 h) Sh2 was a significant determinant of most characters. The interactions between these two loci were significant for several characters,particularly for yield components,under both long- and short-photoperiod regimes. Under the long-day treatment,Ppd-H1 influenced plant height: through the determination of node number. There was an epistatic association between the two loci for both 1000-kernel weight and tillering. The combination of photoperiod insensitivity and vernalization requirement caused a significant increase in tillering. This was paralleled by a decrease in 1000-kernel weight. Under the long-day treatment,neither Ppd-H1 nor Sh2 influenced plant yield. Under short-day conditions,the combination of photoperiod insensitivity and vernalization requirement had a pronounced negative effect on plant yield. [References: 17].

811 Kohler,B.; Raschke,K. (2000) **The delivery of salts to the xylem. Three types of anion conductance in the plasmalemma of the xylem parenchyma of roots of barley.** *Plant Physiology. 122(1):243-254.* English. [Univ Gottingen,Albrecht Von Haller Inst Pflanzenwissensch Untere Karspule 2 D-37073 Gottingen Germany].

To explore possible pathways for anions to enter the xylem in the root during the transport of salts to the shoot,we used the patch-clamp method on protoplasts prepared from the xylem parenchyma of barley (Hordeum vulgare L.) plants. K+ currents were suppressed by tetraethylammonium or N-methylglucamine in the solutions in the pipette and the bath,and the permeating anions were Cl- or NO3-. We recorded the activities of three distinct anion conductances: (a) an inwardly rectifying anion channel (X-IRAC),characterized by activation at hyperpolarization and open times of up to several seconds; (b) a quickly activating anion conductance (X-QUAC),important for anion efflux at voltages between -50 mV and the equilibrium potential of the prevailing anion; and (c) a slowly activating anion conductance (X-SLAC),activating above -100 mV. Both X-IRAC and X-QUAC were permeable for Cl- and NO3-; X-QUAC was also permeable for malate. The occurrence of X-IRAC became more frequent with an increase in cytoplasmic Ca2+,while the occurrence of X-QUAC decreased. Anion currents through X-SLAC,and particularly through X-QUAC,were estimated to be large enough to account for reported rates of xylem loading,which is in accordance with the notion that xylem loading is a passive process. [References: 54].

812 Kordas,L. (Akademia Rolnicza,Wroclaw (Poland). Katedra Ogolnej Uprawy Roli i Roslin); Kordas,R.; Szubzda,B.; Wilczynski,W. (1998) **Effects of the magnetic field on growth and development of winter wheat and oats plants.** *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rolnictwo (Poland) (no.347) p. 107-113.* 4 fig.; 8 ref. Polish. (AGRIS 2000-009957).

The subject of the experiment carried out in 1996-97 in laboratory conditions was to determine the influence of the magnetic field on seed germination at the first stage of winter wheat and oats development. The kernels of these plants were

exposed to the external magnetic field in two ways: before and during germination and at the initial stage of plant development. In both cases the stimulating influence of the experimental factors was observed,namely an increase in germination capacity and dynamics was observed. The plants were higher and produced more green and dry matter as compared to non-exposed plants.

813 Kumlehn,J.; Lorz,H.; Kranz,E. (1999) **Monitoring individual development of isolated wheat zygotes: a novel approach to study early embryogenesis.** *Protoplasma. 208(1-4):156-162.* English. [Univ Hamburg,Inst Allgemeine Bot Ohnhorststr 18 D-22609 Hamburg Germany].

A culture method has been established by which development of isolated wheat (Triticum aestivum L.) zygotes can be monitored individually until formation of multicellular structures. As was shown recently these isolated zygotes have a high capacity to form differentiated embryos and normal plants,and thus constitute a suitable object to study early embryogenesis. After being isolated within 6 h alter pollination (hap),zygotes were immobilized in an agarose droplet directly on a microscopic chamber slide,which allows for both subsequent development through co-culture with feeder aggregates,as well as detailed observation and photographic documentation of individual behavior. Shortly after fertilization,the wheat zygote,like the unfertilized egg cell,is characterized by one conspicuous nucleolus. Typically,a second and a third nucleolus appeared between 5 and 8.5 hap. Between 7 and 15 hap,we observed nucleolar vacuolation indicating enhanced ribosomal activity. Continuous cell expansion with slight cell elongation was detected until around 15 hap,followed by a period of transitory reduction in cell volume which roughly corresponded with mitosis. Mitotic prophase of a zygote could easily be detected by the disappearance of all nucleoli within a few minutes. The division plane was generally established perpendicular to the formerly established cell elongation axis. At cytokinesis,which was completed by 19 hap in 90% of the individuals observed,2 or 3 nucleoli were detected again per daughter cell. The first cell division,including the establishment of a cleavage furrow with intercellular spaces,was completed in all cases within 23 hap. Since this result is in accordance with what is known from earlier studies based upon fixed material,and since the zygotes subsequently continue embryogenesis,in vitro development is assumed to be analogous to that: in planta. This experimental system constitutes a valuable experimental tool for further detailed research,both at the cellular and at the molecular level. [References: 29].

814 Maes,O.; Comeau,A.; Nadeau,P.; Simard,RR.; St-Pierre,CA. (1999) **Characterization of the natural chemical and osmotic environment of early wheat embryogenesis.** *Physiologia Plantarum. 107(2):220-229.* English. [Agr & Agroalimentaire Canada,Ctr Rech 2560 Hochelaga St Foy PQ G1V 2J3 Canada].

Soluble carbohydrates,amino acids,and major inorganic ions were quantified and compared,vith the total osmolarity of the ovule,Most of the analyzed components increased rapidly in concentration,reaching a peak at 1 day post anthesis (DPA) and decreasing quickly 1 day later. Within this time period,the osmolarity decreased from 1.49 to 1.18 MPa,The osmolarity then increased to 1.39 MPa at 4 DPA,and yet the overall concentration of analyzed molecules decreased,At 1 DPA,inorganic ions were observed at levels that could produce a high osmolarity (1.11 MPa),followed by the carbohydrates (0.37 MPa) and amino acids (0.07 MPa),Maltose was detected in ovules only from 0 to 2 DPA,Inositol was abundant in the ovules on the day of anthesis,but decreased to non-detectable levels after 4 DPA,This suggested that ovules allow the rapid entry of solutes into the syncytial endosperm after fertilization,but are osmotically buffered through the increase and decrease of partly identified substances. Specific gravity tests on the liquid squeezed from young endosperm supported this new hypothesis,Osmolarity in ovules seems only indirectly related to morphogenetic regulation mechanisms,and it may play a lesser role than the fluctuations of certain specific substances,The observed chemical changes offer insights into the rapidly varying nutritional needs of proembryos. Thus,this research yielded a useful complex amino acid formula,derived from knowledge of the natural environment of the proembryo,and also an improved proembryo and ovule culture medium. [References: 40].

815 Marschner,P.; Gerendas,J.; Sattelmacher,B. (1999) **Effect of N concentration and N source on root colonization by Pseudomonas fluorescens 2-79RLI.** *Plant & Soil. 215(2):135-141.* English. [Inst Angew Bot Marseiller Str 7 D-20355 Hamburg Germany].

Wheat (Triticum aestivum L.) was grown in nutrient solution with low or high N supply (NH4NO3 as N source). To further evaluate the influence of N form and its interaction with the nutrient solution pH,wheat plants were grown with NH4+ or NO3- either in an conventional nutrient solution or in a nutrient solution in which the pH was maintained at pH 6.5 using a pH-stat system. The nutrient solution was inoculated with Pseudomonas fluorescens 2-79RLI,a genetically modified bacterium that contains lux genes activated by a ribosomal promoter. Cell numbers and physiological status of P. fluorescens 2-79RLI (length of the lag phase of bioluminescence) in the rhizosphere were determined at the root tip and in the lateral root zone. Nitrogen deficiency decreased both plant growth and root colonization by P. fluorescens 2-79RLI at the root tip while it had no effect on root colonization in the lateral root zone. The physiological status of P. fluorescens 2-79RLI was not affected by nitrogen deficiency. Ammonium nutrition increased root colonization by P. fluorescens 2-79RLI at the root tip and in the lateral root zone when the pH of the nutrient solution was allowed to change according to the N form provided. Under these conditions,the physiological status of P. fluorescens 2-79RLI was higher in the lateral root zone than at the root tip. In contrast,N source had no effect on root colonization or physiological status of P. fluorescens 2-79RLI in the nutrient solution maintained at pH 6.5. It is concluded that the stimulation of root colonization by NH4+ in the nutrient solution,not maintained at a constant pH,may be due to increased leakage of solutes into the rhizosphere as a result of impaired exudate retention by high H+ concentration in the rhizosphere or the apoplast. [References: 32].

816 Meng Songdong; Guan Guilan; Wang Weiping (Academia Sinica,Urumqi (China). Xinjiang Inst. of Biology,Pedology and Desert) (1998) **Effect of phytohormone produced by the rhizosphere microorganisms on wheat growth.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 34(6) p. 427-429.* 3 tables; 9 ref. Chinese. (AGRIS 2000-002205).

817 Nikus,J.; Jonsson,LMV. (1999) **Tissue localization of beta-glucosidase in rye,maize and wheat seedlings.** *Physiologia Plantarum. 107(4):373-378.* English. [Swedish Univ Agr Sci,Dept Plant Biol Box 7080 S-75007 Uppsala Sweden].

The localization of beta-glucosidase was determined at the tissue level in roots and shoots of rye,wheat and maize seedlings,using an immunohistochemical approach with antibodies directed against purified maize beta-glucosidase as the primary antibody. In the roots,the beta-glucosidase was found in the epidermis and the underlying cell layer. In the leaves,staining was seen in the epidermis (rye and wheat) and nearby vascular tissue (rye,wheat and maize). In all 3 species,beta-glucosidase activity was highest in the coleoptile. Here the enzyme was restricted to the epidermis in wheat and to cells near the vascular tissue in maize,but was found in the whole tissue,except the vascular tissue,in rye. Maize,wheat and rye all contain hydroxamic acid glucosides,and results are discussed in relation to a proposed role of beta-glucosidase as part of a defense system releasing hydroxamic acid aglucone upon herbivore attack,pathogen penetration or aphid infestation. [References: 14].

818 Orlov,PA.; Becker,D.; Shewe,G.; Lorz,H. (1999) **Cytoplasmic effects on pollen embryogenesis induction in wheat microspore culture.** *Cereal Research Communications. 27(4):357-363.* English. [NASB,Inst Cytol & Genet Akad Skaya Str 27 Minsk 220072 Byelarus].

Three alloplasmic wheat lines and the donor of nuclear genome have been tested for their ability for inducing pollen embryogenesis in microspore culture. Cultivation with an initial density of 2 x 10(5) microspores per ml in C17 medium conditioned by young anther-derived embryoids was used to induce microspore cell division and the subsequent plant regeneration. Microspore viability after pre-treatment and during cultivation,cytoplasm reorganisation,frequency of microcalli and embryoids,the number of regenerants have been studied. Cytoplasmic effects during the first stages of pollen embryogenesis in isolated microspore culture were detected. Alloplasmic line (turgidum) x M808 was the best genotype for all parameters studied. One way analysis of variance and determination of the genetic distance also exhibited cytoplasmic influence. It can be concluded that the cytoplasmic effects exist at early stages of pollen embryogenesis induction in wheat microspore culture and they should be taken into account in investigations involving pollen embryogenesis induction. [References: 23].

819 Paliwal,J.; Shashidhar,NS.; Jayas,DS. (1999) **Grain kernel identification using kernel signature.** *Transactions of the ASAE. 42(6):1921-1924.* English. [Univ Manitoba,Fac Agr & Food Sci 256 Agr Bldg Winnipeg MB R3T 2N2 Canada].

A machine vision algorithm was developed to distinguish the kernels of Canada Western Red Spring (CWRS) wheat,Canada Western Amber Durum (CWAD) wheat,barley,oats,and lye. The algorithm is based oil the assumption that the shape of any of these kernels can be described by a radial function using the properties of Fourier descriptors which are invariant to translation,rotation,and scale. To evaluate the discrimination capability of the algorithm,color images of 2000 kernels for each type of grain (200 each from ten growing regions across Canada) were taken. For each kernel,three attributes viz. length,shape function (Fourier descriptors in polar coordinates),and color were extracted which were collectively called the kernel signature. Each attribute was then averaged for each grain type to form a training set. To identify any unknown kernel,all the three attributes were calculated for it and were compared against the corresponding values for each grain type in the training set using three different distance functions one each for each attribute. Classification was done by assigning different weights to the attributes,shape being the most important and length being the least. Robustness of the algorithm was tested by taking the test kernels from growing regions alien to the draining set. Classification accuracies of 100,94,93,99,and 95% were obtained for CWRS wheat CWAD wheat barley,oats,and rye,respectively. [References: 14].

820 Ramos,C.; Molbak,L.; Molin,S. (2000) **Bacterial activity in the rhizosphere analyzed at the single-cell level by monitoring ribosome contents and synthesis rates.** *Applied & Environmental Microbiology. 66(2):801-809.* English. [Tech Univ Denmark,Dept Microbiol Bldg 301 DK-2800 Lyngby Denmark].

The growth activity of Pseudomonas putida cells colonizing the rhizosphere of barley seedlings was estimated at the single-cell level by monitoring ribosomal contents and synthesis rates. Ribosomal synthesis was monitored by using a system comprising a fusion of the ribosomal Escherichia coli rrnBP1 promoter to a gene encoding an unstable variant of the green fluorescent protein (Gfp). Gfp expression in a P. putida strain carrying this system inserted into the chromosome was strongly dependent on the growth phase and growth rate of the strain,and cells growing exponentially at rates of greater than or equal to 0.17 h-l emitted growth rate dependent green fluorescence detectable at the single-cell level. The single-cell ribosomal contents were very heterogeneous,as determined by quantitative hybridization with fluorescently labeled rRNA probes in P. putida cells extracted from the rhizosphere of 1-day-old barley seedlings grown under sterile conditions. After this,cells extracted from the root system had ribosomal contents similar to those found in starved cells. There was a significant decrease in the ribosomal content of P. putida cells when bacteria were introduced into nonsterile bulk or rhizosphere soil,and the Gfp monitoring system was not induced in cells extracted from either of the two soil systems. The monitoring system used permitted nondestructive in situ detection of fast-growing bacterial microcolonies on the sloughing root sheath cells of 1- and 2-day-old barley seedlings grown under sterile conditions,which demonstrated that it may be possible to use the unstable Gfp marker for studies of transient gene expression in plant-microbe systems. [References: 55].

821 Reynolds,TL. (2000) **Effects of calcium on embryogenic induction and the accumulation of abscisic acid,and an early cysteine-labeled metallothionein gene in androgenic microspores of Triticum aestivum.** *Plant Science. 150(2):201-207.* English. [Univ N Carolina,Dept Biol 9201 Univ City Blvd Charlotte,NC 28223 USA].

A cloned cDNA to the wheat (Triticum aestivum) early cysteine-labeled metallothionein (EcMt) has been identified as a molecular marker for pollen embryogenesis in this plant. This transcript is not detected in uninucleate microspores at the time of culture or in pollen at any stage during normal ontogeny; its mRNA does increase in embryogenic microspores within 6 h of culture,peaks at around 24 h,declines,then levels off through the next 21 days of development. Additionally,the accumulation of the embryoid-abundant EcMt gene transcript shows a direct and positive correlation with an increase in abscisic acid (ABA) in embryogenic microspores and developing pollen embryoids. External Ca2+ is required for in vitro pollen morphogenesis,since reduced Ca2+ concentrations in the medium suppressed EcMt transcript accumulation and the ability of microspores to form embryoids; however,endogenous ABA levels were unaffected my manipulating calcium concentrations in the medium. The calmodulin antagonist,W-7 also suppressed androgenesis and EcMt levels in treated microspores without altering ABA concentrations. These results suggest that ABA alone cannot maintain sporophytic differentiation of microspores and that Ca2+ may play a role in signal transduction during pollen androgenesis in bread wheat. (C) 2000 Elsevier Science Ireland Ltd. All rights reserved. [References: 27].

822 Singh,P.; Bhaglal,P.; Bhullar,S. (2000) **Wheat germ agglutinin (WGA) gene expression and ABA accumulation in the developing embryos of wheat (Triticum aestivum) in response to drought.** *Plant Growth Regulation. 30(2):145-150.* English. [Guru Nanak Dev Univ,Dept Biotechnol Amritsar 143005 Punjab India].

Expression of wheat germ agglutinin (WGA) gene in the developing embryos of wheat (Triticum aestivum L. cv. C-306) was studied in relation to abscisic acid (ABA) accumulation under water stress conditions. Imposition of water stress resulted in elevated ABA levels in the embryos at three developmental stages (18,24 and 30 DPA). On the contrary,the effect of drought stress on WGA accumulation was stage dependent with significant increase in WGA content being observed at only 24 DPA. Our results suggest that apart from ABA,other factors which are temporally expressed,are also involved in regulation of WGA gene expression. [References: 28].

823 Sivertsen,T.H. (Planteforsk Norsk Inst. for Planteforsking,Aas (Norway)); Nejedlik,P.; Oger,R.; Sigvald,R. (1999) **The phenology of crops and the development of pests and diseases. Literature,research,models and future operational integration. A report from a working group on phenology,pests and diseases on crops. COST 711.** *Rapport - Planteforsk (Norway); no. 1/99 87 p.* The Norwegian Crop Research Institute. tables,figures; ref. English. (AGRIS 2000-009882).

824 Sodkiewicz,W. (1999) **Sprouting resistance and Falling Number values in introgressive Triticale/T-monococcum lines.** *Biologia Plantarum. 42(4):533-539.* English. [Polish Acad Sci,Inst Plant Genet Strzeszynska 34 PL-60649 Poznan Poland].

The aim of this work was to evaluate how the Falling Number (FN) in introgressive triticale lines is influenced by introduced Triticum monococcum genes responsive for mature spikes sprouting resistance (SR). These lines were developed in two independent series (A and B) by incorporating of diploid wheat (T. monococcum) genes in two different strains of hexaploid triticale

(LT 176/10 and LT 522/6) using the synthetic allotetraploid T. monococcum /Secale cereale (A(m)A(m)RR) as a bridging form,In three consecutive vegetation seasons the mature spikes response to artificial wetting was tested to assess SR. FN was evaluated in full milling of seeds to characterize the level of starch-protein matrix damage in 57 introgressive triticale lines,The obtained results showed twofold higher coefficients of variation of the SR than FN. SR-FN correlation was generally significant in a B-series of lines and statistically insignificant in an A-series showing dependence on the triticale recipient parent and year,In opposite to SR,in both series there was not a line having FN comparable with that of diploid wheat parent,This demonstrates that genetic background of the FN is more complicated in relation to inheritance of SR. [References: 22].

825 van,Bergen,S.; Kottenhagen,MJ.; van,der,Meulen,RM.; Wang,M. (1999) **The role of abscisic acid in induction of androgenesis: A comparative study between Hordeum vulgare L- cvs. Igri and Digger.** *Journal of Plant Growth Regulation. 18(3):135-143.* English. [TNO,Dept Plant Biotechnol,Ctr Phytotechnol UL Wassenaarseweg 64 NL-2333 AL Leiden Netherlands].

Under the same mannitol pretreatment and culture conditions,regeneration efficiency in the barley cultivar. (cv.) Igri was about 10 times higher than in the cv. Digger,a difference only partially reflected by a difference,in viable microspores after anther pretreatment. Therefore,a comparative study between cvs. Igri and Digger was carried out under various pretreatment conditions. For both cultivars,under water,CPW buffer and mannitol pretreatment conditions,there was a positive correlation between microspore viability and regeneration efficiency in that mannitol > CPW buffer >> water. Mannitol pretreatment of cv. Igri produced a much higher endogenous abscisic acid (ABA) level than as to Digger. Addition of ABA stimulated both percentages of viability and regeneration efficiency except in the case of mannitol pretreatment. Under CPW buffer pretreatment conditions,addition of ABA significantly stimulated regeneration efficiency and was ABA concentration dependent. However,cv. Digger was less responsive to ABA than cv. Igri. In both cultivars,under less optimal pretreatment conditions (e.g.,water and CPW buffer),the effect of ABA was to stimulate increased percentages of viability and/or to reduce the number of binucleate microspores. Moreover,in cv. Igri,direct culture of anthers for 4 days without pretreatment caused an increased number of binucleate microspores compared with microspores with pretreatment for 4 days. These binucleate microspores showed DNA degradation in the nuclei. However,with mannitol pretreatment binucleate microspores and DNA fragmentation in the nuclei of microspores was rarely observed. On the basis of our observations,we suggest that the difference in regeneration efficiency:in cv. Igri and cv. Digger is related to the differences in endogenous ABA production levels under mannitol pretreatment and responsiveness to ABA. One of the effects of ABA is likely due to an inhibition of cell death. [References: 29].

826 Von,Well,E.; Fossey,A. (1999) **A comparison of NOR activity in seminal root tip cells of two polyploid wheat (Triticum) species.** *Seed Science & Technology. 27(2):645-655.* English. [Univ Pretoria,Dept Genet ZA-0002 Pretoria South Africa].

Nucleolar activity in root tips of the Triticum tetraploid,T. durum (AABB),and the hexaploid,T. aestivum (AABBDD),was compared for the first 24 hours of kernel imbibition as an indicator of cell metabolic activity. Nucleoli were silver impregnated and counterstained with Azure B. Nucleolar activity was evaluated by determining cell frequencies with different numbers of nucleoli,total number of nucleoli,average number of nucleoli per cell and average total nucleolar area per cell. Within two hours four nucleoli were visible in both species,with marked differences in the frequencies of the different nucleolated cells at first DNA replication and onset of mitosis. The activation of individual 1B and 6B NQR's were earlier in T. aestivum and after the first DNA replication cycle,the 5D NOR's were activated in a low number of cells. Significant statistical differences were noted for the number of nucleoli over the whole period ($P < 0.001$),as well as in the pattern of change in numbers over time between the species ($P < 0.001$). T. aestivum showed significantly larger average total nucleolar area per cell ($P < 0.001$),but followed a similar pattern of increase during the period ($P = 0.2041$). The differences in metabolic activity between the polyploids were reflected by the overall nucleolar activity. [References: 13].

827 Wuest,SB.; Albrecht,SL.; Skirvin,KW. (1999) **Vapor transport vs. seed-soil contact in wheat germination.** *Agronomy Journal. 91(5):783-787.* English. [USDA ARS,Columbia Plateau Conservat Res Ctr POB 370 Pendleton,OR 97801 USA].

The assumption that seed-soil contact is important for germination of seeds has influenced imbibition research and equipment design but has not been tested,This study compared germination with and without seed-soil contact. Over a temperature range from 3 to 28 degrees C,wheat (Triticum aestivum L.) seed was either provided with good seed-soil contact or separated from soil by fiberglass cloth,The germination system was sealed to prevent evaporation. At soil water potentials of -4.5 and -2.3 MPa,no seeds germinated in either treatment,When the soil water potential was -1.1 to -0.15 MPa,the average increase in germination time due to the absence of seed-soil contact was 0.3 d (5.6%). Days to germination ranged from 1.1 d at -0.15 MPa and 28 degrees C,to 18.3 d at -1.1 MPa and 3 degrees C. These results show that vapor transport may he the most important mechanism for imbibition and that liquid transport through seed-soil contact may make little contribution. Recognition of vapor transport as a sufficient,and perhaps dominant,mechanism for water transport between seed and soil should improve modeling efforts and planting equipment designs. [References: 16].

828 xu Xiangyang; Kang Minghui (Henan Academy of Agricultural Sciences,Zhengzhou (China). Inst. of Wheat) (1998) **A study on grain filling degree and grain filling models in winter wheat.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(4) p. 8-13.* 2 tables; 1 ill.,3 ref. Chinese. (AGRIS 2000-009956).

829 Zhang Zhimeng (Hebei Agrotechnical Teachers Coll.,Changli (China). Dept. of Agronomy) (1998) **Studies on the contributions of growing process,filling properties,storage capacity to grain weight for wheat in north China.** *Journal of Agricultural University of Hebei (China). Hebei Nongye Daxue Xuebao (China) v. 21(2) p. 22-27.* 5 tables; 1 ill.,11 ref. Chinese. (AGRIS 2000-009954).

## H10 PESTS OF PLANTS

830 Brar,D.S.; Singh,Rajwant; Mahal,M.S.; Brar,S.S. (Punjab Agricultural University,Ludhiana (India). Department of Entomology) (1996) **Effect of some cultural practices on the carryover of Scirpophaga incertulas (Walker) under rice-wheat rotation system in Punjab.** *Journal of Insect Science (India) v. 9(1) p. 52-54.* 1 table; 5 ref. English. (AGRIS 2000-002410).

831 Brzozowska,I.; Brzozowski,J.; Jastrzebska,M. (University of Agriculture and Technology,Olsztyn (Poland). Dept. of Soil and Plant Cultivation) (1997) **Effect of plant protection measures and plant protection-fertilization measures on the grain yields,content and the quality of protein in winter wheat grain.** *Fragmenta Agronomica (Poland) v. 14 p. 32-39.* 5 tables; 22 ref. Polish. (AGRIS 2000-010406).

The effect of pesticides application (Aminopielik D,Tilt 250 EC,Bayleton 25 WP) and their mixtures with urea and plant regulator Bercema CCC on the grain yields,content of total protein in wheat grain and their biological value were studied. The significant favourable effect of weeding with Aminopielik D and additional foliar nitrogen nutrition on wheat yields and no effect of fungicides and growth regulator have been found. The tendency towards increase of protein concentration in grain under the effect of fungicides application has been also found.

832 Eenpuu,R.; Luik,A. (1999) **Occurrence of carabids in differently cultivated barley fields [Estonian].** *TRANSACTIONS OF THE ESTONIAN AGRICULTURAL UNIVERSITY,VOL 205 : AGRONOMY. 205:13-17.* Estonian. [EAU,Dept Plant Protect 64 Kreutzwaldi St EE-51014 Tartu Estonia].

833 Gianoli,E. (1999) **Within-plant distribution of Rhopalosiphum padi on wheat seedlings is affected by induced responses.** *Entomologia Experimentalis et Applicata. 93(2):227-230.* English. [Univ Chile,Fac Ciencias,Dept Ciencias Ecol Casilla 653 Santiago Chile].

834 Glazek,M.; Mrowczynski,M. (Institute of Plant Protection,Poznan (Poland)) (1999) **Combined application of agrochemicals in modern cereal production technology. 3.** All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 119-126.* 7 tables; 1 ref. Polish. (AGRIS 2000-010407).

Several mixtures of agrochemicals were presented in the study,which based on the positive results of laboratory and greenhouse tests,were selected for field application. The efficacy of the mixture is not inferior to that of the component formulas applied separately; in some cases it was even found to be superior. No injury-related symptoms were observed. However,one should bear in mind that only well tested and proved combinations should be used. The analysis of the data and some other tests show high economic merits of combined application of agrochemicals.

835 Harvey,TL.; Seifers,DL.; Martin,TJ.; Brown-Guedira,G.; Gill,BS. (1999) **Survival of wheat curl mites on different sources of resistance in wheat.** *Crop Science. 39(6):1887-1889.* English. [KSY,Agr Res Ctr Hays,KS 67601 USA].

Wheat (Triticum aestivum L.) yield is limited by wheat streak mosaic virus which is vectored by the wheat curl mite (WCM) Aceria tosicheilla (Keifer). Host resistance to WCM has reduced losses. This study was conducted to evaluate the effectiveness of resistance in wheat to WCM collected from various locations in the Great Plains. Collections of WCM from Montana,Nebraska,South Dakota,Texas,Alberta,Canada,and eight locations in Kansas were compared for their ability to survive and reproduce in the greenhouse on seven lines of wheat and wheat relatives previously identified as resistant. The lines and their sources of resistance were: AC PGR16635 (Aegilops tauschii Coss.,Cmc1),PI525452 (Thinopyrum ponticum (Podp.) Liu and Wang,Cmc2),KS96WGRC40 (Ae. tauschii and Secale cereale L.),TA920 (Triticum timopheevii (Zhuk.) Zhuk spp. armenidcum),PI 475772 (S. cereale),TAM 107 (S. cereale),PI 222655 (T. aestivum). KS96WGRC40 and TA920 were the only entries that were resistant to all WCM collections. Other sources of resistance were effective against WCMs from some but not all locations. PI 222655 was resistant to WCMs from Nebraska and central Kansas but not to mites from most other locations. WCMs that were virulent to TAM 107 generally were also virulent to PIs 222655 and 475772 but avirulent to Cmc2. The WCMs from western Kansas,where TAM 107 is widely grown,were generally more virulent to that cultivar than WCM from central Kansas where the hectarage of TAM 107 is smaller. WCMs collected at different times or locations may vary in their responses to different sources of resistance; therefore,testing mites for their response to resistance genes advanced in breeding programs may be needed before resistant cultivars are deployed in the field. [References: 17].

836 Kindler,SD.; Jensen,KB.; Springer,TL. (1999) **Detection and characterization of mechanisms of resistance to Russian wheat aphid (Homoptera : Aphididae) in crested wheatgrass.** *Journal of Agricultural & Urban Entomology. 16(2):129-139.* English. [USDA,ARS,Plant Sci & Water Conservat Res Lab 1301 N Western St Stillwater,OK 74075 USA].

The Russian wheat aphid,Diuraphis noxia (Mordvilko),is an introduced pest that is an economic threat to wheat,Triticum aestivum L.,and barley,Hordeum vulgare L.,production. Crested wheatgrass,Agropyron cristatum (L.) Gaertner,is an important alternative summer host that provides a food source for Russian wheat aphid populations between spring harvest and fall planting of cereal crops. Greenhouse experiments were conducted to identify accessions of crested wheatgrass plant introductions (PI) resistant to Russian wheat aphids. Four accessions,PI 281862,297869,325180,and 439912,were highly resistant to leaf chlorosis and leaf rolling caused by aphid feeding. Further tests were done to characterize the plant components (antibiosis,antixenosis [nonpreference],and tolerance) contributing to resistance of these PI. Resistant PI had high levels of antibiosis,demonstrated by Russian wheat aphid's reduced rates of fecundity when compared with fecundity on susceptible genotypes. When infested with Russian wheat aphids,the resistant PI had reduced dry mass foliage loss compared with susceptible PI,but the losses were not significantly different among entries indicating no measurable tolerance. We detected strong antixenosis (nonpreference) resistance components in the resistant PI when D. noxia were given a choice of several genotypes. PI 281862,297869,325180,and 439912 may be new sources of resistance for germplasm enhancement efforts. [References: 28].

837 Michels,GJ.; Piccinni,G.; Rush,CM.; Fritts,DA. (1999) **Using infrared transducers to sense greenbug (Homoptera : Aphididae) infestations in winter wheat.** *Southwestern Entomologist. 24(4):269-279.* English. [Texas A&M Univ,Texas Agr Expt Stn 2301 Expt Stn Rd Bushland,TX 79012 USA].

Winter wheat was grown under four regimes (normally-watered,and not infested,normally-watered and infested,water-stressed but not infested,and infested and water stressed) to determine if infrared transducers (IRTs) could be used sense greenbug infestations and distinguish them from water stress. The IRTs were able to sense temperature differences among plants of the different treatments,and when the IRT data were converted to differences from ambient temperatures,significant differences were found among the treatments. When sampled at 0900 hours,plants undergoing water stress and infested with greenbugs were always significantly warmer ($p = 0.05$) than normally-watered,noninfested plants. Temperatures of plants either water stressed or infested by greenbugs were between these extremes and were not statistically distinguishable from each other. However,on several occasions,they could be distinguished from nonstressed plants and those stressed by both factors. Analysis of greenbug abundance and temperature differences between normally-watered and water-stressed plants resulted in two significantly-different regressions that were nearly parallel,indicating that,within natural parameters,there may be a constant ratio between damage by greenbug and water stress in wheal. In conclusion,IRTs were found not to be a tool that can be used alone to distinguish greenbug infestations in winter wheat. Unless certain water stress conditions are met (absence or uniform),there is no practical way to differentiate greenbug infestations from water stress in winter wheat. [References: 26].

838 Morrill,WL.; Kushnak,GD. (1999) **Planting date influence on the wheat stem sawfly (Hymenoptera : Cephidae) in spring wheat.** *Journal of Agricultural & Urban Entomology. 16(2):123-128.* English. [Montana State Univ,Dept Entomol Bozeman,MT 59717 USA].

Wasps of the wheat stem sawfly,Cephus cinctus Norton (Hymenoptera: Cephidae),lay eggs in wheat stems,and larval feeding causes lodging and lower yields. Late-planted spring wheat fields avoid attack if stem elongation begins after termination of the annual oviposition period. Moderate delays of 12-20 days in spring wheat planting trials in 7 years resulted in significantly lower infestation levels in 4 years,and complete avoidance of infestation in 3 years. However,delayed spring planting is known to make less efficient use of critical soil moisture,resulting in lower crop yields. Based on our data,safe planting dates for C. cinctus in spring wheat cannot currently he established because of annual variation in the duration of wasp flights,seasonal plant development,and amount of available moisture. We suggest that fields with a history of heavy infestations should be planted last in producers' production program. [References: 23].

839 Ridgway,C.; Chambers,J.; Portero-Larragueta,E.; Prosser,O. (1999) **Detection of mite infestation in wheat by electronic nose with transient flow sampling.** *Journal of the Science of Food & Agriculture. 79(15):2067-2074.* English. [Cent Sci Lab Sand Hutton York YO41 1LZ N Yorkshire England].

A total of 71 wheat samples of 70g each,to which were added 0-70 flour mites (Acarus siro L,),were scanned,1-2 weeks after preparation,by a conducting polymer-type electronic nose with transient flow sampling. The device uses an array of non-selective sensors to produce a digital fingerprint (odour profile) relating to the volatile composition of the sample. The results demonstrate the ability of the device to detect the mites in wheat at concentrations of relevance to the cereal trade,of the order of just 1000 A sirokg(-1) (around 0.001% by weight). One week from preparation,discrimination between samples with no added mites and samples with 70 added mites achieved a classification accuracy of over 83%. Evidence is presented which suggests the known mite-produced volatile undecane as the origin of the electronic nose response. (C) Crown copyright 1999. [References: 22].

840 Riedell,WE.; Blackmer,TM. (1999) **Leaf reflectance spectra of cereal aphid-damaged wheat.** *Crop Science. 39(6):1835-1840.* English. [USDA ARS,No Grain Inserts Res Lab Brookings,SD 57006 USA].

The efficiency of field monitoring for insect pests would be improved with knowledge of reflected solar radiation from crop canopies during insect outbreaks,The objectives of this greenhouse study were to characterize leaf reflectance spectra of wheat (Triricum aestivum L.) damaged by Russian wheat aphids (Diuraphis noxia Mordvilko) and greenbugs (Schizaphis graminum Rondani) and to determine those leaf reflectance wavelengths that were most responsive to crop stress imposed by these aphid pests. When the ligule was visible on second oldest leaf,wheat plants were infested with four wingless adult Russian wheat aphids,four wingless adult greenbugs,or left uninfested (four replicate plants per treatment). Plants and aphid populations were allowed to grow under greenhouse conditions for 3 wk,after which leaf-reflected radiation (from the adaxial surface across the 350-1075 nm range),dry weight,area,and chlorophyll concentrations were measured. When compared with the control,greenbug feeding damage caused general necrosis in oldest (first) leaves and dramatically lowered the dry weight,leaf area,and chlorophyll concentration of the second,third,and fourth leaves. Russian wheat aphid feeding resulted in a reduction in leaf dry weight and area in the third and fourth leaves,and a reduction in total chlorophyll concentration in all leaves. Leaf reflectance in the 625- to 635-nm and the 680- to 695-nm ranges,as well as the normalized total pigment to chlorophyll a ratio index (NPCI),were significantly correlated with total chlorophyll concentrations in both greenbug- and Russian wheat aphid-damaged plants. Thus,both of these wavelength ranges,as well as this reflectance index,were good indicators of chlorophyll loss and leaf senescence caused by the aphid feeding damage. [References: 35].

841 Tao Xun (Shandong Academy of Agricultural Sciences,Jinan (China). Inst. of Plant Protection) (1998) **Efficacy of Haizhengmiechongling (abamectin) on pest insects of vegetable,cotton and wheat.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 4) p. 25-26.* 4 tables. Chinese. (AGRIS 2000-010166).

842 Trdan,S.; Milevoj,L. (Ljubljana Univ. (Slovenia). Biotechnical Fac.,Agronomy Dept.) (1999) **The cereal aphid (Sitobion avenae F.) wheat pest.** *Sodobno kmetijstvo (Slovenia) v. 32(3) p. 119-128.* 2 ill.,101 ref. Slovenian. (AGRIS 2000-010358).

The cereal aphid (Sitobion avenae F.) is the dominant cereal aphid species in Slovenia and in many other countries. It can cause direct damage with sucking the fruits from leaves,stalks and ears or indirect damage with viruses transmissing and fungal disease spreading on honeydew. Directly it can reduce yield by 10 to 50% and indirectly by 20 to 80%. The most important causes for the increasing of Sitobion avenae F. meaning are weather conditions,agrotechnical measures (size of parcel,rotation of crops,nutrition,sowing,soil cultivation),presence (absence) of natural enemies and introducing of new cultivars. The meaning of the cereal aphid (Sitobion avenae F.) could become more important in the future although now we retain its numerous with insecticide use almost without problems. Integrated pest management become more and more important and the meaning of the natural enemies are invaluable now and will be invaluable in the future.

843 Urek,G. (Agricultural Inst. of Slovenia,Ljubljana (Slovenia)) (1999) **Population dynamics of Pratylenchus crenatus Loof,1960,in field soil and the influence of growth interruption of host plants on the relationship of the species P. crenatus in soil and roots.** *Sodobno kmetijstvo (Slovenia) v. 32(1) p. 2-7.* 6 tables; 4 ref. Slovenian. (AGRIS 2000-010342).

The population dynamics of Pratylenchus crenatus which was monitored in field soil in the years 1993 and 1994 was very different as it was very much reduced in the dry period and increased in the spring and autumn period of both studied years. Fast increase of the population density in soil during the year was also caused by particular agrotechnical measures which forced the immigration of P. crenatus from roots into soil. When the influence of growth interruption of host plants: Zea mays,Triticum vulgare,Polygonum persicaria,Stenactis annua was studied it was found out that their vigour or their decay influenced statistically significantly the population density of P. crenatus in roots or in soil.

844 Velozo,JA.; Alvarez,RI.; Wachter,GA.; Timmermann,BN.; Corcuera,LJ. (1999) **Increase in gramine content in barley infested by the aphid Schizaphis graminum R.** *Phytochemistry. 52(6):1059-1061.* English. [Concepcion Univ,Fac Ciencias Nat & Oceanog,Dept Bot Casilla 160 C Concepcion Chile].

The kinetics of accumulation of gramine were measured in three aphid infested and non-infested cultivars of barley (Hordeum vulgare; cvs. Frontera,Libra and Acuario). After 6 days of infestation gramine content increased 10-fold in the cvs. Libra and Acuario,while in the cv. Frontera it only doubled. The maximum level found in infested cv. Acuario was 50% of the level observed in non-infested plants of the cv. Frontera. Therefore,in the cvs. Libra and Acuario gramine content is mainly an inducible response,while it is mainly constitutive in the cv. Frontera. This increase in gramine may be of significance in resistance to aphids. (C) 1999 Elsevier Science Ltd. All rights reserved. [References: 15].

845 Winder,L.; Perry,JN.; Holland,JM. (1999) **The spatial and temporal distribution of the grain aphid Sitobion avenae in winter wheat.** *Entomologia Experimentalis et Applicata. 93(3):277-290.* English. [Univ Plymouth,Seale Hayne Fac Newton Abbot TQ12 6NQ Devon England].

The spatial and temporal distribution of the grain aphid Sitobion avenae F. (Homoptera: Aphididae) was studied within a field of winter wheat during the summer of 1996. Sampling was done using four nested grids comprising 133 locations. Analysis by Taylor's power law gave results typical for insect populations. Analysis by SADIE (Spatial Analysis by Distance Indices) showed spatial pattern due to edge effects and sampling scale,and positive but mild spatial association,although spatial patterns were ephemeral. Reasons for these findings and the implications for integrated crop management are discussed. [References: 36].

846 Xia Jingyuan (Chinese Academy of Agricultural Sciences,Anyang,Henan (China). Research Inst. of Cotton) (1998) **Anthropod community structures in different cotton cropping systems.** *Acta Gossypii Sinica (China). Mian Hua Xue Bao (China) v. 10(1) p. 26-32.* 4 tables; 12 ref. Chinese. (AGRIS 2000-010157).

847 [Some elements on fungicides on wheat] (1998) Institut Technique des Cereales et des Fourrages,Paris (France). *Semences et Progres (France) (no 97) p. 212-213.* French. (AGRIS 2000-002746).

848 Baker,SJ.; Newton,AC.; Gurr,SJ. (2000) **Cellular characteristics of temporary partial breakdown of mlo-resistance in barley to powdery mildew.** *Physiological & Molecular Plant Pathology. 56(1):1-11.* English. [Univ Oxford,Dept Plant Sci S Parks Rd Oxford OX1 3RB England].

When water-stress is relieved,powdery mildew (Erysiphe graminis f.sp. hordei) infection increases on both Mlo-susceptible and mlo-resistant spring barley cultivars. The breakdown is temporary and is determined by the genetic background rather than the specific resistance allele. The relief of water-stress time-point for maximum mildew infection frequency on mlo-resistant barley is approximately 7 h post-inoculation. The degree of breakdown varies with epidermal cell type; increased infection frequency is greatest on short followed by long and adjacent epidermal cell types,rather than on the stomatal subsidiary cells with which occasional colonies are typically associated. Infection frequency on the short cells of mlo-resistant cv. Aem increases from less than 1 %,under a non-stressed Watering regime to more than 10 % after a relief of water-stress at 7 h post-inoculation. Following haustorium formation,colonies develop and reach sporulation within 7 days post-inoculation. In host epidermal cells,the extent of cross-linked protein at interaction sites is reduced under conditions of water-stress or stress-relief Cross-linked protein is reduced in terms of the frequency of occurrence at primary germ tube interaction sites 7 h post-inoculation and the deposition size at appressorial germ tube interaction sites 24 h post-inoculation. This indicates a delayed or reduced defence response during the recovery period. These data demonstrate a differential cellular response to powdery mildew in barley genotypes prone to resistance expression breakdown following relief of water-stress. (C) 2000 Academic Press. [References: 31].

849 Balmas,V.; Santori,A.; Corazza,L. (Istituto Sperimentale per la Patologia Vegetale,Rome (Italy)) (1998) **[The snow mould of hard wheat ear [Triticum durum Desf. - fungal diseases - Italy]].** *Informatore Agrario (Italy) v. 54(36) p. 53-55.* 3 tables. Italian. (AGRIS 2000-002755).

850 Bateman,GL.; Hornby,D. (1999) **Comparison of natural and artificial epidemics of take-all in sequences of winter wheat crops.** *Annals of Applied Biology. 135(3):555-571.* English. [AFRC,Inst Arable Crops Res Harpenden AL5 2JQ Herts England].

Winter wheat was grown for six successive years (Expt 1) and for three successive years (Expt 2) in field experiments on different soil types. Artificial inoculum of the take-all fungus (Gaeumannomyces graminis var. tritici cultured on autoclaved oat grains) was incorporated in the soil of some of the plots just before,or at,sowing of the first winter wheat crop. Expt I tested the incorporation of similar amounts of inoculum (212 kg ha(-1)) at different depths. Expt 2 tested different amounts of inoculum at the same,shallow depth. Early sowing (September),late sowing (October) and spring inoculation were additional treatments,applied to the first crop only,in Expt 2. Seasonal factors apart,the disease outcome in the first year after inoculation depended an amounts and placement of applied inoculum,as well as date of sowing. Deeper inoculum resulted in less disease (Expt I). Severe take-all was produced in Expt 2 by incorporating inoculum shallowly in sufficient quantities (400 kg ha(-1) or more). Less inoculum (200 kg ha(-1)) generated less disease,especially in earlier-sown plots. Differences in disease amongst inoculum treatments were greatest in the first year and diminished subsequently,particularly where sowing had been early in the first year. In Expt I,where first crops exposed to artificial inoculum developed moderate-to-severe disease,disease in subsequent second and/or third crops was less. In the fourth crop a second peak of disease occurred,coinciding with a first peak in sequences without added inoculum. Take-all decline (TAD) appeared to be expressed in all sequences thereafter. In Expt 2 in sequences without added inoculum,TAD occurred after a peak of disease in the second crop. Where 400 kg ha(-1) or more of inoculum were added,disease was severe in the first year and decreased progressively in successive years. Disease was less patchy in plots that received artificial inoculum. However,it remains uncertain that severe disease caused by artificial inoculation achieved an early onset of true TAD. The infectivity of the top 12 cm of soil in the first 3 yr of Expt 1,determined by bioassay,depended on the depth of added inoculum and amount of disease in subsequent crops. However,at the time of the naturally occurring peak of disease severity (in either inoculated or non-inoculated plots) it did not predict either disease or TAD. Differences and similarities amongst epidemics developing naturally and those developing from different amounts and placement of applied inoculum have been revealed. The epidemiological implications of adding inoculum and the potential value of artificially-created epidemics of take-all in field trials are discussed. [References: 29].

851 Bateman,GL.; Kwasna,H. (1999) **Effects of number of winter wheat crops grown successively on fungal communities on wheat roots.** *Applied Soil Ecology. 13(3):271-282.* English. [IACR Rothamsted Harpenden AL5 2JQ Herts England].

Roots were taken from winter wheat plants sampled in early summer in each of three years. In each year,first,third and continuous (ninth or subsequent) wheat crops were grown on the same site so that epidemics of take-all disease (causal fungus: Gaeumannomyces graminis var. tritici) were in,respectively,pre-build-up,build-up and decline stages. Fungi on pieces from the upper parts of the roots,serially washed 20 times,were identified by growing onto agar media and allowing them to sporulate. Approximately 107 species of 50 genera were identified,including some that were previously unrecorded in Britain or on wheat. There was usually a trend (with statistically significant differences only in one year) for more fungal isolations per root piece with increasing number of successive wheat crops. Changes in populations of several fungi were associated with number of wheat crops in one or more years but only Fusarium culmorum increased with increased number of crops in all years. While individual fungi or the fungal community may be involved in take-all suppression or enhancement,then were no clear relationships between either total numbers of fungal species or abundance of individual species and the stage of the take-all epidemic. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 37].

852 Benhamou,N.; Nicole,M. (1999) **Cell biology of plant immunization against microbial infection: The potential of induced resistance in controlling plant diseases [Review].** *Plant Physiology & Biochemistry. 37(10):703-719.* English. [Univ Laval Pavillon Charles Eugene Marchand St Foy PQ G1K 7P4 Canada].

During the course of their co-evolution,plants and pathogens have evolved an intricate relationship resulting from a continuous exchange of molecular information. Pathogens have developed an array of offensive strategies to parasitize plants and,in rum,plants have deployed a wide range of defence mechanisms similar in some respects to the immune defences produced in animals. The recent advances in molecular biology and plant transformation have provided evidence that sensitizing a plant to respond more rapidly to infection could confer increased protection against virulent pathogens. One important facet in ascertaining the significance of defence molecules in plant disease resistance is the exact knowledge of their spatio-temporal distribution in stressed plant: tissues. In an effort to understand the process associated with the induction of plant disease resistance,the effect of microbial and chemical elicitors on the plant cell response during attack by fungal pathogens was investigated and the mechanisms underlying the expression of resistance to bacteria and nematodes studied by both histo- and cytochemistry. Evidence is provided that the disease-resistance response correlates with changes in cell biochemistry and physiology that are accompanied by structural modifications including the formation of callose-enriched wall

appositions and the infiltration of phenolic compounds at sites of potential pathogen penetration. Activation of the phenylpropanoid pathway is a crucial phenomenon involved in pathogen growth restriction and host cell survival under stress conditions. Ultrastructural and cytochemical approaches have the potential to significantly improve our knowledge of how plants defend themselves and how plant disease resistance is expressed at the cell level. (C) 1999 Editions scientifiques et medicales Elsevier SAS. [References: 69].

853 Bertelsen,J.R. (1999) **Effect of Azoxystrobin on filamentous fungal leaf saprophytes,senescence and yield of winter wheat [including 2 papers].** Kongelige Veterinaer- og Landbohoejskole,Copenhagen (Denmark). KVL. 4 ill.,161 ref. 82 p. English. (AGRIS 2000-010681).

854 Bodson,B.; Falisse,A. (Faculte universitaire des sciences agronomiques de Gembloux (Belgium). Unite de phytotechnie des regions temperees); Meeus,P. (1998) **Interest and timing of a fungicide application before caring in winter wheat in the cropping conditions of Belgium.** 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3b) p. 1033-1039.* 3 ref. French. (AGRIS 2000-002750).

855 Borgen,A. (The Royal Veterinary and Agricultural Univ.,Taastrup (Denmark). Agroecology) (1998) **Abstract on resistance in wheat against common bunt (Tilletia tritici).** 16. Nordic Postgraduate Course in Plant Pathology. Biri (Norway). 18-25 Apr 1998. *Resistance to plant pathogens. The 16th Nordic postgraduate course in plant pathology,Honne Konferansesenter,Biri,Norway,18-25 April 1998. Programme and abstracts. Tronsmo,A.M.; Ergon,Aa. (Eds.) vp. p. 33.* Nordic Veterinary and Agricultural University,NOVA. 10 ref. English. (AGRIS 2000-010676).

856 Carmona,MA.; Barreto,DE.; Reis,EM. (1999) **Detection,transmission and control of Drechslera teres in barley seed.** *Seed Science & Technology. 27(2):761-769.* English. [Univ Buenos Aires,Fac Agron Av San Martin 4453 RA-1417 Buenos Aires DF Argentina].

The objectives of the present work were to compare methods to detect Drechslera teres (Sacc.) Shoem. in barley seed,to analyze the potential role of seed borne D. teres as primary inoculum for net blotch epidemics,and to evaluate fungicide seed treatments. Results from the two types of assays used to detect D. teres,deep freezing (Jorgensen,1983) and selective medium for Cochliobolus sativus (Ito et Kurib.) (Reis 1983),differed significantly. In all cases,the selective medium was more sensitive and revealed a higher incidence of seed infection. Symptom and symptomless transmission of D. teres from seeds to plumules and coleoptiles of barley were quantified in experiments carried out under greenhouse conditions. The pathogen was detected in symptomless seedling coleoptile tips beginning at 7 days after sowing and reaching the maximum infection incidence on the fourth week. Number of conidia of D. teres on coleoptile tips was zero during the first and second weeks after sowing but it increased later to 1094 conidia/100 coleoptiles at the fifth week. Transmission efficiency of D. teres from seed to coleoptile tips in symptomless seedlings was 21.7%. Passsage of the pathogen,based on symptoms to plumule was 9%. The seed treatment studies indicated that the fungicides used in Argentina such as thiram,tebuconazole and flutriafol,were less effective against D. teres than iminoctadine,guazatine + triticonazole,iprodione + triticonazole,and iprodione + thiram. [References: 14].

857 Chaure,P.; Gurr,SJ.; Spanu,P. (2000) **Stable transformation of Erysiphe graminis,an obligate biotrophic pathogen of barley.** *Nature Biotechnology. 18(2):205-207.* English. [Univ London Imperial Coll Sci Technol & Med,Dept Biol Imperial Coll Rd London SW7 2AZ England].

Barley powdery mildew,Erysiphe graminis f.sp. hordei,is an obligate biotrophic pathogen and as such cannot complete its life cycle without a living host. The inability to transform this fungus and manipulate its genome has constrained research towards understanding its life cycle and pathogenicity. Here we describe an in planta transformation system based on delivery of DNA using a gold-particle gun and selection using benomyl or bialaphos. Using this method,we consistently obtained stable transformants with efficiencies comparable to other filamentous fungi. Stable expression of the beta-glucuronidase in E. graminis was demonstrated by cc-transforming the uidA gene with the selectable markers. [References: 16].

858 Choi,IR.; French,R.; Hein,GL.; Stenger,DC. (1999) **Fully biologically active in vitro transcripts of the eriophyid mite-transmitted wheat streak mosaic tritimovirus.** *Phytopathology. 89(12):1182-1185.* English. [Univ Nebraska,USDA ARS Lincoln,NE 68583 USA].

Infectious RNA of wheat streak mosaic virus (WSMV) has been produced using a full-length cDNA clone as a template for in vitro transcription with SP6 RNA polymerase. Infectivity was dependent on the use of template plasmid DNA that had not undergone spontaneous rearrangement during amplification in Escherichia coli. The presence of WSMV in systemically infected wheat plants inoculated with in vitro transcripts was confirmed by reverse-transcription polymerase chain reaction of the WSMV P3 gene and by accumulation of WSMV coat protein as detected by immunoblotting. Maintenance of the full-length WSMV cDNA in the high copy number plasmid pUC18 was problematic because of spontaneous rearrangement of WSMV sequences during growth in liquid media for more than similar to 8 h or if the clone was subcultured. Stability of the WSMV cDNA clone was improved by the use of the low copy number plasmid pACYC177,and it could be grown in large scale volumes (up to I liter) of liquid culture for similar to 14 h without noticeable rearrangements. Both the original WSMV culture and the progeny virus derived from infectious in vitro transcripts were efficiently transmitted by the natural eriophyid mite vector Aceria tosichella. This is the first report of infectious in vitro transcripts for any eriophyid mite-transmitted plant virus and represents the only monopartite member of the family Potyviridae infecting monocotyledonous hosts for which infectious in vitro transcripts are available. [References: 15].

859 Clarke,J.L. (The Norwegian Crop Research Inst.,Aas (Norway)) (1998) **Expression of fungal chitinase genes in wheat for bette protection of the crop against plant pathogenic fungi.** 16. Nordic Postgraduate Course in Plant Pathology. Biri (Norway). 18-25 Apr 1998. *Resistance to plant pathogens. The 16th Nordic postgraduate course in plant pathology,Honne Konferansesenter,Biri,Norway,18-25 April 1998. Programme and abstracts. Tronsmo,A.M.; Ergon,Aa. (Eds.) vp. p. 34.* Nordic Veterinary and Agricultural University,NOVA. 4 ref. English. (AGRIS 2000-010677).

860 Commandeur,U.; Huth,W. (1999) **Differentiation of strains of wheat dwarf virus in infected wheat and barley plants by means of polymerase chain reaction.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 106(5):550-552.* English. [Rhein Westfal TH Aachen,Inst Biol D-52074 Aachen Germany].

A method is described which enabled the differentiation of both hitherto known strains of wheat dwarf virus by PCR using universal and strain-specific primers. [References: 7].

861 De,Wolf,ED.; Francl,LJ. (2000) **Neural network classification of tan spot and Stagonospora blotch infection periods in a wheat field environment.** *Phytopathology. 90(2):108-113.* English. [Ohio State Univ,Dept Plant Pathol Wooster,OH 44691 USA].

Tan spot and Stagonospora blotch of hard red spring wheat served as a model system for evaluating disease forecasts by artificial neural networks. Pathogen infection periods on susceptible wheat plants were measured in the field from 1993 to

1998,and incidence data were merged with 24-h summaries of accumulated growing degree days,temperature,relative humidity,precipitation,and leaf wetness duration. The resulting data set of 202 discrete periods was randomly assigned to 10 model-development or -validation (n = 50) data sets. Backpropagation neural networks,general regression neural networks,logistic regression,and parametric and nonparametric methods of discriminant analysis were chosen for comparison. Mean validation classification of tan spot incidence was between 71% for logistic regression and 76% for backpropagation models. No significant difference was found between methods of modeling tan spot infection periods. Mean validation prediction accuracy of Stagonospora blotch incidence was 86 and 81% for backpropagation and logistic regression,respectively. Prediction accuracies of other modeling methods were less than or equal to 78% and were significantly different (P = 0.01) from backpropagation,but not logistic regression,results. The best back-propagation models of tan spot and Stagonospora blotch incidences correctly classified 82 and 84% of validation cases,respectively. High classification accuracy and consistently good performance demonstrate the applicability of neural network technology to plant disease forecasting. [References: 24].

862 Derycke,V.; Haesaert,G.; Latre,J. (Hogeschool Gent (Belgium). Dept. of Biotechnology,Landscape Architecture and Agriculture); Reekmans,S.; Auda,M.; Hartmann,F. (1998) **Effect of adjuvants on the activity of fungicides in winter wheat under field conditions.** 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3b) p. 1041-1045.* 6 ill.,5 ref. English. (AGRIS 2000-002751).

863 Dill-Macky,R.; Jones,RK. (2000) **The effect of previous crop residues and tillage on Fusarium head blight of wheat.** *Plant Disease. 84(1):71-76.* English. [Univ Minnesota,Dept Plant Pathol St Paul,MN 55108 USA].

Effects of previous crop residues and tillage practices on Fusarium head blight (FHB) of wheat were examined. Fusarium head blight was monitored in plots of the FHB-susceptible spring wheat cultivar Norm following crops of corn,wheat,and soybeans in 1995,1996,and 1997. Moldboard plow,chisel plow,and no-till treatments were imposed perpendicular to crop strips to establish a range of residue levels in each of the previous crop residues. Fusarium head blight incidence and severity were greatest when wheat followed corn and least when wheat followed soybeans. Incidence and severity were lower in moldboard plowed plots than in either chisel plowed or no-till plots,although differences among chisel plow and no-till treatments were not apparent. Yields of wheat were approximately 15% lower in plots where wheat followed corn or wheat than in wheat following soybeans and were 10% greater in moldboard plowed plots than in either chisel plowed or no-till treatments. The deoxynivalenol (DON) content of harvested grain was significantly correlated with FHB incidence and severity. The DON level in wheat following soybeans,averaged across tillage treatments,was 25% lower than in wheat following wheat and 50% of the level in wheat following corn. These findings suggest that changes in regional tillage practices,principally the move toward conservation tillage and reduced-till systems,contributed to the recent FHB epidemics in the Upper Midwest. Because differences in the type and quantity of crop residues in small plots affected disease development,it is likely that local sources of inoculum,such as those within a grower's field,contribute directly to the inoculum load and disease potential. The implication of these findings is that selection of cultural practices aimed to reduce inoculum-borne residues will assist in the control of FHB. [References: 36].

864 Dill-Macky,R.; Roelfs,AP. (2000) **The effect of stand density on the development off Puccinia graminis f. sp tritici in barley.** *Plant Disease. 84(1):29-34.* English. [Univ Minnesota,Dept Plant Pathol St Paul,MN 55108 USA].

The progress of stem rust epidemics caused by race Pgt-QCCJ of Puccinia graminis f. sp. tritici was examined in field plots of the six-rowed barley cvs. Robust and Steptoe at four stand densities,and in short rows and hill plots. Cv. Robust carries Rpg1,which confers resistance to most races of P. graminis f. sp. tritici,other than Pgt-QCCJ,while cv. Steptoe lacks any reported genes for resistance to P. graminis f. sp. tritici. The stand-density treatments established were approximately double,the equivalent of,half of,and one quarter of the planting rate recommended for commercial barley. Stem rust caused by race Pgt-QCCJ spread more rapidly in cv. Steptoe than in cv. Robust,irrespective of the stand-density treatment. The effect of stand density on rust severity was,however,greater than the effect of cultivar. Rust severity was 18 to 36% greater in sparse stands than in dense stands of both cultivars. Reductions in kernel size were most severe in sparse stands where rust development was greatest. Knowledge that reduced stand densities may promote the development of stem rust in barley may be useful in refining procedures for screening breeding material for resistance to stem rust,and in allaying concern over the high levels of stem rust occasionally reported in lightly seeded seed increases and in commercial fields where sparse stands are encountered. [References: 27].

865 Dobrev,D.; Kolev,K. (Institut po Introduktsya i Rastitelni Resursi "K. Malkov",Sadovo (Bulgaria)) (1998) **Resistance of introduced Triticum durum Desf. and Triticum sphaerococcum Perc. varieties to some Fusarium genus strains.** Selskostopanska Akademiya,Sofia (Bulgaria). *Rasteniev"dni Nauki (Bulgaria). Plant Science v. 35(10) p. 898-900.* 2 tables; 9 ref. Bulgarian. (AGRIS 2000-002757).

866 El Ghamry,M.A. (Ministry of Agriculture,Cairo (Egypt). Plant Pathology Research Inst.) (1997) **Effectiveness of Pagenes on partial resistance to barley leaf rust at adult stage.** *Egyptian Journal of Agricultural Research (Egypt) v. 75(4) p. 869-881.* 4 tables; 23 ref. English. (AGRIS 2000-002610).

867 Faccini,N.; Alberici,R.; Pecchioni,N.; Delogu,G. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)); Caciagli,P. (Consiglio Nazionale delle Ricerche,Turin (Italy). Istituto di Fitovirologia Applicata); Gotta,P. (Regione Piemonte,Turin (Italy). Settore Fitosanitario) (1998) **[The distribution of barley viroses in Lombardy and Piedmont [Hordeum vulgare L.]].** *Informatore Agrario (Italy) v. 54(39) p. 65-69.* 3 tables; 3 graphs. Italian. (AGRIS 2000-002613).

868 Finckh,MR.; Gacek,ES.; Czembor,HJ.; Wolfe,MS. (1999) **Host frequency and density effects on powdery mildew and yield in mixtures of barley cultivars.** *Plant Pathology. 48(6):807-816.* English. [Univ Kassel,Dept Ecol Plant Protect,FB 11 Nordbahnhofstr 1A D-37213 Witzenhausen Germany].

The effects of frequency and density of susceptible plants on barley powdery mildew epidemics were studied in a combined set of addition and replacement series of field trials. In the addition series,plant densities in pure stands of three cultivars,Rambo,Rodos and Grosso (susceptible,moderately resistant and immune,respectively) were varied six-fold. In the replacement series,the three possible two-way mixtures were analysed at different frequencies but at a density corresponding to the maximum pure stand density. Disease and yield were assessed on a per-plant basis. In the pure stands,tillering reduced the range of densities from six-fold to between three- and four-fold,while in the mixtures,frequencies changed only slightly over time,indicating that competitive interactions among the cultivars were roughly equal. Yield per plant decreased logarithmically with increasing density as expected. However,yield per seed head was not correlated with the final number of heads per plot,indicating low competition among heads even at the highest density. Disease in susceptible pure stands increased strongly with decreasing density in 1994 and to a lesser degree in 1995. These differences could have been caused by differences in plant nutritional status and consequent epidemiological effects. Disease reduction on the susceptible cultivars in mixtures varied between 33% and 71% among years. Depending on the length and strength of the

epidemic,the effects of host density and frequency on disease severity varied substantially among years. [References: 46].

869 Golinski,P.; Kiecana,I.; Kaczmarek,Z.; Kostecki,M.; Kaptur,P.; Wisniewska,H.; Chelkowski,J. (1999) **Scab response of selected winter wheat cultivars after inoculation with Fusarium avenaceum (Fr.) Sacc.** *Journal of Phytopathology-Phytopathologische Zeitschrift. 147(11-12):717-723.* English. [August Cieszkowski Agr Univ,Dept Chem Ul Wojska Polskiego 75 PL-60625 Poznan Poland].

Inoculation experiments with 10 winter wheat cultivars were performed in two different regions of Poland,which have different climates,located at Cerekwica (Central-west) and Sitaniec (South-east part of Poland),in the seasons of 1995 and 1996,and Fusarium avenaceum isolate KF 203 (ATCC 64451) (producing moniliformin) was used in inoculation of winter wheat heads. The percentage of scabby kernels was changeable during the experiment,although no interaction environment x cultivar was observed. Yield traits confirm that the climatic conditions in Sitaniec are favourable for higher scab incidence,and indicate that cultivar Aleta was (at both locations) the most resistant to the disease. Reduction of all yield traits for all the cultivars,at two locations,during two vegetative seasons,indicates that cvs Aleta,Almari and Begra were of the lowest susceptibility to scab,whereas Rosa and Parada were the most susceptible to the disease. Accumulation of moniliformin in kernels on average in Sitaniec was 2.28 mu g/g during 1995 and 0.41 mu g/g in 1996,and in Cerekwica it was 2.12 and 1.77 mu g/g in 1995 and 1996,respectively. The results of chemical analysis confirm low susceptibility of cultivar Aleta to scab. [References: 33].

870 Henriksen,B. (Norwegian Crop Research Inst.,Dept. of Plant Pathology,Aas (Norway)) (1999) **Factors affecting Fusarium infection and mycotoxin content in cereal grains.** Norges Landbrukshoegskole,Aas (Norway). *Agricultural University of Norway. Doctor Scientiarum Theses (Norway); no. 1999:4 vp.* Norges Landbrukshoegskole,NLH. tables,figures; ref. 4 papers are incl. in the thesis. English. (AGRIS 2000-010678).

871 Khan,M.A. (University of Agriculture,Faisalabad (Pakistan). Dept. of Plant Pathology); Trevathan,L.E. (1998) **A decision-support model based on agro-environmental data for the economic chemotherapy of leaf rust on winter wheat in Mississippi.** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 295-298.* 1 ill.,1 table,21 ref. English. (AGRIS 2000-002748).

Environmental data recorded by a weather station installed in experimental wheat plots established during 1991-93 were used to develop leaf rust predictive model for economic fungicide application. Natural inoculum was relied upon for infection. Five fungicides were evaluated on five varieties during the spring of 1992 and 1993 in 15 treatments based on mode of active ingredient,crop growth stage (GS),initial appearance of leaf rust symptoms and environmental conditions. Fungicide treatments suppressing disease severity and enhancing the yield of rust tolerant varieties were subjected to economical analysis. Weekly maximum air temperature (23 degree centigrade),minimum air temperature (12 degree centigrade),and average air temperature (17 degree centigrade),soil temperature (29 degree centigrade),rainfall (0.88 cm),relative humidity (86 percent),wind movement (12 km/h),solar radiation (26 mj/m raise to the power is 2) and dew point (17 degree centigrade) resulted in greater leaf rust severity at Starkville,in 1992. Weekly maximum air temperature (25 degree centigrade),minimum air temperature (22 degree centigrade),and average air temperature (21 degree centigrade),soil temperature (27 degree centigrade),rainfall (3.77 cm),relative humidity (90 percent),wind movement (28 km/h) solar radiation (19 mj/m) and dew point (16 degree centigrade) resulted in lower leaf rust development in 1993. Application of flusilazole alone,or flusilazole or propiconazole at GS-9 followed by mancozeb at GS-10.5 was recommended for maximizing profitable yield from Coker 9323 and Pioneer 2555.

872 Klechkovaskaya,EA. (1999) **Ecological and biochemical characteristics of Fusarium spp. on winter wheat in Prichernomorskaya steppe in Ukraine.** *Mikologiya i Fitopatologiya. 33(4):280-289.* Russian. [Ukrainian Acad Sci,Select Genet Inst Odessa Ukraine].

Fusarium spp. population is not homogeneous in the south-west of Ukraine. Fungi with high pathogenicity account for 20 % of population. Pathogenic strains of Fusarium spp,mainly possess a high level of xylanase activity. Hydrolases activity of each Fusarium strains separately was significantly higher,than common enzymes activity of the mixture of these strains. Analysis of the biochemical reactions of the plants,infected by obligate and facultative pathogens,gives us possibility to suppose,that resistance is the most benefit plants reaction an the obligate pathogens infection. The most beneficial reaction on the facultative pathogens infection is susceptibility. Therefore,the set of different facultative pathogens would be dominant in the stable agrocenosis,balanced out by macro- and microflora relationships. [References: 11].

873 Klechkovskaya,EA. (1999) **Wheat resistance to different of Fusarium species.** *Mikologiya i Fitopatologiya. 33(5):360-367.* English. [Plant Breeding & Genet Inst Odessa Ukraine].

Among the difficulties in creation and selection of wheat plants which are Fusarium resistant,one should mention the fact,that Fusarium spp. association is rich in species and strains which can affect plants in many different ways. The following question is of a great importance: to what extent do the same wheat genotypes differ from each other in their response to infection by different species and strains of these fungi? Is there a general resistance of plants to the disease,caused by so a great number of causative agents? The overhelming majority of studies of the interrelations between wheat and fusaria,as a general rule,are focused on the effect of a pathogenic strain of a singular species upon a set of investigated varieties. The exceptions to the rule,as to our knowledge,are the early papers by FV. Feekes et al,(1967) and M. Mladenov et al. (1983). The former paper deals with the sources of resistance to F. graminearum and F. culmorum,the latter report on the resistance to the pathogenic monospore isolates of F. graminearum,F. culmorum,F. moniliforme and F. poae. In the present paper we tried to estimate the response of different wheat lines and varietes to the effect of the Fusarium spp. strains,distributed in the South-West of Ukraine and ranged from low to high pathogenicity to wheats. [References: 9].

874 Kolev,K.; Dobrev,D. (Institut po Introduktsiya i Rastitelni Resursi "K. Malkov",Sadovo (Bulgaria)) (1998) **Response of introduced soft wheat varieties toward three Fusarium strains causing fusariose of the ear.** Selskostopanska Akademiya,Sofia (Bulgaria). *Rastenievʺdni Nauki (Bulgaria). Plant Science v. 35(10) p. 895-897.* 2 tables; 8 ref. Bulgarian. (AGRIS 2000-002752).

875 Lee,HK.; Tewari,JP.; Turkington,TK. (1999) **Histopathology and isolation of Rhynchosporium secalis from infected barley seed.** *Seed Science & Technology. 27(2):477-482.* English. [Univ Alberta,Dept Agr Food & Nutr Sci Edmonton AB T6G 2P5 Canada].

Rhynchosporium secalis-infected barley seeds collected during 1996 and 1997 were examined. The scald symptoms were distributed over the lemmas,paleas,awns,glumes and rachises,but were more common on glumes and awns. Fungal growth consisting of hyphae and spores was mostly present on the inner surfaces of lemmas,paleas and glumes in masses surrounded by what appeared to be mucilaginous material. Hyphae and spores along with mucilaginous material were also observed on the outer surfaces of the awns and rachises. Lemmas and paleas with lesions were incubated for various periods in sterile distilled water amended with streptomycin and the scald pathogen was successfully isolated using a streaking method. By this method,number of seeds,lemmas and paleas from which gave rise to scald fungus colonies,did not vary much for different incubation periods. However,as the incubation time was increased,contaminants often overwhelmed the scald colonies.

Therefore,either no incubation or an incubation period of 12 hr was suitable for isolating the scald fungus using the streaking method. This appears to be the first report on successful isolation of the scald fungus from infected barley seed. [References: 7].

876 Lennartz,B.; Schoene,P.; Oerke,E.C. (University of Bonn (Germany). Inst. for Plant Diseases) (1998) **Biocontrol of Botrytis cinerea on grapevine and Septoria spp. on wheat.** 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3b) p. 963-970.* 5 ill.,2 tables,14 ref. English. (AGRIS 2000-002775).

877 Li Lanzhen; Zhao Huijie; Yang Huiwu (Henan Agricultural Univ.,Zhengzhou (China). Coll. of Agronomy) (1999) **The relationship between wheat rust and metabolism of active oxygen in leaves.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 35(2) p. 115-117.* 3 tables; 12 ref. Chinese. (AGRIS 2000-002754).

878 Limpert,E.; Godet,F.; Muller,K. (1999) **Dispersal of cereal mildews across Europe.** *Agricultural & Forest Meteorology. 97(4):293-308.* English. [Swiss Fed Inst Technol,Inst Plant Sci CH-8092 Zurich Switzerland].

Following the evolution and spread of the barley and the wheat mildew pathogens,(Blumeria (Erysiphe) graminis fsp. hordei and tritici,respectively) over a long period and a large scale in Europe brought us new insight into their population biology which appears to be much more affected by aerial dispersal than generally believed. Results on the local evolution of the number of colony forming units m(-3) of air (cfu) gave us an insight into the major features of population genetics and epidemiology of the barley mildew pathogen. Firstly,the evolution of cfu demonstrates and quantifies the epidemiological significance of volunteer plants. Moreover,three or four periods of primary infections become evident per year,forcing the wind-borne pathogen spores to move from one held (or region) to the next. This makes the pathogen to be highly nomadic,and points out to be of major interest for studies across Europe. Pathogen samples were analyzed from within the geographical triangle Spain-Scotland-Byelorussia for virulence to host resistance. Most unexpectedly,virulence complexity (i.e. number of virulence genes per spore) increased by approximately one virulence per 1000 km from west to east,from Scotland and France to central and eastern Europe. It is presumably caused by the interaction of prevailing winds,pathogen spores migrating on them,and host selection. Prevailing westerly winds carry pathogen spores to the east. Along the way,they encounter barley cultivars with different genes for race-specific resistance,and selection increases virulence complexity. The increase is elucidating for basic concepts of population genetics of wind-borne species,and important for gene deployment strategies. There was ample evidence for the dispersal of genes and genotypes from the regional to the continental level and beyond. Depending on year and location,detailed analyses showed that major parts of the population in one region can be assumed to originate from neighboring or distant regions. Dispersal is reduced by distance,barriers like mountain chains,and host-free spaces. Further,mildew 'waves' consisting of populations highly adapted through selection in one region appear to move across Europe on the prevailing westerly winds,covering approximately 100 km/year. Another important unexpected finding relates to fundamental features of the evolution of new and dangerous pathotypes. The established way of thinking starts with the effect of (regional) mutation as the basis of variability. In contrast,our evidence stresses the importance of the extraordinary variability already present in the pathogen population due to inoculum exchange over the vast continuous areas of Europe,northern Africa and Asia where the pathogen is endemic. Though mutation will remain of importance in the end,variability through spore dispersal among regions appears to be of more immediate relevance for the rapid adaptation of cereal mildew populations. Implications of our findings for fundamental aspects of population biology and integrated pest management strategies,from the regional to the continental and intercontinental level,are outlined and discussed. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 73].

879 Lyngs Joergensen,H.J.; Luebeck,P.S.; Thordal Christensen,H.; De Neergaard,E.; Smedegaard Petersen,V. (The Royal Veterinary and Agricultural Univ.,Frederiksberg (Denmark). Dept. of Plant Biology) (1998) **Induction of resistance in barley against Drechslera teres by preinoculation with Bipolaris maydis and Septoria nodorum.** 16. Nordic Postgraduate Course in Plant Pathology. Biri (Norway). 18-25 Apr 1998. *Resistance to plant pathogens. The 16th Nordic postgraduate course in plant pathology,Honne Konferansesenter,Biri,Norway,18-25 April 1998. Programme and abstracts. Tronsmo,A.M.; Ergon,Aa. (Eds.) vp. p. 41.* Nordic Veterinary and Agricultural University,NOVA. 2 ref. English. (AGRIS 2000-010528).

880 Marie-Jeanne,V.; Sohn,A.; Lesemann,DE.; Peyre,J.; Alliot,B.; Signoret,PA. (1999) **Characterization of an antiserum raised against coat protein of wheat spindle streak mosaic virus overexpressed in E-coli.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 106(6):654-659.* English. [INRA,ENSA,UFR Biol & Pathol Vegetales 2 Pl Pierre Viala F-34060 Montpellier 1 France].

An antiserum to overexpressed coat protein of wheat spindle streak mosaic virus (WSSMV) was obtained after rabbit immunization. This antiserum showed high reactivity in immunoenzymatic tests like indirect ACP-ELISA,DAS-ELISA and Western blot analysis with WSSMV isolates,European isolates so Far designated wheat yellow mosaic virus (WYMV-E) and barley yellow mosaic virus (BaYMV) and it revealed equally high decoration titers with WSSMV isolates as an antiserum to purified particles of an isolate of WYMV-E in immunoelectron microscopy tests. [References: 17].

881 Meeus,P. (Centre de recherches agronomiques,Gembloux (Belgium). Dept. de phytopharmacie); Bodson,B. (1998) **Optimising strobilurine fungicide uses in a reasoned protection of winter wheat.** 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3b) p. 1023-1027.* 6 tables,6 ref. English. (AGRIS 2000-002749).

882 Menzies,JG.; Thomas,PL.; Woods,S. (1999) **The effect of flowering stage in wheat on the infection efficiency of Ustilago tritici.** *Phytoprotection. 80(1):13-19.* English. [Agr & Agri Food Canada,Cereal Res Ctr 195 Dafoe Rd Winnipeg MB R3T 2M9 Canada].

In general,in western Canada,the inoculation of wheat (Triticum aestivum) lines to determine the level of resistance to Ustilago tritici occurs when the plants are at the mid-anthesis stage of spike development. However,it is not always possible to inoculate at this stage so occasionally inoculations are done a few days before or after mid-anthesis. The objective of this study was to determine if inoculation of wheat spikes with U. tritici at different stages of spike development using the partial-vacuum method affected the number of viable seed per spike and subsequent percentage of smutted plants grown from inoculated seed. Four lines of wheat were inoculated at three different stages of spike development in the field each year for 5 years. The stages of spike development studied were preanthesis,mid-anthesis (anthers at either end of the spike were dehisced while those in the middle of the spike were yellow),and post-anthesis tall anthers dehisced). There were significant differences among the four wheat lines and the 5 years of the study for the number of viable seed per spike and the percent of smutted plants. Inoculation at post-anthesis resulted in a significantly greater number of viable seed per spike and lower percentage of smutted plants. We conclude that the partial-vacuum method of inoculation with Ustilago tritici should be done at the pre- or mid-anthesis stage of wheat head development to minimize the negative effect of maturity on infection efficiency. [References: 15].

883 Miot,S.; Frey,P.; Pinon,J. (1999) **Varietal mixture of poplar clones: Effects on infection by Melampsora larici-populina and on plant growth.** *European Journal of Forest Pathology. 29(6):411-423.* English. [INRA F-54280 Champenoux France].

The effects of poplar varietal mixture on infection levels caused by Melampsora larici-populina and on plant growth were studied during two consecutive growing seasons. The varietal mixture consisted of an Intimate mixture of three poplar clones,Populus x interamericana 'Boelare','Rap' and Populus candicans 'NNT',expressing different race-specific resistances. Infection levels of M. larici-populina were assessed in monoclonal and polyclonal plots. Plant heights were determined at the end df each growing season. Infection levels in the growing season of the first year were not significantly different between monoclonal and polyclonal plots at the end of the epidemic. During the second growing season,a naturally occurring complex pathotype,able to infect clones 'Boelare' and 'Rap',invaded some plots prematurely and changed the composition of pathogen population. During this season,four infection assessments were conducted. Infection reduction in polyclonal plots compared with monoclonal plots was observed on 'Boelare' and P. candicans plants. Nevertheless,no significant difference was observed for growth between monoclonal and polyclonal plots. Biological factors which may be involved in the reduction of infection levels in polyclonal plots are dilution of susceptible individuals,physical barriers caused by resistant plants and cross-protection. A high auto-infection ratio may have partly hidden the positive effects of the clonal mixture. [References: 44].

884 Niu Liyuan; Ru Zhengang; Shi Mingwang (Henan Vocation Technical Teachers' Coll.,Xinxiang (China). Dept. of Agronomy) (1998) **[Studies on changes of SOD and POd activites and its relations to the resistance to powdery mildew in wheat before and after powdery mildew infection].** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(suppl.) p. 65-71.* 3 tables; 2 ill.,11 ref. Chinese. (AGRIS 2000-010683).

885 Paulech,P. (Slovenska Akademia Vied,Ivanka pri Dunaji (Slovak Republic). Ustav Experimentalnej Fytopatologie a Entomologie) (1999) **Changes in plastids number and chlorophylls content in leaf of wheat infected with fungus Tilletia caries (DC) Tul.** *Polnohospodarstvo (Slovak Republic). Agriculture - Journal for Agriculture Sciences v. 45(9-10) p. 597-605.* 2 tables,1 ill.; 12 ref. Slovak. (AGRIS 2000-010674).

Experiments with respect to the changes in plastid number and chlorophyll content (including chlorophyll a,chlorophyll b,and total content of chlorophylls a + b) of the cells of leaf tissues of two Slovak winter wheat cultivars (Hana and Ilona) as infected with a fungal pathogen Tilletia caries (DC.) Tul. were conducted. Reduction in plastid number in the leaf cells of infected wheat cultivars (Hana 53.25 %,Ilona 58.77) was higher as compared to its number in leaf cells of uninfected (Healthy) wheat plants of these cultivars. The chlorophyll a content was also reduced to an higher extent in the infected wheat cultivars (Hana 61.11 %,Ilona 65.97 %). Similar trend was apparent in case of chlorophyll b (Hana 46.63 %,Ilona 59.6 %). The total sum of chlorophyll a + b was also reduced at an higher extent in the infected wheat cultivars (Hana 56.63 %,Ilona 61.73 %) as compared to its healthy counter-part. There were close relations among susceptibility,or on other hand resistance of studied winter wheat cvs. and plastids number,as well as chlorophyll content changes. Further studies and data needs to be generated especially on the reaction of photosynthetic apparatus of these two wheat cultivars after the infection by a fungal pathogen (T. caries). This will enable to undertake possible resistance wheat breeding programmes against smut pathogen and devise more effective,ecologically safe and environmentally friendly plant protection measures.

886 Peltonen,S. (1999) **Induced defence responses of cereals to pathogen attack [Review].** *Agricultural & Food Science in Finland. 8(4-5 Special Issue SI):479-492.* English. [Univ Helsinki,Dept Plant Biol,Plant Pathol Sect POB 28 FIN-00014 Helsinki Finland].

The defence responses of plants are usually composed of a multitude of structural and biochemical events. Some occur constitutively,whereas others,which are emphasised in this review,are formed in response to pathogen attack and are considered as active reactions of plants. Induction of defence mechanisms can be observed in all plants regardless of their genetic background. Thus,this phenomenon can occur in cultivars with or without known genes for disease resistance. The general defence features of plants may contribute significantly to the overall disease resistance of plants and increasing evidence for the role of different defence molecules are being obtained from molecular studies. In this review,induction of defence mechanisms,especially phenylpropanoid metabolism and its role in the defence responses of cereals to pathogen attack is addressed. Also,induced resistance as a potential tool for disease control in cereals will be briefly discussed. [References: 113].

887 Pritsch,C.; Muehlbauer,GJ.; Bushnell,WR.; Somers,DA.; Vance,CP. (2000) **Fungal development and induction of defense response genes during early infection of wheat spikes by Fusarium graminearum.** *Molecular Plant-Microbe Interactions. 13(2):159-169.* English. [Univ Minnesota,Dept Agron & Plant Genet St Paul,MN 55108 USA].

Fusarium head blight (FHB) of wheat is a crippling disease that causes severe economic losses in many of the wheat-growing regions of the world,Temporal patterns of fungus development and transcript accumulation of defense response genes mere studied in Fusarium graminearum-inoculated wheat spikes within the first 48 to 76 h after inoculation (hai),Microscopy of inoculated glumes revealed that the fungus appeared to penetrate through stomata,exhibited subcuticular growth along stomatal rows,colonized glume parenchyma cells,and sporulated within 48 to 76 hai. No major differences in the timing of these events were found between Sumai 3 (resistant) and Wheaten (susceptible) genotypes,In complementary experiments,RNA was extracted from spikes at several time intervals up to 48 hai and temporal expression patterns were determined for defense response genes encoding peroxidase,PR-1,PR-2 (beta-1,3-glucanase),PR-3 (chitinase),PR-4,and PR-5 (thaumatin-like protein),In both genotypes,transcripts for the six defense response genes accumulated as early as 6 to 12 hai during F,graminearum infection and peaked at 36 to 48 hai,Greater and earlier PR-4 and PR-5 transcript accumulation was observed in Sumai 3,compared with Wheaten. Our results show that the timing of defense response gene induction is correlated with F,graminearum infection. [References: 69].

888 Ruiz-Lozano,JM.; Gianinazzi,S.; Gianinazzi-Pearson,V. (1999) **Genes involved in resistance to powdery mildew in barley differentially modulate root colonization by the mycorrhizal fungus Glomus mosseae.** *Mycorrhiza. 9(4):237-240.* English. [CNRS,Lab Phytoparasitol,INRA,CMSE BV 1540 F-21034 Dijon France].

Arbuscular mycorrhizal fungi (AMF) and Erysiphe graminis are obligate biotrophic fungi with different outcomes in their interaction with plants,different targeted host tissues,but similar patterns of development and infection processes. These similarities raise the question of whether the two types of biotrophic fungal infections have common features in their regulation. To investigate this question,we compared a number of Ror and Rar barley mutants susceptible to E.graminis f. sp. hordei,as well as their resistant progenitors,for susceptibility to infection by the AMF Glomus mosseae. The two powdery mildew-resistant lines BC Ingrid and Sultan presented a similar reduction in G. mosseae development within roots when compared to the wildtype cultivar Ingrid,indicating a systemic effect of the altered genes in the plant. Ror and Rar mutants,in which susceptibility to powdery mildew is restored,showed increased resistance to AM fungal development in their roots when compared to their progenitors,which suggests that corresponding mutations must have affected genes which differentially modulate symbiotic and pathogenic biotrophic plant-fungus interactions. [References: 42].

889 Segarra,J.; Marin,J.P.; Bernaus,J.R.; Sopena,A. (Universidad de Lleida (Espana). Escuela Tecnica Superior de Ingenieros Agronomos) (1999) **Selection of Erysiphe graminis f.sp. hordei on various barley cultivars,1: Virulence frequencies.** *Investigacion Agraria. Produccion y Proteccion Vegetales (Espana) t. 14(1-2) p. 49-58.* 5 tablas; 30 ref. Spanish. (AGRIS 2000-002611).

Se analizo la estructura de virulencia de la poblacion Erysiphe graminis f.sp. hordei seleccinada por los genotipos de cebada (Hordeum vulgare L.) Pallas,linea isogenica de Pallas P-02 (Mla3) y Klaxon (Mla7+Mlk+MlLa) y se compararon las frecuencias de virulencia. Se pone de manifiesto que la resistencia raza-especifica selecciona fuertemente el/los alelo(s) de virulencia complementario(s) y ninguno de los alelos innecesarios de virulencia.

890 Segarra,J.; Marin,J.P.; Bernaus,J.R.; Sopena,A. (Universidad de Lleida (Espana). Escuela Tecnica Superior de Ingenieros Agronomos) (1999) **Selection of Erysiphe graminis f.sp. hordei on various barley cultivars,2: Virulence complexity and diversity.** *Investigacion Agraria. Produccion y Proteccion Vegetales (Espana) t. 14(1-2) p. 59-72.* 6 tablas,1 graf.; 33 ref. Spanish. (AGRIS 2000-002612).

Se completa el estudio de virulencia de la poblacion de Erysiphe graminis f.sp. hordei seleccionada por los cultivares de cebada Pallas,linea isogenica de Pallas P-02 (Mla3) y Klaxon (Mla7+Mlk+MlLa) a traves de analisis de la distribucion racial y de la complejidad y diversidad de la virulencia. La estructura de la poblacion seleccionada por la variedad susceptible Pallas es similar a la de la poblacion aerea. Se evidencia un incremento de la complejidad y una reduccion simultanea de la diversidad al aumentar el numero de genes de resistencia del genotipo huesped. Dichas correlaciones se explican a traves de las frecuencias de los alelos necesarios de virulencia y de la existencia o no de desequilibrio gametico.

891 Sharma,BK.; Basandrai,AK. (1999) **Efficacy of some plant extracts for the management of Karnal bunt [Neovossia (Tilletia) indica] of wheat (Triticum aestivum).** *Indian Journal of Agricultural Sciences. 69(12):837-839.* English. [Himachal Pradesh Krishi Vishvavidyalay,Reg Res Stn Sirmour 173001 Himachal Prades India].

A study was conducted during 1992-94 on the efficacy of leaf extract of plants against the Karnal bunt (Neovossia (Tilletia) indica) disease of the wheet (Triticum aestivum L. emend. Fiori & Paol). Crude leaf extracts of Cannabis saliva L.(Hemp),Lantana camara L. (lantana),Ageratum conyzoides l (Ageratum),Vitex negundo L. (banna),Azadirachta indica A. Juss. (Neem).,Cassia fistula L.(amaltas),Eucalyptus tereticornis,(safeda),Melia azdirachta L. (Dek) and Murraya,koenghii L. (gandla),were sprayed on wheat at boot leaf stage,48 hr after inoculation with Neovossia (Tilletia) indica. Of these,the extracts of A. indica,L. camara gave more than 65% control of the disease as compared with the unsprayed check. [References: 11].

892 Shen Xiaorong; Zhou Miaoping; Ren Lijuan (Jiangsu Provincial Academy of Agricultural Sciences,Nanjing (China). Inst. of Agrobiological Genetics and Physiology) (1998) **RFLP analysis of wheat varieties resistant or susceptible to scab (Fusarium graminearum).** *Jiangsu Journal of Agricultural Sciences (China). Jiangsu Nongye Xuebao (China) v. 14(3) p. 129-134.* 4 tables; 1 ill.,14 ref. Chinese. (AGRIS 2000-002753).

In order to select one most divergent pair of parents for a mapping population,RFLP was used to detect polymorphisms among eight wheat varieties,including four accessions ("Alondra","Chinese Spring","Ningmai 3" and "Yangmai 3") susceptible and four accessions ("Wangshuibai","Sumai 3","894037" and "895004") resistant to scab. The results showed that the combinations of Wangshuibai/Alondra,Sumai 3/Alondra,894037/Alondra had the highest polymorphisms and were suitable for constructing a mapping population. Now the recombinant inbred line(RIL) populations of these three crosses have advanced to F5 generations with a total of 98 RFLP probes tested,the frequencies of the polymorphism were 30.6 percent,28.6 percent and 24.5 percent in above three mentioned combinations,respectively. When probe KSUF11 was hybridized to the genomic DNA digested with EcoRI,Hind III and BamHI,one specific band was observed in all four resistant varieties,but absent in susceptible cultivars,indicating the probe may be related to scab resistance. Two somaclonal variants were also identified with RFLP in this experiment.

893 Stadnik,MJ.; Buchenauer,H. (1999) **Control of wheat diseases by a benzothiadiazole-derivative and modern fungicides.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 106(5):466-475.* English. [Univ Hohenheim,Inst Phytomed 360 D-70593 Stuttgart Germany].

The effectiveness of the resistance inducer BTH (Bion((R)),benzo [1,2,3] thiadiazole-7-carbothioic acid S-methyl eater) and fungicides azoxystrobin,cyprodinil as well as NAD 21100 F was studied with the susceptible wheat cv. 'Monopol' in field trials during 3 years (1995-1997). BTH-treatment at the end of the tillering stage (GS 28) reduced powdery mildew severity more effectively than when applied in the middle of tillering stage (GS 25),whereas the earlier application led to higher grain yields. The fungicide cyprodinil (GS 31) controlled the powdery mildew and eyespot disease more efficiently than BTH,and significantly enhanced the grain yield. BTH applications revealed a variable effectiveness against Septoria tritici disease. In contrast,the fungicides azoxystrobin and NAD 21 100 F (trifloxystrobin + propiconazole) markedly reduced the disease severity of S. tritici. However,when the Septoria infection pressure was very high,a single application of azoxystrobin at GS 32 was not sufficient to control the disease on the upper leaves at later growth stages. On the other hand,applications of wheat at GS 51 with azoxystrobin or NAD 21100 F significantly reduced Septoria disease development,even when reduced doses were used. While all tested fungicides increased the grain yield of wheat,the combinations of BTH with fungicides did not show any additional effect on yield,although sometimes a stronger reduction of the foliar diseases was observed. [References: 28].

894 Stadnik,MJ.; Buchenauer,H. (1999) **Effects of benzothiadiazole,kinetin and urea on the severity of powdery mildew and yield of winter wheat.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 106(5):476-489.* English. [Univ Hohenheim,Inst Phytomed 360 D-70593 Stuttgart Germany].

The effects of benzo (1,2,3) thiadiazole-7-carbothioic acid S-methyl ester (BTH; Bion((R))),kinetin and urea on disease severity and yield were investigated in field and outdoor pot experiments during 2 years. A foliar application of BTH at tillering induced systemic resistance of wheat to powdery mildew as well as to speckled leaf blotch. BTH-treatment at end of tillering (GS 28) provided better protection than when applied at mid-tillering (GS 25). In contrast,yield increases tended to be higher when BTH was sprayed at GS 25. Dry environmental conditions during tillering seemed to be a prerequisite for the development of a more erect leaf position following BTH-treatment. Both,kinetin and urea,did nor show any effect on the foliar arrangement modified by BTH. Kinetin applied three times during tillering and beginning of tiller elongation significantly increased the powdery mildew severity and reduced grain yield. Alteration of the microclimate within the crop due to an enhanced number of tillers per m(2) may be responsible for disease increase caused by kinetin. Although urea enhanced powdery mildew severity,highest yield increases were obtained by the combination of BTH and a 8 % urea solution. The epidemiological development of the powdery mildew on the cvs. 'Monopol' (susceptible),'Rektor' (pm5 gene or resistance) and 'Zentos' (resistant) was differently affected by BTH. Significant yield increases (ca. 4 dt) were only observed with the cv. 'Monopol'. The effects of BTH and urea on nitrate concentration in stem base of tillers,number of ears per m(2) and grains per ear,thousand-grain weight and protein content of grains were also studied. [References: 34].

895 Szunics,L.; Vida,G. (1999) **Changes in the race composition of the wheat powdery mildew population over the last 25 years.**

*Novenytermeles. 48(4):357-366.* Hungarian. [Magyar Tud Akad Mezogazdasagi Kutatoint Brunszvik 2 H-2462 Martonvasar Hungary].

Over the last quarter-century substantial microevolutional processes have taken place in the wheat powdery mildew population,leading to a considerable change in the race composition of the pathogen population,including a change in the prevalent races. Of the 78 races identified only ten (2; 26; 32; 35; 44; 46; 47; 52; 67; 75) "lived" for more than 15 years. The same races could often be isolated from the majority of varieties which were closely related to each other genetically. Nine races (46; 51; 59; 63; 70; 72; 77; 86; 90) isolated Simultaneously From the related varieties Bezostaya 1,Yubileinaya 50,Martonvasari 4 and Kavkaz proved to make up 83.5% of the pathogen population over the average of five years,thus explaining the development of epidemics. Using cluster analysis,the wheat powdery mildew population between the years 1971 and 1998 could be divided into Four distinct groups on the basis of race composition. In general,small changes take place in the pathogen population over a 2-5 year interval,followed by greater changes after 5-7 years. Genotypes with various degrees of resistance have a considerable influence on these changes. The majority of powdery mildew isolates proved virulent to most known resistance genes. Complete resistance was only provided by the gene Pm4a (Khapli). [References: 24].

896 Tandrup Poulsen,T.; Gjetting,S.; Gregersen,P.L.; Collinge,D.B.; Thordal Christensen,H. (The Royal Veterinary and Agricultural Univ.,Frederiksberg (Denmark). Dept. of Plant Biology,Plant Pathology Section); Folling,L.; Bryngelsson,T.; Olesen,A. (1998) **Towards transgenic barley with enhanced resistance against the powdery mildew fungus.** 16. Nordic Postgraduate Course in Plant Pathology. Biri (Norway). 18-25 Apr 1998. *Resistance to plant pathogens. The 16th Nordic postgraduate course in plant pathology,Honne Konferansesenter,Biri,Norway,18-25 April 1998. Programme and abstracts. Tronsmo,A.M.; Ergon,Aa. (Eds.) vp. p. 45.* Nordic Veterinary and Agricultural University,NOVA. 4 ref. English. (AGRIS 2000-010532).

897 Tang Yulan (Shandong Academy of Agricultural Sciences,Jinan (China). Inst. of Plant Protection) (1998) **Investigation on wheat scabs in different wheat varieties(lines) and its control measures.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 5) p. 35-36.* 1 table; 2 ref. Chinese. (AGRIS 2000-010679).

898 Turner,AS.; O'Hara,RB.; Rezanoor,HN.; Nuttall,M.; Smith,JN.; Nicholson,P. (1999) **Visual disease and PCR assessment of stem base diseases in winter wheat.** *Plant Pathology. 48(6):742-748.* English. [John Innes Ctr Plant Sci Res Norwich NR4 7UH Norfolk England].

Stem base disease (eyespot,sharp eyespot and brown foot rot) was assessed visually and by the polymerase chain reaction (PCR) technique on single plants sampled at four-week intervals in two crops of winter wheat grown in the UK in 1992-3. PCR assays were conducted for Fusarium avenaceum,F. culmorum,both varieties of Microdochium nivale,both eyespot-causing species of Tapesia and Rhizoctonia cerealis. PCR diagnoses were compared with visual diagnoses at each time point. Eyespot was caused principally by T. acuformis (R-type) and developed rapidly late in the season. Visual diagnoses of eyespot were largely confirmed by PCR but T. acuformis was detected in many plants lacking eyespot symptoms. R. cerealis was detected at relatively low incidences on both sites,and sharp eyespot visual diagnoses did not correlate with the incidence of any of the pathogens assayed by PCR. Brown foot rot,caused principally by Microdochium nivale var. majus,accumulated earlier in the season than eyespot. Overall,visual diagnoses of stem base disease coincided poorly with PCR data until after growth stage (GS) 30. [References: 25].

899 Vilich,V. (Rheinische Friedrich Wilhelms Univ. Bonn (Germany). Inst. fuer Pflanzenkrankheiten,Phytomedizin in Bodenoekosystemen) (1998) **Effect of benzoxazolinone allelochemicals from wheat on selected soil-borne pathogens and antagonists.** 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3b) p. 971-976.* 4 ill.,1 table,11 ref. English. (AGRIS 2000-002756).

900 Xi,K.; Burnett,PA.; Tewari,JP.; Chen,MH.; Turkington,TK.; Helm,JH. (2000) **Histopathological study of barley cultivars resistant and susceptible to Rhynchosporium secalis.** *Phytopathology. 90(1):94-102.* English. [Alberta Dept Agr,Lacombe Res Ctr 6000 C&E Trail Lacombe AB Canada].

Differences in the penetration process by Rhynchosporium secalis were compared in resistant and susceptible barley cultivars at the seedling stage. Percent penetration and percent host cell wall alteration (HCWA) differed significantly among cultivars and isolates as revealed by light microscopy. Based on these two variables,the cultivars were statistically separated into two groups that corresponded to their disease reactions. The resistant cultivars,Johnston and CDC Guardian,showed 81.2 to 99.3% HCWA and 0.1 to 20.1% penetration at encounter sites,whereas the susceptible cultivars,Harrington,Argyle,and Manley,had 30.1 to 78.3% HCWA and 31.8 to 81.8% penetration. In the current study,cv. Leduc,which is susceptible at the seedling stage and resistant at the adult stage,showed the same percent HCWA and penetration as did susceptible cultivars. A significant negative correlation ($P < 0.01$) was found between percent penetration and percent HCWA for cultivars inoculated with two isolates of the pathogen. Isolate 1 was less virulent than isolate 2 with respect to percent penetration and induced significantly fewer HCWA. Scanning electron microscopy showed various shapes of fungal appressoria but no apparent difference in host reaction between resistant and susceptible cultivars. Transmission electron microscopy revealed interactions between the host and pathogen at various stages of penetration. The resistant cv. Johnston responded by producing appositions,as evidenced by a layer of compact osmiophilic material deposited on the inner side of the cell wall. Infection pegs produced by conidia were unable to penetrate the cuticle where an apposition had formed inside. When penetration occurred in the susceptible cv. Argyle,cytoplasmic aggregates and separation of the plasmalemma were visible from the host cell wall,but the layer of compact osmiophilic material was not always present. Data. based on light microscopic observations suggested that HCWA may be one of the mechanisms responsible for resistance that is characterized as penetration prevention rather than as a slow rate of mycelial growth after successful penetration HCWA occurred in response to attempted cuticle penetration,suggesting that HCWA may produce chemical barriers that help to prevent penetration. [References: 35].

901 Zhou,F.; Collinge,D.B.; De Neergaard,E.; Thordal Christensen,H. (The Royal Veterinary and Agricultural Univ.,Frederiksberg (Denmark). Dept. of Plant Biology,Plant Pathology Section) (1998) **H2O2 generated by oxalate oxidase triggers hypersensitive response of barley to the powdery mildew fungus.** 16. Nordic Postgraduate Course in Plant Pathology. Biri (Norway). 18-25 Apr 1998. *Resistance to plant pathogens. The 16th Nordic postgraduate course in plant pathology,Honne Konferansesenter,Biri,Norway,18-25 April 1998. Programme and abstracts. Tronsmo,A.M.; Ergon,Aa. (Eds.) vp. p. 56.* Nordic Veterinary and Agricultural University,NOVA. 6 ref. English. (AGRIS 2000-010529).

## H50 MISCELLANEOUS PLANT DISORDERS

902 Al-Yahya,SA. (1999) **Deterioration rates of wheat as measured by CO2 production.** *Canadian Agricultural Engineering. 41(3):161-166.* English. [King Saud Univ,Coll Agr & Vet Med,Dept Agr Engn,Gassim Branch POB 1482 Buraidah Saudi Arabia].

Carbon dioxide production was used as an indicator to determine the allowable storage time (AST) for wheat under different conditions of temperature,moisture,and mechanical

damage. The four grain moisture contents used were 15,18,21,and 24% wet basis (wb). Temperature levels used were 4,15,25,and 40 degrees C. Three levels of percentage of mechanical damage used were 0,15,and 30%. Each level of moisture was tested in three replicates with each temperature and each level of mechanical damage. Statistical comparisons were made,in regard of the AST among temperatures,moistures,and mechanical damage. The analyses showed significant differences among all of the levels. A general equation was developed to easily calculate the AST or deterioration rate under the above storage conditions. [References: 19].

903 Barnard,A. (Agricultural Research Council,Bethlehem (South Africa). Small Grain Inst.) (1999) **[Cold/chill damage on wheat].** *Wheat Focus (South Africa) v. 17(6) p. 14-16.* 11 photos. Afrikaans. (AGRIS 2000-010745).

904 Bean,BW.; Piccinni,G.; Salisbury,CD. (1999) **Wheat cultivar tolerance to atrazine.** *Journal of Production Agriculture. 12(4):597-600.* English. [Texas A&M Agr Res & Extens Ctr 6500 Amarillo Blvd Amarillo,TX 79106 USA].

Winter wheat (Triticum aestivum L.) in the Texas High Plains often follows a crop or fallow period where atrazine was used for weed control. A study was conducted in 1991-1992 and repeated in 1993-1994 to determine if differences exist among commonly grown winter wheat cultivars in their tolerance to atrazine. Eighteen hard red winter wheat cultivars common to the region were planted on 13 Nov. 1991,and 26 Oct. 1993,in plots treated with 0,0.25,0.5,0.75,and 1.0 lb a.i./acre atrazine. Variation in atrazine tolerance was observed among cultivars and years,but cultivar differences in atrazine tolerance were identified. Cultivars that exhibited tolerance to atrazine were 'Triumph','Scout','Siouxland 89','TAM 107',and 'Quantum 588A'. Most susceptible cultivars were 'TAM 109','TAM 200','TAM 201',and 'TAM 202'. These data suggest cultivars are available to minimize yield loss for planting in fields where atrazine residues in soil are suspected. Alternatively,where atrazine is applied to wheat stubble after harvest,cultivars that are susceptible to atrazine could be planted to aid in control of volunteer wheat. [References: 14].

905 Cavallini,A.; Natali,L.; Durante,M.; Maserti,B. (1999) **Mercury uptake,distribution and DNA affinity in durum wheat (Triticum durum Desf.) plants.** *Science of the Total Environment. 244:119-127.* English. [Univ Pisa,Dipartimento Biol Piante Agrarie,Sez Genet Via Matteotti 1-B I-56124 Pisa Italy].

Mercury uptake,distribution and translocation mechanisms in plants of Triticum durum were studied after treatments with Hg-203(NO3)(2) (mercuric nitrate). Results show that the highest mercury levels are observed in the roots or in the leaves depending on the way by which mercury was subministrated to the plants (i.e. by water or air,respectively). Autoradiographic experiments on histological sections show that mercury is preferentially bound to the cell walls of the outer layers of the root cortical cylinder; moreover,labeling is also observed in the outer layer of the central cylinder and in the parenchyma cell nuclei. In the leaf,mercury is incorporated on epidermal and stomatal cell walls and on parenchyma cell nuclei. DNA extracted from Hg-203-treated leaves was analyzed in Cs2SO4 gradients and it was observed that mercury is preferentially linked to certain DNA families. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 30].

906 Dong Aihua; Tong Weixing; Pan Weihuai (Zhejiang Univ.,Hangzhou (China). Coll. of Life Science) (1999) **Study on correlation between Al3+ tolerance in barley and plant-induced pH changes of nutrient solution.** *Acta Agriculturae Shanghai (China). Shanghai Nongye Xuebao (China) v. 15(3) p. 38-41.* 1 table; 1 ill.,12 ref. Chinese. (AGRIS 2000-002801).

907 Dong Dengfeng (Guangxi Univ.,Nanning (China). Coll. of Agriculture) (1999) **Effects of chemical regulation on physiological and yield characteristics of wheat at booting stage under waterlogging stress.** *Journal of Guangxi Agricultural and Biological Science (China). Guangxi Nongye Shengwu Kexue (China) v. 18(4) p. 258-260.* 3 tables; 7 ref. Chinese. (AGRIS 2000-010748).

908 Ghani,A.; Ahmad,A.N. (University of Agriculture,Faisalabad (Pakistan). Dept. of Botany); Meo,A.A. (1999) **Interactive effect of water stress and nitrogen on yield and biomass of wheat (Triticum aestivum L.).** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 840-842.* 2 tables,18 ref. English. (AGRIS 2000-002825).

The interactive effect of water stress and nitrogen on yield and biomass of wheat varieties Inqalab "91" and Parwaz "94" were investigated. The objective of present study is to evaluate the compensating role of nitrogen fertilizer in relation to drought stress on the growth and yield of these wheat varieties. Urea as nitrogen fertilizer was applied before imposition of water stress in plots and water stress was imposed 25,35 and 45 days after germination. The data reveal that sporadic stress and urea fertilizer have highly significant response. The effects of water stress were mostly reduced to greater extent at high nitrogen level (98 gm/plot). Nitrogen applied at higher rates had effectively balanced the adverse effects of water stress.

909 Gibson,LR.; Paulsen,GM. (1999) **Yield components of wheat grown under high temperature stress during reproductive growth.** *Crop Science. 39(6):1841-1846.* English. [Iowa State Univ Sci & Technol,Dept Agron Agron Hall Ames,IA 50011 USA].

High temperature is a major determinant of wheat (Triticum aestivum L.) development and growth,decreasing yields by 3 to 5% per 1 degrees C increase above 15 degrees C in plants under controlled conditions. Even greater yield differences have been reported between favorable and unfavorable temperature conditions in the field. The objective of this study was to identify the yield components of the hard red,winter wheat cultivar Karl 92 that are affected by controlled high temperature during maturation of intact plants under simulated field populations. Plants at a final density of 144 m(2) were grown in the greenhouse until anthesis and transferred to growth chambers for temperature treatment. Day/night temperatures of 20/20,25/20,30/20,and 35/20 degrees C were imposed from 10 and 15 d after anthesis until ripeness in two experiments,and temperatures of 25/20,30/20,and 35/20 degrees C were applied from 20 d after anthesis until ripeness in a third experiment. Grain yield was reduced by 78%,kernel number was reduced by 63%,and kernel weight was reduced by 29% at 35/20 degrees C compared,vith 20/20 degrees C from 10 d after anthesis until ripeness. The yield loss from high temperature applied during this period was much greater than for previous controlled-environment studies. Kernel numbers in treatments applied during early reproductive growth in our study were as sensitive to high temperature as wheat plants in previous field studies. High temperature applied 15 d after anthesis until ripening reduced grain yield 18%,Since kernel number was set by this time,the loss was exclusively due to decreased kernel weight. High temperature imposed from 20 d after anthesis decreased kernel weight by 18%. [References: 26].

910 Guo Fangqing; Zhou Jianming; Tang Zhangcheng (Academia Sinica,Shanghai (China). Shanghai Inst. of Plant Physiology) (1999) **Difference in the accumulation of some organic solutes and gene expression in leaves between the salt-tolerant mutant and the wild type of wheat under NaCl stress.** *Acta Phytophysiologica Sinica (China). Zhiwu Shengli Xuebao (China) v. 25(3) p. 263-268.* 5 ill.,15 ref. Chinese. (AGRIS 2000-002831).

911 Gut,A.; Neftel,A.; Staffelbach,T.; Riedo,M.; Lehmann,BE. (1999) **Nitric oxide flux from soil during the growing season of wheat by continuous measurements of the NO soil-atmosphere concentration gradient: A process study.** *Plant & Soil. 216(1-2):165-180.* English. [Max Planck Inst Chem D-55020 Mainz Germany].

The surface flux of nitric oxide from a wheat field was investigated from 23 March to 29 May 1997 in the Kerzersmoos,Switzerland. A plot fertilised with 19 kg N ha(-)1 in cattle slurry and 40 kg N ha(-1) in mineral NH4NO3 fertiliser and a

plot receiving no nitrogen containing fertiliser were compared. The flux was calculated based on hourly measurements of the NO soil-atmosphere concentration gradient using the one-dimensional soil diffusion model of Galbally and Johansson (1989). The soil bulk diffusion coefficient was determined from measurements of the Rn-222 surface flux and the activity gradient between 10 cm depth and the surface. It ranged between 79% and 0.3% of the NO diffusion coefficient in air and was parameterised by air filled soil pore space. The indirectly determined NO flux agreed well with standard flux measurements using dynamic chambers. The largest NO emission was found following fertiliser application and irrigation. The emission occurred in pulses,which lasted for 4 days up to 3 weeks coinciding with elevated soil ammonium concentrations. Nitric oxide emission in 5 days following application of cattle slurry were 31 g NO-N ha(-)1 and 5 g NO-N ha(-1) from the non-fertilised plot,respectively. Nitric oxide emission in 15 days following application of NH4NO3 was 95 g NO-N ha(-1) and 10 g NO-N ha(-1) from the non-fertilised plot,respectively. NO emission in 4 days following irrigation on 21 April were 36 g N ha(-1) from the fertilised and 39 g N ha(-1) from the non-fertilised plot. The daily NO emission before and after fertiliser and irrigation pulses was between 0.3 and 0.7 g NO-N ha(-1) d(-1). NO production and NO uptake of the soil was measured regularly. No systematic influence of management or climate on NO uptake was found. NO production was strongly stimulated by fertiliser input and soil moisture content. The simulation of NO production could be reproduced using a nitrification algorithm (Riedo et al.,1998) driven by soil temperature,moisture and ammonium concentration. A NO production rate constant of 1.1.10(-3) h(-1) at 15 degrees C was derived from a linear regression between nitrification and NO production. Introducing the parameterisation of NO production into the model of Galbally and Johansson (1989) the duration and the strength of the NO emission pulses could be reproduced and the total NO emission during the experiment was approximated within a factor of two. [References: 22].

912 Hakala,K.; Helio,R.; Tuhkanen,E.; Kaukoranta,T. (1999) **Photosynthesis and Rubisco kinetics in spying wheat and meadow fescue under conditions of simulated climate change with elevated CO2 and increased temperatures.** *Agricultural & Food Science in Finland. 8(4-5 Special Issue SI):441-457.* English. [Agr Res Ctr Finland FIN-31600 Jokioinen Finland].

Spring wheat (Triticum aestivum L. cv. Polkka) and meadow fescue (Festuca pratensis Hudson cv. Kalevi) were grown in ambient and elevated (700 mu l 1(-1)) carbon dioxide concentration both at present ambient temperatures and at temperatures 3 degrees C higher than at present simulating a future climate. The CO2 concentrations were elevated in large (3 m in diameter) open top chambers and the temperatures in a greenhouse built over the experimental field. The photosynthetic rate of both wheat and meadow fescue was 31-37% higher in elevated carbon dioxide (eCO(2)) than in ambient CO2(aCO(2)) throughout the growing season. The enhancement in wheat photosynthesis in eCO(2) declined 10-13 days before yellow ripeness,at which point the rate of photosynthesis in both CO2 treatments declined. The stomatal conductance of wheat and meadow fescue was 23-36% lower in eCO(2) than in aCO(2). The amount and activity of ribulose-1,5-bisphosphate carboxylase-oxygenase (Rubisco) in wheat were lower under conditions of eCO(2),except at elevated temperatures in 1993 when there was a clear yield increase. There was no clear change in the amount and activity of Rubisco in meadow fescue under eCO(2) at either elevated or ambient temperature. This suggests that adaptation to elevated CO2 at biochemical level occurs only when there is insufficient sink for photosynthetic products. While the sink size of wheat can be increased only by introducing new,more productive genotypes,the sink size of meadow fescue can be regulated by fitting the cutting schedule to growth. [References: 36].

913 Hanif,M.; Davies,M.S. (Wales Univ. (United Kingdom). Dept. of Pure and Applied Biology) (1998) **Effects of NaCl on meristem size and proximity of root hairs to the root tips in Secale cereale (cv. K2) and Triticum aestivum (cv. Chinese spring).** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(1) p. 15-18.* 2 ills.,19 ref. English. (AGRIS 2000-002821).

A 8 day exposure to NaCl reduced the length of root apical meristem in Secale cereal (cv. K2) to a greater extent than Triticum aestivum (cv. Chinese Spring). NaCl induced also root hair formation much closer to the root cap boundary than in the control roots. Contrasting cultivars were differentially sensitive by NaCl in respect of distance of the first root hair from the root cap boundary in root meristem and this may be used as a character for screening genotypes at the seedling stage for variability in NaCl tolerance.

914 Hanif,M.; Davies,M.S. (Wales Univ. (United Kingdom). Dept. of Pure and Applied Biology) (1998) **Effects of NaCl on meristem size and proximity of root hairs to the root tips in Triticum aestivum (cvs. Lyallpur-73,Pak-81 and Lu-26-S).** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(1) p. 1-4.* 2 ills.,18 ref. English. (AGRIS 2000-002826).

Seedlings of Triticum aestivum cvs. Lyallpur-73,Pak-81 and Lu 26-S were grown in solution culture at varying concentrations of NaCl for 8 days. Increasing concentrations of NaCl reduced the size of apical meristem and caused the most distal root hair to form closer to the root tip in all the cultivars. Although the position of the first root hair from the root cap boundary was reduced by salinity,yet there were comparatively little differences between these Pakistani Wheat cultivars in response to NaCl,thus in these studies the relative positions of root hairs is not a good discriminating character for assessing the salt tolerance.

915 Hanif,M.; Davies,M.S. (Wales Univ.,Cardiff (United Kingdom). School of Pure and Applied Biology) (1998) **The influence of NaCl on the cell cycle and growth fraction in the root meristems of Triticum aestivum cvs. Lyallpur 73 and Lu-26-S.** *Pakistan Journal of Biological Sciences (Pakistan) v. 1(4) p. 252-255.* 6 ills.,1 table,10 ref. English. (AGRIS 2000-002827).

The seedlings of Triticum aestivum cvs. Lyallpur 73 and Lu-26-S were grown in aerated 0.1 Rorison nutrient solution for 72 hours. Then the kinetics of cells cycle in the root meristem were determined by a pulse labelling experiment with low specific activity tritiated thymidine following a 70 hours exposures to three concentrations of NaCl (0,30,70 mM NaCl). Treatments with 30 and 70 mM NaCl increased the length of cell cycle in cv Lu-26-S but that of Lyallpur 73 was decreased. The growth fraction (refers to percentage of meristematic cells which are actively cycling as opposed to these that are not cycling in the meristem) was increased in Lyallpur 73 from 7.9 to 11.11% over the range of 0-70 mM NaCl whereas that of Lu-26-S was decreased in response to increasing NaCl concentration.

916 Hudak,C.; Bender,J.; Weigel,HJ.; Miller,J. (1999) **Interactive effects of elevated CO2,O-3,and soil water deficit on spring wheat (Triticum aestivum L-cv. Nandu).** *Agronomie. 19(8):677-687.* English. [Fed Agr Res Ctr FAL,Inst Agroecol Bundesallee 50 D-38116 Braunschweig Germany].

This study investigated the interactive effects of elevated carbon dioxide (CO2),ozone (O-3),and soil water deficit on spring wheat (Triticum aestivum L. cv. Nandu). Plants were grown in open-top chambers (OTCs) which were arranged in a 2 x 2 factorial design consisting of two O-3 levels (ambient and 1.5-times ambient) in combination with two CO2 levels (ambient and ambient plus 320 mu mol mol(-1) CO2) Subplots in each OTC were subjected to two levels of watering,well-watered and restricted water supply. Total leaf conductance (g(L)),growth and biochemical analyses were determined to assess plant responses. The relative reduction in g(L) due to CO2,soil water deficit and/or O-3 depended on plant growth stage. However,complex interactions between the experimentally controlled factors occurred on many days. Reduced water supply resulted in growth reduction but provided some protection against the loss in dry weight caused by O-3. Elevated CO2 stimulated plant growth,but no interactive effects between CO2,soil water deficit and/or O-3 were observed,suggesting that elevated CO2 reduced the adverse effects of O-3 and/or soil water deficit in an additive manner. The complex nature of the multiple

stress interactions involved was also illustrated by the responses of specific biochemical variables (carbohydrates,proline,pigments). (C) 1999 Inra/Editions scientifiques et medicales Elsevier SAS. [References: 48].

917 Ikeda,M.; Yamanishi,T. (1999) **Accumulation of nitrogen supplied as ammonium in the root tips of aluminum-stressed wheat cultivars differing in aluminum sensitivity.** *Journal of the Faculty of Agriculture Kyushu University. 44(1-2):33-38.* English. [Kyushu Univ,Dept Agr Chem,Lab Plant Nutr,Fac Agr Fukuoka 8128581 Japan].

Ammonium labeled with N-15 was supplied for two days to two wheat (Triticum aestivum L.) cultivars treated with Al. At a low Al concentration,root elongation was greatly inhibited by treatment for 24 hours in cultivar Chikushikomugi,while in cultivar Shirosanjyaku,significant inhibition of root elongation required treatment for 48 hours. Decreases in pH values of nutrient solution were greater in Shirosanjyaku than Chikushikomugi and smaller at a higher Al concentration in both the varieties. These results indicate that uptake of ammonium was more strongly inhibited by Al in Chikushikomugi than Shirosanjyaku. Accumulation of newly absorbed nitrogen (N-15) was decreased at a low Al concentration in the apical part of root tip (0-12 mm) of Chikushikomugi. In Shirosanjyaku treated with a low concentration of Al,accumulation of N-15 increased rather than inhibited. At a high Al concentration,accumulation of N-15 Slightly decreased in the root tip of Skirosanjyaku. Accumulation of N-15 in four segments dissected from a root tip was differently affected between Shirosanjyaku and Chikushikomugi. It is considered that Shirosanjyaku is able to maintain active nitrogen metabolism in the root tip under Al-stress conditions compared to Chikushikomugi. [References: 20].

918 Jamjod,S.; Rerkasem,B. (1999) **Genotypic variation in response of barley to boron deficiency.** *Plant & Soil. 215(1):65-72.* English. [Chiang Mai Univ,Fac Agr,Dept Agron Chiang Mai 50200 Thailand].

Responses of a range of barley (Hordeum vulgare L.) genotypes to boron (B) deficiency were studied in two experiments carried out in sand culture and in the field at Chiang Mai,Thailand. In experiment 1,two barley genotypes,Stirling (two-row) and BRB 2 (six-row) and one wheat (Triticum aestivum L.) genotype,SW 41,were evaluated in sand culture with three levels of applied B (0,0.1 and 1.0 mu M B) to the nutrient solution. It was found that B deficiency depressed flag leaf B concentration at booting,grain number and grain yield of all genotypes. In barley Stirling,B deficiency also depressed number of spikes plant(-1),spikelets spike(-1) and straw yield. However,no significant difference between genotypes in flag leaf B concentration was found under low B treatments. Flag leaf B concentration below 4 mg kg(-1) was associated with grain set reduction and could,therefore,be used as a general indicator for B status in barley. In experiment 2,nine barley and two wheat genotypes were evaluated in the field on a low B soil with three levels of B. Boron levels were varied by applying either 2 t of lime ha(-1) (BL),no B (B0) or 10 kg Borax ha(-1) (B+) to the soil prior to sowing. Genotypes differed in their B response for grain spike(-1),grain spikelet(-1) and grain set index (GSI). The GSI of the B efficient wheat,Fang 60,exceeded 90% in all B treatments. The B inefficient wheat SW 41 and most of the barley genotypes set grain normally (GSI > 80%) only at the B+. In B0 GSI of the barley genotypes ranged from 23% to 84%,and in BL from 19% to 65%. Three of the barley with severely depressed GSI in B0 and BL also had a decreased number of spikelets spike(-1). In experiment 3,21 advanced barley lines from the Barley Thailand Yield Nursery 1997/98 (BTYN 1997/98) were screened for B response in sand culture with no added B. Grain Set Index of the Fang 60 and SW 41 checks were 98 and 65%,respectively,and GSI of barley lines ranged between 5 and 90%. One advanced line was identified as B efficient and two as moderately B efficient. The remaining lines ranked between moderately inefficient to inefficient. These experiments have established that there is a range of responses to B in barley genotypes. This variation in the B response was observed in vegetative as well as reproductive growth. Boron efficiency should be considered in breeding and selection of barley in low B soils. [References: 17].

919 Jorhem,L.; Slanina,P. (2000) **Does organic farming reduce the content of Cd and certain other trace metals in plant foods? A pilot study.** *Journal of the Science of Food & Agriculture. 80(1):43-48.* English. [Natl Food Adm Box 622 S-75126 Uppsala Sweden].

The effect of organic cultivation systems on the level of Cd in wheat was studied in two consecutive harvests. Additionally,the concentrations of Cd,Pb,Cr and Zn were analysed in single harvests of rye,carrots and potatoes from different farming systems. Wheat and rye were obtained from controlled field trials using several conventional and ecological systems at two separate locations in Sweden. Potatoes and carrots were collected at private farms with conventional or ecological production. These farms were juxtapositioned and had similar soil properties. The levels of Cd in the wheat did not correlate with the cultivation system or the Cd content in the soil. Conventionally grown wheat from one field trial showed a significantly higher Cd level compared with ecologically grown wheat,while in the other field trial significantly lower Cd levels were detected in the conventionally grown wheat. No statistically significant differences in the concentrations of Cd,Pb,Cr or Zn in rye,carrots and potatoes were detected between the cultivation systems. The results indicate that organic farming,at least in the short term,does not necessarily result in reduced levels of Cd and other potentially harmful metals in foods of vegetable origin. Factors other than cultivation system may be of greater importance for the final concentration of Cd and other metals in plant foods. (C) 2000 Society of Chemical Industry. [References: 10].

920 Kandil,M.M.; Koreish,E.A.; Kaloosh,A.A.; Gomah,A.M. (Alexandria Univ.,(Egypt). Faculty og Agriculture) (1997) **Improving wheat growth under salt stress condition using vam inoculation.** *Menofiya Journal of Agricultural Research (Egypt) v. 22(6) p. 1707-1718.* 4 tables; 27 ref. English. (AGRIS 2000-002823).

921 Kisana,N.S. (National Agricultural Research Centre,Islamabad (Pakistan). Wheat Programme); Tahir,M.; Mujahid,M.Y.; Ahmed,I.; Majid,A.; Mustafa,S.Z.; Ahmed,Z. (1999) **Variability and relationship between morpho-phenological traits and grain yield in winter and facultative barley under stress environments.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 767-771.* 2 ills.,5 tables,11 ref. English. (AGRIS 2000-002800).

Variability and relationship among different morpho-phenological traits for twenty four lines/varieties in each of the two winter and facultative barley trials were studied at two locations (Tel Hadya and Breda) in northern Syria. A significant variation was observed in barley lines for grain yield,plant height,days to heading and maturity,grain filling period and growth period. Since the winter during 1994-95 was mild at the both locations and drought and high temperatures were major stresses,most of the high yielding genotypes were facultative types. A significant positive correlation was found between plant height and grain yield. There was,however,significant negative correlation between grain yield and days to heading and maturity. Grain filling period was positively associated with yield (except for winter types at Breda). A negative correlation between growth habit and yield at both locations can be attributed to mild winter and severe drought and high temperatures during crop growth period.

922 Ma Wenshi (Hebei Normal Univ.,Shijiazhuang (China). Dept. of Biology) (1998) **Studies on the polypeptide changes of thylakoid membrane of albinism line in wheat during the albinism period.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(suppl.) p. 56-58.* 2 ill.,5 ref. Chinese. (AGRIS 2000-010749).

923 Maheswari,M.; Joshi,DK.; Saha,R.; Nagarajan,S.; Gambhir,PN. (1999) **Transverse relaxation time of leaf water protons and membrane injury in wheat (Triticum aestivum L.) in response to**

high temperature. *Annals of Botany. 84(6):741-745.* English. [Indian Agr Res Inst,Nucl Res Lab New Delhi 110012 India].

The relationship between high temperature stress injury and temperature dependence of the transverse relaxation time (T-2) of leaf water was examined using NMR in four cultivars of wheat differing in their sensitivity to high temperature stress. The T-2 declined with increasing temperature between 25 and 35 degrees C. A comparison of relative injury based on electrolyte leakage and T-2,between 40 and 50 degrees C,indicated that while membrane permeability increased with increasing temperature there was an increase in T-2 until 44 and 48 degrees C in susceptible and tolerant cultivars respectively,followed by a sharp decline. This pattern of change in T-2 with increasing temperature was consistent whether the same or different samples were used for each treatment temperature. Loss of temperature dependence of T-2 after heat killing indicated irreversible changes in T-2,probably due to the loss of membrane integrity. Heat tolerant varieties,which suffered less membrane injury,had a higher T-2 compared to susceptible varieties. Tolerant Varieties also maintained the T-2 of leaf water protons to higher temperatures than did sensitive varieties. This NMR-based,non-invasive,rapid technique could be used to efficiently detect heat injury in leaf tissues. (C) 1999 Annals of Botany Company. [References: 33].

924 Meyer,U.; Kollner,B.; Willenbrink,J.; Krause,GHM. (2000) **Effects of different ozone exposure regimes on photosynthesis,assimilates and thousand grain weight in spring wheat.** *Agriculture Ecosystems & Environment. 78(1):49-55.* English. [Univ Cologne,Inst Bot Gyrhofstr 15 D-50931 Cologne Germany].

The aim of the study was to compare two ozone exposure patterns with different peak concentrations under equal dose conditions. Spring wheat (Triticum aesthivum cv. 'Nandu') was 'pre-cultivated' under glasshouse conditions and exposed to two different ozone exposure scenarios (A: 1700-0900 h: 20 ppb,0900-1700 h: 65 ppb; B: 1600-1200 h: 20 ppb,1200-1600 h: 110 ppb) in large fumigation chambers for two weeks during anthesis. Control plants received charcoal filtered ambient air (<5 ppb ozone 24 h/day) (CF). Chlorophyll content as well as chlorophyll fluorescence (Fv:Fm ratio) and carbohydrate composition (hexoses,sucrose,starch) were monitored in flag leaves and in the case of carbohydrate content also in the penultimate internode during and after ozone exposure. Thousand grain weight (TGW) was determined for estimating yield effects,photosynthesis decreased markedly in both treatments expressed as Fv :Fm ratio. in treatment B chlorophyll content (a + b) of leaves was reduced by 40% after 7 and 14 days of exposure (p less than or equal to 0.001). Carbohydrate content decreased significantly as compared with CF-plants to 20% (p less than or equal to 0.001) in the case of sucrase and starch. Effects were especially pronounced in treatment B (110 ppb for 4 h) and could be observed even seven days after exposure under CF conditions. After 14 days of exposure during anthesis,plants were incapable of recovery as shown by a significant reduction in thousand grain weight of ozone treated plants compared with CF-plants (treatment B: 22% at p less than or equal to 0.001). Effects on photosynthesis and carbon content even under moderate daily ozone peaks as in treatment A induced a significant yield loss of 11% (p less than or equal to 0.001) as well,when applied during anthesis. It can be concluded that under equal dose conditions ozone treatments with comparatively high peak concentration induce more pronounced effects than ozone patterns with moderate peaks. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 38].

925 Musselman,RC.; Minnick,TJ. (2000) **Nocturnal stomatal conductance and ambient air quality standards for ozone [Review].** *Atmospheric Environment. 34(5):719-733.* English. [US Forest Serv,Rocky Mt Res Stn,USDA 240 W Prospect Rd Ft Collins,CO 80526 USA].

Vegetation response to ozone depends on ozone conductance into leaves and the defensive action inside the leaf. Ozone parameters currently used for air quality standards do not incorporate conductance or defensive components. Nighttime flux has often been ignored in ozone metrics relating to plant response,since ozone concentration and conductance are considered to be minimal at night. However,ozone concentration can remain relatively high at night,particularly in mountainous areas. Although conductance is lower at night than during the day for most plants,nocturnal conductance can result in considerable ozone flux into plants. Further,plants can be more susceptible to ozone exposure at night than during the daytime,a result of lower plant defenses at night. Any ozone metric used to relate air quality to plant response should use a 24 h ozone exposure period to include the nighttime exposures. It should also incorporate plant defensive mechanisms or their surrogate. Published by Elsevier Science Ltd. [References: 150].

926 Piccinni,G.; Rush,CM.; Vaughn,KM.; Lazar,MD. (2000) **Lack of relationship between susceptibility to common root rot and drought tolerance among several closely related wheat lines.** *Plant Disease. 84(1):25-28.* English. [Texas A&M Univ,Texas Agr Expt Stn PO Drawer 10 Bushland,TX 79012 USA].

Common root rot caused by Bipolaris sorokiniana is a disease of wheat associated with plant stress. Three cultivars (Siouxland,TAM 200,and TAM 107) and several hard red winter wheat lines closely related to TAM 107,but known to differ with respect to drought tolerance,were included in a 2-year dryland field study to evaluate whether observed variation in drought tolerance was associated with susceptibility to B. sorokiniana. Untreated seed of each entry or seed treated with imazalil was planted in soil naturally infested with B. sorokiniana. Plants were evaluated at jointing and at harvest. Disease incidence and severity,number of plants,number of heads,and grain weight per meter were evaluated. Grain weight and number of heads of individual plants were recorded in order to correlate disease rating of each plant with yield components. Plot yield and test weight also were measured. There were significant entry by seed treatment interactions for number of heads per plant,grain weight per plant,and grain weight per meter. A year by treatment interaction was found for the jointing disease index,and plants grown from seed treated with imazalil had a significantly lower disease index than those grown from nontreated seed. Observed drought tolerance among the three varieties and eight closely related plant introductions was not associated with disease susceptibility to common root rot. [References: 17].

927 Piech,M.; Maciorowski,R. (University of Agriculture,Szczecin (Poland). Dept. of Biometry and Experimentation) (1997) **Reaction of winter triticale cultivars to urea herbicides.** *Fragmenta Agronomica (Poland) v. 14 p. 40-46.* 1 fig.,1 table; 14 ref. Polish. (AGRIS 2000-010744).

The greenhouse experiment was conducted in plastic boxes in 1995 with follwoing factors: - winter triticale cultivars; - active substances for herbicides: Arelon 75WP,Tolurex 80WP; - doses of active substances (0,0.2,0.4 and 0.6 g pro square m). A herbicide application was done at growth stage of three unfolded leaves 13 DC. Three weeks after the herbicide treatment fresh,dry matter,leaf area and pigments concentration were estimated. The investigated herbicides increased a concentration of photosynthetically active pigments: chlorophyll a,b and carotenoids independently upon triticale cultivars. Arelon 75WP limited plant development of all investigated triticale cultivars more than Tolurex 80 WP.

928 Polcyn,J. (Zespol Szkol Rolniczych,Borzostow (Poland)) (1999) **Allelopathic potential of water extract of Chenopodium album in relation to spring wheat seedlings "Igna".** *Zeszyty Naukowe Akademii Techniczno-Rolniczej w Bydgoszczy. Rolnictwo (Poland) (no.43) p. 25-29.* 3 fig.; 15 ref. Polish. (AGRIS 2000-010742).

The aim of the study was to estimate the influence of the part of pran pelants above groung of Chenopodium album. It was stated,that water extract from Chenopodium album decrease radicles length,number of seeds germination and decrease coleoptile length of spring wheat "Igna".

929 Rau,D.; Attene,G. (Sassari Univ. (Italy). Dipartimento di Scienze Agronomiche); Arru,L.; Vale,G.; Pecchioni,N. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)) (1998) [Effects of

anoxia on barley development. Present biotechnological strategies [Hordeum vulgare L. - plant breeding]]. *Informatore Agrario (Italy) v. 54(33) p. 51-54.* Italian. (AGRIS 2000-002799).

930 Saneoka,H.; Shiota,K.; Kurban,H.; Chaudhary,MI.; Premachandra,GS.; Fujita,K. (1999) **Effect of salinity on growth and solute accumulation in two wheat lines differing in salt tolerance.** *Soil Science & Plant Nutrition. 45(4):873-880.* English. [Hiroshima Univ,Fac Appl Biol Sci Higashihiroshima 7398528 Japan].

Wheat (Triticum aestivum L.) line,Saline Agriculture Research Center line 1 (SARC),was selected in a salinity tolerance improvement program at the University of Agriculture,Faisalabad,Pakistan. In this study we compared SARC with Pothowar which is a common wheat cultivar grown in the same region,in order to study the mechanism of salinity tolerance in the SARC line. Two wheat lines were planted in pots and were subjected to salt stress by daily application of a 200 mM NaCl solution for 30 d during the vegetative growth stage. Dry weight of plant parts,leaf area,leaf water status,and solute concentrations in the cell sap of the leaf tissues were determined at 13 and 30 d after initiation of the stress treatment. Decrease in the plant dry weight and leaf area due to salt stress was more pronounced in Pothowar than in SARC,indicating that SARC was more tolerant to salinity. SARC maintained a higher turgor at low leaf water potentials and showed a higher capacity of osmotic adjustment compared to Pothowar. Major osmotica that increased by salinity in order to maintain a lower osmotic potential in the two lines were Na+,Cl-,K+,and glycinebetaine. Increase in the concentrations of Na+,Cl-,and glycinebetaine was much higher in SARC than in Pothower. These results suggested that the SARC line had a physiological mechanism that conferred a higher salinity tolerance. [References: 28].

931 Subedi,KD.; Gregory,PJ.; Gooding,MJ. (1999) **Boron accumulation and partitioning in wheat cultivars with contrasting tolerance to boron deficiency.** *Plant & Soil. 214(1-2):141-152.* English. [Univ Reading,Dept Soil Sci POB 233 Reading RG6 6DW Berks England].

Two pot experiments at the Plant Environment Laboratory (PEL),Reading,UK investigated sterility,boron (B) accumulation and B partitioning of wheat cultivars grown with limited B in the growing medium. The first experiment evaluated nine cultivars of spring wheat with diverse field responses to low available soil B,supplied with or without 20 mu M B. A second experiment examined the response of a susceptible (SW-41) and a tolerant (Fang-60) cultivar to B-deficiency. These cultivars were supplied with either 20 mu M B from sowing to flag leaf emergence and no added B thereafter,or 20 mu M B from sowing to maturity. When B was not supplied in the nutrient solution,the number of grains ranged from 4 per ear (cv. BL-1135) to 32 per ear (cv. BL-1249) and sterility of competent florets ranged from 39% to 93%. Boron concentration in the flag leaf at anthesis did not differ greatly when the growing medium contained limited B,but differences between cultivars were evident when B was unlimited. Tolerance of B-deficiency was not related to the B concentration in the flag leaf. Some cultivars produced viable pollen and set grains while others failed to do so at similar B concentrations in the flag leaf. The two contrasting cultivars did not differ much in their pattern of B partitioning when B supply was restricted from flag leaf emergence onwards. Similarly,little evidence was found that the tolerant cultivars translocated B from their leaves,roots or stems when the supply in the growing medium was restricted. The proportion of total B partitioned in different organs was the same irrespective of B supply and cultivar. On average,leaves contained 68% of the total B content in the whole plant compared to 16% in the roots,10% in the ears and only 6% in the stems. Tolerant or susceptible cultivars of wheat could not be distinguished based on the B concentration and B content of the flag leaf. [References: 21].

932 Toker,C.; Gorham,J.; Cagirgan,MI. (1999) **Assessment of response to drought and salinity stresses of barley (Hordeum vulgare L.) mutants.** *Cereal Research Communications. 27(4):411-418.* English. [Akdeniz Univ,Fac Agr,Dept Field Crops POB 510 TR-07070 Antalya Turkey].

Eight barley mutants (M-K 23,M-K 25,M-K 35,M-K 55,M-K 63,M-Q 54 and M-Q 76),two parents (Kaya and Quantum) and two checks (Chevron,salt sensitive and CM 67,salt tolerant) were grown in order to assess of response to drought and salinity in drought and saline (150 mol m(-3) NaCl + 7.7 mel m(-3) CaCl2) treatments. Net photosynthesis (mu mol(-2) s(-1)),stomatal conductance (mmol m(-2) s(-1)) and transpiration rates (mmol m(-2) s(-1)) were measured at the beginning of the flowering stage. Generally,salinity and drought negatively and severely affected net photosynthesis,transpiration rate and stomatal conductance of genotypes. From mutants,M-K 25 had the highest photosynthetic activity in drought; similarly M-K 63 had the highest photosynthetic activity in the external saline treatments. For ion analysis,the youngest fully-emerged leaf was used and measured chloride,sodium and potassium measured. Chloride accumulation in the leaves was generally higher in drought and saline treatments than control plants. Also,potassium concentration remained high in both treatments. Sodium accumulation,however,was slightly higher in drought than untreated control except for M-K 35 and M-K 55. Chloride concentration in M-Q 54 was the lowest among the genotypes in salinity condition. Quantum,M-Q 54 and M-Q 76 had the lowest sodium concentrations,while Kaya had the highest concentration in the saline treatment. In drought treatment,M-Q 54 had the highest potassium concentration,but CM 67 was the highest in saline treatment. Different responses to drought and salinity were found among the barley mutants. [References: 19].

933 Veha,A.; Gyimes,E. (1999) **Investigation of kernel hardness in winter wheat varieties with hammermill.** *Cereal Research Communications. 27(4):463-470.* English. [Attila Jozsef Univ,Coll Food Ind,Dept Food Technol & Environm Management Moszkvai Krt 5-7 H-6725 Szeged Hungary].

934 Wang Yuefu (Shandong Agricultural Univ.,Taian (China)) (1998) **Effect of soil water stress on water use efficiency of different drought-tolerant wheat varieties.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 3) p. 5-7.* 5 tables; 4 ref. Chinese. (AGRIS 2000-010746).

935 Wu Yuye; Li Dequan; Zhao Shijie (Shandong Agricultural Univ.,Taian (China). Dept. of Plant Sciences) (1999) **Effects of exogenous osmotica on water status and photosynthesis of wheat seedling leaves under osmotic stress.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 35(1) p. 23-26.* 4 tables; 7 ref. Chinese. (AGRIS 2000-002828).

936 Xu Changcheng; Li Dequan; Zou Qi (Shandong Agricultural Univ.,Taian (China). Dept. of Plant Science); Zhang Jianhua (1999) **Effect of drought on chlorophyll fluorescence and xanthophyll cycle components in winter wheat leaves with different ages.** *Acta Phytophysiologica Sinica (China). Zhiwu Shengli Xuebao (China) v. 25(1) p. 29-37.* 5 ill.,23 ref. English. (AGRIS 2000-002824).

937 Yang Zhimin; Zheng Shaojian; Hu Aitang (Nanjing Agricultural Univ. (China). Coll. of Resources and Environmental Sciences) (1999) **Effects of different levels of P supply and pH on the content of cadmium in corn and wheat plants.** *Journal of Nanjing Agricultural University (China). Nanjing Nongye Daxue Xuebao (China) v. 22(1) p. 46-50.* 1 table; 3 ill.,18 ref. Chinese. (AGRIS 2000-002839).

938 Yu Hongxin (Shandong Inst. of Managerial Cadres of Agriculture,Jinan (China)) (1998) **Resistance of different genotype of winter wheat to kanamycin.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 6) p. 18-19.* 3 tables; 5 ref. Chinese. (AGRIS 2000-010747).

939 Zhang Shigong (Chinese Academy of Agricultural Sciences,Beijing (China). Inst. of Agricultural National Resources and Agricultural Regional Planning); Gao Jiyin (1999) **Effects of salicylic acid and aspirin on wheat (Triticum aestivum L.) seed**

**germination under salt stress.** *Plant Physiology Communications (China). Zhiwu Shenglixue Tongxun (China) v. 35(1) p. 29-32.* 4 tables; 11 ref. Chinese. (AGRIS 2000-002829).

940 Zhang Shigong (Chinese Academy of Agricultural Sciences,Beijing (China). Inst. of Agricultural National Resources and Agricultural Regional Planning); Gao Jiyin (1999) **Mitigative effects of salicylic acid and aspirin on salt stress-induced injuries in wheat (Triticum aestivum L.).** *Acta Phytophysiologica Sinica (China). Zhiwu Shengli Xuebao (China) v. 25(2) p. 159-164.* 2 tables; 2 ill.,15 ref. Chinese. (AGRIS 2000-002830).

## H60 WEEDS

941 Ambolet,B. (Bayer S.A.,Puteaux (France)); de Keyzer,A. (1998) **JV 485: a new herbicide for pre-emergence broad spectrum weed control in winter wheat [phenyl pyrazoles].** 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 1 p. 473-480. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 5 tableaux. French. (AGRIS 2000-002987).

942 Baghestani,A.; Lemieux,C.; Leroux,GD.; Baziramakenga,R.; Simard,RR. (1999) **Determination of allelochemicars in spring cereal cultivars of different competitiveness.** *Weed Science. 47(5):498-504.* English. [Agr & Agri Food Canada 2560 Hochelaga Blvd St Foy PQ G1V 2J3 Canada].

Competitive cereal cultivars are less susceptible than others to weed interference. Their characterization may provide selection criteria that can be used as guidelines to develop new,even more competitive cultivars. Root exudates are a potential means by which competitive cultivars reduce weed growth. The objectives of this study were to evaluate the effect of cereal root exudates on Brassica kaber (DC.) L. C. Wheeler growth,to isolate and characterize the allelochemical compounds released by spring cereal cultivars,and to determine ifa relation exists between these allelochemicals and cultivar competitiveness. Highly competitive (HC) and lesser competitive (LC) cultivars of four crop kinds (Triticum aestivum L. [wheat],Avena sativa L. [wild oat],two- and six-rowed Hordeum vulgare L. [barley]) were selected based on previous work. Exudates from undisturbed root systems of B. kaber and cereals were collected and used in a bioassay test with B. kaber. Root exudates were analyzed for 16 common phenolic compounds using high-performance liquid chromatography (HPLC). Bioassays indicated that cereal exudates had no negative effect on B. kaber germination,but all concentrations of cereal root exudates inhibited B. kaber root and hypocotyl growth. As cereal root exudate concentration increased,B. kaber growth decreased. For each crop kind,B. kaber growth inhibition was greater with HC cultivars than with LC cultivars. The root exudates of all crop kinds and cultivars contained benzoic,caffeic,ferulic,o-coumaric,and vanillic acids as well as scopoletin. Para-hydroxybenzoic acid was found in exudates from T. aestivum,A. sativa,and two-rowed H. vulgare cultivars. Para-coumaric acid was not identified in root exudates from LC H. vulgare cultivars. Gentisic acid was produced by A. sativa and H. vulgare. Vanillic and o-coumaric acids along with scopoletin may be responsible for the allelopathic effects of H: vulgare,T. aestivum,and A. sativa cultivars. These three compounds may be useful as possible indicators of allelopathic potential of genotypes under development and thus considered for use in breeding programs. [References: 30].

943 Barberi,P. (Universita della Tuscia,Viterbo (Italy). Dipartimento di Produzione Vegetale); Ginanni,M. (Pisa Univ. (Italy). Centro Interdipartimentale di Ricerche Agroambientali); Peruzzi,A.; Nasorri,V.; Raffaelli,M.; Silvestri,N. (Pisa Univ. (Italy). Dipartimento di Agronomia e Gestione dell'Agroecosistema) (1998) **[Mechanical control of wheat weeds by spiked chain harrow on tilled and sod soil [Triticum durum Desf. - Tuscany]].** *Informatore Agrario (Italy) v. 54(42) p. 83-89.* 2 tables; 10 graphs. Italian. (AGRIS 2000-003000).

944 Bell,CE. (1999) **Field evaluation of MKH-6561 for Phalaris minor control in durum wheat.** *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :211-216.* English. [Univ Calif Cooperat Extens Holtville,CA 92250 USA].

Six field experiments have been conducted on durum wheat from 1996 through 1999 in the Imperial Valley of southeastern California,USA to evaluate Phalaris miller control with MKH-6561,a new herbicide being developed by Bayer Co. Phalaris minor is an important weedy annual grass in warm temperate and subtropical cereal growing regions,such as the southwestern USA northern Mexico,the Mediterranean,and south Asia. This grass is not adequately controlled by currently available herbicides. In addition,durum wheat is usually more easily injured by grass control herbicides that are safe to other types of wheat,which further reduces the herbicide options for Phalaris minor control. In these experiments,comparisons of MKH-6561 were made to five herbicides; diclofop-methyl,tralkoxydim,clodinafop,fenoxaprop,and flucarbazone-sodium. Over the six trials,MKH-6561 has provided the most consistent control of Phalaris mirror among the herbicides tested. Crop injury has been observed in some cases,but appears to be related to stage of growth of the crop and herbicide dosage at time of application. Yield data from these trials indicates that MKH-6561,at most of the tested rates and timing of application,is safe to the crop. [References: 10].

945 Blair,AM.; Cussans,JW.; Lutman,PJW. (1999) **A biological framework for developing a weed management support system for weed control in winter wheat: Weed competition and time of weed control.** *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :753-760.* English. [ADAS Boxworth Cambridge CB3 8NN England].

There is a need to target weed control practices more precisely,both for economic and environmental reasons. The development of a Weed Management Support System for winter wheat provides a tool for the effective transfer of optimum advice on herbicides and weed control to farmers and their advisors. The proposed system defines the need for weed control and then selects the treatments to meet that need. Tn order to define the need for control,potential effects of the weeds on wheat yield and profitability have to be integrated with population dynamics data on the longer-term consequences of leaving weeds untreated. This paper concentrates on the competitive effects of weeds and on the effects of herbicide timing,using data for Stellaria media and Alopecurus myosuroides as examples. It describes key elements of a predictive approach to weed management,including; how to predict yield losses,how to incorporate risk into these estimates,reasons for allocating weeds to a limited number of competition classes and the effects of timing of control on yield loss. [References: 13].

946 Cauchy,P. (FMC France S.A.,Saint Didier au Mont d'Or (France)); Laffranque,J.P.; Leblanc,J. (1998) **[Effect of a new active ingredient carfentrazone-ethyle,for the early cleaver control in cereals [carfentrazone-ethyle + MCPPp]].** 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 1 p. 505-512. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 5 ref. French. (AGRIS 2000-002979).

947 Citron,G. (Institut Technique des Cereales et des Fourrages,Boigneville (France). Station Experimentale); Orlando,D.; Viron,H. (1998) **Efficacy of the new herbicids on cereals [Carat (flurtamone + diflufenicanil); Cedra (prosulfocarbe + ioxynil),Laureat (chlortoluron + diflufenicanil),Lexus class (flupyrsulfuron-methyle + carfentrazone-ethyle),Magestan (clodinafop-propargyl + cloquintocet mexyl + ioxynil + MCPP),Allie express (metsulfuron-methyle + carfentrazone-**

ethyle),Platform express (MCPP-P + carfentrazone-ethyle),Lexus XPE (flupyrsulfuron-methyle + metsulfuron-methyle)]. 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 2 p. 603-616. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 7 tableaux. French. (AGRIS 2000-002990).

948 Couloume,B. (Rhone Poulenc Agro France,Lyon (France)); Pelossier,R. (1998) [EXP31511,a new speciality containing pyraflufen,bifenox and ioxynil for post-emergence weed control in soft wheat and winter barley]. 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998;Dijon (France). *Annales ANPP (France) v. 1 p. 513-520. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 5 tableaux. French. (AGRIS 2000-002988).

949 Dahroug,S.M. (Ain Shams Univ.,Cairo (Egypt). Faculty of Agriculture) (1996) Uptake and distribution of Diclofop-Methyl and Fenoxaprop-P-Ethyl in wheat and wild oat. 6. Conference of Agricultural Development Research. Cairo (Egypt). 17-19 Dec 1996. *Annals of Agricultural Science (Egypt) Special Issue,p. 245-253.* 4 tables; 12 ref. English. (AGRIS 2000-002985).

950 Domaradzki,K.; Rola,H. (Institute of Soil Science and Plant Cultivation,Pulawy (Poland). Dept. of Ecology and Weeds Control) (1999) Regulation of degree of weed infestation in cereals with use of reduction herbicide doses. 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 63-71.* 4 tables; 3 ref. Polish. (AGRIS 2000-010817).

The evaluation of herbicides efficacy used in lowered doses was tested during 1996-98. To investigations seven recommended herbicides for weed control in cereals were used. How results from experiments exists possibility to lowering doses of investigated herbicides about 12.5 to 30 percent,obtaining good effects of weed control without significant decrease of yielding of cultivated plants. Usage of the herbicides in lowered doses in spring cereals brings the best effects,particulary on plantations where weeds are a little overgrown and occurs low degree of weeds infestation.

951 Eisele,J.A. (University of Bonn (Germany). Inst. of Organic Agriculture) (1998) Strategies for the control of Vicia hirsuta (L.) S.F. Gray in organic farming. 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3a) p. 705-711.* 7 ill.,7 ref. English. (AGRIS 2000-002982).

952 Feucht,D.; Muller,KH.; Wellmann,A.; Santel,HJ. (1999) BAY MKH 6561 - A new selective herbicide for grass control in wheat,rye and triticale. *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :53-58.* English. [Bayer AG,Agr Ctr Monheim D-51368 Leverkusen Germany].

BAY MKH 6561 is a new sulfonylaminocarbonyltriazolinone herbicide discovered and developed by Bayer. Its mode of action is inhibition of the enzyme acetolactate synthase (ALS). It can be applied post-emergence to wheat,rye and triticale at rates of 30 to 70 g a.i./ha. Target weeds are important grasses such as Bromus species,Alopecurus myosuroides and Apera spica-venti. In addition the product can be used to control the perennial grass Elymus repens selectively; due to its systemic mobility BAY MKH 6561 also kills underground rhizomes of this weed. BAY MKH 6561 has a favourable toxicological and environmental profile. [References: 1].

953 Froud-Williams,RJ. (1999) A biological framework for developing a weed management support system for weed control in winter wheat: Weed seed biology. *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :747-752.* English. [Univ Reading,Dept Agr Bot,Sch Plant Sci 2 Earley Gate Reading RG6 6AU Berks England].

In order to predict the consequences of failure to control weeds in any single season,it is proposed that a knowledge of the population dynamics of the species concerned is essential. For annual species this may be represented by a seed cycle. The various processes within this cycle,viz. seed production,seed rain,seedbank and seedling recruitment,are subject to potential loss which ultimately will affect seed survival and population size. Available information on weed seed biology of selected grass and broad-leaved species is reviewed and notable gaps identified. It is concluded that whilst a wealth of literature is available,a number of areas require further investigation. In particular,with regard to reproductive output further information on the effects of inter and intra-specific competition,sub-lethal herbicide doses,nitrogen rates and genetic variation is required for individual species. So too,with regard to seedbank dynamics,information is notably lacking on post-dispersal predation,post-incorporation mortality,half-lives and seedling mortality post-emergence. [References: 31].

954 Genot,B.; Hullebroeck,M.L. (FMC Europe,Brussel (Belgium)) (1998) Carfentrazone-ethyl + Mecoprop-P (Platform S): a new herbicide for the control of cleavers [Galium aparine] and other broad-leaved weeds [Veronica hederifolia,Veronica persica,Stellaria media] in wheat and barley. 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3a) p. 751-759.* 3 ill. English. (AGRIS 2000-002984).

955 Gibson,G.; de,Kerchove,G. (1999) Timing-related yield increases in winter wheat after applications of MON37500 herbicide to control Barren Brome (Bromus sterilis). *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :87-92.* English. [Monsanto Plc,Agr Sector Maris Lane Cambridge CB2 2LQ England].

Twenty small plot replicated trials were sprayed in Northern Europe between 1996 and 1999,in order to assess the impact on the control of Barren Brome (Bromus sterilis) and yields of winter wheat. The herbicide used was MON37500,a sulfonylurea herbicide which checks the growth of Barren Brome,reducing weed competition with the crop. Applications of herbicide were made in the Spring,from late tillering to stem extension of the crop. Results from this series of trials indicate that removal of competition from Barren Brome is most advantageous when herbicide application is made early in the Spring. Weed control at harvest,measured by biomass reduction,was not significantly better from early or late sprays,but yield increases were more often greater from earlier applications. Untreated yields and the yield increase associated with herbicide treatment were both negatively correlated with weed panicle numbers at harvest. [References: 2].

956 Gobert,L. (Novartis Agro S.A.,Rueil Malmaison (France)); Bouvard,E. (1998) [A new formulation containing clodinafop [clodinafop-propargyl + cloquintocet-mexyl]]. 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 2 p. 625-632. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 7 tableaux. French. (AGRIS 2000-002992).

957 Hamal,A. (INRA,Meknes (Morocco). Lab. de malherbologie); Benbella,M.; Msatef,Y.; Bouhache,M.; Rzozi,S.B. (1998) Integrated strategy combining tillage and herbicide to control the brome (Bromus rigidus Roth) in durum wheat (Triticum durum Desf.) in the Sais area of Morocco. 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3a) p. 817-827.* 11 tables,22 ref. French. (AGRIS 2000-003001).

958 Hamal,A. (Institut National de la Recherche Agronomique,Meknes (Maroc)); Rzozi,S.B.; Benella,M.; Bouhache,M.; Msatef,Y. (1998) **Chemical control of Bromus rigidus in bread wheat Triticum aestivum L.) in Sais,Morocco [TND,metribuzine,dimethenamid,triallate,diclofop-methyl].** 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 2 p. 641-647. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 13 ref. French. (AGRIS 2000-002993).

959 Jasieniuk,M.; Maxwell,BD.; Anderson,RL.; Evans,JO.; Lyon,DJ.; Miller,SD.; Morishita,DW.; Ogg,AG.; Seefeldt,S.; Stahlman,PT.; Northam,FE.; Westra,P.; Kebede,Z.; Wicks,GA. (1999) **Site-to-site and year-to-year variation in Triticum aestivum-Aegilops cylindrica interference relationships.** *Weed Science. 47(5):529-537.* English. [Montana State Univ,Dept Land Resources & Environm Sci Bozeman,MT 59717 USA].

Crop yield loss-weed density relationships critically influence calculation of economic thresholds and the resulting management recommendations made by a bioeconomic model. To examine site-to-site and year-to-year variation in winter Triticum aestivum L. (winter wheat)-Aegilops cylindrica Host. (jointed goatgrass) interference relationships,the rectangular hyperbolic yield loss function was fit to data sets from multiyear field experiments conducted at Colorado,Idaho,Kansas,Montana,Nebraska,Utah,Washington,and Wyoming. The model was fit to three measures of A. cylindrica density: fall seedling,spring seedling,and reproductive tiller densities. Two parameters: i,the slope of the yield loss curve as A. cylindrica density approaches zero,and a,the maximum percentage yield loss as A. cylindrica density becomes very large,were estimated for each data set using nonlinear regression. Fit of the model to the data was better using spring seedling densities than fall seedling densities,but it was similar for spring seedling and reproductive tiller densities based on the residual mean square (RMS) values. Yield loss functions were less variable among years within a sire than among sires for all measures of weed density. For the one site where year-to-year variation was observed (Archer,WY),parameter a varied significantly among years,but parameter i did not. Yield loss functions differed significantly among sites for 7 of 10 comparisons. Sire-to-site statistical differences were generally due to variation in estimates of parameter i. Site-to-site and year-to-year variation in winter T. aestivum-A. cylindrica yield loss parameter estimates indicated that management recommendations made by a bioeconomic model cannot be based on a single yield loss function with the same parameter values for the winter T. aestivum-producing region. The predictive ability of a bioeconomic model is likely to be improved when yield loss functions incorporating time of emergence and crop density are built into the model's structure. Nomenclature: Aegilops cylindrica Host. AEGCY,jointed goatgrass; Triticum aestivum L.,winter wheat. [References: 21].

960 Kulshrestha,G.; Singh,SB.; Yaduraju,NT. (1999) **Mechanism of isoproturon resistance: the metabolism of isoproturon in susceptible and resistant biotypes of Phalaris minor.** *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :167-172.* English. [Indian Agr Res Inst,Div Agr Chem New Delhi 110012 India].

Possible mechanisms of resistance to the photosynthetic inhibiting herbicide isoproturon were examined in a resistant biotype of Phalaris minor from India. Experiments were conducted under controlled and field conditions to evaluate metabolic fate of isoproturon. The resistant biotype tolerated a three times higher dose than the susceptible biotype. In a field experiment,isoproturon was completely degraded in 8 days in the resistant biotype and wheat,but persisted up to 18 days in the susceptible biotype. The toxic monodesmethyl and didesmethyl analogues were found in the susceptible biotype for up to 18 days. In the resistant biotype and wheat,two additional nontoxic metabolites,p-isopropyl aniline and a hydroxy derivative,were detected from 8 days onward confirming that metabolism of isoproturon in resistant P. minor was similar to that in wheat. [References: 11].

961 Legere,A.; Bai,YG. (1999) **Competitive attributes of A-sativa,T-aestivum,and H-vulgare are conserved in no-till cropping systems.** *Weed Science. 47(6):712-719.* English. [Soils & Crops Res & Dev Ctr 2560 Hochelaga Blvd St Foy PQ G1V 2J3 Canada].

The robustness of competitive attributes of cereals such as rapid and uniform seedling emergence,tillering,early biomass accumulation and canopy closure,and height advantage over weeds have not yet been tested under environmental conditions typical of no-till (NT) cropping systems. Our objective was to evaluate the effects of NT practices on growth and productivity of Avena sativa,Triticum aestivum,Hordeum vulgare,and. associated weeds. The experiment was conducted on a Kamouraska clay at La Pocatiere,QC,in 1994,1995,and 1996,Avena sativa,T. aestivum,and H. vulgare were grown under tilled and NT practices. Cereal growth parameters were measured six (1994) or seven (1995) times between planting and the 11th week after planting bur only once in 1996. Grain yields and yield components were determined at crop maturity. Avena sativa and H. vulgare populations were little affected by tillage,whereas T. aestivum populations were reduced by 16 to 20% in NT systems. Growth in height in NT systems was either similar or greater than in tilled systems in all three cereals. Cereal leaf area index (LAI) and biomass accumulation was also comparable between tillage systems,except for T. aestivum LAI in 1994,which was greater in tilled plots on two sampling dates. Response of annual dicots to tillage was inconsistent in all crops. Annual monocots dominated in some but not all NT systems. Perennial dicots dominated in Tar systems,whereas perennial monocots were more abundant in tilled systems in all three cereals. Avena sativa and T. aestivum yields in NT plots were comparable or greater than in tilled plots,in spite of having either lower test weights (A. sativa) or lower 1,000-grain weights (T. aestivum). NT T. aestivum productivity was maintained in spite of reduced plant establishment. Hordeum vulgare yields were also similar across tillage systems,except in 1995,when yields in tilled plots were greater than in NT plots. The height advantage observed for NT H. vulgare did not result in improved yields. All three cereals,and particularly A. sativa,appeared well suited re NT systems,despite the pressure provided by different weed groups,compared To tilled systems. However,results suggest that NT production of cereals could benefit from improved attention to perennial dicot control and crop seedling establishment,particularly for T. aestivum. [References: 41].

962 Lepiece,D. (Dow AgroSciences,Wilrijk (Belgium)); Thompson,A.; McReath,A. (1998) **Florasulam Primus,a new selective triazolopyrimidine sulfonanilide (ALS) herbicide to control broad-leaved weeds in cereals; Belgian results from 1994 to 1997.** 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3a) p. 735-749.* 12 tables,8 ref. English. (AGRIS 2000-002983).

963 Leterrier,J.L. (AgrEvo France,Gif sur Yvette (France)); Gohier,J.M. (1998) **[Interest of two new specialities containing fenoxaprop-p-ethyl and mefenpyr-diethyl for post-emergence grass weed control in cereal].** 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 2 p. 657-664. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 5 tableaux. French. (AGRIS 2000-002994).

964 Miranda,T. (Instituto Nacional des Investigaciones Agrarias,Madrid (Espagne). Departamento de Proteccion Vegetal); Escorial,C.; Chueca,M.C.; Garcia Baudin,J.M. (1998) **Chortoluron response of two lines of Tritordeum (Hordeum x Triticum) [chlorophyll fluorescence].** 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon

(France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 1 p. 213-219. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 12 ref. French. (AGRIS 2000-003002).

965 Novent,O. (Monsanto Technical Center Europe,Louvain la Neuve (Belgique)) (1998) **[MON 37588: a new herbicide for growth control of couch grass rhizome (Elymus repens (L.) Gould).** 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 1 p. 99-105. Association Nationale de Protection des Plantes,Paris (France).* ANPP. French. (AGRIS 2000-002978).

966 Prado,J.L. de; Osuna,M.D.; Prado,R.A. de (Universidad de Cordoba (Spain). Dept. de Quimica Agricola y Edafologia); Shimabukuro,R.H. (1998) **Biochemical and physiological resistance mechanism to diclofop-methyl in Lolium rigidum.** 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3a) p. 681-689.* 4 ill.,2 tables,10 ref. English. (AGRIS 2000-002980).

967 Rapparini,G. (Bologna Univ. (Italy). Dipartimento di Protezione e Valorizzazione delle Risorse Agroforestali) (1998) **[The pre-emergence weed control of cereals [Triticum aestivum L. - Triticum durum Desf. - Avena sativa L. - Hordeum vulgare L. - Secale cereale L.]].** *Informatore Agrario (Italy) v. 54(3) p. 79-89.* 4 tables. Italian. (AGRIS 2000-002996).

968 Rapparini,G. (Universita degli Studi,Bologna (Italie). Centro di Fitofarmacia,Dipartimento di Protezione e Valorizzazione Agroalimentare); Tallevi,G.; Bartolini,D. (1998) **Study of miscibility between grass and broad leaf herbicides applied in post-emergence of wheat.** 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 2 p. 673-680. Association Nationale de Protection des Plantes,Paris (France).* ANPP. French. (AGRIS 2000-002999).

969 Santel,HJ.; Bowden,BA.; Sorensen,VM.; Mueller,KH. (1999) **Flucarbazone-sodium - a new herbicide for the selective control of wild oat and green foxtail in wheat.** *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :23-28.* English. [Bayer Corp Kansas City,MO 64120 USA].

Flucarbazone-sodium is a new sulfonylaminocarbonyltriazolinone herbicide. The product acts as an inhibitor of the enzyme acetolactate synthase (ALS). It provides excellent activity against grass weeds and several important broadleaf weeds when applied post-emergence to wheat. In field experiments conducted in Canada and the US,the product has demonstrated strong and consistent activity against wild oat (Avena fatua) and green foxtail (Setaria viridis). At the suggested use rate of 30 g a.i./ha,both weeds were selectively controlled in wheat. Control of biotypes resistant to ACCase inhibiting herbicides,triallate or dinitroanilines was also observed. Flucarbazone-sodium has an excellent human health and environmental effects profile. [References: 2].

970 Stefan,S. (Institut de Recherches sur la Protection des Plantes,Bucuresti (Roumanie)); Bucur,E. (1998) **[Effect of imazethapyr on crops].** 17. conference du COLUMA. Journees internationales sur la lutte contre les mauvaises herbes. Dijon (France). 9-11 Dec 1998. 17. COLUMA conference. International meeting on weed control,9-10-11 December 1998,Dijon (France). *Annales ANPP (France) v. 1 p. 429-437. Association Nationale de Protection des Plantes,Paris (France).* ANPP. 8 graph. French. (AGRIS 2000-002896).

971 Steinmann,H.H. (University of Goettingen (Germany). Research Center of Agriculture and the Environment) (1998) **Can integrated arable farming systems achieve long-term stability of crop yield and weed infestation?** 50. International Symposium on Crop Protection. Gent (Belgium). 5 May 1998. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen Universiteit Gent (Belgium) v. 63(3a) p. 697-703.* 3 ill.,3 tables,15 ref. English. (AGRIS 2000-002981).

972 Tanveer,A.; Ayub,M.; Ahmad,R. (University of Agriculture,Faisalabad (Pakistan). Dept. of Agronomy); Ali,A. (1999) **Use of wetting agent (Surfactant) to enhance the phytotoxicity of 2,4-D for control of broad leaf weeds in wheat.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 867-868.* 2 tables,9 ref. English. (AGRIS 2000-002997).

A field study was conducted to evaluate the effect of adding a wetting agent to 2,4-D on weed control in wheat. Triton @ 200 and 250 was used as wetting agent with recommended (1.3 kg ha-1) and reduced rate (1.00 kg ha-1) of 2,4-D. Weed check and sole application of 2,4-D was also included for comparison. Different weed control treatments significantly reduced the weed population compared to weedy check. Application of 2,4-D @ 1.3 kg ha-1 added with wetting agent @ 200 ml kg-1 of 2,4-D gave 39 percent more grain yield than weedy check.

973 Tillett,ND.; Hague,T.; Blair,AM.; Jones,P.A.; Ingle,R.; Orson,JH. (1999) **Precision inter-row weeding in winter wheat.** *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :975-980.* English. [Silsoe Res Inst Silsoe MK45 4HS Beds England].

A novel inter-row steerage hoe based on computer vision guidance is described and its row following performance is found to be reliable with an RMS error of 16 mm. Trials to compare the relative performance of the experimental hoe and harrowing using a spring tine weeder are described. Both techniques reduced weed dry weight compared to an untreated control though there was no significant effect on yield. A further complementary experiment to investigate the effect of row width is also described. Results indicate that yield is not affected by row width up to the 22 cm used by the steerage hoe. [References: 5].

974 Tu Xiuliang (Hubei Univ.,Wuhan (China). Inst. of Ecology); Hu Bingmin (1999) **Research on competetitive effects model of Alopecurus aequalis and wheat.** *Journal of Zhejiang Agricultural University (China). Zhejiang Nonye Daxue Xuebao (China) v. 25(1) p. 36-40.* 3 tables; 11 ref. Chinese. (AGRIS 2000-002998).

975 Welsh,JP.; Philipps,L.; Bulson,HAJ.; Wolfe,M. (1999) **Weed control strategies for organic cereal crops.** *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :945-950.* English. [Elm Farm Res Ctr Newbury RG20 0HR Berks England].

Weed control remains one of the most significant agronomic problems associated with organic arable crop production. This paper aims to report the major findings from a series of research projects designed to evaluate a range of weed control approaches. Crop rotation is shown to have a significant effect on weed levels with the most effective control resulting from the alternation of autumn/spring cropping as well as from the inclusion of break crops such as potatoes. Intercropping wheat with field beans offers a competitive advantage over sole cropping,whilst,in isolation,cultivation in darkness was of limited practical use. Spring-tine harrowing in winter wheat was rarely beneficial in terms of improved yield whilst inter-row hoeing demonstrated considerably greater potential. [References: 19].

## J11 HANDLING,TRANSPORT,STORAGE AND PROTECTION OF PLANT PRODUCT

976 Casada,ME.; Alghannam,A. (1999) **Aerating over-dry grain in the Northwest.** *Transactions of the ASAE. 42(6):1777-1784.* English. [Univ Idaho,Dept Biol & Agr Engn Moscow,ID 83844 USA].

Grain in the U.S. Northwest is typically both over-dry and too warm for safe storage after harvest. Laboratory and computer

studies were used to examine aeration with cool and high humidity air to alleviate both deficiencies,while maintaining grain quality with safe storage conditions. A wide range of high humidity aeration conditions was produced in the laboratory to study the effect of moisture condensation on the grain and moisture adsorption during and after cooling the grain. Computer simulations were used to evaluate long-term temperature and moisture changes from aeration. Results demonstrated the possibility of maintaining optimum grain temperature and moisture content when these processes are correctly managed. The tests showed that moisture accumulation (by adsorption),but not moisture condensation,needs to be monitored for safe aeration management. Unsafe storage conditions can occur when aerating for long,or even short,periods with high relative humidity air. [References: 23].

977 Rehman,ZU.; Shah,WH. (1999) **Biochemical changes in wheat during storage at three temperatures.** *Plant Foods for Human Nutrition. 54(2):109-117.* English. [Pakistan Council Sci & Ind Res,Biotech & Food Res Ctr Labs Complex,Ferozpur Rd Lahore 54600 Pakistan].

Biochemical changes in wheat grains stored at 10,25 and 45 degrees C for six months were studied. A significant decrease in pH and an increase in titratable acidity was observed during storage of wheat grains at 25 degrees C and 45 degrees C. Moisture contents of wheat grains decreased by 15% at 25 degrees C and 26% at 45 degrees C during six months of storage. A significant decrease in water soluble amylose (20-28%) along with an increase in insoluble amylose contents (7.6-17%) were observed during storage at 25 and 45 degrees C. Amylase activity of the samples showed a decrease as the storage progressed. Total soluble sugars increased by 9% at 10 degrees C and 12% at 25 degrees C; a 37% decrease was observed after six months storage at 45 degrees C. Total available lysine decreased by 18.0% and 22.6% at 25 and 45 degrees C,respectively,after six months storage. In vitro protein digestibility of wheat grains decreased by 5.00% at 25 degrees C and 10.28% at 45 degrees C during six months of storage. However,no significant biochemical changes occurred during storage at 10 degrees C. [References: 29].

978 Samuels,R.; Modgil,R. (1999) **Physico-chemical changes in insect infested wheat stored in different storage structures.** *Journal of Food Science & Technology-Mysore. 36(5):479-482.* English. [HP Krishi Vishvavidyalaya,Coll Home Sci,Dept Food Sci & Nutr Palampur 176062 Himachal Prades India].

Effect of insect infestation on nutritional quality of wheat stored in jute bags,peru,polythene bags and metal bins was studied by following changes in physical properties (weight,per cent damage and density),proximate composition,energy value,non-protein nitrogen (NPN),uric acid,true proteins,feed efficiency ratio (FER) and protein efficiency ratio (PER). With increase in storage period,significant decreases in weight,density,crude fat,calorific value and true proteins were observed,whereas moisture,ash,crude proteins,crude fibre,non-protein nitrogen and uric acid increased significantly ($P<0.05$). Changes were maximum in wheat,stored in jute bag and minimum in wheat stored in metal bin. Nature of packaging was found to play an important role in determining the extent of infestation damage. [References: 20].

979 White,NDG.; Hulasare,RB.; Jayas,DS. (1999) **Effects of storage conditions on quality loss of hull-less and hulled oats and barley.** *Canadian Journal of Plant Science. 79(4):475-482.* English. [Agr & Agri Food Canada,Cereal Res Ctr 195 Dafoe Rd Winnipeg MB R3T 2M9 Canada].

Oat and barley cultivars were stored at various temperatures (10-30 degrees C) and relative humidities (35-80%) for one year to determine rates of seed deterioration. Two hulled oat cultivars (Robert and AC Marie),one hull-less oat cultivar (AC Belmont),one hulled barley cultivar (Bedford) and one hull-less barley cultivar (Condor) were stored. Experimental data were obtained at specified intervals for fat acidity values (FAV),germination and moisture content to determine the deterioration during storage. FAV were initially 69 mg KOH 100 g(-1) dry seed for AC Marie,43 for Robert,and 46 for AC Belmont oats. Values for barley were 8 mg KOH 100 g(-1) dry seed for Bedford and 9 for Condor. The incidence of microfloral infection by Aspergillus glaucus group,Penicillium spp.,Cladosporium spp.,Rhizopus spp.,and Alternaria alternata during the storage period was determined. Storage guidelines for barley and oat,based on grain moisture and temperature,were related to FAV increases of 1.5-fold for oats and two-fold for barley. Generally,hull-less cultivars of both crops stored as well as hulled cultivars at cool,dry conditions,but they deteriorated faster at high temperatures and high moisture contents. [References: 30].

## L02 ANIMAL FEEDING

980 Hejlesen,C. (1999) **[Palatability experiments with CO2 stored barley].** Pelsdyrerhvervets Foesoegs- og Raadgivningsvirksomhed,Holstebro (Denmark). *Faglig Aarsberetning (Denmark) (no.1998) p. 95-100.* 5 tables. Danish. (AGRIS 2000-011595).

981 Hejlesen,C. (1999) **[Palatability experiments with CO2 stored wheat].** Pelsdyrerhvervets Foesoegs- og Raadgivningsvirksomhed,Holstebro (Denmark). *Faglig Aarsberetning (Denmark) (no.1998) p. 101-106.* 5 tables. Danish. (AGRIS 2000-011596).

982 Kim,M.K.; Paek,J.E. (Ewha Womans University,Seoul (Korea Republic). Department of Food and Nutrition) (1997) **Effect of dietary fibers in rice and barley on lipid and cadmium metabolism in the rat.** *The Korean Journal of Nutrition v. 30(3) p. 252-265.* 10 tables; 66 ref. Korean. (AGRIS 2000-003655).

983 Liu Jiangchang; Pan Tingguo; Su Shuiquan(Fujian Agricultural Uni.,Fuzhou (China). College of Animal Science and Technology) (1998) **Feeding experiment of waste substrate of fungi instead of wheat bran for pigs.** *Chinese Journal of Animal Science (China). Zhongguo xumu zazhi (China) v. 34(2) p. 26-27.* 5 tables; 5 ref. Chinese. (AGRIS 2000-011689).

984 Medel,P.; Salado,S.; de,Blas,JC.; Mateos,GG. (1999) **Processed cereals in diets for early-weaned piglets.** *Animal Feed Science & Technology. 82(3-4):145-156.* English. [Univ Politecn Madrid,Dept Anim Prod,ETSI Agron E-28040 Madrid Spain].

Two trials were carried out to study the influence of cereal processing in diets for early-weaned piglets. Six diets were formulated on an alternate base of two cereals: barley or maize,and three types of processing: control (raw),extrusion and micronization according to a factorial arrangement. In Trial 1,120 male piglets weaned at 23 days and weighing an average of 6.4 kg,were randomly affected by litter in successive blocks and used in a 25-days performance trial. In Trial 2,18 piglets,three animals per treatment,were used to measure apparent faecal digestibility of dry matter (DMD),organic matter (OMD),energy (ED),crude protein (CPD) and neutral detergent fibre (NDFD). Ileal viscosity,and pH of stomach,caecum and colon were also performed. In Trial 1,piglets fed barley-based diets grew faster than piglets fed diets based on maize (423 versus 404 g/d; $P = 0.04$. Heat processing of the cereal improved daily gain (423 versus 396 g/d,$P = 0.01$) and feed conversion ratio (1.18 versus 1.25 g/g,$P = 0.02$) with respect to diets based on raw cereal. An interaction between type of cereal and heat processing was observed for the first 2 weeks of the experiment: the improvement in daily gain associated with heat treatment was higher for barley than for maize (13.7 versus -4.3%; $P = 0.08$). The same occurred for feed efficiency (-14.5 versus 3%; $P = 0.06$). No differences were detected between types of processing for growth or feed efficiency. In Trial 2,maize-based diets had higher DMD (0.908 versus 0.871; $P < 0.001$),OMD (0.921 versus 0.880; $P < 0.001$),ED (0.905 versus 0.863; $P < 0.001$),CPD (0.886 versus 0.860; $P = 0.04$) and NDFD (0.795 versus 0.708; $P = 0.03$),than barley-based diets. Processing of cereals increased digestibility of nutrients but only OMD was improved significantly (0.908 versus 0.886; $P = 0.05$). Neither ileal

viscosity nor pH of stomach and caecum contents were affected by the experimental treatment. Maize-based diets reduced colon pH compared to barley-based diets (6.18 versus 7.00; P < 0.01). It is concluded that processing of cereals improves performance and OMD of diets for piglets and that this improvement is higher for barley than for maize. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 34].

985 Muwalla,MM.; Harb,MY.; Abdullah,AY. (1999) **Optimum use of straw based diets for suckled Awassi ewes.** *Annales de Zootechnie. 48(5):389-395.* English. [Univ Jordan Amman Jordan].

An experiment was conducted using three complete rations containing either 31.2,45.0,or 58.6 % chopped wheat straw. Sixty Awassi ewes were divided into three experimental groups arranged in a randomized block design. Individual feed intake,mill; yield from lambing to weaning of the lambs,and body weight of ewes and lambs were measured. The reduction in barley grain proportions with elevated levels of straw resulted in a reduction of the calculated metabolizable energy (ME) from 10.5 to 9.6 to 8.5 MJ.kg(-1) in rations 1,2,and 3,respectively. The crude protein (CP) contents were 14.2,14.4 and 15.1 % DM for these rations,respectively. The voluntary feed intake decreased significantly and was lowest (P < 0.05) for group 3 until the seventh week,but leveled off thereafter until the end of the experiment at 13 weeks of lactation. Average body weights were 61.2,60.1,and 51.6 kg at the end of eight weeks of the experiment for treatments 1,2,and 3,respectively. The body weights in the third group were significantly lower (P < 0.05) than those of the other groups during the first 8 weeks post-partum. The decreased body weight of the third group was then maintained throughout the experimental period. Thus,the average body weights were 66.2,66.9,and 56.4 kg for rations 1,2,and 3,respectively,at the end of the experimental period. Total milk yields were not significantly different among the three groups,being 34.5,37.9,and 39.0 for groups 1,2,and 3,respectively. Such a pattern of milk yield was not,however; well reflected by the weight of lambs at weaning,which was the lowest (P < 0.05) for group 3 compared with the other experimental groups. ((C) Elsevier / Inra). [References: 30].

986 Nigul,L. (Estonian Agricultural Univ.,Tartu (Estonia)) (1999) **Rye as a feed for swine.** Estonian Academic Agricultural Society,Tartu (Estonia). *Transactions of the Estonian Academic Agricultural Society (Estonia). Proceedings of the Estonian Academic Agricultural Society. April 15-16,1999 (no.10) p. 57-58.* 2 tables; 5 ref. Estonian. (AGRIS 2000-003671).

During the one-month trial period the ration consisting of Provimi enzyme Provizym-cera and 50 per cent of rye guaranteed a very high growth performance of pigs (955g; 2.55 kg/kg),which did not differ from that of the pigs fed barley diet. 17 per cent decrease (to 792g and 3.27 kg/kg) in performance,observed in the following fattening period of the trial,brings into question the necessity of long-term feeding of the above-mentioned ration. The lean meat content of the pig carcasses of both groups was practically similar (59.8 and 58.2 per cent). Obviously the inhibitors in rye might have a certain effect. During the growing and fattening period from 44 to 102 kg the average gain of the pigs of the rye group was 866 g with feed consumption 3.18 kg/kg (P<0.05),which is considered rather good fattening performance in our conditions.

987 Nikolov,I. (Institut po Z"rneni Khrani i Furazhna Promishlenost,Kostinbrod (Bulgaria)); Kozelov,L.; Iliev,F (1999) **Digestibility of rations with different protein resources (maize-gluten meal,sunflower meal and wheat bran) for ruminants.** Selskotopanska Akademiya,Sofia (Bulgaria). *Zhivotnov"dni Nauki (Bulgaria). Animal Science v. 36(3-4) p. 46-49.* 3 tables; 11 ref. Bulgarian. (AGRIS 2000-003650).

Three rations equalized in energy content,row protein,Ca and P were tested.For the first experiment as a source of protein was used maize - gluten meal (MGM),for the secound - wheat bran,and for the third - sunflower meal.Results show a tendency for better digestibility of dry and organic matter for rations with wheat bran and sunflower meal,68.7% and 67% for the dry matter respectively and 70.3 and 68.7 for the organic one compared to the ration with MGM,where it was 64.5% and 66.3% respectively.Digestibiliyt of row proteins in rations conteined MGM and wheat bran what was 70.7% and 70.6% respectively was lower compared to the ration with sunflower meal,that was 74% and the difference being nonsignificant (P>0.005>.

988 Rafique,S. (Arid Zone Research Institute (Pakistan Agricultural Research Council),Quetta (Pakistan).) (1996) **Value of barley grain and cottonseed cake as supplements to fourwing saltbush,and the live weight gains and water consumption of sheep fed the diets.** *Asian-Australasian Journal of Animal Sciences v. 9(6) p. 647-650.* 1 illus.; 2 tables; 12 ref. Korean. (AGRIS 2000-011659).

989 Ridla,M. (Okayama University,Okayama (Japan). Faculty of Agriculture) (1997) **Effects of cellulase and brewers' grains addition on the fermentation quality and nutritive value of barley straw silage.** *Asian-Australasian Journal of Animal Sciences v. 10(6) p. 575-580.* 4 tables; 18 ref. Korean. (AGRIS 2000-011666).

990 Singh,P.; Kishan,J. (1999) **Evaluation of various modes of urea supplementation in straw based diets of Murrah buffalo calves.** *Indian Journal of Animal Sciences. 69(11):986-987.* English. [Indian Vet Res Inst,Anim Nutr Div Izatnagar 234122 Uttar Pradesh India].

991 Weremko,D. (Polish Academy of Sciences,Jablonna near Warsaw (Poland). Animal Physiology and Nutrition); Kim,J.H. (Seoul National University,Suwon (Korea Republic). Department of Animal Science and Technology,College of Agriculture and Life Sciences) (1997) **Bioavailability of phosphorus in feeds of plant origin for pigs.** *Asian-Australasian Journal of Animal Sciences v. 10(6) p. 551-566.* 8 tables; 101 ref. Korean. (AGRIS 2000-011628).

## L51 ANIMAL PHYSIOLOGY-NUTRITION

992 Adogla-Bessa,T.; Owen,E.; Adesogan,AT. (1999) **Ensiling of whole crop wheat with cellulase-hemicellulase based enzymes 3. Comparing effects of urea or enzyme treatment on forage composition and stability.** *Animal Feed Science & Technology. 82(1-2):51-61.* English. [Univ Wales,Welsh Inst Rural Studies Llanbadarn Campus Aberystwyth SY23 4AL Dyfed Wales].

This work compared the effect of ensiling technique and application of urea or a cellulase-hemicellulase enzyme mixture (FSO2) on the conservation of whole crop wheat. A wheat crop harvested at 600 g dry matter (DM) kg(-1) was conserved with or without the application of urea (40 g kg(-1) DM) and four levels of FSO2 (0,1750,3500 and 15 503 ml t(-1) DM). Each forage (5 kg DM) was conserved in polythene-bag silos that were evacuated and sealed immediately sealed immediately but not evacuated or evacuated and sealed after 24 h. After at least 42 days of conservation,the silos were opened and analysed for chemical composition,rumen fluid-pepsin in vitro digestibility and aerobic stability. In non-urea-treated forages,increasing enzyme application rate did not affect in vitro digestibility,but increased water soluble carbohydrate and lactic acid contents,and reduced pH,neutral detergent fibre,acid detergent fibre and cellulose contents. Compared to the FSO2 only treatments,urea treatment increased pH and N content and reduced ensiling DM loss,neutral detergent fibre,acid detergent fibre,acid detergent lignin and cellulose contents. Application of FSO2 and urea (FSO2 + U) produced forages with higher in vitro digestibility and lower cell wall contents than in FSO2 only forages. NDF and ADF contents were also 5-10% lower in FSO2 + U forages than in those conserved with only urea. Immediate evacuation of silos did not enhance fermentation quality. Delaying silo sealing by 24 h increased lactic acid content and aerobic stability relative to either of the immediate seal treatments. Urea treatment alone and the high enzyme level alone also enhanced aerobic stability. However,increasing the enzyme application rate in the FSO2 + U

treatments did not enhance s(t)ability. These findings indicate that in whole crop wheat,the medium (3500 ml t(-1) DM) and high (15 501 ml t(-1) DM) levels of FSO2 application are as effective as urea in degrading cell walls and maintaining aerobic stability. However,nutritive value is optimised when whole crop wheat is conserved using a mixture of urea and the low level (1750 ml t(-1) DM) of FSO2. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 29].

993 Brand,TS.; Franck,F.; Durand,A.; Coetzee,J. (2000) **The intake and nutritional status of sheep grazing wheat stubble.** *Small Ruminant Research. 35(1):29-38.* English. [Elsenburg Agr Ctr Private Bag X1 ZA-7607 Elsenburg South Africa].

Wheat stubble was grazed continuously during the summer (December-April) for 154 days by producing ewes (n=12) from mid-pregnancy to early lactation as well as dry ewes (n=20) at stocking rates of 1 and 2 ewes ha(-1). Available material was determined by quadrate (n=10) during each month,while samples for chemical analysis were also collected monthly by oesophageally fistulated (OF) sheep. Rumen samples were obtained from fistulated,wethers. Intake of ewes was estimated monthly by means of controlled chromium release devices. The average available dry matter was 1771 kg ha(-1) (1 ewe ha(-1)) and 1705 kg ha(-1) (2 ewes ha(-1)) during the experimental period. The mean crude protein (CP),digestible organic matter (DOM),acid detergent fibre (ADF) and neutral detergent fibre (NDF) contents of OF samples were respectively 161,516,407 and 590 g kg(-1) (1 ewe ha(-1)) and 108,520,539 and 721 g kg(-1) (2 ewes ha(-1)) over the experimental period. Dry ewes at the lower stocking rate consumed more (P less than or equal to 0.05) CP than at the higher stocking rate in December (195 vs 150 g ewe(-1) day(-1)) and January (213 vs 149 g ewe(-1) day(-1)). Correspondingly the CP intake of ewes at the lower stocking rate was higher (P less than or equal to 0.05) during mid-pregnancy (253 vs 142 g ewe(-1) day(-1)),late pregnancy (226 vs 91 g ewe(-1) day(-1)) and lactation (277 vs 84 g ewe(-1) day(-1)). The overall mean DOM intake by dry ewes was 850 g d(-1) (1 ewe ha(-1)) and 675 g d(-1) (2 ewes ha(-1)). For producing ewes DOM intake at the lower stocking rate appeared to increase from mid-pregnancy (922 g d(-1)) to late pregnancy (1028 g d(-1)) and lactation (1225 g d(-1)),with an opposite tendency at the higher stocking rate from mid-pregnancy (820 g d(-1)) to late pregnancy (661 g d(-1)) and lactation (658 g d(-1)). Wethers at the higher stocking rate maintained lower rumen NH3-N and VFA concentrations which corresponded to the lower CP and DOM intakes of ewes at this stocking level. Results indicated a need for supplementary protein and energy for pregnant and lactating ewes when grazing wheat stubble at a stocking rate of 2 ewes ha(-1) for such a long period. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 41].

994 Danicke,S.; Simon,O.; Jeroch,H. (1999) **Effects of supplementation of xylanase or beta-glucanase containing enzyme preparations to either rye- or barley-based broiler diets on performance and nutrient digestibility.** *Archiv fur Geflugelkunde. 63(6):252-259.* English. [Fed Agr Res Ctr Braunschweig Volkenrode,Inst Anim Nutr Bundesallee 50 D-38116 Braunschweig Germany].

A growth experiment and a balance study were carried out to examine the effects of supplementation of either a rye (R)- or a barley (B)- based broiler diet with either a xylanase (X)- or a beta-glucanase (beta)-based enzyme preparation on performance and nutrient digestibility. Xylanase addition to the rye based diet improved performance and digestibility parameters to a greater degree than addition of beta-glucanase to the same diet type. Both xylanase and beta-glucanase addition to the barley based diet improved parameters only slightly when compared to the negative barley based control. Beta-glucanase supplementation tended to be more effective than xylanase addition. Birds fed barley based diets performed generally better than those fed the rye based diets. Differences in performance and digestibility between dietary treatments were mainly explained by differences in intestinal viscosity. Viscosity of ileal digesta supernatant of 480.4,308.8,404.2,10.24,5.0,and 4.58 mPas in R,R-X,R-beta,B,B-X,B-beta,respectively,corresponded to respective feed to gain ratios of 2.507,2.197,2.641,1.916,1.903 and 1.879 gig and apparent fat digestibilities of 41.7,68.8,48.4,76.0,78.2 and 80.0 gf 100 g,respectively. [References: 21].

995 Fisher,DJ.; McKinnon,JJ.; Mustafa,AF.; Christensen,DA.; McCartney,D. (1999) **Evaluation of wheat-based thin stillage as a water source for growing and finishing beef cattle.** *Journal of Animal Science. 77(10):2810-2816.* English. [Univ Saskatchewan,Dept Anim & Poultry Sci Saskatoon SK S7N 5B5 Canada].

Two trials were conducted to evaluate the nutritional value of wheat-based thin stillage as a water source for cattle. In Trial 1,20 large-framed steers were fed a basal diet based primarily on barley grain and barley silage,with ad libitum access to water or thin stillage at one of three DM concentrations (2,4,and 6.1%) in a completely randomized design. The trial consisted of a 70-d growing period and a finishing phase. In Trial 2,total-tract nutrient digestibility coefficients of the basal diet and water treatments fed in the growing period were determined in a randomized complete block design using 12 medium-framed steers. The results showed that when only DMI from the basal diet was considered,there was a Linear reduction (P < .01) in DMI and a linear improvement (P < .01) in the gain:feed ratio with no effect on daily gain as thin stillage DM concentration increased. No differences were detected in DMI or efficiency of gain when total DMI (basal diet and thin stillage) was considered. Carcass traits indicated a trend toward increased (P < .06) carcass fat with increasing thin stillage DM concentration. Results of Trial 2 indicated a linear improvement (P < .05) in apparent digestibility of DM,CP,NDF,and energy of the total diet (basal diet and thin stillage) as thin stillage DM concentration increased. We concluded that supplementing growing and finishing cattle with thin stillage reduced the amount of the basal diet required for gain and improved nutrient utilization. [References: 20].

996 Hill,J.; Leaver,JD. (1999) **Energy and protein supplementation of lactating dairy cows offered urea treated whole-crop wheat as the sole forage.** *Animal Feed Science & Technology. 82(3-4):177-193.* English. [Writtle Coll,Dept Agr & Rural Management Chelmsford CM1 3RR Essex England].

Whole-crop wheat treated with 40 kg urea/t/DM was examined in two experiments as the sole forage offered ad libitum. The objective was to evaluate the nutritive value of the forage,and the response in milk production to energy and protein supplements. In Experiment 1,12 Holstein Friesian lactating cows in three 4 x 4 Latin squares were offered four concentrates,A-6 kg/day of 208 g CP kg/DM,B-6 kg/day of 276 g CP kg/DM,C-8 kg day of 208 g CP kg/DM and D-10 kg/day of 208 g CP kg/DM. The apparent digestibility of the forage was measured at maintenance and ad libitum levels of feeding with four Holstein Friesian heifers in a changeover design. In Experiment 2,six Holstein Friesian lactating cows in two 3 x 3 latin squares were offered,E-4 kg/day of a concentrate containing 166 g CP kg/DM,F-4 kg/day of 333 g CP kg/DM (additional soya-bean meal) and G-4 kg/day of 329 g CP kg/DM? (additional soya-bean meal and fish meal). Digestibility of diets was measured in the same cows by the total collection of faeces. In experiments 1 and 2,respectively,mean in vivo DOMD (g/kg/DM) of urea treated whole-crop wheat was 646 and 738,and mean DM intakes (kg/day) were 14.12 and 18.68. These high forage intakes produced only moderate levels of milk production. Estimated energy balances indicated that on average 48 MJ ME intake in Experiment 1,and 70 MJ ME intake in Experiment 2 could not be accounted for in the ME requirements estimated from measured animal performance. This indicates a low efficiency of utilisation of the digested energy of urea-treated whole-crop wheat. Milk production responses to concentrate level were similar to those observed with other types of forage. Additional protein in the supplement from fish meal but not from soya-bean meal significantly increased milk yield. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 27].

997 Inborr,J.; Puhakka,J.; Bakker,J.G.M.; Meulen,J. van der (1999) **Beta-glucanase and xylanase activities in stomach and ileum of growing pigs fed wheat bran based diets with and without enzyme treatment.** Finnfeeds International Ltd.,Marlborough,Wiltshire (United Kingdom). *Archives of Animal Nutrition (Germany) v. 52(3) p. 263-274.* English. (AGRIS 2000-004224).

998 Iwanchysko,P.; McKinnon,JJ.; Mustafa,AF.; Christensen,DA.; McCartney,D. (1999) **Feeding value of wheat-based thin stillage: In vitro protein degradability and effects on ruminal fermentation.** *Journal of Animal Science. 77(10):2817-2823.* English. [Univ Saskatchewan,Dept Anim & Poultry Sci Saskatoon SK S7N 5B5 Canada].

Two experiments were conducted to evaluate the nutritive value of wheat-based thin stillage as a fluid source for ruminants. In vitro CP degradability of thin stillage was estimated relative to canola meal and heated canola meal in a completely randomized design. Four ruminally cannulated steers were used in a double cross-over design to determine the effects of consuming thin stillstge or water as drinking sources on ruminal fermentation traits. The in vitro CP degradability of thin stillage (55.4%) was lower (P < .05) than that of canola meal (59.4%) and higher than that of heated canola meal (31.6%). Ruminal pH for steers consuming thin stillage was higher (P < .05) at 1000 and 1100 and lower (P < .05) at 1900 and 2000 than that for steers consuming water. Total VFA followed a pattern that was the reverse of that reported for pH. Ruminal NH3 N levels were higher (P < .05) for steers fed thin stillage than for water-fed steers through most of the collection period. Ruminal fluid and particulate matter passage rates were not affected by treatment and averaged .165 and .06 /h,respectively. The amount of thin stillage and water that did not equilibrate with the ruminal fluid and,thus,was considered to bypass the rumen was estimated to be 51.9 and 59.2% of total fluid consumed,respectively. Feeding wheat-based thin stillage had no adverse effects on ruminal metabolism. [References: 38].

999 Jaroni,D.; Scheideler,SE.; Beck,MM.; Wyatt,C. (1999) **The effect of dietary wheat middlings and enzyme supplementation - II: Apparent nutrient digestibility,digestive tract size,gut viscosity,and gut morphology in two strains of leghorn hens.** *Poultry Science. 78(12):1664-1674.* English. [Univ Nebraska Lincoln,NE 68583 USA].

An experiment was conducted with two strains of Leghorn hens,DeKalb Delta (D) and Hisex White (H),to investigate the effect of a commercial poultry enzyme preparation (EZ; xylanase plus protease) on the digestibility of protein,fat,Ca,and P and to determine any changes in the relative size of the digestive tract,gut morphology,and gut viscosity (GV) of birds fed wheat middlings (WM) over an 18-wk period. Three hundred birds (150 birds per strain) were randomly assigned to six diets: Diet 1,control (corn-soybean); Diets 2 and 3,8% and 16% WM,respectively; Diet 4,8% WM and 0.1% enzyme (EZ); and Diets 5 and 6,16% WM and 0.1% and 0.2% EZ,respectively. There were five replicates per diet per strain. At 50 wk,protein digestibility increased significantly with supplementation of EZ,but,at 60 wk,all responses were similar. Protein digestibility was greater in DeKalb Deltas for WM with EZ compared with Hisex on the same treatment. Fat digestibility was greater for Diet 1 than the other diets at 50 wk but showed a similar response at 60 wk. The PI strain showed a reduction in fat digestibility with WM diets with EZ. The control diet showed greater Ca digestibility than the other diets at 50 wk but did not differ at 60 wk. Phosphorus digestibility increased significantly for WM diets with or without EZ at 60 wk. Intestinal weight was significantly higher for WM with or without EZ at 50 wk,but was equal to the control diet at 60 wk. At 60 wk,gizzard weights (GW) were also lower in birds fed WM and WM with EZ compared with birds fed the control,but GV was not affected by dietary treatments. Histological observations on jejunum of birds fed WM without EZ showed shortening,thickening,and atrophy of the villi,all of which improved when EZ was included in the diet. Availability of some nutrients in WM diets was improved with supplementation of enzyme. Gastrointestinal (GI) tract and organ size were increased,and gut morphology appeared to be improved. [References: 38].

1000 Laurinen,P.; Siljander-Rasi,H.; Karhunen,J.; Alaviuhkola,T.; Nasi,M.; Tuppi,K. (2000) **Effects of different grinding methods and particle size of barley and wheat on pig performance and digestibility.** *Animal Feed Science & Technology. 83(1):1-16.* English. [Agr Res Ctr FIN-31600 Jokioinen Finland].

The effect of grinding method of barley and wheat on total tract digestibility of barley-soyabean meal and wheat-soyabean meal diet,N-balance (experiments 1 and 2) and pig performance (experiments 3 and 4) was studied. Cereals were ground by four mill types and there were two degrees of grinding fineness within each mill type. Mill types were a hammer mill (HM,sieve size 3 and 5 mm),a crimping roller mill (RM1,gap between rolls 0.5 and 0.8 mm),a flattening roller mill (RM2,gap between rolls 0.15 and 0.35 mm) and a triple roller mill (RM3,gap between the Ist and 2nd roll 0.2 and 0.65 mm,gap between the 2nd and 3rd roll was fixed at 0.65 mm). Data were analysed in a nested design,mill type as the main treatment tall 4 mill types in experiments 1,3 and 4,mill types HM,RM1 and RM2 in Experiment 2) and fineness of grinding (fine and coarse) as the subtreatment within each mill type. Digestibility and N-balance experiment with barley was conducted with eight castrated male pigs (25.9-91.9 kg) in a 8 x 6 cyclic change-over design (Experiment 1) and with wheat,using 12 castrated male pigs (31.2-83.8 kg) in two 6 x 6 Latin square design (Experiment 2). A growth experiment was conducted with 160 growing-finishing pigs (25.2-101.5 kg) housed per pair tone female and one castrated male per pen,10 pens per treatment) with barley (Experiment 3) and an other 160 pigs (25.2-100.3 kg) with wheat using the same procedure (Experiment 4). RM1 depressed digestibility of crude protein ($p < 0.05$ and $p < 0.10$,with barley and wheat) and ether extract ($p < 0.01$ and $p < 0.05$,with barley and wheat) in both cereals and improved digestibility of NDF ($p < 0.01$) and crude carbohydrates,which were defined as total organic matter - (ether extract + crude protein) ($p < 0.05$) in barley compared to the other mill types. Coarse grinding within RM1 decreased all measured digestibilities ($p < 0.05$) in both cereals,except for NDF in barley,compared to fine grinding. The mill type had no effect on N retention g/day,but the proportion of faecal N excretion was increased with RM1 and RM3 barley ($p < 0.05$) and with RM1 and RM2 wheat compared to hammer milling ($p < 0.10$). Coarse grinding within RM1 increased the proportion of faecal N excretion with both cereals compared to fine grinding. RM1 increased the total feed consumption with barley and depressed the daily gain and feed conversion ratio ($p < 0.10$) compared to the other mill types. The coarse grinding within RM1 and RM3 increased barley based feed consumption ($p < 0.10$) and depressed daily gain and feed conversion ratio ($p < 0.05$),but neither mill type nor fineness of grinding had any effect on carcass quality with barley. The mill type had no effect on feed intake,pig performance or carcass quality with wheat. It was concluded that mill type had no effect on dry matter and gross energy digestibility in barley and wheat. Also,pig performance with rolled barley and wheat was equal to that obtained with hammer milled cereals,if the total feed consumption was not influenced by the grinding method. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 27].

1001 Lizardo,R.; Peiniau,J.; Lebreton,Y.; Aumaitre,A. (1999) **Digestive consequences of including extruded wheat and non-starch polysaccharides in the diet of weaning piglets.** *Sciences des Aliments. 19(3-4):333-347.* French. [Inst Natl Rech Agron,Rech Porcines Stn F-33590 St Gilles France].

The faecal and ileal digestibility of dietary non-starch polysaccharides (NSP) fractions (and other major components),as well as the activity of pancreatic and intestinal enzymes have been measured in weaning piglets,fed diets containing either raw or extruded wheat combined with sugar beet pulp. Extrusion of wheat caused no observable effect either on the digestibility of dietary NSP (and other major dietary components) or on the enzyme activities in the small intestine. Faecal digestibility of dietary gross energy,nitrogen and neutral detergent fibre (NDF) was not affected by the presence of sugar beet pulp. However,an

increase in the flow of ileal chyme significantly reduced the ileal digestibility of energy (P<0.01) and that of NDF (P<0.01). In contrast,the postileal digestibilities of energy,nitrogen and NDF were increased by 0.08,0.12 and 0.06,respectively. In the presence of sugar beet pulp,the faecal digestibility was almost complete for mannose and galactose,whilst that of arabinose and uronic acids was increased from 0.672 to 0.720 (P<0.01) and from 0.953 to 0.968 (P<0.05),respectively. Similarly,the ileal digestibility of pentoses was very low; that of mannose and galactose were reduced by 0.15 and 0.12,respectively,whereas that of uronic acids was increased by 0.05. Only the activity of pancreatic lipase was slightly increased by the inclusion of sugar beet pulp in the diet (P<0.10). The activities of other pancreatic and intestinal enzymes were not affected. In conclusion,the inclusion of a low level of sugar beet pulp in the weaning diet could contribute to the development of the digestive capacity of the piglet. [References: 36].

1002 Mandebvu,P.; Galraith,H. (1999) **Effect of sodium bicarbonate supplementation and variation in the proportion of barley and sugar beet pulp on growth performance and rumen,blood and carcass characteristics of young entire male lambs.** *Animal Feed Science & Technology. 82(1-2):37-49.* English. [Univ Aberdeen,Dept Agr 581 King St Aberdeen AB9 1UD Scotland].

Forty-eight Suffolk x Mule entire male lambs (22.3 kg average live weight,two months old) were used to study the effects of addition of sodium bicarbonate and increasing quantities of molassed sugar beet pub (MSBP) to diets based on barley grain (780 g kg(-1) fresh weight and approximately iso-energetic and iso-nitrogenous). Measurements were made of dry matter (DM) intake,growth,some ruminal and blood plasma metabolites and hormone profiles and body composition. The animals were allocated by randomised block design on the basis of live weight to one of six dietary treatments and an initial slaughter control group (n = 7 and mean live weight = 22.3 kg per treatment). Animals in the initial slaughter control group were slaughtered on Day 1 of the study in which barley was supplemented with sodium bicarbonate (15 g kg(-1) fresh weight) (Experiment A) or replaced with increasing quantities of MSBP in a separate experiment (B) to provide diets containing 75,50,25 and 0% of the maximum quantity of barley (Experiment B). The diets had similar in vitro dry matter digestibility and contained similar estimated values for metabolisable energy concentration. In Experiment A,the inclusion of sodium bicarbonate had no significant effect on Live weight gain,DM intake,feed utilisation efficiency,ammonia concentration and the molar proportion of ruminal volatile fatty acids,rumen fluid,carcass and soft tissue characteristics and composition. In Experiment B,increases in level of barley in the diet had no effect on ruminal pH,but linearly increased the molar proportion of propionate in rumen fluid (p < 0.01),hot- and cold-carcass weights (p < 0.01),empty body weight (p < 0.01),perirenal and retroperitoneal fat (p < 0.05) and gain of crude protein in cold carcass (p < 0.01). Evidence was also obtained for decreases in concentrations of ruminal ammonia and plasma area associated with increasing concentrations of dietary MSBP. Certain significant quadratic effects on plasma insulin concentration,which were not associated with indices of carcass and digesta-free body growth,were also recorded. It is concluded that the diet based on MSBP alone was not utilised as effectively for growth and body weight gain as MSBP-based diets also containing barley grain. The results suggest that any limitations in growth performance by entire male lambs fed a diet containing high levels of MSBP may be effectively abolished by the replacement with barley at a substitution rate of 25% or greater. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 16].

1003 Martin,C.; Philippeau,C.; Michalet-Doreau,B. (1999) **Effect of wheat and corn variety on fiber digestion in beef steers fed high-grain diets.** *Journal of Animal Science. 77(8):2269-2278.* English. [INRA Theix,Unite Rech Herbivores F-63122 St Genes Champanelle France].

Six Salers steers,fitted with ruminal and duodenal cannulas,were used in a double 3 x 3 Latin square design to assess the depressive effect of the nature of wheat,flint corn,and dent corn on fiber digestion in animals fed high-concentrate diets,and to determine the mechanisms involved in these negative digestive effects. Diets were balanced to be equal in starch content (47.7 +/- 2.3%). The three cereals were characterized by ruminal starch digestibilities of 86.6,60.8,and 34.8% for the wheat,dent corn,and flint corn,respectively. Ruminal digestion of NDF was lower with wheat- than with corn-based diets (49.4 vs 55.2%; P < .001),and with dent corn than with flint corn (53 vs 57.3%; P < .01). Degradability of hay in nylon bags was not affected by the grain source in the diet (P > .1). The mean retention time of forage particles in the rumen was similar between wheat and corn diets (P >.),but it was lower for steers fed dent corn than for those fed flint corn (P < .05). Most fibrolytic activities of the solid-associated microorganisms were lower (P < .05) in animals fed wheat than in those fed corn. Differences in fibrolytic activities of the solid-associated microorganisms between the two corn genotypes were not statistically significant (P > .1),but activities of all fibrolytic enzymes were lower (P < .05) with the dent than with the flint corn diet. Protozoal number in ruminal fluid was lower in animals receiving wheat than in those fed corn (177 vs 789 x 10(3)/mL; P < .001) and was related to the high ruminal acidity (P < .01) of the wheat diet. Large modifications in the rumen microbial ecosystem between the two corn genotypes were not visible ia protozoal numbers or pH. Total-tract digestion of NDF was the same for wheat and for corn diets,averaging 55% for the three diets. A postruminal compensation of NDF digestion (14% of the total tract NDF digestion) seemed to occur with the wheat diet. The lack of any postruminal NDF digestion (0%) with the two corn diets may suggest negative digestive interactions in the hindgut similar to those in the rumen. [References: 48].

1004 Oloffs,K.; Jeroch,H.; Schoener,F.J. (1999) **The efficiency of non-starch-polysaccharide hydrolysing enzymes on nutrient digestibility and gross energy convertibility of barley/rye and wheat/rye diets for laying hens.** Halle-Wittenberg Univ.,Halle (Germany). Inst. fuer Tierernaehrung und Vorratshaltung. *Archives of Animal Nutrition (Germany) v. 52(2) p. 155-165.* German. (AGRIS 2000-004109).

1005 Philippeau,C.; Martin,C.; Michalet-Doreau,B. (1999) **Influence of grain source on ruminal characteristics and rate,site,and extent of digestion in beef steers.** *Journal of Animal Science. 77(6):1587-1596.* English. [INRA Theix,Stn Rech Nutr Herbivores F-63122 St Genes Champanelle France].

Six cannulated Salers steers (305 +/- 17 kg initial BW) were used in a double 3 x 3 Latin square design to compare the effects of the nature of the cereal (wheat vs corn) and the corn genotype (dent vs flint) on rate,site,and extent of digestion of high-concentrate diets. The cereals were coarsely cracked,and the diets were balanced to have the same percentage of starch (47.7 +/- 2.3%) and CP (14.6 +/- .7%). Differences in ruminal starch digestion were observed between wheat- and corn-based diets (86.6 vs 47.8%; P < .001) and between corn genotypes (60.8 vs 34.8% for dent and flint corns; P < .001). For flint corn,more than half the starch was digested in the hindgut. Total tract digestion of starch was greater (P < .001) by steers fed wheat than by those fed corn and did not differ (P > .1) between the two corn genotypes. Ruminal mean pH (P < .01) was lower and total VFA concentration (P < .1) was higher for wheat- than for corn-based diets. Ruminal acetate:propionate tended to increase with the decrease in the amount of starch degraded in the rumen,but differences were not significant (P > .1). When wheat replaced corn,nonammonia,nonmicrobial N duodenal flow decreased (P < .01),and microbial duodenal flow increased (P < .05),so there were no differences in the duodenal flow of nonammonia N duodenal flaw (P > .1). The lower nonammonia N duodenal flow for the dent corn- than for the flint corn-based diet (P < .05) was related to a lower passage of nonammonia,nonmicrobial N into the duodenum. Efficiency of microbial protein synthesis was inversely correlated with the amount of starch degraded in the rumen. Nature of the cereal,wheat vs corn,and genotype of the corn,dent vs flint,alter the site and extent of starch digestion. [References: 46].

1006 Prestlokken,E. (1999) **Ruminal degradability and intestinal digestibility of protein and amino acids in barley and oats expander-treated at various intensities.** *Animal Feed Science & Technology. 82(3-4):157-175.* English. [Agr Univ Norway,Dept Anim Sci POB 5025 N-1432 As Nlh Norway].

The objectives of the experiment were to study effects of pelleting or expander treatment at various intensities (mild,medium,hard or maximum) prior to pelleting at two temperatures in the mixer-conditioner (60 and 75 degrees C) on ruminal degradation and intestinal digestibility of protein and amino acids in barley and oats,using nylon bag methods. Temperatures achieved were 85-95,100-110 and 115-125 degrees C at mild. medium and hard intensity,whereas maximum temperature achieved was 125 degrees C for barley and 140 degrees C for oats. Thus,temperatures higher than 130-135 degrees C appeared unrealistic under commercial conditions. Pelleting decreased ruminal degradation of protein,especially at high temperature in the mixer-conditioner. Expander treatment decreased ruminal degradation of protein further and the lowest effective protein degradability (EPD) achieved was 30% for barley and 29% for oats,both obtained at maximum temperature in the expander and high temperature in the mixer-conditioner. These values are low compared to previous results and need to be verified. No negative effects of treatment on digestibility of protein were observed. This indicates that the treatments shifted site of protein digestion from the rumen to the small intestine. Expander treatment did not alter the contents of any individual amino acid either in barley or in oats. Expander treatment reduced ruminal degradation of total amino acids to the same extent as protein. The variation in ruminal degradation among amino acids was considerable. Thus,ruminal degradation of protein cannot be used for determination of ruminal degradation of all individual amino acids. Expander treatment did not increase the content of indigestible amino acids in barley or oats,indicating that amino acids were not heat-damaged. (C) 1999 Elsevier Science B.V. All rights reserved. [References: 38].

1007 Sahoo,B.; Saraswat,ML.; Haque,N.; Khan,MY. (2000) **Energy balance and methane production in sheep fed chemically treated wheat straw.** *Small Ruminant Research. 35(1):13-19.* English. [Indian Vet Res Inst,Div Anim Nutr Bareilly 243122 Uttar Pradesh India].

Ram lambs of:the Muzaffarnagari breed weighing 42 kg were randomly assigned to three groups of five animals. These animals were used to study the effect of chemically treated wheat straw on methane production and energy balance. Wheat straw was treated either with urea (4 kg urea per 100 kg DM) with a storage time of 21 days (treatment I; control) or with urea (1.5 kg per 100 kg DM) without storage time (treatment II) or with urea plus calcium hydroxide (3 kg urea plus 3 kg calcium hydroxide per 100 kg DM) with a storage time of 21 days (treatment III). All straws were fed ad libitum,The crude protein content of wheat straw during feeding was 7.8%,7.9% and 7.6% in treatments I-III,respectively. Corresponding dry matter (DM) intake was 43.7,34.9 and 49.5 g kg(-1) W-0.75,respectively which was significantly higher in treatment III than that of treatment II. The DM digestibility in treatments I (54.2%) and III (50.9%) was higher than that of treatment II (42.7%). The digestible energy (DE) intake that was measured in kJ kg(-1) W-0.75 d(-1) was higher in treatments I (412) and III (471) than that of treatment II (282),Similar trend was observed in metabolizable energy (ME) intake. Methane production per kg digested organic matter (OM) per d was lower in treatments I (301) and III (291) than that of treatment II (461). The energy balance was measured in kJ kg(-1) W-0.75 d(-1) in treatments I-III,respectively. The energy balance in treatments I (113) and III (170) was higher than that of treatment II (-40). It is concluded that treatment of straw with urea and/or a mixture of urea with calcium hydroxide followed by storage can improve digestibility compared to spraying with urea solution prior to feeding and also reduce methane production per kg digested OM and increase energy balance. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 21].

1008 Villalba,JJ.; Provenza,FD. (2000) **Postingestive feedback from starch influences the ingestive behaviour of sheep consuming wheat straw.** *Applied Animal Behaviour Science. 66(1-2):49-63.* English. [Utah State Univ,Dept Rangeland Resources Logan,UT 84322 USA].

Plant species present a complex array of biochemicals to herbivores that in conjunction with a plant's physical structure influence intake. Our objective was to determine the role of postingestive feedback from macronutrients on the ingestion of a low-quality forage by sheep (Ovis aries). We compared the ingestive behaviour of two groups of lambs conditioned with intraruminal infusions of starch (100 g/lamb/day; Group 1) or water (250 ml/lamb/day; Group 2) while they grazed wheat straw (held erect in wooden frames; 30 cm height; Trials 1,2 and 3) or consumed wheat straw from food boxes (1-2 cm particle size; Trial 4). Lambs were conditioned as individuals during Trials 1 and 4,in pairs during Trial 2,and as two groups (Groups 1 and 2) during Trial 3. Ingestive behaviour - intake,intake rate,number of bites,bite size,bite rate was assessed during individual tests that lasted 5 min/lamb. After conditioning and testing,all animals had restricted access (80% of their daily energy requirements) to a basal diet of alfalfa pellets. No differences between soups were detected during initial tests (before infusing starch) or during Trial 1 ($P > 0.05$). Lambs conditioned with starch in Trial 2 consumed more straw (8 vs. 2 g; $P < 0.05$) at higher rates (2.3 vs. 1.0 g/min; $P < 0.1$),and took more (13 vs. 5; $P < 0.1$) and larger (0.59 vs. 0.31 g/bite; $P < 0.05$) bites than lambs conditioned with water. This pattern was maintained during Trial 3: Lambs infused with starch showed higher intake (24 vs. 5 g; $P < 0.01$),intake rate (5.4 vs. 1.4 g/min; $P < 0.001$),bites (29 vs. 10; $P < 0.01$),bite rate (6.7 vs. 2.6 bites/min; $P < 0.01$) and bite size (0.86 vs. 0.54 g/bite; $P < 0.05$) than lambs infused with water. In Trial 4,lambs conditioned with starch consumed more straw (21 vs. 9 g; $P < 0.1$),at higher rates (5.4 vs. 2.6 g/min; $P<0.1$),than lambs conditioned with water. Thus,the postingestive effects of energy played an important role in modulating rates of food intake,and our findings suggest postingestive feedback from macronutrients is a fundamental factor influencing the ingestive behaviour of herbivores. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 39].

1009 Yin,YL.; McEvoy,JDG.; Schulze,H.; Hennig,U.; Souffrant,WB.; McCracken,KJ. (2000) **Apparent digestibility (ileal and overall) of nutrients and endogenous nitrogen losses in growing pigs fed wheat (var. Soissons) or its by-products without or with xylanase supplementation.** *Livestock Production Science. 62(2):119-132.* English. [Queens Univ Belfast,Dept Agr & Environm Sci Newforge Lane Belfast BT9 5PX Antrim North Ireland].

The main aims of this experiment were: 1) to study the sites and extent of digestion of the nutrients in wheat (var. Soissons) and its by-products (bran,middlings) and in recombined wheat (flour + bran + middlings); 2) the contribution of microbial action (VFA apparent production) and endogenous secretion of N in the small intestine; and 3) interactions with an exogenous non-starch polysaccharide (NSP) degrading enzyme (xylanase). The post valve "T" caeçal cannulae (PVTC,12 pigs) and end-to-end ileo-rectal anastomosis (IRA,30 pigs) ileal digesta collection methods with TiO2 and Cr2O3 as the indigestible markers,and the N-15-isotope dilution technique were used in this study. Four diets,based on wheat (W),recombined wheat (WR),wheat plus bran (WB) or wheat plus middlings (WM) were used without or with xylanase addition. NSP content was highest in the diet based on wheat bran and lowest in the W and WR diets. Recombination of the milled fractions had no effect on digestibility values relative to the ground wheat. Negative correlations ($P < 0.001$) occurred for apparent overall and ileal digestibility of dry matter (DM),energy,crude protein (CP) and amino acids with NSP content,As shown in some previous studies,NSP contributed to a higher ileal flow of endogenous nitrogen ($P < 0.001$) and volatile fatty acids (VFA) ($P = 0.021$) and the proportion of DM fermented in the large intestine was increased ($P (0.001)$. Although statistically significant ($P < 0.05$),the improvements associated with enzyme addition in overall apparent digestibility of DM,CP and gross energy were only of the

order of 1% and those at the ileal level were less than 2% (P > 0.05). However,with the WE diet the improvements for all three parameters were approximately 2% for overall apparent digestibility and 4% for ileal apparent digestibility. (C) 2000 Elsevier Science BN. All rights reserved. [References: 51].

*1010* Zyla,K.; Koreleski,J.; Swiatkiewicz,S.; Wikiera,A.; Kujawski,M.; Piironen,J.; Ledoux,DR. (2000) **Effects of phosphorolytic and cell wall-degrading enzymes on the performance of growing broilers fed wheat-based diets containing different calcium levels.** *Poultry Science. 79(1):66-76.* English. [Univ Agr,Dept Food Biotechnol 29 Listopada Ave 46 PL-31425 Krakow Poland].

A study was conducted to determine the cumulative effects of phosphorolytic enzymes,cell wall-degrading enzymes,and citric add and Ca levels on feed intake,BW gain (BWG),feed conversion,intestinal viscosity,and toe ash of broilers (d 1 to 21) fed wheat-based diets. Broilers were fed the following six diets at either 0.59,0.69,or 0.79% Ca: 1) a negative control (NC) diet,0.17% available P;2) NC + 750 phytase units/kg diet; (3) phytase + 3,156 units of acid phosphatase/kg diet; 4) phytase + add phosphatase + 1,900 units of pectinase/g diet; 5) phytase + acid phosphatase + pectinase + 3% citric acid; and (6) NC plus 0.24% available P. The 18 dietary treatments were fed to four pen replicates of eight birds each. Phytase addition at the low Ca level increased BWG,improved feed intake and conversion and toe ash,and reduced intestinal viscosity and Ileal length. Subsequent addition of acid phosphatase,at 0.69% Ca,resulted in increases in BWG,42%; feed intake 32%; feed conversion 7.5%; and toe ash,63% over the NC diet. Pectinase addition produced further improvements in 21-d BWG and feed intake at 0.59 and 0.79% Ca,increased toe ash in chicks fed 0.79% Ca,and reduced intestinal viscosity. Supplementation of wheat-based 0.17% available P diets with phytase and acid phosphatase and with appropriate concentrations of pectinase,citric acid,and Ca significantly improved BWG,feed intake and conversion and intestinal viscosity over the 0.41% available P diets. Bone mineralization of chicks fed phytase + acid phosphatase and 0.69% Ca and these fed phytase + acid phosphatase + pectinase + citric add and 0.59% Ca was similar to that of chicks fed the 0.41% available P diets. [References: 35].

## L72 PESTS OF ANIMALS

1011 Waldenstedt,L.; Elwinger,K. (SLU,Uppsala (Sweden)); Hooshmand Rad,P.; Thebo,P.; Uggla,A. (1999) **Comparison between effects of standard feed and whole wheat supplemented diet on experimental Eimeria tenella and Eimeria maxima infections in broiler chickens.** *Acta Veterinaria Scandinavica (Denmark) v. 39(4) p. 461-471.* 2 ill.,5 tables; 17 ref. English. (AGRIS 2000-012355).

## N20 AGRICULTURAL MACHINERY AND EQUIPMENT

1012 Radojevic,R.; Pavlekic,S.; Oljaca,M. (Poljoprivredni fakultet,Beograd Zemun (Yugoslavia)) (1998) **Cleaning system research in wheat combines.** *Poljoprivredna tehnika (Yugoslavia) v. 22(2) p. 37-44.* 7 graphs; 1 table; 8 ref. Serbian. (AGRIS 2000-012898).

Air velocities were measured in a combine cleaning shoe above the upper chaffer. Here are given average air velocities estimated during investigation conducted in the two Yugoslav "Zmaj" combines Z-143 and Z-191 H,used for harvesting soybean. Fans for these cleaning systems are with one section,centrifugal with six rotary blades. Air velocities were measured above the upper sieve,and it was found that uniformity of flow was not satisfactory in the middle of the sieve,because of lower velocities. This might be the reason for inappropriate grain cleaning.

## P06 RENEWABLE ENERGY RESOURCES

1013 Schmidt,A.S.; Tenkanen,M.; Thomsen,A.B.; Woidemann,A. (1998) **Hydrolysis of solubilized hemicellulose derived from wet-oxidized wheat straw by a mixture of commercial fungal enzyme preparations.** Risoe National Lab.,Roskilde (Denmark). *Risoe-R (Denmark); no. 1042(EN) 41 p.* Risoe. 10 ill.,8 tables; 65 ref. English. (AGRIS 2000-013298).

1014 Thomsen,A.B.; Schmidt,A.S. (1999) **Further development of chemical and biological processes for production of bioethanol: optimisation of pre-treatment processes and characterisation of products.** Risoe National Lab.,Roskilde (Denmark). *Risoe-R (Denmark); no. 1110 74 p.* RNL. 40 ill.,54 tables; 41 ref. English. (AGRIS 2000-013299).

## P33 SOIL CHEMISTRY AND PHYSICS

1015 Bhushan,L.; Sharma,P.K. (Himachal Pradesh Krishi Vishwavidyalaya,Palampur (India). Department of Soil Science). (1999) **Effect of depth,bulk density and aeration status of root zone on productivity of wheat.** *Journal of the Indian Society of Soil Science (India). v. 47(1) p. 29-34.* 1 fig.; 3 tables; 11 ref. English. (AGRIS 2000-005182).

1016 Maiksteniene,S. (Lithuanian Institute of Agriculture,Joniskelis (Lithuania). Joniskelis Research Station) (1997) **Improvement of the properties of heavy soils by increased rates of organic matter.** 14. ISTRO Conference on Agroecological and Ecological Aspects of Soil Tillage Pulawy (Poland). 27 Jul - 1 Aug 1997. *Fragmenta Agronomica (Poland) v. 2B p. 439-442.* 2 tables; 10 ref. English. (AGRIS 2000-013677).

The highest amount of humus accumulated in the treatments where Italian ryegrass and spring rape had been incorporated in the soil. The highest amount of the most valuable stable aggregates was in the treatment where by-product and clover aftermath had been ploughed down annually. An increased organic matter application on heavy loam soil improved agrochemical properties and increased nutrient content. Such positive change of heavy loam soils resulting from the application of various organic matters increased the yield of the crop rotation plants. The yield increase,as compared with the check treatment,made up 11.8,5.1 and 6.2 percent respectively.

1017 Sarkar,S.; Singh,S.K.; Singh,S.R.; Singh,A.P. (Banaras Hindu University,Varanasi (India). Institute of Agricultural Sciences). (1999) **Influence of initial profile water status and nitrogen dosses on yield and evapotranspiration rate of dryland barley.** *Journal of the Indian Society of Soil Science(India). v. 47(1) p. 22-28.* 1 ill.; 4 tables; 10 ref. English. (AGRIS 2000-005064).

## P34 SOIL BIOLOGY

1018 Chmiel,M.; Pasmionka,I. (Akademia Rolnicza,Krakow (Poland). Katedra Mikrobiologii) (1998) **Occurrence of toxin producing fungi in the phyllosphere of cultivated plants in Cracow region.** 31. All-Polish Microbiological Symposium: Biologically Active Metabolites of Microorganisms in Soil - Advantages and Injuriousness. Sobotka Gorka (Poland) 4-7 Sep 1996. *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Konferencje (Poland) (no.332) p. 69-78.* 4 tables; 22 ref. Polish. (AGRIS 2000-013765).

The study was focused on the occurrence of toxin producing fungi and phytotoxicity of their metabolites. The number of fungal isolates and the presence of dominant species depended on the dates of sample collection and plant species. In some cases,the number of toxin producing species of fungi in the phyllosphere reached 50 percent. Phytotoxicity of their metabolites ranged from 30-100 percent. The most frequent toxin producing fungi were:

Alternaria alternata,Aspergillus flavus,Cladosporium cladosporioides,Fusarium graminearum,Penicillium citreoviride,P. notatum,P. variabile and Trichothecium roseum. The strongest phytotoxicity on green pea and wheat seeds was found in the cultures of Aspergillus flavus,Penicillium citrinum,P. rubrum and Trichothecium roseum.

1019 Mahmoud,W.H.; Thabet,F.M.; El Saify,N. (Monoufeya Univ. (Egypt). Faculty of Agriculture) (1997) **Effect of using local isolates of Azotobacter chroococcum as biofertilizers on growth parameters.** *Menofiya Journal of Agricultural Research (Egypt) v. 22(6) p. 1491-1510.* 8 tables; 39 ref. English. (AGRIS 2000-005238).

## P35 SOIL FERTILITY

1020 Bogdanovic,D.; Malesevic,M.; Starcevic,Lj.; Cuvardic,M. (Poljoprivredni fakultet,Novi Sad (Yugoslavia). Naucni institut za ratarstvo i povrtarstvo) (1998) **Effect of fertilization on chernozem production potentials.** *Savremena poljoprivreda (Yugoslavia) (no. 3-4) p. 173-178.* 3 graphs; 2 tables; 8 ref. Serbian. (AGRIS 2000-013812).

After seven rotations in a long-term three-field trial (wheat,maize and spring barley),the chernozem soil is rich in micronutrients. The level of readily available phosphorus in fertilized treatments has increased statistically significant in relation to the non-fertilized one. The level of readily available potassium in mineral fertilizer treatments that included the incorporation of harvest residues has increased significantly relative to the control treatment and mineral fertilizer treatments without harvest residues. There are no significant differences in microelement content between the different fertilization treatments relative to the non-fertilized treatment. Yield losses in the non-fertilized treatment varied according to the crop species,ranging from 49% in spring barley (the first and fourth rotation) to 10% in maize.

1021 Fliessbach,A. (1999) **[DOC-trial: The microbial biomass of the soil as mediator in the carbon budget].** 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte". AMS Berlin (Germany). 23-25 Febr 1999. Forschungsinstitut fuer biologischen Landbau,Frick (Switzerland). . Hoffmann,H.;Muller,S. *Beitrage zur 5. Wissenschaftstagung zum Okologischen Landbau "Vom Rand zur Mitte" [Proceedings of the fifth scientific conference on ecological farming "From the periphery to the focus of attention"] p. 178-181. Forschungsinstitut fuer biologischen Landbau,Frick (Switzerland).* Dr. Koster. German. (AGRIS 2000-005319).

Ziel der Untersuchungen war die Prufung der Hypothese,dass okologische Landbewirtschaftung die Diversitat der Mikroflora des Bodens erhoht und damit die Okonomie der Nutzung vorhandener Ressourcen optimiert. Die Untersuchungen wurden durchgefuhrt mit Boden des DOK-Versuches in Therwil (Schweiz),in welchem seit 1978 die Anbausysteme biologisch-dynamisch,organisch-biologisch und konventionell auf zwei Dungungsniveaus verglichen werden. Die Ergebnisse beruhen auf Untersuchungenan Bodenproben aus dem Ap-Horizont aus den Jahren 1995-1997 unter Winterweizen.

1022 Gupta,S.P.; Ram Kala; Singh,S.P. (CCS Haryana Agricultural University,Hisar (India). Department of Soil Science) (1998) **Depletion of micronutrients from soil and their uptake in a pearl millet-wheat rotation.** *Journal of the Indian Society of Soil Science (India) v. 46(4) p. 706-708.* 1 table; 3 ref. English. (AGRIS 2000-005294).

1023 Huang Lifen; Zhuang Hengyang; Liu Shiping (Agricultural Coll. of Yangzhou Univ.,Jiangsu (China). Dept. of Agronomy) (1999) **Effect of long-term minimal and no tillages on rice and wheat yields and soil fertility.** *Journal of Yangzhou University (Natural Science Edition) (China). Yangzhou Daxue Xuebao (Ziran Kexue Ban) (China) v. 2(1) p. 48-52.* 2 tables; 3 ill.,11 ref. Chinese. (AGRIS 2000-005293).

1024 Isla,R.; Aragues,R. (Servicio de Investigacion Agroalimentaria,Zaragoza (Espana). Unidad de Suelos y Riegos); Angas,P.; Cantero Martinez,C. (1999) **Root and aerial development of barley (Hordeum vulgare L.) in saline conditions.** *Investigacion Agraria. Produccion y Proteccion Vegetales (Espana) t. 14(1-2) p. 83-99.* 4 tablas,6 graf.; 28 ref. Spanish. (AGRIS 2000-005273).

El objetivo de este trabajo es cuantificar el efecto de la salinidad edafica sobre el desarrollo radicular de la cebada y comparar el mismo con el que se produce sobre el rendimiento en grano y la biomasa aerea. Se sembraron 13 cultivares de cebada en un gradiente de salinidad impuesto por la triple linea de aspersion sobre los que se midio el rendimiento en grano (RG) y la biomasa aerea (BMA) en nueve tratamientos salinos y la densidad de longitud radicular (Lv) en la fase de antesis en tres tratamientos salinos (control-T0,salinidad intermedia-T4,y salinidad elevada-T8). En el cultivar Kym se midio ademas Lv en cinco fases de desarrollo en los tratamientos T0,T4 y T8. La salinidad retrasa la tasa maxima diaria de crecimiento radicular del cultivar Kym,de tal manera que dicha tasa maxima se alcanza entre ahijado y encanado en T0,entre encanado y espigado en T4,y entre espigado y antesis en T8. La distribucion vertical de raices se linealiza con el incremento de la salinidad,de tal forma que,respecto a la Lv total media de los 13 cultivares,la Lv sub(0-25) media en los primeros 25 cm de suelo desciende desde el 67% en T0,hasta el 45% en T8 mientras que la Lv sub(25-50) aumenta desde el 17% en T0 hasta el 33% en T8. Para salinidades moderadas (T4) se produce un efecto negativo similar en los sistmas aereos y radicular,mientras que para salinidades elevadas (T8) el sistema radicular es mas tolerante a la salinidad que el sistema aereo,lo que hace que la relacion Lv/RG en el tratamiento T8 sea un 60% mayor que en los tratamientos T0 y T4. La existencia de variabilidad genotipica en el desarrollo radicular,junto con la correlacion significativa (P menor que 0,05) observada entre RG y Lv en condiciones de salinidad elevada,abre perspectivas interesantes para la mejora de cultivares de cebada por su tolerancia a la salinidad a traves del incremento de su densidad de longitud radicular.

1025 Kumar,J.; Singh,R.; Sharma,K.L. (Govind Ballabh Pant University of Agriculture and Technology,Pantnagar (India). College of Agriculture) (1999) **Use of iron oxide paper strip method for determination of critical limit of available P for wheat in Tarai soils.** *Journal of the Indian Society of Soil Science (India) v. 47(1) p. 174-175.* 1 fig.; 1 table; 6 ref. English. (AGRIS 2000-005322).

1026 Kundu,S.; Barman,K.K.; Singh,M.; Takkar,P.N. (Indian Institute of Soil Science,Bhopal (India)) (1998) **Influence of depth of N application on availability and loss of N in wheat.** *Journal of the Indian Society of Soil Science (India) v. 46(4) p. 620-623.* 1 fig.; 1 table; 10 ref. English. (AGRIS 2000-005324).

1027 Purnomo,E.; Black,AS.; Smith,CJ.; Conyers,MK. (2000) **The distribution of net nitrogen mineralisation within surface soil. 1. Field studies under a wheat crop.** *Australian Journal of Soil Research. 38(1):129-140.* English. [Charles Sturt Univ,Sch Agr POB 588 Wagga Wagga NSW 2678 Australia].

To test the hypothesis that net nitrogen (N) mineralisation is concentrated in the surface few centimetres following minimal soil disturbance for crop establishment,mineralisation was measured during the growth of wheat. The soil was a Red Kandosol located in southern New South Wales. Mineralisation was estimated using in situ incubations inside capped PVC tubes,which were sampled every 3 weeks. Soil from the tubes was sampled at depth intervals of 2 cm to a depth of 10 cm and at 5-cm intervals from 10 to 20 cm. The results showed that net N mineralisation decreased with depth to 20 cm. Over the season,an average of 32% of the N mineralised in the top 20 cm of soil originated from the 0-2 cm layer,72% was from the 0-6 cm layer,and only 13% was from soil below 10 cm. The decrease in N mineralisation with soil depth was highly correlated with decreases in the organic carbon ($r(2) = 0.84, P < 0.05$) and total N ($r(2) = 0.83, P < 0.05$) concentration. The soil's N-supplying ability is concentrated near the surface where it is

susceptible to erosional loss. The N supply may also be inhibited by temperature and moisture extremes,which are common in the surface few centimetres of soil where mineralisation was concentrated. The PVC enclosures created artefacts in soil temperature and moisture,although it is argued that the effects on net N mineralisation were small in most sampling periods. [References: 41].

1028 Sharma,P.K.; Gupta,R.A.; Ghosh,D. (Govind Ballabh Pant University of Agriculture and Technology,Pantnagar (India)) (1999) **Fertilizer requirements of wheat for maximum and economic yields of an inceptisol of Uttar Pradesh.** *Journal of the Indian Society of Soil Science (India) v. 47(1) p. 164-166.* 1 table; 7 ref. English. (AGRIS 2000-005321).

1029 Singh,M.; Tripathi,A.K.; Kundu,S.; Raman,S.; Takkar,P.N. (Indian Institute of Soil Science,Bhopal (India).) (1998) **Effect of seed inoculation and FYM on biological N fixation in soybean and nitrogen balance under soybean-wheat system on Vertisol.** *Journal of the Indian Society of Soil Science (India) v. 46(4) p. 604-609.* 3 figs.; 4 tables; 12 ref. English. (AGRIS 2000-005267).

1030 Singh,N.P.; Sachan,R.S.; Pandey,P.C.; Bisht,P.S. (Govind Ballabh Pant University of Agriculture and Technology,Pantnagar (India). Department of Soil Science) (1999) **Effect of a decade long fertilizer and manure application on soil fertility and productivity of rice-wheat system in a Mollisol.** *Journal of the Indian Society of Soil Science (India) v. 47(1) p. 72-80.* 5 figs.,2 tables; 20 ref. English. (AGRIS 2000-005288).

1031 Srinivasa Rao,Ch.; Subba Rao,A. (Indian Institute of Soil Science,Bhopal (India)) (1999) **Impact of farmyard manure and phosphorus application on soil potassium status and K uptake in a Vertisol under soybean-wheat system.** *Journal of the Indian Society of Soil Science (India) v. 47(1) p. 176-178.* 1 fig.; 2 tables; 5 ref. English. (AGRIS 2000-005323).

1032 Suri,V.K.; Verma,T.S. (Himachal Pradesh Krishi Vishvavidyalaya,Palampur (India). Department of Soil Science) (1999) **Targetted yield concept for efficient and economic fertilizer use in a maize-wheat cropping system and build-up of native fertility in a Typic Hapludalf.** *Journal of the Indian Society of Soil Science (India) v. 47(1) p. 67-72.* 6 tables; 9 ref. English. (AGRIS 2000-005334).

## P36 SOIL EROSION,CONSERVATION AND RECLAMATION

1033 Osler,GHR.; van,Vliet,PCJ.; Gauci,CS.; Abbott,LK. (2000) **Changes in free living soil nematode and microarthropod communities under a canola-wheat-lupin rotation in Western Australia.** *Australian Journal of Soil Research. 38(1):47-59.* English. [Univ Western Australia,Fac Agr Nedlands WA 6907 Australia].

Diversification of the crops used in wheat production systems provides alternative sources of income and can interrupt wheat pathogen lifecycles. Two important alternative crops in Western Australia are canola and lupins,which may both improve growth of following wheat. Improved growth of wheat following canola may be the consequence of biofumigation or increased root penetration by the wheat. Available nitrogen may be increased following lupins. We examined free-living soil fauna in a canola-wheat-lupin rotation near Moora,Western Australia,to determine the effects of these crops on the soil fauna. Each crop in the rotation was sampled in June,August,and October 1998. Nematodes were sorted into functional groups and arthropods were sorted to order level. Prostigmatid mites were the dominant arthropod group and they were sorted to morphospecies. An active and abundant faunal community was present under all crops,demonstrating that the canola variety in this study,Pinnacle TT,did not eliminate the free-living fauna. The structure of the mite communities changed throughout the year and the changes were different under the 3 crops. The soil arthropod communities were distinctly different under lupins compared with the other crops at the end of the growing season in 2 ways. First,5 times more animals were present under the lupins than under wheat or canola,primarily due to an increase in the numbers of a tydeid and a tarsonemid mite species. Second,the tarsonemid species was always the second most abundant species under lupins but was infrequently the second ranked species under the other 2 crops. The soil arthropod communities were also different at the start of the growing season when the prostigmatid community under canola was dominated by a rhagidiid species,whilst under lupins and wheat a caligonellid and eupodid species dominated. The canola followed a lupin crop and therefore the difference in June may be attributed to the preceding lupins. Mite data from the lupin plots were consistent with a previously described succession from another environment. We hypothesise that if net nutrient mineralisation rates are greatest at the start of a succession then net mineralisation rates under lupins may be rapid at the end of the lupin crop and slow when the next crop is planted in the remaining lupin stubble. The difference between lupins and canola in their mite communities would then imply that net mineralisation rates are a factor creating differences between the effects of break crops on the following wheat crop. [References: 47].

## Q00 PROCESSING OF AGRICULTURAL PRODUCTS

1034 **AgriPro Wheat and Zeneca Plant Science join forces in research** (2000) *Food Technology. 54(1):14.* English.

## Q01 FOOD SCIENCE AND TECHNOLOGY

1035 Matuz,J.; Veha,A.; Markovics,E. (1999) **Effect of crop-year on the alveograph values of winter wheat varieties from Szeged.** *(Novenytermeles) (no. 2) p. 115-124.* Hungarian. (AGRIS 2000-005395).

There are very few data about the alveograph bread-making quality of Hungarian wheat varieties. The aim of the present work was to determine the quality of wheat from Szeged by alveograph and to study the effect of crop-year on the alveograph values. The quality of 29 winter wheat varieties grown after mustard forecrop was determined over 3 years. The following quality parameters were tested: wet gluten content,farinograph value,alveograph P,L,P/L,G and W values.

1036 Veha,A.; Gyimes,E. (1999) **Analysis of the grain hardness of winter wheat varieties using a hammer mill.** *(Novenytermeles) (no. 2) p. 143-152.* Hungarian. (AGRIS 2000-005396).

The paper presents the method elaborated by the authors to measure grain hardness,according to which the grinding resistance calculated from granulometric characteristics registered during grinding is a significant physical property of the wheat variety,giving a clear indication of the given grain structure. The method consists of grinding in a hammer mill of simple construction,modified for the purpose of the experiments,followed by sieve analysis. On the basis of the energetic data measured during grinding and the new ground surface values,the grinding resistance can be dimensionalised.

1037 Weidner,S.; Amarowicz,R.; Karamac,M.; Dabrowski,G. (1999) **Phenolic acids in caryopses of two cultivars of wheat,rye and triticale that display different resistance to pre-harvest sprouting.** *European Food Research & Technology. 210(2):109-113.* English. [Polish Acad Sci,Inst Anim Reprod & Food Res,Div Food Sci Ul Tuwima 10,POB 55 PL-10718 Olsztyn 5 Poland].

This study confirmed the significant role of phenolics in the dormancy of cereal caryopses. Investigations were conducted on two cultivars of wheat (Elena and Alba),rye (Amilo and Dankowskie Zlote),and triticale (Ugo and Bogo),with characteristic deeper or shallow dormancy,respectively. In germination studies,cultivars susceptible to sprouting (Alba,Dankowskie Zlote

and Bogo) displayed higher germination percentages than those resistant to sprouting (Elena,Amilo and Ugo). The phenolic acid contents (i.e. free,liberated from soluble esters,and liberated from soluble glycosides) in caryopses were determined by an HPLC method. Caffeic,p-coumaric,ferulic and sinapic acids were the dominant phenolic acids detected. The majority of phenolic acids were found in the form of soluble esters. For all species examined,the levels of phenolic acids liberated from soluble esters and the total phenolic acid contents in caryopses showing shallow dormancy were higher than in those showing deeper dormancy. Slight differences in the UV spectra of extracts of phenolic compounds from caryopses showing shallow or deeper dormancy were noted. [References: 30].

## Q02 FOOD PROCESSING AND PRESERVATION

1038 Afzal,TM.; Abe,T.; Hikida,Y. (1999) **Energy and quality aspects during combined FIR-convection drying of barley.** *Journal of Food Engineering. 42(4):177-182.* English. [Ehime Univ,Lab Agr Proc Engn,United Grad Sch Agr Sci Tarumi 3-5-7 Matsuyama Ehime 7908566 Japan].

Barley was dried in thin layers both under combined FIR-convection and convection alone. The highest temperature attained by the grain at the end of radiation drying at different intensities was used for convection drying. The experimental results show that the use of far infrared radiation enhances the drying rate and the energy consumption was reduced considerably. An intensity level of 0.333 W cm(-2) was found to be optimum for radiation drying. Air velocity showed a strong effect on energy consumption. Germination and bulk density were used as the quality parameters. (C) 2000 Elsevier Science Ltd. All rights reserved. [References: 8].

1039 Almas,R.; Almas,K.; Bhatty,N. (University of Agriculture,Faisalabad (Pakistan). Dept. of Home Economics); Abid,A.R. (1999) **Preparation and evaluation of weanling food consisting of sprouted wheat and stillage sludge protein isolate.** *Pakistan Journal of Biological Sciences (Pakistan) v. 2(3) p. 881-884.* 3 tables,13 ref. English. (AGRIS 2000-005540).

Availability of animal protein due to low production and high cost is limited. Therefore,vegetable protein being cheeper source,may be used in the preparation of weaning food for infants. The present study was carried out to prepare a weaning food consisting of sprouted wheat and protein isolate from an unconventional source,like stillage sludge. The chemical evaluation of weaning food was conducted. Amino acid profile of the protein isolate showed the chemical score was 36.42. However thyronine was the limiting amino acid. Results of biological trial conducted on weanling Albino rats showed the digestibility,96.40,97.83. Net protein utilization (NPU) 76.34,78.8,biological value 79.20,80.54 and protein efficiency ratio 4.0,4.6 of skim milk diet respectively.

1040 Brummer,J. M.; Neumann,H. (1998) **German wheat flours for traditional foreign baked products.** Bundesanstalt fur Getreide-,Kartoffel- und Fettforschung,Detmold (Germany). Inst. fur Getreide-,Kartoffel- und Starketechnologie. *Getreide Mehl und Brot (Germany) v. 52(6) p. 348-350.* German. (AGRIS 2000-005796).

Das Angebot auslandischer Brot- und Kleingebacksorten ist in Deutschland in den letzten Jahren grosser geworden. Nach Baguette erfreuen sich Ciabatta und turkisches Fladenbrot (Pide) grosser Beliebtheit. Alle drei Gebacke zeichnen sich durch einen hohen Krustenanteil und besondere Krumeneigenschaften aus. Ursprunglich wurden diese Gebacksorten in ihren Herkunftslandern aus weniger gut backfahigen Weizenmehlen mit langer Teigfuhrung,meist ohne Einsatz backverbessernder Zusatze,wenig intensiv geknetet und manuell zu kleinen Teigstucken aufgearbeitet,die schnell von der Backhitze durchdrungen werden konnten. In Deutschland werden die Gebacke aus Mehlqualitaten mit verbesserten Backeigenschaften hergestellt. Es wird die Ansicht vertreten,dass die typischen Qualitatsmerkmale von Baguette,Ciabatta und Pide nicht so sehr von den Rohstoffen,sondern vielmehr von der Herstellungstechnologie bestimmt werden. Es werden daher Rezeptur- und Herstellungshinweise gegeben,mit denen Baguette,Ciabatta und Pide aus Weizenmehl der Type 550 mit Qualitatseigenschaften hergestellt werden konnen,die den ursprunglichen traditionellen auslandischen Vorbildern entsprechen.

1041 Chun,E.H. (Kyung Hee University,Yongin (Korea Republic). Department of Food Science and Technology); Lee,K.S. (International College of Hotel Administration Kyung Hee University,Seoul (Korea Republic). Department of Culinary Science) (1999) **Growth conditions of rope bacteria isolated from korean wheat bread.** *Korean Journal of Food Science and Technology v. 31(3) p. 734-738.* 5 illus.; 2 tables; 15 ref. Korean. (AGRIS 2000-005804).

1042 Edwards,CA.; Parrett,AM. (1999) **Colonic fermentation - in vitro and in vivo approaches to measurement [Review].** *Sciences des Aliments. 19(3-4):291-300.* English. [Univ Glasgow,Yorkhill Hosp,Dept Human Nutr Glasgow G3 8SJ Lanark Scotland].

Investigation of colonic fermentation is important as the colonic microflora may be involved in both prevention and causation of disease. It is very difficult to study fermentation directly in man due to the inaccessibility of the proximal colon where most fermentation takes place. In vitro and animal models can be used to provide essential preliminary data on the fermentation of foods and food ingredients. However,these models are limited in their ability to simulate human colonic fermentation completely. Each model has its own particular strengths. In vitro models are cheap and useful as a screening tool for new food products. Animal models are more expensive but allow ready access to colonic material in controlled dietary studies. Animals,however,have a different microflora from man and may not react in the same way. Human flora associated rat models,however,produce results that mimic human fermentation more closely. Human studies generally use indirect measurements of faecal and plasma short chain fatty acids and breath hydrogen. More invasive methods are needed to measure fermentation directly. New technologies,such as stable isotope breath tests,may provide a useful method to quantify human fermentation in vivo and are safe for use in all age groups. [References: 41].

1043 Engelke,F. (1999) **(Specifications of the grain quality from a mill,based on consumer's view).** Kampffmeyer Muhlen GmbH,Hameln (Germany). Werk Wesermuhlen. *Getreide Mehl und Brot (Germany) v. 53(3) p. 141-143.* German. (AGRIS 2000-005805).

Getreideprodukte stehen in der Wertschatzung des Verbrauchers fur Genuss,Gesundheit,Geschmack,Vielfalt,Preiswurdigkeit und Umweltfreundlichkeit. Die konsequente Umsetzung der Verbrauchererwartungen muss in der gesamten Wertschopfungskette der Massstab sein. Die Zuchtung ist aufgefordert,Sorten mit optimalen Verarbeitungseigenschaften,verbunden mit einer guten Mahlfahigkeit,einem geringen Krankheitsdruck und hoher Ausnutzung der bodeneigenen Wertstoffe,zur Verfugung zu stellen. Die neuen Erkenntnisse uber die sekundaren Pflanzeninhaltsstoffe sollten gezielt umgesetzt werden. Die Landwirtschaft sollte bewusst umweltfreundlich und preiswurdig,die auf ihren Boden und in ihrem Klima optimalen,vom Markt geforderten Sorten anbauen und dem Erfassungshandel sortenrein anliefern. Der Handel sollte den Muhlen die gewunschten Qualitaten in aufbereiteter Form zum gewunschten Zeitpunkt liefern. Die bewusste Ausrichtung der gesamten Wertschopfungskette auf die Verbraucherbedurfnisse steigert die Chance den Absatz und die wirtschaftliche Situation zu verbessern.

1044 Felder,R. (1999) **(On-line measurement with wheat semolina).** Buhler AG,Uzwil (Switzerland). *Getreide Mehl und Brot (Germany) v. 53(4) p. 208-210.* German. (AGRIS 2000-005447).

Zusammenfassend wird festgestellt,dass der Vorteil der Online-Messung eine stete Uberwachung der Produktion und nicht eine Momentanaufnahme durch die Probenahme ist. Dies erlaubt die kontinuierliche Qualitatskontrolle Tag und Nacht,das sofortige Erkennen von Qualitatsveranderungen,die Speicherung der Messwerte und die Moglichkeit,anhand der gemessenen Inhaltsstoffe Produkte beizumischen. Gemessen werden konnen der Feuchtigkeits- und Proteingehalt,der Mineralstoffgehalt und der Farbwert. Abschliessend wird ein Bildanalysen-Messgerat vorgestellt: Die Entwicklung in der Videotechnik eroffnet neue Moglichkeiten der Messung der Stippenzahl und des Kleieanteils.

1045 Filloux,A.M. (Ecole Nationale d'Industrie Laitiere,Surgeres (France)) (1998) **[Quality assessment of wheat flour for bread making].** *Industries Alimentaires et Agricoles (France) v. 115(5) p. 17-19.* 6 tableaux. French. (AGRIS 2000-005794).

1046 Godbillot,L. (Universite de Reims (France). UFR des Sciences,Laboratoire de Chimie Physique Industrielle); Mathlouthi,M. (1999) **Water - native wheat starch - Small molecules interactions.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998. *Colloques de l'INRA (France); no. 91 p. 131-135. Institut National de la Recherche Agronomique,Paris (France).* INRA. 6 graph. English. (AGRIS 2000-005801).

The objective of this work is to study the influence of water and some small molecules on the thermomechanical properties of starch. Addition of small molecules in a binary starch-water mixture may induce changes in the structure of water hence modifying the properties of starch gel. Rheological properties of starch gels were analysed during gel formation in terms of time and frequency using a dynamic rheometer. Results show that sucrose does not modify rheological properties whereas glycerol and urea induce changes.

1047 Gresle,E. (Perten Instruments France,Epinay sur Seine (France)) (1999) **[Physical characteristics of French wheat. First trials with the SKCS 4100 (Single kernel characterization system)].** *Industries des Cereales (France) (no 113) p. 19-23.* 14 ref. French. (AGRIS 2000-005717).

Le SKCS 4100 est le seul appareil capable de caracteriser les lots de ble en mesurant 4 criteres physiques simples: mase,durete,diametre et teneur en proteines. Il permet aux organnismes stockeurs de: determiner la composition des lots,classer les bles en fonction de leurdurete (biscuitiers,boulangers,ameliorants),controler la regularite des lots recus et expedies. Pour un laboratoire,il permet de caracteriser rapidement l'incidence au niveau du grain: d'un suivi cultural particulier,d'un evenement climatologique du terroir.

1048 Handreck,G.; Potschke,L.; Senge,C. (1999) **(Variants for intensive break-grinding of wheat).** TU Berlin (Germany). Fachber. Aufbereitungs- und Mullereitechnologie. *Getreide Mehl und Brot (Germany) v. 53(4) p. 211-216.* German. (AGRIS 2000-005448).

Die Untersuchungen zum intensiven Aufschroten von Weizen erfolgten fur den I. und II. Schrot mit der direkten zweistufigen Zerkleinerung im simulierten Acht-Walzenstuhl. Mit den Walzenkonfigurationen Quetschen/Schroten sowie Schroten/Schroten wurde der Einfluss unterschiedlicher Zerkleinerungsparameter optimiert. Die gunstigsten Schrotergebnisse wurden mit der Mahlwalzenkombination Schroten,grob/Schroten,fein erzielt. Der Mehlanfall betrug 19,2% mit 0,47% i.Tr. Mineralstoffgehalt (MG),der Dunstanfall 28,2% mit 0,46% i.Tr. MG,die Fein- und Mittelgriesse 23,6% mit 0,58% i.Tr. MG und die Ubergange d >630 µm 29,0% mit 4,42% i.Tr. MG. Der Schrotauszug an Feingriessen und Dunsten von etwa 52% mit 0,5% i.Tr. MG sowie der oben genannte Mehlanfall sind eine entscheidende Voraussetzung fur hohe Ausbeuten der Mehltype 550. Die Optimierung des III. Schrotes,der mit nur 29% hoch ausgemahlenem Gut (4,42% i.Tr. MG) beschickt wird,ergab einen Mehlanfall von 5,9 % mit 0,76% i.Tr. MG und 3,9% Dunst mit 1,87 % i.Tr. MG. Durch das intensive Aufschroten des Weizens wird eine weitere Verkurzung des Vermahlungsdiagramms bei Gewahrleistung der Mehlausbeute und Mehlqualitat erreicht. Beim Vermahlen eines Gemisches aus E-,A- und B-Weizen sowie von A-Weizen wurde eine Ausbeute der Type 550 von 79.80% bei 0,63% i.Tr. MG erzielt. Die Gesamtmehlausbeuten lagen bei 80.81%.

1049 Hwang,S.Y. (Hankyong National University,Ansung (Korea Republic). Institute of Food Industry); Eom,I.T. (Kyonggi Provincial Goverment Nothern Branch Office,Kyonggido (Korea Republic).) (1999) **Effects of emulsifiers on the quality of steamed bread.** *Korean Journal of Food Science and Technology v. 31(4) p. 977-983.* 7 tables; 23 ref. Korean. (AGRIS 2000-005439).

1050 Ibanoglu,S.; Ibanoglu,E. (1999) **Effect of time and temperature on lactic acid fermentation of a white wheat flour-yoghurt mixture.** *Nahrung-Food. 43(6):414-417.* English. [Gaziantep Univ,Dept Food Engn TR-27310 Gaziantep Turkey].

A white wheat flour-yoghurt mixture was fermented by its indigenous microflora at different temperatures (20 to 40 degrees C) and for different times (0 to 42 h). Response surface methodology was applied to find a quadratic equation showing the relationship between the pH and the acidity of the mixture and the fermentation time and temperature. Setting the first derivative of the quadratic equations to zero and solving for the time gives the duration of the lag phase period. When the temperature was increased from 20 to 40 degrees C,the fermentation time to attain a pH of 4.0 was reduced by approximately 5 times from 24.1 to 5.2 h and the lag phase period (no net change in pH) was reduced from 19.8 to 3.6 h. The activation energy (E-a) was 10.4 J/mol. [References: 11].

1051 Motte,J. (Grandes Malteries Modernes,Marquette lez Lille (France)); Delatte,J.L. (1999) **The history of building the brewer,maltster and merchant coalition to assess the value of selecting malting barleys.** *Boissons Bios Conditionnement (France) v. 30(282) p. 80-81.* Orge,malt,biere. English. (AGRIS 2000-005623).

Cet article fait l'historique de l'organisation de la filiere Biere Malt et Orge en France. Les professionnels de la filiere ont ainsi cree le Comite Orge Malt Biere (CBMO) qui a mis au point des procedures et des tests pour apprecier la qualite des orges nouvellement inscrites afin de determiner leurs aptitudes a etre utilisees en Brasserie. Le resultat de ce travail permet d'etablir la liste officielle des orges de brasserie publiee par les "Malteurs de France".

1052 Munzing,K.; Bergthaller,W.; Albrecht,V. (1999) **(Influence on wheat flour properties by using expander-technique).** Bundesanstalt fur Getreide-,Kartoffel- und Fettforschung,Detmold (Germany). *Getreide Mehl und Brot (Germany) v. 53(4) p. 217-223.* German. (AGRIS 2000-005797).

Bei der Studie zur Expanderbehandlung von handelsublichem Weizenmehl werden zwei unterschiedliche Aspekte der Expanderbehandlung berucksichtigt: 1. Stabilisierung des Hygienestatus von Weizenmehl mittels Expander durch Hitzebehandlung unter weitgehender Beibehaltung der nativen strukturellen,funktionellen und sensorischen Eigenschaften (Keimzahlreduzierung) und 2. Modifikation struktureller und funktioneller Mehleigenschaften mittels Expander auf minimalem (Keksmehle),mittlerem und maximalem Beanspruchungsniveau (Quellmehle oder Panaden). Handelsubliches Weizenmehl der Type 550 wurde in einer Expanderanlage mit vorgeschaltetem Mischer unterschiedlichen hydrothermischen und druckmechanischen Behandlungen unterworfen. Die hergestellten Expandate zeigten im Vergleich zum Mehl veranderte Struktur- und Funktionseigenschaften sowie mikrobielle,sensorische und enzymatische Veranderungen. Es werden erste Vorschlage fur die Verwendung der expandermodifizierten Mehlen gegeben,z.B. fur Kindernahrmittel,Keksmehle und Paniergranulate.

1053 Pilosof,A.M.R. (Universidad de Buenos Aires (Argentine). Facultad de Ciencias Exactas y Naturales,Departamento de Industrias); Elizalde,B.E. (1999) **Kinetics of physico-chemical**

changes occurring during storage of gluten in the vicinity of the glass transition temperature. Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998az. *Colloques de l'INRA (France); no. 91 p. 241-245. Institut National de la Recherche Agronomique,Paris (France).* INRA. 15 ref. English. (AGRIS 2000-005803).

The objective of this work was to evaluate the kinetics of water absorption,color and foaming changes of wheat gluten as a result of storage in the glassy or rubbery state (up to 45 degrees above Tg) and to analyze the occurrence of specific temperature and moisture effects besides the glass transition. Rate constants were very low in the glassy state but highly incteased in the rubbery state where water absorption increased,gluten browned,foaming capacity decreased and foam collapse increased. Arrhenius plots of rates of water absorption and color changes showed breaks,indicating the importance of Tg. Estimated activation energies for color and water absorption changes in the rubbery state were lower than those around Tg. Empirical models developed to describe the observed changes indicated that besides the distance between the storage temperature and Tg,the interdependent effects of moisture and temperature were also very important.

1054 Raccach,M.; Tully,T. (1999) **The fermentation of whole wheat flour by Pediococcus pentosaceus.** *Food Science & Technology International. 5(3):243-249.* English. [Arizona State Univ E,Sch Agribusiness & Resource Management,Food Sci Program 6001 S Power Rd Mesa,AZ 85206 USA].

A whole wheat flour:water brew (1:3) was fermented (at 32 degrees C) with a Pediococcus pentosaceus culture at inoculation levels (I) of log(10)I = 0 (control),5,6,7 and 8 cfu/g brew. A direct relationship was observed between the inoculation level and the absolute values of the b and c parameters of the fitted fermentation equation: pH = a + bt + ct(2). The first derivative of the fermentation equation was used to determine the duration of the lag phase period. When the inoculation level was increased from log(10)I = 0 to log(10)I = 8 cfu/g brew the lag phase period (Lp) and the fermentation time (t) decreased from 5.2 to 0.8 h and from 18.0 to 4.2 h,respectively. The model lag phase period and the model fermentation time at inoculation levels other than those examined in this study were calculated using the equations Lp(M) = 5.2 + 0.0245I - 0.0714I(2) and t(M5.0) = 18 - 1.15I - 0.075I(2),respectively. The acid production phase comprised 68% of the fermentation period. The fermentation rate (F) within each of the three periods of the fermentation increased as the inoculation level increased. The acid production rate-inoculation plot showed a discontinuity at an inoculation level of log(10)I = 7.0 cfu/g brew. [References: 23].

1055 Rayment,P. (King's College London (Royaume Uni). Division of Life Sciences,Biopolymers Group); Savage,A.W.J.; Ross Murphy,S.B.; Shewry,P.R.; Tatham,A.S. (1999) **The rheology and structure of wheat gluten proteins.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998az. *Colloques de l'INRA (France); no. 91 p. 235-238. Institut National de la Recherche Agronomique,Paris (France).* INRA. 5 ref. English. (AGRIS 2000-005802).

The unique viscous and elastic properties of wheat gluten are largely responsible for the end properties of wheat flours. These properties are determined by the structures of the proteins and their interactions with each other and other dough components. At present,we still have little understanding of factors that influence elastic and viscous behaviour at the molecular level. With this work,we aim to understand the molecular basis of the biophysical and functional properties of wheat gluten using a combination of rheological and spectroscopic methods on characterised protein fractions from gluten and those derived from protein engineering. Protein fractions from wheat and homologous proteins from barley and rye have been tested using dilute solution viscometry,and dynamic oscillatory testing on the Rheometrics Fluids Spectrometer (RFSII,Rheometric Scientific Inc.,USA). Protein samples at a number of different moisture contents were tested at 25 degrees and the effect of strain and frequency of these proteins were determined. The increased understanding of gluten protein and homologous barley protein fonctionality should facilitate the more efficient use of wheat gluten proteins in traditional end uses and identify new areas in which they could be utilised.

1056 Reddy,I.; Seib,PA. (2000) **Modified waxy wheat starch compared to modified waxy corn starch.** *Journal of Cereal Science. 31(1):25-39.* English. [Kansas State Univ,Dept Grain Sci & Ind Manhattan,KS 66506 USA].

Waxy wheat starch (WWS) and waxy corn starch (WCS) were cross-linked in an aqueous slurry at c. 37% starch solids with 0.013 to 0050% phosphoryl chloride (starch basis) at pH 11.5 for 60 min in the presence of c. 2.1% sodium sulphate (starch basis). Increasing levels of phosphoryl chloride caused a steady decline in the final paste consistency of cross-linked WWS,but that of WCS proceeded through an optimum. Starch paste consistency was the resistance to stirring measured in a pasting instrument. WWS cross-linked at a low level gave a higher final paste consistency compared with cross-linked WCS. WWS and WCS were hydroxypropylated (HP) to low (c. 2.0%) and medium (c,4.0%) levels by reaction with propylene oxide at pH 11.5 and 45 degrees C. and the HP starches were then cross-linked with 0.008 to 0.018% phosphoryl chloride. Again,cross-linked HP-WWS gave pasting curves with higher consistency at 6.25% starch solids compared with HP-WCS. WWS and its modified forms yielded pastes of lower clarity than those from WCS,but the pastes from HP/ cross-linked WWS had better freeze-thaw stability. Cross-linking with phosphoryl chloride (0.025%) followed by acetylation with acetic anhydride (8.0%) yielded modified waxy wheat and waxy corn starches with similar paste consistencies,but a force-distance instrument indicated that the modified WCS was significantly stringier than the modified WWS. (C) 2000 Academic Press. [References: 48].

1057 Ridder,ER.; Nokes,SE.; Knutson,BL. (1999) **Optimization of solid-state fermentation parameters for the production of xylanase by Trichoderma longibrachiatum on wheat bran in a forced aeration system.** *Transactions of the ASAE. 42(6):1785-1790.* English. [Univ Kentucky,Dept Agr & Biosyst Engn 128 Agr Engn Bldg Lexington,KY 40546 USA].

The effect of aeration an the production of xylanase by Trichoderma longibrachiatum on wheat bran in a solid-state fermentation (SSF) system has not been investigated. This study was conducted to investigate the interactive effects of aeration,initial moisture content of the substrate,and depth of the substrate on xylanase activity produced in a tray fermenter The experiment was conducted as a split plot experiment with factorial treatments and three replications of each treatment combination. The whole plot treatment was aeration rate (0,2.9,5.7 L/min/kg bran). Initial moisture content (45,55,65% w.b.) and depth of substrate (1.0 and 2.5 cm) were investigated factorially. Trays of wheat bran were assayed after fermentation by Trichoderma longibrachiatum to determine the production of xylanase activity. Aeration rate had a significant nonlinear effect on enzyme activity with highest yields obtained at an aeration rate of 2.9 L/min/kg bran (738 U/g,averaged over all initial moisture contents and depth of substrates). Initial moisture content of the substrate also had a significant nonlinear effect an enzyme activity with the highest yields at 55% (556 U/g,averaged over all airflow rates and depths of substrate). Depth of substrate had no significant statistical effect on enzyme activity. The treatment combination of 2.9 L/min/kg airflow rate and 55% moisture content resulted in the highest yields (948 U/g,averaged over depth of substrate). [References: 25].

1058 Schluentz,EJ.; Steffe,JF. (1999) **Convergence angle of wheat dough in a zero length die.** *Journal of Food Process Engineering. 22(4):331-335.* English. [Michigan State Univ,Dept Agr Engn 209 Farrall Hall E Lansing,MI 48824 USA].

A mechanical system was designed,and constructed,to experimentally determine the angle of convergence (required to

calculate extensional viscosity from converging flow data) of wheat flour dough flowing through a zero-length die. To determine the convergence angle,and investigate potential dead spaces,tests were conducted with angled inserts. The mean angle for a flat-entry die was 43.1 degrees with a standard deviation of 5.30 degrees. Results show that convergence patterns did not follow straight lines,and entrance angles for wheat dough could nor be closely controlled with angled inserts. Based on these findings,calculating extensional viscosity from converging die data cannot be expected to provide accurate values for wheat dough. [References: 5].

1059 Shewry,P.R. (University of Bristol (Royaume Uni). Institute of Arable Crop Research,Long Ashton Research Station,Department of Agricultural Sciences); Gilbert,S.; Tatham,A.S.; Belton,P.S. (1999) **The high molecular weight subunits of wheat glutenin and their role in determining the functional properties of wheat gluten and dough.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998. *Colloques de l'INRA (France); no. 91 p. 13-18. Institut National de la Recherche Agronomique,Paris (France).* INRA. 14 ref. English. (AGRIS 2000-005799).

The HMW subunits of wheat glutenin are present in high M,glutenin polymers,the amounts and properties of which have major effects on the visco-elasticity and hence processing properties of doughs. The individual HMW subunits contain an extensive domain of repeated sequences,which appears to form an unusual spiral supersecondary structure. We propose that the HMW subunits form the "backbone" of the glutenin polymers,stabilized by inter-chain disulphide bonds between cysteine residues present in the non-repetitive N- and C- terminal domains. We also propose that inter-chain hydrogen bonding between the repetitive domains of adjacent subunits may contribute to gluten viscoelasticity,via a "loop and train" mechanism.

1060 Straub,J.A.; Hertel,C.; Hammes,W.P. (1999) **Limits of a PCR-based detection method for genetically modified soya beans in wheat bread production.** *Zeitschrift fuer Lebensmittel-Untersuchung und -Forschung (Germany) v. 208(2) p. 77-82.* English. (AGRIS 2000-005524).

The official PCR-based method for the detection of recombinant DNA from glyphosphate-tolerant soya beans (GTS),laid down in the collection of methods according to Sect. 35 of the German Food Law,was investigated for applicability.

1061 Thievin,M. (Institut National de la Recherche Agronomique,Nantes (France). Centre de Nantes,Unite de Biochimie et de Technologie des Proteines); Elmorjani,K.; Mangavel,C.; Michon,T.; Popineau,Y.; Gueguen,J. (1999) **Conception and study of periodic polymers modelled on the repetitive domain of wheat gliadins.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998. *Colloques de l'INRA (France); no. 91 p. 19-23. Institut National de la Recherche Agronomique,Paris (France).* INRA. English. (AGRIS 2000-005800).

Gliadins and glutenins contain a repetive domain which might be involved in the macroscopic mechanical properties of gluten. In order to analyse the specific contribution of these domains we built synthetic genes encoding repetitive amino acid blocks mimicking one of the consensus repeats found in gliadins (ie Pro-Gln-Gln-Pro-Tyr (PQQPY)). Using a combination of cohesive and non cohesive ends,a convenient strategy was deviced in order to design a gene family encoding (PQQPY)8,(PQQPY)16,and (PQQPY)32. We optimized conditions for high level expression and purification of such peptides in Escherichia coli. After their obtention,the repetitive polypeptides were identified and further characterized by spectroscopic technics (UV and IR spectroscopy,circular dichroism).

1062 Toufeili,I.; Ismail,B.; Shadarevian,S.; Baalbaki,R.; Khatkar,BS.; Bell,AE.; Schofield,JD. (1999) **The role of gluten proteins in the baking of Arabic bread.** *Journal of Cereal Science. 30(3):255-265.* English. [Amer Univ Beirut,Dept Food Technol & Nutr Beirut Lebanon].

Fractionation and reconstitution/fortification techniques were utilised to study the role of gluten in Arabic bread. Glutens from two wheat cultivars of contrasting breadmaking quality were fractionated by dilute HCl into gliadin and glutenin. Gluten,gliadin and glutenin doughs from the good quality flour had higher G' and lower tan delta values than those from the poor quality hour at all the frequencies examined. Interchanging the gliadin and glutenin fractions between the reconstituted hours showed that the glutenin fraction is largely responsible for differences in the breadmaking performance. Fortification of an average quality flour with the gliadin and glutenin fractions from the poor and good quality flours,at the levels of 1 % and 2 % (protein to flour mass),induced marked differences in the mechanical properties of bread. The resilience of the leaves was not adversely affected by the addition of gliadins and increased,with a concomitant significant ($P<0.05$) improvement in quality,at the 2 % level of fortification with gliadins from the good quality flour. Addition of glutenin resulted in leaves with leather-like properties that became particularly apparent at the higher level of fortification; the observed deterioration in quality paralleled the increase in the elastic character of the doughs. It is suggested that highly-elastic doughs are not compatible with the rapid expansion of gases at the high-temperature short-time conditions employed in the baking of Arabic bread and that there exists a threshold in dough elasticity beyond which a rapid decline in quality takes place. (C) 1999 Academic Press. [References: 38].

## Q03 FOOD CONTAMINATION AND TOXICOLOGY

1063 Backes,F.; Kramer,J. (1999) **(Microbiological and mycotoxic quality of winter wheat from organic farming as raw material for food).** Rheinische Friedrich-Wilhelms-Univ.,Bonn (Germany). Inst. fur Pflanzenkrankheiten. *Getreide Mehl und Brot (Germany) v. 53(4) p. 197-201.* German. (AGRIS 2000-005942).

An Winterweizen aus Organischem Landbau wurden mikrobiologische und mykotoxikologische Qualitatsparameter mittels kultureller und immunologischer Methoden erfasst. Zur Ermittlung der Mykotoxinbelastung wurden die Proben auf das Fusarium-Leittoxin Deoxynivalenol (DON) und auf das von bestimmten Aspergillus- und Penicillium-Spezies gebildete Ochratoxin A (OTA) mittels ELISA analysiert. Daruber hinaus wurden Gesamtkeimzahlen sowie spezifische Keime oder Keimgruppen (Salmonella,L.monocytogenes,C. perfringens,B. cereus,E. coli,Coliforme) an den Proben bestimmt. 1994-1996 standen erntefrische Proben zur Verfugung. In diesen Jahren war insgesamt eine niedrige Belastung des Erntegutes mit Pilzen der Gattungen Fusarium,Aspergillus und Penicillium festzustellen. In den Jahren dominierten Cladosporium und Alternaria. In allen Proben wurde DON nachgewiesen. 1996 waren die DON-Gehalte aufgrund einer feuchteren Periode nach der Blute gegenuber den Vorjahren erhoht. OTA wurde in keiner erntefrischen Probe gefunden. Die Auswirkungen der Nacherntebehandlung auf DON- und OTA-Gehalte wurden ebenfalls untersucht. Die DON-Gehalte stiegen in den Lagerproben binnen 14 Tagen an. Trotz Nachweis von Aspergillus- und Penicillium-Keimen,wurde kein OTA gefunden. Der Weizen aus Organischem Anbau wies in den Jahren 1994-1996 insgesamt eine gute mikrobiologische Qualitat auf.

1064 El Kashlan,I.H. (Ministry of Agriculture,Cairo (Egypt). Plant Protection Research Inst.); Abd El Hamid,M.; Helal,E.; Abd El Latif,M.A.; El Shazly,L.; Hamza,M.A. (1997) **Toxicity to mice fed on wheat flour infested with tenebrionid beetles.** *Egyptian Journal of Agricultural Research (Egypt) v. 75(4) p. 969-986.* 8 fig. 3 tables; 21 ref. English. (AGRIS 2000-005971).

1065 Gareis,M. (1999) **Contamination of German malting barley and of malt produced from it with the mycotoxins ochratoxin A**

and B. *Archiv fuer Lebensmittelhygiene (Germany) v. 50(4/5) p. 83-87.* German. (AGRIS 2000-005916).

1066 Kehl,B.; Bostel,W. (1999) **(Examination of the current sanitary condition in milled wheat products of the pasta industry).** Analytisches Inst. W. Bostel,Stuttgart (Germany). *Getreide Mehl und Brot (Germany) v. 53(4) p. 242-248.* German. (AGRIS 2000-005972).

Die Arbeit umfasst sowohl die rein mikrobiologische Untersuchung der Weizenmahlprodukte als auch die aktuelle Situation bezuglich der Mykotoxine,d.h. der Stoffwechselprodukte von Schimmelpilzen. Ergebnisse und Wirkungen folgenderKeimarten werden aufgefuhrt: Koloniezahl,Sporen,Hefen,Schimmelpilze,coliforme Bakterien,Escherichia coli,Enterokokken,Staphylococcus aureus,Salmonellen. Die mikrobiologischen Untersuchungen der Weizenmahlprodukte erbrachten insgesamt sehr positive Ergebnisse im Sinne einer guten Hygiene. Uber die Verunreinigung mit Mykotoxinen und ihre toxikologischen Wirkungen wird ebenfalls berichtet. Die Gehalte folgender Mykotoxine in Weizenmahlprodukten werden aufgefuhrt: Aflatoxine,Ochratoxin A (OTA),Zearalenon,Deoxynivalenol (DON). Insgesamt wurden nur sehr geringe Gehalte an Aflatoxin B1 und Ochratoxin A gefunden,jedoch hohe Gehalte an dem Fusarientoxin DON. Es wurden Werte von 20 bis 850 ppb gefunden,bei einer Nachweisgrenze von 10 ppb. Legt man den osterreichischen Richtwert von 750 ppb bei Hartweizen zugrunde,dann uberschritt eine Probe diesen Richtwert. 3 % der Proben waren mit Zearalenon belastet,jedoch in Konzentrationen unter dem in Osterreich vorhandenen Richtwert von 60 ppb.

1067 Miedaner,T.; Reinbrecht,C. (1999) **(Fusarium diseases in cereals - the role of agronomy and resistance breeding in reducing yield loss and mycotoxin contamination).** Univ. Hohenheim,Stuttgart (Germany). Landessaatzuchtanstalt; Groetzner Pflanzenzucht,Dingelstedt (Germany). *Getreide Mehl und Brot (Germany) v. 53(3) p. 135-140.* German. (AGRIS 2000-005840).

Fusarium-Arten konnen alle Getreidearten einschliesslich Mais in allen Entwicklungsstadien befallen. Am wirtschaftlich wichtigsten sind bei kleinkornigem Getreide der Fusskrankheits- und Ahrenbefall. Letzterer fuhrt zu erheblichen Einbussen im Ertrag und in der Qualitat sowie einer Kontamination des Erntegutes mit Mykotoxinen. Bei kleinkornigem Getreide spielen dabei Deoxynivalenol (DON) und seine Derivate 3-Acetyl-DON,15-Acetyl-DON,sowie Nivalenol (NIV) die grosste Rolle. Zur Bekamp-fung von Ahrenfusariosen ist neben pflanzenbaulichen Massnahmen die Resistenzzuchtung besonders wichtig. Im Jahre 1998 waren noch rund 25 % der Weizenanbauflache in Deutschland mit hoch anfalligen Sorten bestellt. Uber folgende Themen wird in der vorliegenden Arbeit diskutiert: naturliches Auftreten und Wirkung von Fusarium-Toxinen,Haufigkeit von Mykotoxinbildnern in Fusarium-Populationen,pflanzenbauliche Massnahmen zur Reduktion von Befall und Toxingehalten,Zuchtung auf verbesserte Fusarium-Resistenz bei Weizen,Zusammenhang zwischen Fusarium-Resistenz und DON-Akkumulation.

1068 Munzing,K.; Gerstenkorn,P.; Lindhauer,M.G. (1998) **[Precautions on deliveries of wheat with fusarium infection].** Bundesanstalt fuer Getreide-,Kartoffel- und Fettforschung,Detmold (Germany). Inst. fuer Getreide-,Kartoffel- und Staerketechnologie. *Muehle + Mischfuttertechnik (Germany) v. 135(19) p. 634-635.* German. (AGRIS 2000-005973).

Fusarienbefallenes Getreide gehort wegen der toxischen Eigenschaften nicht in den Mahlgutstrom oder in Muhlennachprodukte. Grundsatzlich muss die Ware bei Annahme auf Besatzanteile kontrolliert werden. Bei Fusarienbefall ist eine grundliche Reinigung unumganglich. Fusarienbefallene Weizenkorner besitzen im Vergleich zu dem nichtbefallenen,gesunden Grundgetreide ein geringeres spezifisches Gewicht,eine abweichende Form und Oberflachenstruktur sowie Farbe. Die Reinigung geschiehtim allgemeinen durch die Verwendung eines Kleinkornsiebes im Aspirateur bei gleichzeitiger Rucknahme der Durchsatzleistung. Der Haupteffekt kann durch die Erhohung der Luftraten erzielt werden.

## Q04 FOOD COMPOSITION

1069 Abd,El-Hady,EA.; El-Samahy,SK.; Brummer,JM. (1999) **Effect of oxidants,sodium-stearoyl-2-lactylate and their mixtures on rheological and baking properties of nonprefermented frozen doughs.** *Food Science & Technology-Lebensmittel-Wissenschaft & Technologie. 32(7):446-454.* English. [Suez Canal Univ,Dept Food Technol,Fac Agr Ismailia 41522 Egypt].

The effect of adding ascorbic acid and/or potassium bromate as oxidants and sodium-stearoyl-2-lactylate (SSL) as a surface-active agent both individually and as mixtures to frozen wheat bread doughs on ifs rheological and baking quality was examined. The gassing power was measured using a risograph and rheofermentometer,while the rheological properties were measured using modified extensograph and rheofermentometer procedures. The baking quality of the resulting bread was measured by sensory evaluation. The results obtained indicated that the frozen doughs with ascorbic acid alone or mixed with potassium bromate and or SSL showed some increase in gassing power compared to those without ascorbic acid. The dough height at maximum development time (H-m,measured by rheofermentometer) was improved by adding ascorbic acid to the dough formula,compared to those without ascorbic acid or those containing potassium bromate or SSL individually. The maximum resistance of frozen doughs increased and the extensibility decreased in the doughs containing oxidants. The opposite trend occurred in doughs without oxidants or with SSL alone. Addition of ascorbic acid alone or mixed with potassium bromate or SSL improved the final baking score,during frozen storage time compared to a control. We found a strong relationship between the rheological properties (measured by risograph,rheofermentometer and extensograph) and baking quality of the resulting bread from frozen doughs. (C) 1999 Academic Press. [References: 29].

1070 Accerbi,M.; Rinaldi,VEA.; Ng,PKW. (1999) **Utilization of highly deoxynivalenol-contaminated wheat via extrusion processing.** *Journal of Food Protection. 62(12):1485-1487.* English. [Michigan State Univ,Dept Food Sci & Human Nutr E Lansing,MI 48824 USA].

Deoxynivalenol (DON) is a toxic natural metabolite produced by Fusarium graminearum. In this study we investigated the effects of sodium bisulfite and extrusion cooking under high temperature and pressure on DON levels in wheat grain and mill fractions. Samples of highly naturally DON-contaminated soft winter wheat were soaked for 1 h in water or aqueous sodium bisulfite (SB) solutions (0.5,1.5,2.5,or 5% SO2 equivalent) and extruded. The soaking treatment with SE solution (5% SO2 equivalent) lowered DON from 7.3 mu g/g to 0.8 mu g/g without extrusion and to 0.3 mu g/g with an extrusion process. When the contaminated kernels were tempered with water or SE solutions (5 or 10% SO2 equivalent) and milled,the flour samples,as expected,showed lower levels of DON (from 7.3 to 3.1 mu g/g). Extrusion of milled flour and whole meal samples,both obtained from SE-tempered wheat,did not change DON levels significantly under the studied extrusion conditions as compared to the nonextruded milled flour and whole meal samples. However,the extrusion process can be utilized to remove moisture and/or odor of chemicals used in the soaking solutions and to produce potentially useful extruded products. [References: 22].

1071 Allam,M.A.; El Shirbeeny,A. (Ministry of Agriculture,Cairo (Egypt). Food Science and Technology Research Inst.) (1996) **Statistical analysis on technological characteristics of wheat.** *Fayoum Journal of Agricultural Research and Development (Egypt) v. 10(2) p. 111-128.* 10 tables; 11 ref. English. (AGRIS 2000-006301).

1072 Andreu,P.; Collar,C.; Martinez-Anaya,MA. (1999) **Thermal properties of doughs formulated with enzymes and starters.** *European Food Research & Technology. 209(3-4):286-293.* English. [CSIC,Inst Agroquim & Tecnol Alimentos Poligono Coma S-N E-46980 Valencia Spain].

Thermal properties (gelatinization,amylose-lipid complex dissociation and amylopectin retrogradation) of bread samples formulated with two different quality wheat flours,two enzymes (alpha-amylase/pentosanase,Lipase and their mixture),and three microbial sourdough starters were studied with a differential scanning calorimeter. The carbohydrases modified gelatinization temperature and enthalpy,whilst the lipase modified the amylose-lipid complex dissociation. The enthalpy of amylopectin retrogradation was significantly influenced only by the storage of breads. Second-order interactive effects of enzymes with flour or starter were found for gelatinization and/or amylose-lipid complex dissociation parameters. Some interesting relationships were observed between thermal and textural properties of fresh and stored breads. [References: 40].

1073 Antes,S.; Wieser,H. (1999) **Model test of the reoxidation behaviour of glutelin subunits of wheat and rye.** Deutsche Forschungsanstalt fuer Lebensmittelchemie,Garching (Germany). *Getreide Mehl und Brot (Germany) v. 53(5) p. 291-295.* German. (AGRIS 2000-006305).

Bei der Reoxidation von Glutelinuntereinheiten mit KBrO3 als Oxidationsmittel bilden sowohl die HMW-UE von Weizen (HMW-REK) und Roggen (HMW-DAN) wie auch die LMW-UE von Weizen (LMW-REK) langsam aber stetig intermolekulare Disulfidbindungen aus. Vergleicht man HMW-REK und HMW-DAN,zeigt sich bei HMW-DAN eine etwas raschere Abnahme der Thiolgruppen. Die Molekulargewichtsverteilung der reoxidierten HMW-DAN laesst auf eine vermehrte Bildung intramolekularer Disulfidbindungen schliessen,da der Anteil an hochmolekularen Aggregaten weitaus geringer ist als bei HMW-REK. Der Gehalt der intermolekularen Disulfidbindungen steigt mit der Erhoehung der eingesetzten Proteinkonzentration. Bei der Reoxidation mit KIO3 bilden die HMW-REK und HMW-DAN hauptsaechlich intramolekulare Disulfidbindungen,wobei auch bei der Reaktion mit KIO3 der Anteil an hochmolekularen Aggregaten bei den HMW-DAN geringer ist als bei HMW-REK. Der Einfluss reoxidierter Glutelin-UE von Weizen auf die Teig- und Backeigenschaften wurde mit Hilfe von Zug- und Backversuchen im Mikromassstab untersucht. Die Ergebnisse der Zugversuche stehen mit den Ergebnissen der Mikrobackversuche im Einklang. So erniedrigen reoxidierte LMW-UE das Gebaeckvolumen betraechtlich,waehrend reoxidierte HMW-UE den Dehnwiderstand des Teiges und auch das Gebaeckvolumen erhoehen.

1074 Arlorio,M.; Coisson,JD.; Martelli,A. (1999) **Identification of Saccharomyces cerevisiae in bakery products by PCR amplification of the ITS region of ribosomal DNA.** *European Food Research & Technology. 209(3-4):185-191.* English. [Univ Piemonte Orientale,Fac Farm,Dipartimento Sci Med,A Avogadro Viale Ferrucci 33 I-28100 Novara Italy].

A non-conventional sensitive and specific method for the detection of Saccharomyces cerevisiae in food is proposed. Polymerase chain reaction (PCR) led to the identification of this yeast in some commercial bakery products. The comparative use of two methods of clean-up of DNA from Triticum spp,S cerevisiae and some foods shows an improvement in extraction yield for the phenol-free method. Analysis of some sequences of ribosomal genes shows different amplified products for Triticum and S. cerevisiae. Internal transcribed spacer amplification (ITS1/ITS4) produced a single band of about 650 and 800 bp for Triticum and S. cerevisiae,respectively. ITS1/ITS2 universal fungal primers gave a single band of about 300 and 450 bp for Triticum and S. cerevisiae,respectively. Both amplification products are able to distinguish between the yeast and the DNA from T. aestivum and T. durum,showing polymorphism in the ITS1 region. Amplification on two primers designed using the sequence of the ITS1 region of S. cerevisiae rDNA (SC1/SC2) led to a single band of 300 bp,species-specific for the yeast. These primers enabled an unambiguous distinction between fermented foods containing S. cerevisiae and those leavened by baking powders to be made. We suggest that this PCR assay could be used for quality control and for the trace detection of S. cerevisiae as a potential food allergen. [References: 26].

1075 Awan,NA.; Murdoch,AJ.; Gooding,MJ. (1999) **Effects of weeds and chemical weed control on yield and breadmaking quality of winter wheat.** *1999 BRIGHTON CONFERENCE: WEEDS,VOLS 1-3. :585-586.* English. [Univ Reading,Dept Agr Earley Gate,POB 236 Reading RG6 6AT Berks England].

An experiment was conducted to investigate the effects of weeds and herbicides on yield and breadmaking quality of wheat in 1997/98. Two herbicides,Cheetah (fenoxaprop-p-ethyl) and Starane2 (fluroxypyr) were applied to the crop sown with and without artificially seeded infestations of blackgrass (Alopecurus myosuroides) and cleavers (Galium aparine) respectively. Protein content and SDS value both increased significantly with increase in herbicide application rate. Herbicide application time,weed species and weed density did not affect these quality characteristics. [References: 4].

1076 Beer,M.U.; Wood,P.J.; Weisz,J.; Fillion,N. (1998) **Cereal beta-glucan: Physicochemical and physiological properties.** Novartis Nutrition Research AG,Neuenegg (Switzerland). *Getreide Mehl und Brot (Germany) v. 52(6) p. 336-340.* German. (AGRIS 2000-006181).

Es werden die physikochemischen und physiologischen Eigenschaften des ss-Glucans im Getreide (Hafer,Gerste,Wachsgerste) diskutiert. Dabei werden die Ergebnisse mitgeteilt,welche die besondere Bedeutung physikochemischer Parameter aufzeigen,wie z.B. die Loslichkeit und das Molekulargewicht. Von diesen Faktoren ist die maximale physiologische Aktivitat des ss-Glucans in Getreide und Getreidelebensmitteln direkt abhangig. Auf die gesundheitsbezogene Werbung fur Haferspeisekleie wird kurz eingegangen. Die "Food and Drug Administration" (FDA) in den USA hat vor kurzem erstmals eine gesundheitsbezogene Werbung erlaubt,und zwar in der Richtung,dass zwischen dem Verzehr von Lebensmitteln mit einem hohen Anteil an Hafer-ss-Glucan und einem reduzierten Risiko fur Herzkranzerkrankungen eine Verbindung besteht.

1077 Billaud,C.; Kohler,B.; Boivin,P.; Nicolas,J. (1999) **Polyphenolic substrates of cationic and neutral/anionic peroxidases from barley and malt using a chronometric method for the determination of pod activity.** *Journal of Food Biochemistry. 23(5):519-545.* English. [Conservatoire Natl Arts & Metiers,Chaire Biochim Ind & Agroalimentaire 292 Rue St Martin F-75141 Paris 03 France].

4-methylcatechol,phenolic acids from the benzoic and cinnamic series,flavan 3-ols and L-tyrosine were tested to determine the catalytic behavior of barley peroxidases (POD) at the expense of hydrogen peroxide. A chronometric assay using L-ascorbic acid was described for determining the peroxidatic activity of basic and neutral/anionic enzymatic fractions. The effects of hydrogen donors H2O2,and Ca++ ion concentrations and pH were studied to set maximal conditions for POD measurement. The sensitivity to endogenous phenolic compounds (ferulic and p-coumaric acids,(+) catechin) along with caffeic acid for POD fractions was investigated and compared with their response versus guaiacol. Under the conditions tested,syringic and sinapinic acids as well as L-tyrosine were very weakly oxidized by POD from barley,whereas ferulic and caffeic acids were rapidly transformed. Levels of POD activity extracted from barley,green malt and kilned malt crude extracts were thereafter compared. [References: 31].

1078 Boggini,G.; D'Egidio,M.G.; Di Fonzo,N.; Novaro,P.; Brandini,R.; Cecchini,C.; Vita,P. de; Fares,C.; Galterio,G.; Palumbo,M.; Virzi,N. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)) (1998) **[Monitoring of hard wheat quality [Triticum durum Desf.]].** *Informatore Agrario (Italy) v. 54(36) p. 45-49.* 3 tables; 3 graphs. Italian. (AGRIS 2000-006132).

1079 Bonafaccia,G.; Galli,V.; Francisci,R.; Mair,V.; Skrabanja,V.; Kreft,I. (2000) **Characteristics of spelt wheat products and nutritional value of spelt wheat-based bread.** *Food Chemistry. 68(4):437-441.* English. [Univ Ljubljana,Biotech Fac POB 2995 SI-1001 Ljubljana Slovenia].

Spelt wheat cultivars (cv.) Hercule,Rouquin and Ostro,grown in the Alpine region of Italy,were compared to the common wheat cv. Manital and durum wheat Grazia for protein,ash and dietary fibre contents. The spelt wheat cultivars studied had higher contents of soluble dietary fibre and protein than the standard wheat or the durum wheat. In the bread of spelt wheat (cv. Hercule),there was mon rapidly digested starch (RDS) and a higher starch digestion index (SDI) in comparison to wheat bread. The bread made of whole spelt wheat flour (cv. Hercule) had less total starch,more resistant starch and less rapidly digested proteins in comparison to bread made of white spelt wheat flour and white wheat flour (cv. Manital). In pasta and extruded products of whole spelt flours,more protein,ash and dietary fibre was found in comparison to the same products made of white spelt wheat flour. (C) 2000 Elsevier Science Ltd. All rights reserved. [References: 14].

1080 Brummer,J. M.; Unbehend,G. (1999) **(Quality of rye and wheat milled products in the cereal economic year 1997/98).** Bundesanstalt fuer Getreide-,Kartoffel- und Fettforschung,Detmold (Germany). Inst. fuer Getreide-,Kartoffel- und Staerketechnologie. *Getreide Mehl und Brot (Germany) v. 53(3) p. 147-153.* German. (AGRIS 2000-006299).

Die mit der Ernte 1974 begonnene Statistik uber die Qualitat der Weizen- und Roggenmahlerzeugnisse der Getreidewirtschaftsjahre wurde auch im Getreidewirtschaftsjahr 1997/98 durch Qualitatsuntersuchungen an Roggenmahlerzeugnissen (Typen 997/1150),Weizenmahlerzeugnissen (Typen 550/1050) und Backschrot/ Vollkornschrot/Vollkornmehl aus Weizen und Roggen fortgesetzt. Die Durchschnittswerte fur das Getreidewirtschaftsjahr 1997/98 bestatigen die Voraussagen,die kurz nach der Ernte 1997 gegeben wurden. Insgesamt hatten die Weizen- und Roggenmahlerzeugnisse eine gute bis sehr gute Verarbeitungsqualitat. Das Qualitatsniveau spiegelt sich auch in den Ergebnissen bei den DLG- und CMA-Qualitatsprufungen fur Brot und Backwaren wider. DemMuhlengewerbe ist es somit auch im Getreidewirtschaftsjahr 1997/98 gelungen,durch den selektiven Einkauf von Roggen und Weizen Getreidemahlerzeugnisse mit guten bis sehr guten Qualitatseigenschaften herzustellen. Wahrend der Verbrauch an Roggenmahlerzeugnissen in 1997/98 auf Vorjahresniveau liegt,ist der Jahresverbrauch an Weichweizenmahlerzeugnissen um 1,8 kg auf 52,5 kg/Jahr angestiegen.

1081 Champenois,Y.; Della,Valle,G.; Planchot,V.; Buleon,A.; Colonna,P. (1999) **Influence of alpha-amylases on bread staling and on retrogradation of wheat starch models [Review].** *Sciences des Aliments. 19(3-4):471-486.* English. [URPOI,Inst Natl Rech Agron Rue Geraudiere,BP 71627 F-44316 Nantes 3 France].

The influence of two commercial a-amylase preparations on starch gelation was studied in breads and starch gels. Amylopectin retrogradation,crumb firming,amylose-lipid complexes,and macromolecular degradation were analyzed in bread samples supplemented with two bacterial enzyme mixtures. The extent of amylopectin retrogradation,as measured by the enthalpy change at 45 degrees C,was reduced by the use of the enzyme mixtures. The firming rate was also strongly related to the extent of amylopepctin retrogradation for breads supplemented with the enzyme preparations. These changes are believed to be related to the depolymerization of starch molecules,which occurs throughout storage,and demonstrates that the amylases in bread were not completely denaturated by baking. Changes of starch gels throughout storage demonstrated that crystallinity and firmness are not correlated. [References: 31].

1082 Choi,U.K.; Kim,Y.J.; Ji,W.D.; Choi,D.H.; Jeong,M.S.; Chung,Y.G. (Yeungnam University,Taegu (Korea Republic). Department of Food Science and Technology); Son,D.H. (Taegu Polytechnic College,Taegu (Korea Republic). Department of Food Preparation) (1999) **The flavor components of traditional sigumjang meju.** *Korean Journal of Food Science and Technology v. 31(4) p. 887-893.* 2 illus.; 2 tables; 13 ref. Korean. (AGRIS 2000-006248).

1083 Collar,C.; Andreu,P.; Martinez,JC.; Armero,E. (1999) **Optimization of hydrocolloid addition to improve wheat bread dough functionality: a response surface methodology study.** *Food Hydrocolloids. 13(6):467-475.* English. [CSIC,Inst Agroquim & Tecnol Alimentos,Lab Cereales Poligono La Coma S-N Paterna 46980 Spain].

Effects of high ester pectin + alpha-amylase + sucrose (GNFZ),a high ester pectin + sucrose (BIG),xanthan gum (XANTHAN) and hydroxypropylmethylcellulose (HPMC) on wheat dough performance have been studied. Effects of hydrocolloids added singly and in association at different levels,on the investigated rheological,mechanical and thermal parameters have been evaluated by response-surface methodology. Optimum hydrocolloid formulations for white wheat bread are recommended. Positive linear and negative quadratic significant effects of GNFZ were observed on both the gluten index (GI) and the energy of dissociation of the amylose-lipid complex (Delta H-x). Optimized dosage of 1.36 g GNFZ/100 g flour,d.b. (maximum of the respective response surface plot) led to maximized values for both GI and Delta H-x,described as good indicators and predictors of the quality of fresh and stored formulated breads to be obtained. The strengthening effect of high ester pectin was reinforced by the negative quadratic effect of GNFZ on gluten extensibility,the positive effect of GNFZ/HPMC on the resistance to extension of gluten,and the negative synergistic effect of the pair BIG/HPMC on dough extensibility. XANTHAN when added singly induced desirable increase in dough resistance to extension,and the incorporation of the pair XANTHAN/GNFZ into dough formula is recommended because of the reduction of the induced degree of softening during mixing (farinograph) of GNFZ formulated doughs. A dosage of 0.109 g XANTHAN/100 g flour annulate the softening effect of GNFZ when added at an optimized dose of 1.36 g GNFZ/100 g flour. Caution should be applied when added XANTHAN in presence of BIG because of the decrease in the extent of amylose-lipid complexation. Addition of HPMC at a level < 1/ > 1 moderate/enhance,respectively,the effect of GNFZ on the resistance to extension of the gluten,and the water binding capability of BIG,and in this respect the incorporation of the cellulose derivative is encouraged at a dose dependent on the required effect. (C) 1999 Elsevier Science Ltd. All rights reserved. [References: 53].

1084 Cui,W.; Wood,PJ.; Blackwell,B.; Nikiforuk,J. (2000) **Physicochemical properties and structural characterization by two-dimensional NMR spectroscopy of wheat beta-D-glucan - comparison with other cereal beta-D-glucans.** *Carbohydrate Polymers. 41(3):249-258.* English. [Agr & Agri Food Canada,So Crop Protect & Food Res Ctr,Food Res Program 93 Stone Rd Guelph ON N1G 2W1 Canada].

The first isolation,purification and characterization of a wheat beta-D-glucan is reported. Alkaline extraction of wheat bran prepared by a novel pre-processing gave a non-starch polysaccharide fraction. Purification was carried out by hydrolyzing the arabinoxylans of this fraction with beta-D-xylanase (T. Viride,EC 3.2.1.8),which had no effect on the molecular weight of the beta-D-glucan. The structure of the purified wheat beta-D-glucan was characterized by NMR spectroscopy,and additional structural detail was revealed by hydrolysis with (1 +/- 3)(1 +/- 4)-beta-D-glucan-4-glucanohydrolase (lichenase,EC 3.2.1.73) and analysis of the oligosaccharide reaction products. Direct and long-range homo(H-1/H-1) and hetero- (C-13/H-1) nuclear shift correlations were used to make complete assignments of both the C-13 and H-1 spectra as well as to confirm sequences and linkage sites. The C-13 NMR Spectrum of wheat beta-D-glucan appeared identical to that of other cereal beta-D-glucans,such as those from oat and barley. However,the ratio of 3-O-beta-cellobiosyl- and 3-O-beta-

cellotriosyl-D-glucose obtained from wheat beta-D-glucan by lichenase hydrolysis was significantly higher than ratios from other cereal beta-D-glucans (approximately 4,3 and 2 for wheat,barley and oat,respectively). The predominant molar proportion of trisaccharide (72.4%) from wheat beta-D-glucan suggests that it will have a more regular structure than the other beta-D-glucans,which might be responsible for its greater gelling ability and poorer solubility in water compared to other cereal beta-D-glucans. (C) 2000 Elsevier Science Ltd. All rights reserved. [References: 29].

1085 D'Egidio,M.G.; Cecchini,C.; Conciatori,A.; Martorana,M.; Novembre,G.; Desiderio,E. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)) (1998) **[Qualitative evaluation of hard wheat varieties [Triticum durum Desf.]].** *Informatore Agrario (Italy) v. 54(suppl.36) p. 21-26.* 9 tables. Italian. (AGRIS 2000-006133).

1086 Davy,A.; Svendsen,I.; Bech,L.; Simpson,DJ.; Cameron-Mills,V. (1999) **LTP is not a cysteine endoprotease inhibitor in barley grains.** *Journal of Cereal Science. 30(3):237-244.* English. [Carlsberg Res Lab Gamle Carlsbergvej 10 DK-2500 Valby Denmark].

Several different protease inhibitors have been identified in the mature barley grain,which are proposed to play a defensive role against potential barley pathogens. Cysteine protease inhibitors have been detected in mature grain and in the early stages of germination. The nature of these inhibitors has recently been investigated,and barley lipid transfer protein (LTP1) has been identified as an effective inhibitor of both cysteine and serine endoprotease activity expressed in germinating grain. We show that barley LTP1,in its native state,is not a cysteine protease inhibitor,but in a denatured state becomes a preferred substrate for the barley endoprotease EP-B and,as such,behaves as a competitive inhibitor for poorer substrates of EP-B. The presence of significant amounts of LTP1 in barley malt peer suggests that this very compact protein is highly resistant to proteolytic attack during malting and mashing and its denaturation during wort boiling coincides with inactivation of the malt endoproteases. Analysis of the cleavage products of denatured LTP1,generated by EP-B,provides further evidence for the cleavage site specificity of this barley cysteine endoprotease,where a hydrophobic residue in the P-2 position is strongly preferred. (C) 1999 Academic Press. [References: 31].

1087 De,Ruiter,JM. (1999) **Yield and quality of malting barley (Hordeum vulgare L-'Valetta') in response to irrigation and nitrogen fertilisation.** *New Zealand Journal of Crop & Horticultural Science. 27(4):307-317.* English. [New Zealand Inst Crop & Food Res Ltd,Canterbury Agr Sci Ctr Private Bag 4704 Christchurch New Zealand].

Interactions of soil water and nitrogen (N) fertiliser application on the quality of barley (Hordeum vulgare L. 'Valetta') for malting were studied in a rain shelter experiment at Lincoln,New Zealand. Treatments were arranged in a factorial design,consisting of five levels of soil water (fully irrigated,rain-fed,early drought,late drought,and full drought) and four levels of N fertiliser (nil,1 x 50,2 x 50,and 3 x 50 kg N/ha). N treatments were applied at emergence,appearance of the second node,and at flowering,respectively. Variables indicative of grain quality (N concentration,grain size,and screenings) and micro-malting characters (water uptake,malting loss,N index,wort-N,beta-glucan,fine extract,coarse extract,and fine-coarse difference) were evaluated for responses to the water and N treatments. Drought influenced the distribution pattern of kernel mass along the main stem and tiller spikes and also influenced the relative proportions of grain in the standard size categories. The level of N fertiliser had little effect on the kernel size properties. Screenings originated from both the proximal and distal ends of tiller spikes and from the proximal end of the main stem spike. The less severely water stressed treatments had fewer small kernels and,mean weight of kernels was greater over all kernel positions. Grain N concentration responded to N fertiliser application but was unresponsive to water treatment. The reverse was true for kernel size and the malting characters of water uptake,malting loss,extract levels,and fine/coarse difference. Drought increased the levels of wort P-glucan and lowered wort N and N index whereas N fertiliser caused an increase in wort P-glucan and wort N but lowered the N index. Interactions between water and N effects were only significant for the latter. Both the timing of drought and fertiliser treatment had strong effects on the biochemical and physical characteristics of grain. [References: 28].

1088 Every,D. (1999) **Purification and characterisation of ascorbate oxidase from flour and immature wheat kernels.** *Journal of Cereal Science. 30(3):245-254.* English. [New Zealand Inst Crop & Food Res Ltd Private Bag 4704 Christchurch New Zealand].

White flour from wheat was shown to contain basic-ascorbate oxidase (AOX) enzymes (pI 7.6-9.6) and acidic-AOX enzymes (pI 5.1-6.6) in a ratio of 0.4:1,based on chromatography data. Immature wheat kernels (two weeks post-anthesis) contained about 12 times more AOX activity (units/g dry weight) than flour from mature grain,and the ratio of basic- to acidic-AOX: was 5:1. Acidic-AOX was purified 90-fold from flour by hydrophobic interaction,gel filtration and anion exchange chromatography. Basic-AOX was purified 20 000-fold from immature wheat by hydrophobic interaction,anion exchange,cation exchange and gel filtration chromatography in a yield of 5%. The acid-AOX had a hi,of 140 k,was optimally active at pH 6.3 and 40 degrees C,and was stable in the pH range 5-9 and at 30 degrees C for 0.5 h at pH 6.2. The Km values were 0.26 mM for L-ascorbic acid and 0.93 mM for D-iso ascorbic acid. The basic-AOX had a M-r of 139 k and subunit M-r of 72 k. The enzyme was optimally active at pH 6.2 and 50 degrees C,and was stable in the pH range 5-9 and at 40 degrees C for 0.5 h at pH 6.2. The Km values were 0.30 mM for L-ascorbic acid and 0.53 mM for D-iso ascorbic acid. The absorption spectrum of basic-AOX had absorption maxima at 280 nm and 607 nm of similar magnitude to those measured in AOX from Cucurbita species (squash). This indicates that wheat AOX contains protein-bound copper similar to other plant AOX. (C) 1999 Academic Press. [References: 28].

1089 Feillet,P. (1999) **Wheat chemistry,technology,and nutrition: Current research priorities.** *Cereal Foods World. 44(11):752-756.* English. [INRA,Unite Technol Cereales & Agropolymeres 2 Pl Viala F-34060 Montpellier France].

1090 Ferraresi,A.; Canestrale,R. (Centro Ricerche Produzioni Vegetali (CRPV),Cesena,Forli (Italy)); Corticelli,C. (Associazione Interprofessionale Cerealicola (ASSINCER),Bologna (Italy)); Balduini,C. (Regione Lombardia,Milan (Italy). Direzione Generale Agricoltura); Empilli,S.; Vaccino,P. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)); Norido,F. (Veneto Agricoltura Azienda Regionale per i Settori Agricoloforestali e Agroalimentare,Legnaro,Padua (Italy)) (1998) **[The quality of wheats in Emilia-Romagna - Lombardy and Veneto [Triticum aestivum L. - Triticum durum Desf.]].** *Informatore Agrario (Italy) v. 54(34) p. 51-56.* 5 tables; 6 graphs. Italian. (AGRIS 2000-006240).

1091 Fickler,J. (1999) **Amino acid variations in raw materials.** Degussa-Huels AG,Hanau (Germany). Anwendungstechnik Futtermitteladditive. *Kraftfutter (Germany) (no.4) p. 128-132,134,136-139.* English. (AGRIS 2000-006155).

Es werden Variationen im Aminosaurengehalt folgender Rohstoffkomponenten verglichen: Mais,Weizen,Gerste,Roggen,Triticale,Weizenkleie,Rapsextraktionsschrot,Sojaextraktionsschrot,Fleischknochenmehl,Fischmehl. Die Analyse der Daten zeigt,dass pflanzliche Proteintrager geringere Variationen aufweisen als Proteine tierischer Herkunft. Die Streuung liegt bei gleichem Proteingehalt,bei pflanzlichen Proteinen bei ca. 10-15% und bei tierischen Produkten bei bis zu 25%. Bei Weizen und Gerste ist in der Tendenz eine Abnahme der Aminosaurengehalte mit zunehmendem Proteingehalt festzustellen. Bei den tierischen Produkten steigen dagegen die Gehalte mit zunehmendem Proteingehalt an.

1092 Finney,PL.; Bains,GS. (1999) **Protein functionality differences in eastern US soft wheat cultivars and interrelation with end-use quality tests.** *Food Science & Technology-Lebensmittel-Wissenschaft & Technologie. 32(7):406-415.* English. [Ohio State Univ,Ohio Agr Res & Dev Ctr,Soft Wheat Qual Lab,Agr Res Serv,USDA Wooster,OH 44691 USA].

Fifty-nine samples of eastern U.S. soft winter wheat consisting of eight cultivars,with six to eight replications,were investigated for milling,cookie baking,and physical and chemical tests of quality and interrelations for predicting end-use quality. Three of the cultivars with 5 + 10 Glu-D1 high molecular weight subunit composition yielded significantly higher (P = 0.01) break flour and gave lower damaged starch,lower gluten hydration,longer dough mixing times and larger diameter cookies with superior top grain compared to those office cultivars with 2 + 12 Glu-D1 high molecular weight subunit composition. Dough development time and gluten hydration tests showed significant positive correlations with the milling parameters and a negative correlation with damaged starch contents of the flours. Due to the highly significant correlation coefficient (r = 0.94,n = 59) of Zeleny- and sodium dodecyl sulfate-sedimentation values,either can be used to test the strength of protein in the soft wheat flours. For better prediction of end-use quality,the results suggest integration of protein/gluten functionality testing with existing tests as an important facet of quality testing in soft reheats. (C) 1999 Academic Press. [References: 45].

1093 Germani,R.; de,Carvalho,JLV. (1999) **Physical characteristics of Brazilian wheat and their utilization as an indication of flour extraction.** *Brazilian Archives of Biology & Technology. 42(1):23-29.* English. [EMBRAPA,Ctr Nacl Pesquisa Tecnol Agroind Alimentos Av Amer 29501 BR-23020470 Rio Piedras RJ Brazil].

An extensive work to determine the test weight (TW),the thousand kernel weight (TKW) and the hardness (HD) of Brazilian wheat,was undertaken for the crop years from 1990 to 1994,with the objective of drawing the Brazilian wheat physical characteristics and their relationship with flour extraction (FE). The results showed a median TW of 78.2kg/hl,a TKW of 34.2g and the HD was graded as hard. The values varied accordingly with the crop year,the local and year vs. local. Among the locals the wheat from the MS/DF/MG/GO States showed the best results. Correlation coefficients between FE and each of the parameters,TW,TKW and HD were low but significant (P < 5.0%) and,therefore,should not be used as a direct relationship but only as an indicator of FE. Segregation of TW,TKW and HD by specific ranges did not improve the correlation coefficient values. [References: 12].

1094 Ghorbel,D.; Launay,B. (1999) **Adhesion properties of wheat flour doughs: description and application of an improved instrumental method.** *Sciences des Aliments. 19(5):559-578.* French. [Ecole Natl Super Ind Agr & Alimentaires,Lab Biophys Mat Alimentaires 1 Ave Olympiades F-91744 Massy France].

A commercially available method (SMS,Stable Microsystems) to measure wheat flour dough adhesion properties was evaluated,The original cell elaborated by CHEN and HOSENEY and an improved version of this cell were compared. The method is based on the extrusion of dough through a stainless-steel screen and on the measurement of adhesion to a Plexiglas probe attached to a texturometer TAXT2 (SMS). It is not suitable for high consistency doughs and the results show rather high standard deviations. Our objective was to improve the reproducibility of the CHEN method and to make it possible to use a stress gauge of 250 N. The new method uses an alveograph dough sample holder to replace the Chen cell (extrusion via uniaxial compression,without torsion),a stainless-steel screen,a disc of diameter greater than that of the Plexiglas probe (contact area more constant) and new test conditions (maximum compression force,holding time). This method gives more reproducible and more discriminant results than those obtained with the two versions of the Chen cell,it was used with several bread and biscuit flours,at different water contents and mixing times. The energy of separation (proportional to the area of the adhesion peak) increases,for the same flour,when mixing time and,more significantly,water content increase. When we take into account the flour used,the results may be ranked differently depending on the method employed. Measurements made on simple laboratory doughs (flour + water,Farinograph mixer) and on bread doughs (Mahot mixer) containing yeast and sodium chloride but no additives and made with the same flour,give well-correlated results. With two flours,the dynamic moduli of doughs at variable water contents showed a good correlation with the energy of separation. This result indicates that dough adhesion is a theologically controlled process,as observed with pressure sensitive adhesives. Nevertheless,other factors associated with the flour itself should also determine the adhesion properties of wheat flour doughs: this is shown by the significant variation in the energy of separation which may be observed with doughs having the same complex viscosity. [References: 36].

1095 Gras,PW.; Carpenter,HC.; Anderssen,RS. (2000) **Modelling the developmental rheology of wheat-flour dough using extension tests.** *Journal of Cereal Science. 31(1):1-13.* English. [CSIRO,Pland Ind,Grain Qual Res Lab POB 7 N Ryde NSW 2113 Australia].

Modern cereal science has progressed to the point where a more detailed and explicit understanding of the rheological properties of wheat-flour dough at the molecular level is required in order to improve plant breeding methodologies,the manufacturing of wheat-flour dough products and the assessment of wheat and wheat-flour quality. The formulation of molecular models provides a basis for predictive tests that can be combined with other protocols. The actual modelling must,in turn,be based on experiments which directly monitor the changing rheology of the dough which occurs during mixing,as it is this evolving rheology which in effect monitors the dough at a molecular level. There are various ways in which this can be done. The perspective adopted here is that,at least on a Mixograph(TM),the mixing of the dough can be viewed as a series of extension tests. It therefore follows that one way to monitor the evolving rheology of a wheat-flour dough during mixing is to perform extension tests on the dough at various stages during the mixing. The results obtained from such experiments are reported in this paper. They show how-the study of the evolving rheology of a wheat-flour dough,during mixing with varying amounts of added water,in effect monitors the molecular processes occurring during mixing in terms of the behaviour of the bonded and unbonded water within the dough. In addition,these results yield confirming evidence for the hypothesis,tentatively proposed by various authors,that the bandwidth of a Mixogram is a key (qualitative) characteristic of a dough for assessing its strength. Together,both these conclusions imply that,as well as a measure of the strength and quality of the dough being mixed,the variation in the bandwidth of a Mixogram is indicative of the role played by the added water during the mixing. [References: 30].

1096 Grewal,HK.; Hira,CK.; Kawatra,BL. (1999) **Zinc,calcium and iron availability using molar ratios in processed and cooked wheat products.** *Journal of Food Science & Technology-Mysore. 36(5):453-456.* English. [Punjab Agr Univ,Dept Foods & Nutr Ludhiana 141004 Punjab India].

Molar ratios for availability of zinc,calcium and iron were calculated from various processed and cooked samples of wheat. Phytate: zinc molar ratio was more than 20 for all processed wheat samples. Phytate x calcium: zinc molar ratio was more than 50 mM/100g in refined flour and semolina and less than this value in rest of the samples. The phytate: calcium,phytate: iron and iron: zinc molar ratios in all processed wheat samples were more than the desired ratios. In cooked products of whole and pearled wheat flour,the phytate: zinc ratio below 20 and phytate x calcium: zinc ratio above 50 were observed in chapati and parantha,but not in pooris. In all refined flour products,the phytate: zinc,phytate x calcium: zinc,phytate: calcium and phytate: iron ratios were found to be lower compared to whole and pearled wheat flour products. [References: 15].

1097 Izydorczyk,MS.; MacGregor,AW. (2000) **Evidence of intermolecular interactions of beta-glucans and arabinoxylans.** *Carbohydrate Polymers. 41(4):417-420.* English. [Univ Manitoba,Dept Food Sci Winnipeg MB R3T 2N2 Canada].

1098 Jegasothy,H.; Wootton,M.; Fairclough,RJ. (2000) **Agarose gel electrophoresis of wheat starch.** *Journal of Cereal Science. 31(1):75-78.* English. [Victoria Univ Technol,Ctr Bioproc & Food Technol,MCMC POB 14428 Melbourne Vic 8001 Australia].

1099 Keya,EL.; Mugambi,PM. (1999) **The influence of amaranth substitution on pasting,dough visco-elastic and bread quality properties of Kenyan home baking grade wheat flour.** *Discovery & Innovation. 11(1-2):41-49.* English. [Univ Nairobi,Dept Food Technol & Nutr POB 29053 Nairobi Kenya].

Amaranth and commercial home baking grade wheat flours were analysed for proximate composition,flour particle size distribution and starch swelling power and solubility before being blended in ratios of 10/90 and 15/85 for comparative studies on flour amylographic pasting,dough visco-elastic,bread baking and bread Organoleptic properties. Pure wheat flour developed significantly higher pasting viscosity than pure amaranth flour. This was attributed mainly to the higher swelling power of wheat starch and to the more coarse particle size distribution in the amaranth flour. The amaranth flour absorbed more water than the wheat flour during dough making. This unexpected result appeared to be due to the presence of larger amounts of crude fibre in the amaranth flour which tended to imbibe and retain more water in the dough. Disregarding the fibre content,it was concluded that amaranth flour could be used in making high dry matter content gruels at desired viscosity. The composite flows compared to wheat flour produced doughs with weaker visco-elastic properties. The composite bread obtained had smaller,darker coloured and denser textured leaves than the pure wheat bread. A slightly bitter after-taste mouth sensation was recognizable in the composite bread. It was concluded that amaranth had high potential as a low level partial substitute for wheat in order to increase the nutritiousness of bread and to spread out the utilization of limited available wheat. [References: 40].

1100 Kim,C.K.; Yang,J.S.; Lee,H.J. (Korea Atomic Energy Research Institute,Taejon (Korea Republic). Department of Food Irradiation) (1999) **Detection of irradiated grains using the DNA 'comet assay'.** *Korean Journal of Food Science and Technology v. 31(4) p. 906-911.* 5 illus.; 1 table; 31 ref. Korean. (AGRIS 2000-006029).

1101 Kipp,B.; Wieser,H. (1999) **Comparative studies of high M-r subunits of rye and wheat. II. Partial amino acid sequences.** *Journal of Cereal Science. 30(3):303-313.* English. [Deutsch Forsch Anstalt Lebensmittelchem Lichtenbergstr 4 D-85748 Garching Germany].

High M-r subunit fractions of two rye cultivars (Danko and Halo) and of the wheat cultivar Rektor were isolated from defatted flours by extraction with 50% (v/v) aqueous propan-1-ol under reducing conditions and 60 degrees C followed by precipitation using a 60% concentration of propan-1-ol,centrifugation,dialysis and lyophilisation. Two single major subunits of rye Danko were isolated by preparative RP-HPLC and characterised by N-terminal sequencing which showed a strong homology to wheat high M-r subunits. Total high M-r subunit fractions of Danko,Halo and Rektor were digested with TPCK-treated trypsin at 37 degrees C for 8 h. The partial hydrolysates were pre-separated into the fractions I (M-r <10 000) and II (M-r >10 000) by centrifugation on a Centriprep 10-membrane. Both fractions were then separated by reversed-phase HPLC on C-18 silica gel. Dominating peptides were purified by preparative rechromatography under slightly changed HPLC conditions and characterised by amino acid analysis and determination of amino acid sequences. The resulting sequences of 19 (Danko),12 (Halo) and 15 peptides (Rektor) were compared with known sequences from x- and y-type high M-r subunits of wheat. With the exception of three peptides,the sequences could be assigned to the three different domains of high M-r subunits. Even when the sequences of the rye peptides were similar to those of wheat,they were not identical in any case; on average the variations were about 20%. Most of rye peptides corresponded to the x-type subunits of wheat. Within the most characteristic sequence motifs belonging to the repetitive domain B,fundamental differences between wheat and rye were not detected. (C) 1999 Academic Press. [References: 13].

1102 Kling,C.I.; Gerstenkorn,P. (1999) **Aptitude of cultivars and eastern regions for the durum wheat production.** Univ. Hohenheim,Stuttgart (Germany). Landessaatzuchtanstalt; Bundesanstalt fuer Getreide-,Kartoffel- und Fettforschung,Detmold (Germany). *Getreide Mehl und Brot (Germany) v. 53(5) p. 264-269.* German. (AGRIS 2000-006134).

Der Erfolg des Durumweizenanbaus in Deutschland ist stark von der Erzeugung geeigneter Durumqualitaeten abhaengig. Die fuer die Teigwarenindustrie massgeblichen Eigenschaften des Farb- und Kochpotentials sind sortentypisch und lassen sich in erster Linie durch die Sortenwahl beeinflussen. Die Ergebnisse von dreijaehrigen Landessortenversuchen von 1995 bis 1997 zeigen,dass derzeit neuere Sorten zur Verfuegung stehen,die die Erwartungen der Teigwarenindustrie an eine hohe Qualitaet mit einem hohem Ertragspotential verbinden. Die Moeglichkeit einer Ausdehnung der Anbauflaechen ist in den klassischen Anbaugebieten an Main,Neckar und Rhein und in bestimmten Regionen in Sachsen-Anhalt,Sachsen und Thueringen vorhanden. Die Betriebsstrukturenin den ostdeutschen Gebieten gewaehrleisten grosse einheitliche Sortenpartien,die fuer die Durummuehlen von besonderem Interesse sind.

1103 Koh,B.K. (Keimyung University,DaeGu (Korea Republic). Department of Foods and Nutrition) (1999) **A comparison of protein characteristics of korean and imported wheat varieties.** *Korean Journal of Food Science and Technology v. 31(3) p. 586-592.* 2 illus.; 4 tables; 33 ref. Korean. (AGRIS 2000-006302).

1104 Larre,C.; Denery-Papini,S.; Popineau,Y.; Deshayes,G.; Desserme,C.; Lefebvre,J. (2000) **Biochemical analysis and rheological properties of gluten modified by transglutaminase.** *Cereal Chemistry. 77(1):32-38.* English. [Unite Physicochim Macromol F-44316 Nantes 3 France].

A transglutaminase from Streptoverticillium sp. was used to create new covalent intermolecular cross-links between proteins in gluten. This modification induced drastic changes in its physicochemical properties as well as in its rheological behavior. To understand these changes,we characterized the gluten extractability in acetic acid and identified the proteins of supernatant and pellet by immunoblotting using antibodies specific for each prolamin class. The proportion of soluble proteins decreased drastically after transglutaminase treatment due to the formation of large insoluble polymers as shown by SDS-PAGE. Among the constitutive proteins of gluten,the high molecular weight glutenin subunits were the most affected in the transglutaminase reaction. The rheological behavior of gluten after 18 hr of incubation with transglutaminase was studied in shear by dynamic measurements over 10(-3) - 10(1) Hz frequency range and by creep and recovery tests. The behavior of treated glutens remained that of a transient network,but the viscoelastic response was shifted toward shorter times and the steady-state viscosity was greatly increased. The enzymatic treatment caused a considerable reinforcement of the network. The modified glutens were also less sensitive to thermal processing than unmodified glutens,as shown by a lower amplitude of variation of storage modulus G' with temperature after enzymatic treatment. [References: 22].

1105 Leinonen,KS.; Poutanen,KS.; Mykkanen,HM. (2000) **Rye bread decreases serum total and LDL cholesterol in men with moderately elevated serum cholesterol.** *Journal of Nutrition. 130(2):164-170.* English. [Univ Kuopio,Dept Clin Nutr FIN-70211 Kuopio Finland].

The objective of this study was to determine the hypocholesterolemic effects of whole meal rye and white wheat breads in healthy humans with elevated serum cholesterol

concentrations,and the changes in plasma glucose and insulin concentrations during rye and wheat bread periods. The subjects were 18 men and 22 women with baseline serum cholesterol concentration of 6.4 +/- 0.2 mmol/L. The study design was a 2 x 4-wk crossover trial during which each subject randomly consumed rye and wheat breads (20% of daily energy) as pari of their usual diet for 4 wk,The bread periods were separated by a 4-wk washout period. Blood samples (after fasting) were collected on two consecutive days at the beginning and end of the bread periods. Serum total cholesterol decreased by 8% (P = 0.002) in men but was not significantly altered in women during the rye bread period. The wheat bread period did not affect any of the variables studied. Analysis of the serum lipids in tertiles of rye bread consumption confirmed the reduction in total cholesterol (P = 0.048) in men and revealed the reduction in LDL cholesterol (P = 0.032); both were dependent on the amount of rye bread consumed (-2,-14 and -10% in total cholesterol and 0,-12 and -12% in LDL cholesterol),Neither rye nor wheat bread influenced the concentrations of glucose and insulin. In conclusion,rye bread is effective in reducing serum total and LDL cholesterol concentrations in men with elevated serum cholesterol. Good compliance with consuming a relatively large amount of rye bread in the usual diet indicates that rye bread offers a practical dietary means of reducing serum cholesterol in men. [References: 38].

1106 Levrat-Verny,MA.; Coudray,C.; Bellanger,J.; Lopez,HW.; Demigne,C.; Rayssiguier,Y.; Remesy,C. (1999) **Wholewheat flour ensures higher mineral absorption and bioavailability than white wheat flour in rats.** *British Journal of Nutrition. 82(1):17-21.* English. [INRA,Ctr Rech Clermont Ferrand Theix,Ctr Rech Nutr Humaine Auvergne,Lab Malad Metab & Micronutriments F-63122 St Genes Champanelle France].

Consumption of unrefined whole flour is thought to affect mineral bioavailability because it contains high levels of fibre and phytic acid. The present experiment was designed to study the absorption of minerals from diets based on wholewheat flour and white wheat flour in rats. Two groups of male Wistar rats were fed on the diets for 3 weeks and absorption and tissue retention of minerals were studied. The rats fed on the wholewheat flour diet had significantly greater food intake,weight gain,faecal excretion and intestinal fermentation than those fed on the white flour diet. Mineral intakes,except for Ca,were significantly greater in rats fed on the wholewheat flour diet (4-fold for Mg,2-fold for Fe and Zn). A significant rise in the apparent absorption of Fe (%) and a significant decrease in the apparent absorption of Zn (%) were observed. The amounts of minerals absorbed (mg/d) were significantly enhanced (excepted for Ca) with the wholewheat flour diet. Moreover,plasma and tibia levels of Mg and plasma,Liver and tibia levels of Fe were significantly increased in rats fed on the wholewheat flour diet compared with those fed on the white flour diet. In conclusion,wholewheat flour,rich in phytic acid and minerals,did not have a negative effect on mineral absorption,but rather improved the bioavailability of some minerals. Human studies are needed to confirm these rat results before extrapolation to human nutrition. [References: 21].

1107 Li Xiuqing (Shandong Academy of Agricultural Sciences,Jinan (China). Central Laboratory) (1998) **Relationship between barley protein content and ecological condition in north China spring barley areas.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 2) p. 20-21.* 1 table; 5 ref. Chinese. (AGRIS 2000-014178).

1108 Lindhauer,M.G.; Meyer,D. (1998) **Evaluation of milling and baking performace of German wheat and rye cultivars.** International Conference "Cereals of Human Health and Preventive Nutrition". AMS Brno (Czech Republic). 7-11 Jul 1998. Bundesanstalt fuer Getreide-,Kartoffel- und Fettforschung,Detmold (Germany). . Vaculova,K.;Ehrenbergerova,J. *Proceedings of the International Conference "Cereals for Human Health and Preventive Nutrition" p. 75-80. Bundesanstalt fuer Getreide-,Kartoffel- und Fettforschung,Detmold (Germany).* German. (AGRIS 2000-006306).

Bevor neue Weizen- und Roggensorten in die vom Bundessortenamt herausgegebene amtliche Sortenliste eingetragen werden konnen,ist es Aufgabe der Bundesanstalt,die neuen deutschen Sorten im Hinblick auf ihre Mahl- und Backeigenschaften zu beurteilen. Diskutiert wird uber die Anforderungen,Methoden und reprasentativen Ergebnisse der neuesten zugelassenen Sorten. Die wichtigsten Klassifikationsparameter werden erlautert.

1109 MacGregor,EA.; Bazin,SL.; Ens,EW.; Lahnstein,J.; Macri,LJ.; Shirley,NJ.; MacGregor,AW. (2000) **Structural models of limit dextrinase inhibitors from barley.** *Journal of Cereal Science. 31(1):79-90.* English. [Univ Manitoba,Dept Chem Winnipeg MB R3T 2N2 Canada].

Two limit dextrinase inhibitors (designated low and high pi inhibitors) isolated from barley had a high sequence homology with a protein sequence coded by a mRNA previously found in barley and thought to code for alpha-amylase-trypsin inhibitor. The inhibitors did not inhibit trypsin or alpha-amylases from malt,I: molitor (yellow mealworm) or pig pancreas under the experimental conditions where they inhibited limit dextrinase. Each inhibitor was heterogeneous and appeared to have 'ragged' carboxyl ends. A molecular model of the inhibitor proteins was developed which showed that of the nine cysteine residues in the molecules,eight were likely to be involved in intramolecular disulphide bonds,leaving one free sulphydryl group. The low pi inhibitor had a major component of molecular mass 12 928 that contained a glutathione residue,probably bound to the free sulphydryl group. The high pi inhibitor had two major components with molecular masses of 12 686 and 12 744 and these may contain cysteine residues bound to the free sulphydryl group. Further analysis of the model showed structural differences between the limit dextrinase inhibitors and alpha-amylase-trypsin inhibitors of the same family. (C) 2000 Academic Press. [References: 45].

1110 Martinez-Anaya,MA.; Devesa,A.; Andreu,P.; Escriva,C.; Collar,C. (1999) **Effects of the combination of starters and enzymes in regulating bread quality and shelf life (vol 4,pg 425,1998).** *Food Science & Technology International. 5(3):NIL_1-+.* English.

The influence of commercial enzymes and starters on white wheat bread quality and keeping properties (microbial and physical shelf life) has been studied. Two different quality flours,two enzymes (alpha-amylase/pentosanase,lipase and their mix),and three microbial starters were used to formulate twenty four breads. The combination of enzymes and starter resulted in beneficial effects greater than those obtained when each technological aid was used in a single way. The effect was mostly stressed when low grade wheat flour was used; in this case,specifically designated combinations facilitated leaves of improved volume and shape,and a crumb texture with initial values and rate of staling close to those found with a high quality flour. [References: 34].

1111 McCafferty,KA.; Bryce,JH. (1999) **Improvements in the characterisation and quality of vigour in malting barley.** *Seed Science & Technology. 27(2):633-644.* English. [Heriot Watt Univ,Dept Sci Biol,Int Ctr Brewing & Distilling Edinburgh EH14 4AS Midlothian Scotland].

Malting conditions during steeping and germination must be optimised if suitably modified malt is to be produced quickly and efficicently. The 'germination profile' which comprises a measurement of germinative energy (percentage germination,GH) over 3 d and calculations of germination index (mean germination time,GI) and germination homogeneity (uniformity of germination,GH),were shown to provide an informative means of characterising the overall vigour and potential germination performance of barley grain under various conditions. These conditions included incubation temperatures of 10 degrees C,20 degrees C and 30 degrees C in petri-dishes and a range of volumes of water,from 0.5 ml to 2.5 ml,added to the incubation vessel (Erlenmeyer flasks). At 20 degrees C,GI was 5.71,higher than at 10

degrees C or 30 degrees C for intact grains,and 9.17 for partially de-husked grains. With 1.0 ml of water,GE was 98.5%,GI 5.00 and GH 53%. More water (2.5 ml) reduced GE to 43.5%,but GI for the grain increased to 6.62. Priming experiments were performed where barley grains were pre-treated by hydrating in water for up to 30 h,then dried back,prior to germination testing. Priming for 20 h was the optimum time required to improve vigour compared to the control. This treatment resulted in a GI of 9.3 (maximum 10) compared to a value of 5.8 for the control and a GH of 74%,compared to 43.8% for the untreated control grains. The priming treatments did not significantly alter the germinative energy values of the samples but these were already high for the control. It is concluded that malting barley quality control should include measurement of a 'germination profile' as a simple means of presenting and analysing the complex data obtained from measurements of germination made over 3 days. [References: 15].

1112 Morris,CF.; Jeffers,HC.; Engle,DA. (2000) **Effect of processing,formula and measurement variables on alkaline noodle color - Toward an optimized laboratory system.** *Cereal Chemistry. 77(1):77-85.* English. [Washington State Univ,USDA ARS,Western Wheat Qual Lab E-202 Food Sci & Human Nutr Facil E Pullman,WA 99164 USA].

A standardized laboratory method for assessing the color potential of flours for yellow alkaline (Cantonese) noodles is needed,especially for evaluating large numbers of small-scale samples such as found in wheat breeding populations. To develop such a method,a number of processing and formula parameters were varied and judged for optimum level based on 1) discrimination and mean separation of flours,2) sensitivity to minor variation in the protocol parameter,3) practicality and simplicity for the technician,and 4) time efficiency. Four flours milled from single-cultivar grain lots representing two with good and two with poor color potential were made into alkaline noodle sheets varying in thickness of 0.75-2.00 mm,water absorption of 33.0-39.0%,mixing time of 2-6 min,and NaCl levels of 0-4% tall flour weight basis). Commission Internationale de l'Eclairage (CIE) tristimulus color space (L*,a* b*) values were measured at 0-24 hr using white,yellow,and black background tiles. Noodle sheet side and a dough resting period were examined. The flours themselves were a consistently large,significant source of variation for color,especially lightness (L*). Based on the optimization criteria,a noodle sheet thickness of 1.5-2.0 mm,an optimum to slightly over optimum water absorption (36% for the flours in this study)·with some adjustment for protein content and dough handling properties,a mixing time of 4 min,no dough resting period,and 2% NaCl were selected. Color measurement at 24 hr on a white or otherwise light-colored background tile was judged best using a consistent side of the noodle sheet. Resting doughs for 1 hr slightly improved handling and sheeting characteristics but was not included for time efficiencies. [References: 36].

1113 Moudry,J.; Dvoracek,V. (1999) **Chemical composition of grain of different spelt (Triticum spelta L.) varieties.** *Rostlinna Vyroba. 45(12):533-538.* English. [Univ S Bohemia,Fac Agr Studentska 13 Ceske Budejovice 37005 Czech Republic].

Ten varieties of spelt wheat Triticum spelta L. (Ostro,Altgold,KR 489-11-15,Oberkulmer,Ostroschwarzer,Lueg,H 9227,H 9228,Rouquin,Hercule),and common wheat Triticum aestivum L. (variety Samara) were cultivated in Ceske Budejovice during the years 1996 to 1998 in the low-input system. The forecrop was mixed crops and no N fertilization was applied after forecrop harvesting. Chemical composition was analyzed in wheat and spelt grains: content of N compounds was determined according to Kjeldahl,fat content according to Soxhlet,fibre content according to Scharrer and Kurschner,P content according to Lorenc,and contents of ash compounds and metals ions (Cu,Zn,Mg,Ca,K,Na,Fe) were determined using AAS. Spelt wheat had in low-input system better resorption ability than common wheat. Statistically significant differences were detected in ash content,and Zn and P contents. Average content of N compounds in spelt grain was about 0.5% higher than in common wheat grain. Old Swiss varieties Ostro and Oberkulmer,and also new breeding material KR 489-11-15 had a little bit higher content of N compounds. Also fibre content was in spelt wheat 0.35% higher than in common wheat. Generally it is possible to recommend spelt wheat for growing in low-input system according to its better utilization of nutrients and higher content of minerals. Older spelt varieties (Ostro,Oberkulmer) and new breeding material KR 489-11-15 have higher contents of fat and N compounds,and are therefore more suitable for low-input system. [References: 11].

1114 Muramatsu,Y.; Tagawa,A.; Kasai,T.; Sakai,H.; Fukushima,M. (1999) **Measurements of thermophysical properties of wheat flour by transient heat flow method using a probe [Chinese].** *Journal of the Japanese Society for Food Science & Technology-Nippon Shokuhin Kagaku Kogaku Kaishi. 46(11):719-724.* Chinese. [Tokyo Univ Agr,Grad Sch Bioind 196 Yasaka Abashiri Hokkaido 0992493 Japan].

Thermophysical properties of wheat flour were measured by the transient heat flow method using a probe at various moisture contents,temperatures and bulk densities. Using the relation of probe temperature versus elapsed time,four parameters were determined by applying a least-square method to an approximate solution of the equation for heat conduction corrected for probe finite diameter. The measured transient probe temperature for wheat flour agreed well with the calculated temperature. Based on the obtained values of four parameters,effective thermal conductivity and effective thermal diffusivity of wheat flour were determined. In addition,using these values and bulk density,the specific heat of wheat flour was estimated. The effects of moisture content,temperature and bulk density on these thermophysical properties were discussed. [References: 2].

1115 Nilsson,M.; Andersson,R.; Andersson,RE.; Autio,K.; Aman,P. (2000) **Heterogeneity in a water-extractable rye arabinoxylan with a low degree of disubstitution.** *Carbohydrate Polymers. 41(4):397-405.* English. [Swedish Univ Agr Sci,Dept Food Sci POB 7051 SE-75007 Uppsala Sweden].

From rye grain samples,water extractable arabinoxylan with a low degree of disubstitution (AX I) was isolated by fractionation on a DEAE-cellulose column. AX I of all rye samples had a similar relative composition of un- and monosubstituted xylose residues and with less than 5% disubstitution. It showed a shear thinning behaviour and the viscosity was related to molecular weight. AX I isolated from different rye varieties had different viscosities at the same concentration. One rye sample had a weight average molecular weight of 125 000 (polydispersity 2) according to calculations from both light scattering and viscosity data. Signals from un- and monosubstituted xylose residues in C-13 NMR spectra were assigned using C-13-HSQC-DEPT and COSY techniques. AX I probably consisted of blocks or different molecules with sparsely and more densely substituted regions. (C) 2000 Elsevier Science Ltd. All rights reserved. [References: 23].

1116 Oury,FX.; Chiron,H.; Pichon,M.; Giraud,A.; Berard,P.; Faye,A.; Brancourt-Hulmel,M.; Rousset,M. (1999) **Reliability of indirect selection in determining the quality of bread wheat for French bread-baking.** *Agronomie. 19(7):621-634.* English. [INRA,Stn Ameliorat Plantes Domaine Crouelle F-63000 Clermont Ferrand France].

Putting together information on French bread-baking drawn from 15 years of multi-local experimentation and results of various technological tests (protein content and grain hardness,Pelshenke test,Zeleny sedimentation test and Chopin alveograph),has made it possible to study the effects of genotype and environment on the traits tested as well as the relationships between them. With the exception of protein content and extensibility L of alveograph,genotype x environment interactions are weak for technological tests,whereas Cnerna bread-baking parameters are strongly influenced by these same interactions. There would appear to be a relatively close connection between the technological tests (except for protein content and extensibility L of alveograph). The technological tests are,however,at best quite weakly linked to bread-baking parameters,making indirect selection quite unreliable. Threshold values making it possible to

eliminate only those genotypes showing little chance of high bread-baking quality are defined for the technological tests. In other respects,it seems that grain hardness has no influence on French bread-baking quality. Knowledge of hardness only seems interesting in helping interpret tests at constant hydration,such as Chopin alveograph,in which it introduces bias. ((C) 1999 Inra/Editions scientifiques et medicales Elsevier SAS. [References: 28].

1117 Pasqualone,A.; Lotti,C.; Blanco,A. (1999) **Identification of durum wheat cultivars and monovarietal semolinas by analysis of DNA microsatellites.** *European Food Research & Technology. 210(2):144-147.* English. [Univ Bari,Inst Agr Ind Via Amendola 165 A I-70126 Bari Italy].

Microsatellites isolated in bread wheat were used to identify 20 Italian durum wheat (Triticum turgidum var. durum L.) cultivars,A total of 15 microsatellite primer pairs were tested against DNA extracted from leaf tissue,single seeds and semolina. Twelve markers showed allelic polymorphism among the 20 cultivars,providing a total of 41 different alleles,Firstly,an analysis of microsatellite informativeness in the chosen set of durum wheat cultivars was made and a set of highly polymorphic microsatellites was established. Secondly,among the most polymorphic cultivars,the minimum number of microsatellites able to distinguish all cultivars was determined. A set of five microsatellites was found sufficient to differentiate the durum wheat cultivars examined. The method is directly applicable to seeds and semolina,and is suitable for detecting seed mixtures in the same seed lot. [References: 12].

1118 Pastore,D.; Trono,D.; Padalino,L.; Simone,S.; Valenti,D.; Di,Fonzo,N.; Passarella,S. (2000) **Inhibition by alpha-tocopherol and L-ascorbate of linoleate hydroperoxidation and beta-carotene bleaching activities in durum wheat semolina.** *Journal of Cereal Science. 31(1):41-54.* English. [Univ Molise,Fac Agraria,Dipartimento Sci Animali Vegetali & Ambiente Via Sanctis I-86100 Campobasso Italy].

In order to gain some insights into durum wheat lipoxygenase (LOX) biochemistry and in particular in order to find out whether the antioxidants alpha-tocopherol and L-ascorbate can prevent the LOX-dependent semolina bleaching,which leads to a low quality of pasta product,a study of LOX activity in a crude protein extract from semolina was performed by means of spectrophotometric techniques. Measurements made of linoleate hydroperoxidation reaction (lambda = 234 nm) and of the coupled beta-carotene bleaching reaction (lambda = 460 nm),demonstrated the existence of more than one enzyme exhibiting LOX activity as revealed by the different pH profiles. The linoleate hydroperoxidation reaction exhibited a sigmoidal dependence on the substrate concentration (K-0.5 = 60 +/- 0.67 mu M,V-max = 1.12 +/- 0.055 units/g of semolina),while beta-carotene bleaching showed a hyperbolic relationship and followed the Michaelis-Menten equation (K-m = 3.3 +/- 0.53 mu M V-max = 0.030 +/- 0.0062 units/g). Both linoleate hydroperoxidation and beta-carotene bleaching were strongly inhibited by added alpha-tocopherol. In both cases,the enzyme affinity for the substrate was reduced,while the V-max was not affected. In particular,beta-carotene bleaching was inhibited in a competitive manner (K-i = 7.7 +/- 0.21 mu M) L-ascorbate also inhibited both reactions: the V-max,of linoleate hydroperoxidation was lowered,while the K-0.5 remained unchanged; in the case of beta-carotene bleaching the inhibition was uncompetitive (k(i) = 445 +/- 71.5 mu M). Therefore,the use of both alpha-tocopherol and L-ascorbate to reduce semolina bleaching during pasta making is suggested. A purification procedure of semolina LOX is also reported,showing the existence of two isoforms. (C) 2000 Academic Press. [References: 27].

1119 Popineau,Y.; Pineau,F.; Evon,P.; Berot,S. (1999) **Influence of pH and salt concentration on the emulsifying properties of native wheat gliadins and of their chymotryptic hydrolysates.** *Nahrung-Food. 43(6):361-367.* English. [INRA,Unite Biochim & Technol Prot Rue Geraudiere,BP 71627 F-44326 Nantes 03 France].

Chymotryptic hydrolysates with degrees of hydrolysis around 1% were prepared from purified beta- and gamma-gliadins of wheat. Some functional properties were studied at pH 4.0 and 6.5 in the absence or in the presence of 1% and 2% NaCl. The hydrolysates were highly soluble in all the conditions of pH and salt concentration tested,whereas the solubility of native gliadins did not exceed 20%,except at pH 4.0,0% NaCl. The differences in emulsifying properties between hydrolysates and native proteins were great in the presence of salt. Phase separation was almost complete immediately after emulsification with the native gliadins,but creaming was slowed down and limited with the hydrolysates. Furthermore,emulsions stabilized with hydrolysates showed a very strong resistance to coalescence. Although some differences were observed between hydrolysates of beta- and gamma-gliadins,the peptides adsorbed at the alcane/water interface were in both cases the more hydrophobic and charged,corresponding to the non-repetitive domain of the gliadin sequences. [References: 23].

1120 Prabhasankar,P.; Rao,PH. (1999) **Lipids in wheat flour streams.** *Journal of Cereal Science. 30(3):315-322.* English. [Cent Food Technol Res Inst,Flour Milling Baking & Confectionery Technol Dept Mysore 570013 Karnataka India].

Lipids play an important role in determining the quality of wheat flour and its suitability for different bakery products. The lipid content and fatty acid composition in various flour streams showed a wide variation. The free lipid content varied from 0.1 to 1.9% (db) and bound lipid content from 0.2 to 2.1% (db) in different hour streams. The amount of bound lipid was more in reduction streams. The palmitic and linoleic acids were the predominant fatty acids present in free and bound lipids. These fatty acids were found to be higher in the 'III' 'Break coarse','IV' 'Break filter','III' 'Break fine','1st' and '4th' 'middling'. The studies showed that the reduction passage flours had more of bound lipids indicating the presence of polar lipids. (C) 1999 Academic Press. [References: 15].

1121 Prakash,M.; Rajalakshmi,D. (1999) **Effect of steamed wheat flour on the sensory quality of batter coated products.** *Journal of Food Quality. 22(5):523-533.* English. [Cent Food Technol Res Inst,Dept Sensory Sci Mysore 570013 Karnataka India].

Steaming of the wheat flour was done to improve the rheological as well as textural characteristics of batters used in coated products. The gluten forming protein completely denatured with increase in the steaming period. The apparent viscosity of the wheat flour batters increased with increasing solid concentration and steaming. A batter concentration of 33% of blend of native and steamed wheat flour used in the preparation of chiklunde (a traditional Indian batter coated snack made up of sweet filling and a wheat flour batter casing) scored 10.12 cm (on a scale of 15 cm) for sensory overall quality. The correlation between sensory attributes,composition of the casing and texture (peak force during shearing) showed that moisture was significantly positively related to adhesion ($r = 0.70$ $p < 0.05$) and negatively related to crispness of the product ($r = -0.74$,$p < 0.05$). The correlation obtained between fat content and crispness ($r = 0.89$,$p < 0.01$) indicated that increasing lat content increased the crispness of the product. [References: 19].

1122 Prakash,M.; Rao,PH. (1999) **Effect of steaming on the rheological characteristics of wheat flour dough.** *European Food Research & Technology. 209(2):122-125.* English. [Cent Food Technol Res Inst,Dept Sensory Sci Mysore 570013 Karnataka India].

The effect of steaming on the various rheological characteristics of wheat flour dough was studied. Steaming of flours at atmospheric pressure for 15 min completely denatured the gluten and reduced the water absorption capacity from 58.4% to 45.0%. Even steaming for just 5 min increased the resistance to extension considerably from 500 BU (Brabender Units) to 1000 BU and the ratio figure (resistance to extension/ extensibility) from 4.2 to 27.4,indicating stiffening of the dough. The dough made from steamed flour had a higher hardness value of 91.1 N than the dough made from raw wheat flour which had a value of 51.1 N. The pasting characteristics of flour steamed for 15 min measured in

a Rapid Visco Analyser showed increased peak viscosity from 218 rapid visco units (RW) to 257 RVU as well. as increased cold paste viscosity from 175 RVU to 200 RVU and increased hot paste viscosity from 94 RVU to 108 RVU for flour steamed for 15 min. [References: 14].

1123 Prakash,M.; Ravi,R.; Rao,PH. (1999) **Effect of blending of raw and steamed wheat flour on the rheological characteristics of dough.** *European Food Research & Technology. 210(2):119-122.* English. [Cent Food Technol Res Inst,Dept Sensory Sci Mysore 570013 Karnataka India].

The blended dough made from raw wheat flour and wheat flour steamed for 15 min at a ratio of 1:1,along with minor ingredients (salt,oil) showed reduced farinograph water absorption capacity. The stability of the blended dough with oil was reduced while the mixing tolerance index increased. The inclusion of salt in the blend increased the resistance to extension and also the area under the curve. The hardness and cohesiveness measured by means of texture profile analysis decreased with the inclusion of oil in the blend,while increasing with the addition of salt. The Rapid Visco-Analyser used to measure pasting characteristics showed a peak viscosity which increased for the blend with salt,but decreased for that with oil. Similarly,the hot paste viscosity,cold paste viscosity and area under the curve increased for the blend with salt,but decreased for the blend with oil. [References: 13].

1124 Rahman,S.; Li,Z.; Batey,I.; Cochrane,MP.; Appels,R.; Morell,M. (2000) **Genetic alteration of starch functionality in wheat [Review].** *Journal of Cereal Science. 31(1):91-110.* English. [CSIRO,Div Plant Ind GPO Box 1600 Canberra ACT 2601 Australia].

1125 Ravi,R.; Manohar,RS.; Rao,PH. (2000) **Influence of additives on the rheological characteristics and baking duality of wheat flours.** *European Food Research & Technology. 210(3):202-208.* English. [Cent Food Technol Res Inst,Dept Mil Baking & Confectionery Technol Mysore 570013 Karnataka India].

The response of Indian commercially milled flour to different additives was studied. The incorporation of reducing agents,such as L-cysteine hydrochloride (L-cysteine HCl),reduced the water absorption capacity (WAC) and stability of medium-strong wheat flour as well as weak wheat flour. This effect was also shown by other reducing agents or enzymes however,the extent of change was found to be greater in medium-strong wheat flour. Surfactants/emulsifiers,such as glycerol monostearate,sodium stearoyl lactylate,and diacetyl tartaric esters of monoglycerides (DATEM),did not alter the WAC significantly,but marginally improved the stability of the dough. The change observed in the extensograph was greater with reducing agents and enzymes. In general,use of L-cysteine HCl or alpha-amylase or protease reduced the resistance to extension and increased the extensibility,depending on the level of addition. L-cysteine HCl,however,gave a greater reduction in the resistance to extension in medium-strong than in weak flour. On the other hand,use of surfactants/emulsifiers increased the resistance to extension and decreased the extensibility,and the effect was greater with DATEM. The bread volume improved considerably on incorporation of L-cysteine HCl,while DATEM also increased the loaf volume considerably at a 1% level in weak flour. Maximum improvement in loaf volume was found for DATEM in the case of weak flour,indicating that the responses of flour to different additives were different. [References: 18].

1126 Sasaki,T.; Yasui,T.; Matsuki,J. (2000) **Effect of amylose content on gelatinization,retrogradation,and pasting properties of starches from waxy and nonwaxy wheat and their F1 seeds.** *Cereal Chemistry. 77(1):58-63.* English. [Natl Agr Res Ctr,MAFF 3-1-1 Kannondai Tsukuba Ibaraki 3058666 Japan].

We studied the effect of amylose content on the gelatinization,retrogradation,and pasting properties of starch using wheat starches differing in amylose content. Starches were isolated from waxy and nonwaxy wheat and reciprocal F1 seeds by crossing waxy and nonwaxy wheat. Mixing waxy and nonwaxy wheat starch produced a mixed starch with the same amylose content as F1 seeds for comparison. The amylose content of F1 seeds ranged between waxy and nonwaxy wheat. Nonwaxy-waxy wheat had a higher amylose content than waxy-nonwaxy wheat. Endothermic enthalpy and final gelatinization temperature measured by differential scanning calorimetry correlated negatively with amylose content. Gelatinization onset and peak temperature clearly differed between F1 and mixed starches with the same amylose content as F1 starches. Enthalpy for melting recrystallized starches correlated negatively with amylose content. Rapid Visco Analyser measurement showed that F1 starches had a higher peak viscosity than waxy and nonwaxy wheat starches. Mixed starches showed characteristic profiles with two low peaks. Setback and final viscosity correlated highly with amylose content. Some of gelatinization and pasting properties differed between F1 starches and mixed starches. [References: 30].

1127 Saxena,DC.; Salimath,PV.; Rao,PH. (2000) **Indian wheat cultivars: their carbohydrate profile and its relation to tandoori roti quality.** *Food Chemistry. 68(2):185-190.* English. [Cent Food Technol Res Inst,Dept Biochem & Nutr Mysore 570013 Karnataka India].

Tandoori roti,a wheat-based Indian traditional product,prepared by sheeting the whole wheat flour dough into 2-3 mm thickness and 15-20 cm diameter,is baked in a special type of oven known as a 'tandoor'. Six commercially-grown wheat varieties were evaluated for their physico-chemical characteristics and carbohydrate profiles. Rheological studies indicated a significant difference among the varieties,especially between varieties having good (Cpan-3004: Sensory score,28.27) and poor (PBW-138: Sensory score,23.22) tandoori roti-making quality. The peak viscosity correlated well with the damaged starch content. The carbohydrate profiles of wheats indicated that the water soluble polysaccharides and destarchified flour fractions contained mainly arabinose and xylose along with glucose. The contents of arabinose and xylose were higher in the fractions of the variety having good tandoori rotimaking quality. (C) 1999 Elsevier Science Ltd. All rights reserved. [References: 29].

1128 Schober,T.; Kuhn,M. (1999) **(Use of capillary electrophoresis and fundamental rheological methods for the characterization of differences between spelt cultivars).** Univ. Hohenheim,Stuttgart (Germany). Inst. fur Lebensmitteltechnologie. *Getreide Mehl und Brot (Germany) v. 53(3) p. 169-176.* German. (AGRIS 2000-006285).

In Dinkel-Zuchtungsprogrammen stellt sich das Problem,mit sehr geringen Probemengen Aussagen uber die technologische Qualitat der Zuchtstamme zu treffen. Fundamentalrheologische Messungen an Feuchtklebern stellen hier eine gute Alternative zu traditionellen Backversuchen dar. Um Zusammenhange zwischen den Rheologiedaten und dem Backergebnis zu finden,wurde ein Backversuch entwickelt,der spezifisch auf das Backverhalten von Dinkel zugeschnitten ist und nur 300 g Mehl erfordert. Zwischen den fundamentalrheologischen Messdaten,analytischen Kennzahlen und den Ergebnisgrossen dieses Backversuchs wurden verschiedene signifikante Korrelationen gefunden. Zur ubersichtlichen Darstellung der Ergebnisse werden sogenannte "Netzdiagramme" verwendet. Zusatzlich zur rheologischen Charakterisierung der Feuchtkleber wurde die Gliadinzusammensetzung der Sorten untersucht. Hierzu wurde Kapillarzonenelektrophorese (CZE) eingesetzt,die durch besonders hohe Auflosung gekennzeichnet ist. Da auch das rheologische Verhalten der Kleber von altem,typischem Dinkel bekannt ist und vom Saatweizen klar abzugrenzen ist,wird versucht,durch Kombination der rheologischen Methoden und der CZE typischen Dinkel mit gleichzeitig guter Backqualitat unter den Zuchtstammen zu erkennen und fur die weitere Zuchtung auszuwahlen.

1129 Sissons,MJ.; Blundell,MJ.; Hill,AS.; Skerritt,JH. (1999) **Antibodies to N-terminal peptides of low M-r subunits of wheat glutenin. I. Characterisation of the antibody response.** *Journal of Cereal Science. 30(3):267-281.* English. [Australian Ctr Int Agr Res GPO Box 1571 Canberra ACT 2601 Australia].

The relationship between allelic composition of the low molecular mass glutenin subunits (LM(r)GS) and dough properties is poorly understood. Differentiating the LM(r)GS on the basis of their N-terminal sequence type may provide an important alternative in understanding the relationship. Polyclonal and/or monoclonal antibodies were produced using synthetic peptides corresponding to each of the seven N-terminal amino acid sequence types of the B- and C-LM(r)GS,namely SHIPGLERPS-,METSHIPGL-,METSRVPGL-,METSCIPGL-,METRCIPGL-,NMQVDPSGQVQ- (gamma-type) and VRVPVPQLQP-(alpha-type). Each of the polyclonal antisera recognised both the corresponding peptide and LM(r)GS. For monoclonal antibodies,the proportion of hybridoma clones that produced antibody which recognised either the peptide or LM(r)GS varied between 1 and 88%. However,antibodies from only 4% of antibody-secreting stable cell lines recognised both the peptide immunogen and intact LM(r)GS. Using ELISA,the majority of the antibodies cross-reacted with related synthetic peptides corresponding to more than one N-terminal LM(r)GS sequence,although several of these bound small groups of LM(r)GS on immunoblots. Different polyclonal antisera prepared to a given immunogen exhibited similar patterns of subunit recognition on immunoblots. Monoclonal antibodies prepared to the same immunogen exhibited a variety of patterns,although each of the antibodies specific for a particular peptide or combination of peptides on ELISA recognised a similar pattern of LM(r)GS on immunoblots. For each sequence type,polyclonal or monoclonal antibodies specific for individual N-terminal sequences were identified. These probes may be useful tools to determine whether the type and amount of each N-terminal sequence is correlated with dough properties. (C) 1999 Academic Press. [References: 33].

1130 Sissons,MJ.; Hac,L.; Skerritt,JH. (1999) **Antibodies to N-terminal peptides of low M-r subunits of wheat glutenin. II. Detection of subunits encoded by different loci.** *Journal of Cereal Science. 30(3):283-301.* English. [Australian Ctr Int Agr Res GPO Box 1571 Canberra ACT 2601 Australia].

A panel of anti-peptide antibodies specific for each of the different N-terminal sequence types of B- and C-low molecular mass glutenin subunits (LM(r)GS) were utilised in immunoblotting studies to identify the chromosomal location of genes encoding different sequences and to characterise the allelic variation of the encoding loci. The MET-type sequences were predominantly found among the B- subunits,while the alpha- and gamma- sequences predominated in the C- subunits. The quantitatively major SHIPGLERPS sequence was found in both the B- and C- mobility regions. Using either biotypes in the cultivar,Aroona or genetic lines containing double rye chromosome 1 substitutions and thus expressing only single LM(r)GS alleles,the sequences were determined for most of the major polypeptides expressed by each LM(r)GS allele. The LM(r)GS from different genomes encoded different numbers of each sequence type. Furthermore,different polypeptides within a particular 'block' of subunits encoded by a given allele often bad differing N-terminal sequences. However,subunits of similar electrophoretic mobilities encoded by different alleles at each locus usually had identical N-terminal sequences,suggesting that they may instead differ in the number of repeats. In Chinese Spring,genes encoding the SHIPGLERPS and METSHIPGL sequence types were predominantly present on chromosomes 1B and 1D,while the related METSRVPGL sequence was only encoded on 1D. In contrast,the METSCIPGL,alpha- and gamma-sequences were encoded on each of chromosomes 1A,1B and 1D. Several different electrophoretic and immunoblotting approaches using null lines suggested that some of the alpha-type LM(r)GS may also be encoded by group 6 chromosomes,particularly 6D. The anti- SHIPGLERPS antibody also recognised chromosome 1B encoded beta-,gamma- and omega-gliadins,while the anti-METSRVPGL antibody recognised 1D encoded alpha- and beta-gliadins. The absence of sequences within the major gliadin families that are highly homologous to the latter two N-terminal LM(r)GS sequences may suggest that some monomeric LM(r)GS could exist within the electrophoretically-resolved gliadins. These antibodies will provide valuable reagents for the study of the roles of particular LM(r)GS families in the structure and function of the glutenin macropolymer,the role of different LM(r)GS types in determining the influence of allelic variation of LM(r)GS composition on dough properties,and potentially in the development of diagnostics for these hour components. (C) 1999 Academic Press. [References: 22].

1131 Sissons,MJ.; Osborne,BG.; Hare,RA.; Sissons,SA.; Jackson,R. (2000) **Application of the single-kernel characterization system to durum wheat testing and quality prediction.** *Cereal Chemistry. 77(1):4-10.* English. [Tamworth Ctr Crop Improvement Tamworth NSW 2340 Australia].

The Single Kernel Characterization System (SKCS 4100) measures single kernel weight,width,moisture content,and hardness in wheat grain with greater speed than existing methods and can be calibrated to predict flour starch damage and milling yield. The SKCS 4100 is potentially useful for testing applications in a durum improvement program. The mean SKCS 4100 kernel weight and moisture values from the analysis of 300 individual kernels gave good correlations with 1,000 kernel weight (r(2) = 0.956) and oven moisture (r(2) = 0.987),respectively. Although significant correlations were obtained between semolina mill yield and SKCS 4100 weight,diameter,and peak force,they were all very low and would be of little use for prediction purposes. Similarly,although there were significant correlations between some SKCS 4100 parameters and test weight and farinograph parameters,they too were small. The SKCS 4100 has been calibrated using either the single kernel hardness index or crush force profile to objectively measure the percentage vitreous grains in a sample with reasonable accuracy,and it correlates well with visual determination The speed and accuracy of the test would be of interest to grain traders. An imprecise but potentially useful calibration was obtained for the prediction of semolina mill yield using the SKCS 4100 measurements on durum wheat. The SKCS 4100 is useful for some traits such as hardness,grain size and moisture for early-generation (F3) selection in a durum improvement program. [References: 20].

1132 Son,H.S.; Lim,S.T. (Korea University,Seoul (Korea Republic). Center for Advanced Food Science and Technology,Graduate School of Biotechnology); Jang,E.H. (Korea University,Seoul (Korea Republic). Graduate School of Natural Resources); Koh,B.K. (Keimyung University,DaeGu (Korea Republic). Department of Foods and Nutrition) (1999) **Quality of korean wheat noodles and its relations to physicochemical properties of flour.** *Korean Journal of Food Science and Technology v. 31(1) p. 138-146.* 8 tables; 24 ref. Korean. (AGRIS 2000-006284).

1133 Song,Y.; Jane,J. (2000) **Characterization of barley starches of waxy,normal,and high amylose varieties.** *Carbohydrate Polymers. 41(4):365-377.* English. [Iowa State Univ,Dept Food Sci & Human Nutr Ames,IA 50011 USA].

Four varieties of barley starches,W.B. Merlin,glacier,high amylose glacier,and high amylose hull-less glacier,were isolated from barley seeds. Apparent and absolute amylose contents,molecular size distributions of amylose and amylopectin,amylopectin branch-chain-length distributions,and Naegeli dextrin structures of the starches were analyzed. W.B. Merlin amylopectin had the longest detectable chain length of DP 67,whereas glacier,high amylose glacier and high amylose hull-less glacier amylopectins had the longest detectable chain length of DP 82,79,and 78,respectively. All the four starches displayed a substantially reduced proportion of chains at DP 18-21. Amylopectins of high amylose varieties did not show significantly larger proportions of long chains than that of normal and waxy barley starch. Onset gelatinization temperatures of all four barley starches ranged from 55.0 to 56.5 degrees C. Absolute amylose contents of W.B. Merlin,glacier,high amylose glacier,and high amylose hull-less glacier were 9.1,29.5,44.7,and 43.4%,respectively; phospholipid contents were 0.36,0.78,0.79,and 0.97%,respectively. (C) 2000 Elsevier Science Ltd. All rights reserved. [References: 32].

1134 Suchy,J.; Lukow,OM.; Ingelin,ME. (2000) **Dough microextensibility method using a 2-g mixograph and a texture analyzer.** *Cereal Chemistry. 77(1):39-43.* English. [Agr & Agri Food Canada,Cereal Res Ctr 195 Dafoe Rd Winnipeg MB R3T 2M9 Canada].

Development of a small-scale method to measure dough extensibility,using a 2-g mixograph and the TA.XT2 texture analyzer (TA) equipped with Kieffer rig,suitable for early-generation wheat quality screening is presented. Three hook speeds 3.3,7.0,and 10.0 mm/sec were tested on the TA. Only at the lower hook speed of 3.3 mm/sec were wheats,varying in quality,clearly differentiated. The ability to differentiate between wheats using the TA was compared with the Brabender Extensigraph. The sample ranking based on the resistance to extension (R-max) from the TA at a hook speed of 10.0 mm/sec correlated highly (r = 0.99) to the ranking obtained on the extensigraph. Dough extensibility data from the extensigraph and the TA,using hook speed 10.0 mm/sec,was correlated (r = 0.90) to loaf volume. Similarly,dough extensibility on the TA,using hook speed 3.3 mm/sec,was correlated to loaf volume (r = 0.96). The effect of three dough water contents (farinograph absorption,farinograph absorption + 6%,and 2-g mixograph water absorption) on physical properties of dough were evaluated by mixing the dough in a 2-g mixograph and testing the extensibility on the TA. Dough prepared at farinograph absorption + 6% and at mixograph absorption allowed differentiation between wheats based on the resistance to extension (R-max). [References: 27].

1135 Sung,J.E.; Ko,Y.S. (Hanyang University,Seoul (Korea Republic). Department of Food and Nutrition); Lee,Y.T. (Kyungwon University,Seonganm (Korea Republic). Department of Food and Bioengineering); Seog,H.M. (Korea Food Research Institute,Songnam (Korea Republic).); Kim,Y.S. (Chonbuk,National University,Chonbuk (Korea Republic). Department of Food Science and Technology) (1999) **Characteristics of Beta-glucan gums from normal and waxy hull-less barleys.** *Korean Journal of Food Science and Technology v. 31(3) p. 644-650.* 3 illus.; 6 tables; 26 ref. Korean. (AGRIS 2000-005996).

1136 Tang,H.; Ando,H.; Watanabe,K.; Takeda,Y.; Mitsunaga,T. (2000) **Some physicochemical properties of small-,medium-,and large-granule starches in fractions of waxy barley grain.** *Cereal Chemistry. 77(1):27-31.* English. [Kinki Univ,Dept Food & Nutr,Fac Agr Nara 6310052 Japan].

Barley grain was divided into eight fractions from the surface layer to the center with a machine used to polish brewers' rice. Small-,medium-,and large-granule starches were isolated from classified barley flour,and their physicochemical properties were investigated. The starch granules were oval to round with a median size of 2 mu m for small,10 mu m for medium,and 12-19 mu m for large granules. From the surface layer to the center,both the median sizes and the ratio of large granules decreased,and the ratio of medium- and small-granules increased. The starches had A-type X-ray diffraction patterns typical of cereal starches. The moisture sorption showed a negative correlation to the granule size. The gelatinization temperatures of starch granules in each layer were approximately the same,but the enthalpies decreased in the order of large,medium,and small granules. [References: 28].

1137 Tillmann,P.; Botterbrodt,S. (1999) **(Network management of NIR and NIT whole grain instruments).** VDLUFA Qualitatssicherung,Kassel (Germany); Arbeitsgemeinschaft Getreideforschung e.V.,Detmold (Germany). *Getreide Mehl und Brot (Germany) v. 53(4) p. 202-207.* German. (AGRIS 2000-006033).

In der Getreideuntersuchung mit NIR- bzw. NIT-Geraten findet zur Zeit ein Ubergang von alteren NIR-Geraten,die die Messungen am Schrot durchgefuhrt haben,zu neueren Ganzkorngeraten statt. Die Grunde fur diesen Wechsel sind wie folgt: Vermeidung von Fehlerquellen bei der Vermahlung,keine Eingriffsmoglichkeiten durch den Bediener,Eichzulassung fur die Gerate,Netzwerkfahigkeit der Gerate. Unter einem Netzwerk versteht man die zentrale Steuerung und Uberwachung der Gerate mit dem Ziel,die Prazision und Verlasslichkeit der Messergebnisse zu verbessern. Ein Netzwerkbetrieb bedeutet,dass alle Gerate eine validierte Kalibriergleichung nutzen,alle Gerate mindestens einmal jahrlich eingestellt werden (Standardisierung) und dass die Analysenergebnisse aller Untersuchungen durch Ringuntersuchungen kontrolliert werden. Neben diesen technischen Details,die die Richtigkeit und Vergleichbarkeit der Analysenergebnisse sichern,sollte ein Netzwerk fur die Benutzer der Analysenergebnisse (Produzenten,Handel und Verarbeiter) transparent sein. Beispiele fur existierende Netzwerke werden dargestellt.

1138 Toivo,J.; Lampi,AM.; Aalto,S.; Piironen,V. (2000) **Factors affecting sample preparation in the gas chromatographic determination of plant sterols in whole wheat flour.** *Food Chemistry. 68(2):239-245.* English. [Univ Helsinki,Dept Appl Chem & Microbiol POB 27,Viikki D FIN-00014 Helsinki Finland].

A fractional factorial experimental design was applied to study factors affecting sample preparation prior to a gas chromatographic determination of total plant sterols in cereal samples. Whole wheat flour was chosen for the representative matrix. Altogether six factors were studied at two levels. The most affecting factors were a type of hydrolysis (combined acid hydrolysis and alkaline hydrolysis over alkaline hydrolysis alone),extraction solvent after saponification (chloroform over hexane-ether),and sample amount (1.0 g over 2.0 g). Also,it was shown that there is no need to perform total lipid extraction prior to hydrolysis. The use of acid hydrolysis prior to alkaline saponification was found to be essential in a plant sterol analysis of flour matrix. In a further method development,that procedure is to be optimized with various foods of plant origin in order to establish a general method to determine plant sterols. Toivo et al.,Factors in the determination of plant sterols (C) 1999 Elsevier Science Ltd. All rights reserved. [References: 18].

1139 Wang Xianze (Shandong Agricultural Univ.,Taian (China). Dept. of Food Science) (1998) **Study on bread's quality characteristics of wheat varieties popularized in Shandong and their cluster analysis.** *Journal of Shandong Agricultural Science (China). Shandong Nongye Kexue (China) (No. 6) p. 4-6.* 2 tables; 1 ill.,5 ref. Chinese. (AGRIS 2000-014234).

1140 Wang Xuqing (Shandong Academy of Agricultural Sciences,Jinan (China). Inst. of Crops) (1999) **Effects of cultural measures and environmental factors on wheat grain quality.** *Journal of Shandong Agricultural Science (China). Shandong Nongye kexue (China) (No. 1) p. 52-55.* 6 ref. Chinese. (AGRIS 2000-014235).

1141 Weipert,D.; Brummer,J. M. (1998) **Whole rye and wheat bread - technical and health aspects.** International Conference "Cereals of Human Health and Preventive Nutrition". AS Brno (Czech Republic). 7-11 Jul 1998. Bundesanstalt fuer Getreide-,Kartoffel- und Fettforschung,Detmold (Germany). . Vaculova,K.;Ehrenbergerova,J. *Proceedings of the International Conference "Cereals for Human Health and Preventive Nutrition" p. 70-74. Bundesanstalt fuer Getreide-,Kartoffel- und Fettforschung,Detmold (Germany).* German. (AGRIS 2000-006231).

The influence of grain quality and milling procedure on milled products and there from baked goods from the technical aspect and the presence and content of primary and secondary substances as the health aspects were shown. Regarding the bread processing,wheat ist superior to rye. Due to the contents of the relevant secondary substances contributing to the health of consumers,concentrated in shorts and bran,whole rye and wheat breads are superior to flour breads. Howeverwhole rye bread is in this context superior to wheat breads.

1142 Wieser,H. (2000) **Simple determination of gluten protein types in wheat flour by turbidimetry.** *Cereal Chemistry. 77(1):48-52.* English. [Deutsch Forsch Anstalt Lebensmittelchem Lichtenbergstr 4 D-85748 Garching Germany].

A simple method based on turbidimetry has been developed for the quantitative determination of total gliadins,glutenin subunits,and high and low molecular weight (HMW and LMW)

subunits of glutenin. The standard procedure includes the subsequent extraction of wheat flour (100 mg) with a salt solution,with 50% 2-propanol (gliadins),and with 50% propanol under reducing conditions and increased temperature (glutenin subunits). Aliquots of the gliadin and the glutenin extracts are mixed with 2-propanol to a final concentration of 83%,and the turbidity of the precipitates is measured photometrically at 450 nm and 20 degrees C after 40 min. Another aliquot of the glutenin extract is mixed with acetone to a final concentration of 40% acetone,and precipitated HMW subunits are determined turbidimetrically after 30 min. The sample is then filtered,and an aliquot of the filtrate is mixed with 2-propanol to a final concentration of 77% to determine the precipitated LMW subunits. Control analyses with reversed-phase HPLC on C-8 silica gel indicate that the precipitation of the different protein types is quantitative and specific,and studies of 16 different wheat flours demonstrate the strong correlation between quantification by HPLC and turbidimetry. The turbidimetric measurements are reproducible,linear over a wide absorbance range (0.2-1.7),and sufficiently sensitive to analyze 40 mu g of protein or 20 mg of flour. The absolute amounts of protein types in flour can be determined by means of calibration curves with protein standards (gliadins,HMW,and LMW subunits). Altogether,the developed method is simple,accurate,sensitive,and specific for the different protein types. The total procedure takes approximate to 6 hr for the analysis of six flour samples in parallel or approximate to 4 hr for three samples in overlapping extraction steps. The chemicals used are inexpensive,scarcely toxic,and easy to dispose. [References: 14].

1143 Yun,SH.; Quail,K. (1999) **RVA pasting properties of Australian wheat starches.** *Starch-Starke. 51(8-9):274-280.* English. [BRI Australia Ltd POB 7 N Ryde NSW 2113 Australia].

Viscosity properties of wheat starch and flour measured by the Rapid Visco Analyser (RVA) were characterised by RVA running conditions and varietal difference. RVA variables including starting temperature of measurement,heating rate and final cooling temperature were found to be the must important factors determining RVA viscosity properties. Starting temperature mostly affected peak time,peal; viscosity,breakdown and setback viscosity for starch,and peak time and breakdown for flour. Heating rate influenced peak time,peak viscosity,holding strength and final viscosity for starch,and peak time,peak viscosity,breakdown and holding strength for flour. Setback viscosity for starch and flour was determined by final cooling temperature. Discrimination of wheat varieties was greatest with the following RVA running profile: starting temperature of 50 degrees C,heating rate of 20 degrees C/min and final cooling temperature for both starch and flour of 43 degrees C. This profile also showed clear classification of wheat varieties tested and accordingly good prediction for softness of cooked white salted noodles. [References: 14].

## Q05 FOOD ADDITIVES

1144 Denisov,M.A. (Ukrainian State Univ. of Food Technologies,Kyiv (Ukraine)) (1998) **[Improving in the technology of malt extracts as biologically active additives to the food products].** 95 ref.; 22 ill.; 36 tables. 130 p. Ukrainian. (AGRIS 2000-014257).

The research is aimed at chosing the optimum ratio between barley,wheat and oat malt and way of their joint processing for obtaining the complex malt extract with high content of the bioactive substanses as a base for creating the products with medicinal action. The complex malt extract formulas with using medicinal herbs are worked out and approved.

1145 Harada,O.; Lysenko,ED.; Preston,KR. (2000) **Effects of commercial hydrolytic enzyme additives on Canadian short process bread properties and processing characteristics.** *Cereal Chemistry. 77(1):70-76.* English. [Canadian Grain Commiss,Grain Res Lab 1404-303 Main St Winnipeg MB Canada].

The effects of increasing levels of eight commercial enzymes representing four types of fungal hydrolytic enzymes (alpha-amylases,proteases,xylanases,and cellulases) on Canadian short process (CSP) bread quality and processing characteristics were studied. Addition of all enzymes types at optimum levels resulted in increased loaf volume and bread score and softer crumb. All four types of enzymes appeared to be equally effective in improving bread properties compared with the controls. At high levels,greater tolerance to the addition of xylanases and cellulases compared with the addition of alpha-amylases and proteases was apparent. Mixing requirements increased with increasing levels of alpha-amylase but no change was apparent with the other enzymes. Addition of all enzymes reduced sheeting work requirements,indicating a dough softening effect. Optimum bread properties for all enzymes were attained within a relatively narrow range of dough sheeting work values,which presumably correspond to optimum dough handling properties. The similarity in response of bread and sheeting characteristics at optimum levels of addition for all four enzyme types suggests a common nonspecific mechanism for improver action that is probably related to water release and the resulting impact on physical dough properties. [References: 31].

## Q51 FEED TECHNOLOGY

1146 Azim,A. (Animal Nutrition Program,National Agricultural Research Center,Islamabad (Pakistan).) (1996) **On farm demonstration of various storage methods for urea treated wheat straw.** *Asian-Australasian Journal of Animal Sciences v. 9(3) p. 281-285.* 5 tables; 16 ref. Korean. (AGRIS 2000-014267).

## Q52 FEED PROCESSING AND PRESERVATION

1147 Jimenez,L.; Perez,I.; de,la,Torre,MJ.; Lopez,F.; Ariza,J. (2000) **Use of formaldehyde for making wheat straw cellulose pulp.** *Bioresource Technology. 72(3):283-288.* English. [Univ Cordoba,Fac Ciencias,Dept Ingn Quim Cordoba 14004 Spain].

A central composite design was used to investigate the influence of the cooking conditions (time,temperature and formaldehyde concentration) for wheat straw with formaldehyde-water mixtures on the properties of the pulp obtained (yield and holocellulose,alpha-cellulose,lignin and ethanol-benzene extractives contents) and the pH of the resulting wastewater. A second-order polynomial model consisting of three independent process variables was found to accurately describe the organosolv pulping of wheat straw The equations derived predicted the yield,the holocellulose,alpha-cellulose,lignin and ethanol-benzene extractives contents of the pulp,and the pH of the wastewater with multiple-R,R-2,adjusted-R-2 and Snedecor F values of 0.99,0.99,0.99 and 321.33,0.98,0.95,0.92 and 35.01; 0.92,0.86,0.78 and 10.68,0.99,0.97,0.96 and 68.19; 0.91,0.83,0.80 and 29.68 and 0.97,0.95,0.93 and 46.10,respectively. While ensuring a high holocellulose content and low lignin and ethanol-benzene-extractive contents entails using high levels of the process variables involved,a compromise can be made in order to achieve both the previous objectives and a high alpha-cellulose content provided a long cooking time,a high temperature and a low formaldehyde concentration are used - alternatively,a long time,a high formaldehyde concentration and a low temperature can be equally effective and save energy. The yield,pH and holocellulose,alpha-cellulose,lignin and alcohol/benzene extractive contents are more sensitive to changes in the cooking time than they are to modifications of the formaldehyde concentration. (C) 1999 Elsevier Science Ltd. All rights reserved. [References: 15].

## Q54 FEED COMPOSITION

1148 Fairbairn,SL.; Patience,JF.; Classen,HL.; Zijlstra,RT. (1999) **The energy content of barley fed to growing pigs: Characterizing the nature of its variability and developing prediction equations for its estimation.** *Journal of Animal Science. 77(6):1502-1512.* English. [Prairie Swine Ctr Inc Saskatoon SK Canada].

Currently,the pork industry attempts to formulate energy levels in swine diets to within a tolerance of 1.5%. This is difficult to achieve in practice when the energy content of primary ingredients fluctuates by up to 15%. This experiment was carried out to define the sources of variation in the energy content of barley and to develop a practical method to accurately estimate the DE and ME content of individual barley samples. Four samples of each of five covered barley varieties (AC Lacombe,B-1602,Bedford,Harrington,and Manley) were collected to obtain a range of quality within each variety. Five measurements were collected on each barley sample using 60 crossbred barrows in an apparent total tract digestibility study. The barrows,average BW of 35.3 kg,were housed in individual metabolism crates to facilitate separate collection of urine and feces. Five-day collection periods followed 5-d diet acclimation periods. Levels of total beta-glucan,ADF,CP,and starch (90% DM) in the 20 barley samples ranged from 2.7 to 4.5%,4.5 to 9.2% 10.8 to 15.1%,and 42.3 to 53.4%,respectively. The mean DE and ME content of the 20 samples were 2,934 and 2,857 kcal/kg (90% DM),respectively,and varied among samples by 15.2% (447 kcal). The complex structural cell wall carbohydrates seemed to have the greatest influence on the energy content of individual barley samples. The ADF fraction alone accounted for 85% of the total variation in energy content of the 20 samples. Converted into a prediction equation,DE = 3,526 - 92.8 x ADF (90% DM),the ADF content was used to estimate the DE content of barley with 85% accuracy. This experiment confirms the large variation in the energy content of barley,describes the factors that influence this variation,and presents equations based on chemical and(or) physical measurements that may be used to predict the DE and ME content of individual barley samples. [References: 41].

1149 Fang,JM.; Sun,RC.; Tomkinson,J.; Fowler,P. (2000) **Acetylation of wheat straw hemicellulose B in a new non-aqueous swelling system.** *Carbohydrate Polymers. 41(4):379-387.* English. [Univ Wales,BioComposites Ctr Bangor LL57 2UW Gwynedd Wales].

The acetylation of wheat straw hemicellulose B was carried out in a homogeneous N,N-dimethylformamide and lithium chloride system with acetic anhydride using 4-dimethylaminopyridine as a catalyst. The degree of substitution of hemicellulose B acetates ranged between 0.59 and 1.25 as a function of experimental conditions. Under an optimum condition (85 degrees C,60 h),approximately 75% of the free hydroxyl groups in native hemicellulose B were acetylated. The molecular weight measurements (31,890-34,090 g mol(-1)) showed a controllable degradation of hemicellulose B chains during the reactions at temperature 60-85 degrees C and duration of 2-60 h. It was found that the thermal stability of the products was increased by chemical modification. (C) 2000 Elsevier Science Ltd. All rights reserved. [References: 22].

1150 Graybosch,RA.; Guo,G.; Shelton,DR. (2000) **Aberrant falling numbers of waxy wheats independent of alpha-amylase activity.** *Cereal Chemistry. 77(1):1-3.* English. [Univ Nebraska,USDA ARS 344 Keim Lincoln,NE 68583 USA].

1151 Huiping,C. (Changsha Institute of Agricultural Modernization,Chinese Academy of Sciences,Changsha (China).) (1996) **Comparative study of fibre characteristics of rice and wheat straws.** *Asian-Australasian Journal of Animal Sciences v. 9(1) p. 51-56.* 4 tables; 10 ref. Korean. (AGRIS 2000-014297).

1152 Karr,GS.; Sun,XZS. (2000) **Strawboard from vapor phase acetylation of wheat straw.** *Industrial Crops & Products. 11(1):31-41.* English. [Kansas State Univ,Dept Grain Sci & Ind Manhattan,KS 66506 USA].

Commercial ground wheat straw was used in a central composite response surface experimental design to examine four acetylating process variables: reaction temperature,reaction time,initial moisture content of straw,and the vapor flow rate of chemical reagent. The response variable was acetyl content determined as a function of straw weight gain. Diphenylmethyane diisocyante was used as a binder to prepare board samples with a hot press. Equilibrium moisture content (EMC) was determined at 65 and 90% RH at 27 degrees C,and dimensional stability was determined using a humidity cycle of 30-90% RH at 27 degrees C,ASTM D1037-93 standard method for a 3-point flex test was used to measure mechanical properties. The microstructures of both treated and untreated wheat straw and boards were observed with a scanning electron microscope. The vapor phase acetylation system used acetylated ground wheat straw to a 24% weight gain (dry weight basis). A mathematical model (R-2 = 0.97) was developed to predict the weight gain as a function of the four acetylation processing variables. The maximum reduction in all strawboard properties occurred at the highest weight gain (24%). The strawboard EMC decreased (30% maximum reduction) as weight gain increased at both 65 and 90% RH. The strawboard dimensional stability increased as the weight gain increased (maximum reductions of 80% in thickness swell and 50% in linear expansion). The initial mechanical properties of the strawboards decreased as the weight gain increased (maximum reductions of 64% in strength and 48% in stiffness). The density of the strawboards decreased as the weight gain increased (23% maximum reduction). SEM micrographs showed no physical evidence of structural damage to cell walls from the acetylation. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 22].

1153 Mueller,A. (1999) **[Farm produced feed mixtures: Be aware of lysine!].** Degussa AG,Hannover (Germany). *Schweinezucht und Schweinemast (Germany) v. 47(5) p. 18-21.* German. (AGRIS 2000-006440).

1154 Penlov,D.; Kostova,Z.; Terziev,Zh. (Vissh Selskotopanski Institut,Plovdiv (Bulgaria)); Surdzhijska,S. (1999) **Nutritive value of triticale in experiments with geese.II.Content and true digestibility of protein and aminoacids.** Selskotopanska Akademiya,Sofia (Bulgaria). *Zhivotnov"dni Nauki (Bulgaria). Animal Science v. 36(3-4) p. 58-62.* 1 ill.,2 tables; 13 ref. Bulgarian. (AGRIS 2000-006417).

Aminoacid content in 4 species of triticale has been established.Using adapted for geese methods (Penkov,D. et al.,1996) the average true digestibility of the aminoacids is 91.52 with variations from 77.55 (by methionine) to 96.37 (by glutamine).

1155 Prestloekken,E. (Norges Landbrukshoegskole,Aas (Norway). Inst. for Husdyrfag) (1999) **Protein value of expander-treated barley and oats for ruminants.** Norges Landbrukshoegskole,Aas (Norway). *Agricultural University of Norway. Doctor Scientiarum Theses (Norway); no. 1999:5 vp.* Norges Landbrukshoegskole,NLH. tables,figures; ref. 3 papers are incl. in the thesis. English. (AGRIS 2000-014294).

1156 Weinberg,ZG.; Szakacs,G.; Ashbell,G.; Hen,Y. (1999) **The effect of Lactobacillus buchneri and L-plantarum,applied at ensiling,on the ensiling fermentation and aerobic stability of wheat and sorghum silages.** *Journal of Industrial Microbiology & Biotechnology. 23(3):218-222.* English. [Agr Res Org,Volcani Ctr,Forage Preservat & Prod Res Unit IL-50250 Bet Dagan Israel].

The effect of applying Lactobacillus buchneri (LB),alone or In combinations with L. plantarum (EP) and yeasts at ensiling,on the ensiling fermentation and aerobic stability of wheat and sorghum silages was studied under laboratory conditions. Treatments comprised LB,LP,yeasts,LB + yeasts,LP + yeasts,LB + LP and B-589 (a lactic acid bacterial strain isolated from wheat silage in Israel) alone. The treatments were also applied to sterilized aqueous extracts of wheat which were incubated at 30 degrees C for 10 days. The pH of all treatments was below 4.0 already on day 4 of the experiment. Silages treated with LB had higher acetic acid concentrations than those treated with LP: 32-34 vs 16-18,and 28-34 vs 4-7 g kg(-1) in the experiments with wheat and sorghum,respectively. Similar results obtained in wheat extracts,In the aqueous phase,marked differences in pH decrease were noticed among the treatments: 4.4 In LB,6.0 in the yeast,and 3.7 in LP and B-589 (from day 3 and onwards). In both crops LB resulted in aerobically stable silages when applied alone or with LP and

yeasts,whereas LP resulted in unstable silages upon aerobic exposure; the stability of the LB-treated silages is attributed to the higher acetic acid concentrations. The isolated strain (B-589) did not exhibit any advantage with regard to aerobic stability. [References: 13].

## Q55 FEED ADDITIVES

1157 Naesi,M.; Partanen,K.; Piironen,J. (1999) **Comparison of Aspergillus niger phytase and Trichoderma reesei phytase and acid phosphatase on phytate phosphorus availability in pigs fed on maize-soybean meal or barley-soybean meal diets.** Helsinki Univ. (Finland). Dept. of Animal Science. *Archives of Animal Nutrition (Germany) v. 52(1) p. 15-27.* English. (AGRIS 2000-006507).

1158 Xu Zirong; Wang Zhenlai; Wang Minqi (Zhejiang Agricultural Univ.,Hangzhou (China). Inst. of Feed Science) (1998) **Effects of xylanase,beta-glucanase and cellulase on growth performance and carcass characteristics of piglets fed with high wheat bran diet.** *Journal of Zhejiang Agricultural University (China). Zhejiang Nongye Daxue Xuebao (China) v. 24(6) p. 643-646.* 5 tables; 8 ref. Chinese. (AGRIS 2000-006465).

## Q60 PROCESSING OF NON-FOOD OR NON-FEED AGRICULTURAL PRODUCTS

1159 Bvochora,JM.; Read,JS.; Zvauya,R. (2000) **Application of very high gravity technology to the cofermentation of sweet stem sorghum juice and sorghum grain.** *Industrial Crops & Products. 11(1):11-17.* English. [Univ Zimbabwe,Dept Biochem POB MP167,Mt Pleasant Harare Zimbabwe].

Ethanol production from mixtures of sweet stem sorghum juice and sorghum grain was investigated under normal and very high gravity (VHG) fermentation conditions. Fermentation was carried out using Saccharomyces cerevisiae yeast strain N96 at 30 degrees C. For VHG fermentation,sucrose was added to the sweet sorghum juice to obtain a concentration of 34 g per 100 mi of dissolved solids. Fermentation was carried out for 96 h using malted and unmalted milled sorghum grain from sorghum cultivars DC-75 and SV-2. Under VHG conditions,maximum ethanol levels were about 16.8% (v/v) and 11% (v/v) for media containing malted and unmalted milled sorghum grain,respectively. Although fermentation did not occur to completion,levels of ethanol obtained under VHG conditions were three times higher than the levels obtained under normal fermentation conditions. Under VHG conditions,about 8 g/100 mi of dissolved solids remained in the fermentation media after ethanol production had ceased while under normal fermentation conditions,about 4 g/100 mi of dissolved solids remained unused in the fermentation media. There was an initial decline in free amino nitrogen (FAN) levels up to 34 h followed by an increase up to 96 h under VHG fermentation conditions. Levels of assayable proanthocyanidins (PAs) from sorghum cultivar DC-75 were reduced during fermentation. (C) 2000 Elsevier Science B.V. All rights reserved. [References: 15].

1160 Gaudin,S. (Institut National de la Recherche Agronomique,Nantes (France). Centre de Nantes,Unite de Recherche sur les Polysaccharides leur Organisation et Interactions); Lourdin,D.; Le Botlan,D.; Forssell,P.; Ilari,J.L.; Colonna,P. (1999) **Relationships between oxygen permeability and polymer-plasticizer interactions on starch-sorbitol-water films.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998. *Colloques de l'INRA (France); no. 91 p. 173-178. Institut National de la Recherche Agronomique,Paris (France).* INRA. 5 ref. English. (AGRIS 2000-006549).

Oxygen permeability (OP) of starch-sorbitol-water films were measured. A difference of behaviour between low and high sorbitol content was observed. The OP decrease with low sorbitol content (0.15 10-(16) cm2/s.Pa for 8.8% (wt%) sorbitol and 1.42 10-(16) cm2/s.Pa without sorbitol). For high sorbitol content >20%,OP reach value near the one obtained for the film without sorbitol (1.30 10-(16) cm2/s.Pa at 28.0% sorbitol). This change of behavior is correlated with a change in mobility determined by time domain NMR and with dynamic mechanical measurements.

1161 Gontard,N. (Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement,Montpellier (France)); Redl,A. (1999) **Glass transition of wheat gluten in its native and film forms.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998. *Colloques de l'INRA (France); no. 91 p. 157-165. Institut National de la Recherche Agronomique,Paris (France).* INRA. 6 ref.,8 graph. English. (AGRIS 2000-006548).

Glass transition of wheat gluten was studied on its native form in relation with shaping processes based on thermoplastic properties such as extrusion or hot pressing,but also in wheat gluten film for a better understanding and control of its functionnal properties that are highly dependant of film water content and thus of ambiant relative humidity.

1162 Graille,J. (Centre de Cooperation Internationale en Recherche Agronomique pour le Developpement,Montpellier (France)); Philippe Roussel,C.; Pina,M. (1999) **Protein lipophilisation by chemical means and by biocatalysis.** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998. *Colloques de l'INRA (France); no. 91 p. 71-80. Institut National de la Recherche Agronomique,Paris (France).* INRA. 36 ref.,9 graph. English. (AGRIS 2000-006540).

Numerous articles and other works have been published on chemical modification of proteins. There are many ways of studying protein structure,active site topography and the spatial distribution of certain amino acid residues ; the methods can also be used to modify their secondary,tertiary or quaternary structure,leading to changes in their physico-chemical and functional properties,particularly their surface properties. Improving these properties would be worthwhile for many scientific and industrial applications,such as foods,pharmacy,cosmetics and biotechnologies. Until now,the work on modifed proteins has mainly concentrated on supplying the food industry with new ingredients enabling either an improvement in an existing technology or the development of new foods. The opening of new outlets for agricultural products in the energy,chemistry and materials fields is currently mobilizing substantial research efforts. The development of biomolecules in the chemistry sector is also a major line of research,in particular the development of agromaterials that can be substituted for plastics and of biomolecules such as plant-based surfactants,biopolymers or lubricants,which could rapidly become competitive given their enviroumental advantages. The functional properties of proteins are defined as all the non-nutritional properties they give to a food product. The most important factors in explaining protein functionality are solubility and the hydrophobic interactions between the proteins and the aqueous phase. As a result,modifying the hydrophobicity of proteins can lead to sufficient hydrophily and thus improve their surface properties. To this end,the hydrophobization reaction,in other words lipophilization,has been applied to numerous proteins,making them more liposoluble,wich facilitates their integration into lipid systems such as liposomes,or their translocation through biological membranes.

1163 Guilbert,S. (Institut National de la Recherche Agronomique,Montpellier (France). Centre de Montpellier,Unite de Technologie des Cereales); Redl,A.; De Regh,H.; Baron,C.; Mujica Paz,H.; Cuq,B.; Gontard,N. (1999) **Gas and solute barrier properties of wheat gluten films: Application to the design of "Active Biopackagings".** Biopolymer science: food and non food applications. Montpellier (France). 28-30 Sep 1998. Biopolymer Science: Food and Non Food Applications. Montpellier (France),September 28-30,1998az. *Colloques de l'INRA (France); no.*

*91 p. 313-320. Institut National de la Recherche Agronomique,Paris (France).* INRA. 9 ref. English. (AGRIS 2000-006550).

Active packaging provide a supplementary means to control physiological,microbiological and physicochemical changes in food products. In this paper,we will expand on the use of wheat gluten films as active layers,i.e. when the film contribute by itself to the food preservation. Some potential uses of these biomaterials (e.g. modified atmosphere packaging of fruits and vegetables,slow release of food preservatives) are described with examples. The development of biopackaging or edible films with selective gas permeability is very promising for controlling respiratory exchange and improving the conservation of fresh or minimally processed fruits and vegetables. Wheat gluten films appear to have suitable O2 barrier properties while remaining relatively permeable to CO2. The gas perrneability's of gluten based films were measured at various temperatures and relative humidites. O2/CO2 selectivity increased from 3 (at 4 degrees and low RH) to more than 45 (at 40 degrees and 95%RH). Some selective gluten-based films have been shown to lead to the creation of very original atmospheres when used to wrap fresh mushrooms. The modified atmosphere rise to an equilibrium composition of 2-3% CO2 and 2-3% O2 which is favourable to the mushroom overall quality. The diffusion of sorbic acid in various wheat gluten film was studied and the release from the film to a model food was measured and modelled. The and-microbial effect of various edible gluten / sorbic acid based films was evaluated against Penicillium notatum . Simple gluten-based films had no own fungicidal effect but the gluten / lipid based films showed a strong sorbic acid retendon and a marked own fungicidal effect,either at 30 degrees or 40 degrees,delaying the Penicillium notatum growth for more then 21 days.

## S01 HUMAN NUTRITION-GENERAL ASPECTS

1164 Zittermann,A.; Scheld,K.; Danz,A.; Stehle,P. (1999) **Wheat bran supplementation does not affect biochemical markers of bone turnover in young adult women with recommended calcium intake.** *British Journal of Nutrition. 82(6):431-435.* English. [Univ Bonn,Dept Nutr Sci Endenicher Allee 11-13 D-53115 Bonn Germany].

We investigated the effect of wheat bran on biochemical indicators of Ca and bone metabolism in nineteen healthy women,aged 25.5 (sE 0.9) years. Subjects received six wheat bran biscuits or six white flour biscuits per day for a period of 4 weeks (crossover). Wheat bran consumption increased fibre intake from 17.7 (sE 1.3) to 29.6 (sE 1.3) g/d (7 d food record) and enhanced P intake from 1225 (sE 59) mg/d to 1663 (sE 65) mg/d; $P < 0.001$. Mean daily Ca intake during wheat bran consumption (1110 (sE 82) mg/d) significantly ($P = 0.008$) exceeded Ca ingestion during the white hour period (955 (sE 67) mg/d). Wheat bran increased the number of defecations per week from 7.9 (sE 0.8) to 12.2 (sE 1.4) ($P = 0.0018$). Urinary Ca excretion over 24 h significantly ($P = 0.021$) decreased from 473 (sE 53) mu mol/mmol creatinine (control period) to 339 (sE 37) mu mol/mmol creatinine (wheat bran period). Serum 25-hydroxyvitamin D,2 h fasting urinary Ca/creatinine excretions and 24 h urinary P excretion remained constant. No differences in serum levels of carboxy-terminal propeptide of type I procollagen (biomarker of bone formation) or in 2 h fasting urinary hydroxyproline/creatinine excretions (biomarker of bone resorption) were observed at the end of the two cycles of dietary supplementation. We conclude that a high fibre intake of approximately 30 g/d has no significant adverse effects on bone turnover in subjects with Ca intakes above 1000 mg/d and that the reduction in 24 h urinary Ca excretion is most probably the result of an adaptation process,induced by a decrease in net absorbed Ca. [References: 33].

## T01 POLLUTION

1165 Guo Xiupu; Kong Xiangsheng; Zhang Miaoxia (Luoyang Agricultural Coll.,Henan (China)) (1998) **A study on the buffer effect of zinc on wheat seedling stressed by cadmium.** *Acta Agriculturae Boreali-Sinica (China). Huabei Nongxuebao (China) v. 13(suppl.) p. 50-55.* 5 tables; 1 ill.,8 ref. Chinese. (AGRIS 2000-014494).

## U10 MATHEMATICAL AND STATISTICAL METHODS

1166 Bloch,Z.; Faber,A.; Demidowicz,G. (Institute of Soil Science and Cultivation of Plants,Pulawy (Poland)); Szymczyk,R. (Research Centre of Cultivar Testing,Slupia Wielka (Poland)) (1997) **Growth and yield simulations of spring barley cultivated in Poland using WOFOST. Pt. 1. Model calibration.** *Fragmenta Agronomica (Poland) v. 14 p. 5-14.* 2 fig.,2 tables; 15 ref. Polish. (AGRIS 2000-014552).

WOFOST 6.0 was calibrated for spring barley in regions within countries of the European Community. The purpose of this study was to validate and calibrate the model in Polish condition. The model was run using the calibration BAR 301 for daily weather data. The results of simulation for Experimental stations: Baborowko,Grabow and Wierzbno showed no effect of water shortage on grain yield and total above-ground production (TAGP). The relative root mean square error RRMSE of simulation was 63.2 percent for grain and 15.8 percent for TAGP.

1167 Bloch,Z.; Faber,A.; Demidowicz,G. (Institute of Soil Science and Cultivation of Plants,Pulawy (Poland)); Szymczyk,R. (Research Centre of Cultivar Testing,Slupia Wielka (Poland)) (1997) **Growth and yield simulations of spring barley cultivated in Poland using WOFOST. Pt. 2. Model validation.** *Fragmenta Agronomica (Poland) v. 14 p. 15-22.* 1 fig.,4 tables; 17 ref. Polish. (AGRIS 2000-014553).

The new calibration of WOFOST was tested against independent data sets for Experimental Station Grabow. The simulation duration to heading and to maturity were close to measured values. The root mean square errors of duration were days: 4.3 to heading and 5.2 to maturity. The relative root mean square error of yield simulation was 28.5 percent. The errors E and ED of simulation were: 27.0 and 26.1 percent. RRMSE of yield estimates was 24.1 percent for all experiments.

1168 Nasr,S.M. (Ministry of Agriculture,Cairo (Egypt). Central Lab. for Design and Statistical Analysis) (1997) **Estimation of optimum plot size,shape and number of replications for wheat yield trials under different fertilization conditions.** *Egyptian Journal of Agricultural Research (Egypt) v. 75(4) p. 1175-1189.* 2 fig. 6 tables; 10 ref. English. (AGRIS 2000-006819).

1169 Nerozzi,F. (Centro Ricerche Produzioni Vegetali (CRPV),Cesena,Forli (Italy)); Zinoni,F.; Marletto,V. (Agenzia Regionale per la Prevenzione e l'Ambiente dell'Emilia Romagna (ARPA),Bologna (Italy). Servizio Meteorologico) (1998) **Calibration and validation of two operational phenological models for winter wheat and maize in Emilia-Romagna [Triticum aestivum L. - Zea mays L.- Emilia-Romagna].** *Rivista di Agronomia (Italy) v. 32(2) p. 112-123.* 6 tables; 5 graphs; 32 ref. Italian. (AGRIS 2000-006820).

To simulate the several phenological stages of winter wheat and maize,some mathematical models already published were utilized. These models were linked together to obtain two comprehensive models describing the whole development cycle of crops by the sequence of the principal phenological stages. In particular,the model for winter wheat predicts the dates of emergence,floral induction,earing and physiological maturity. Instead,for maize the dates relative to emergence,floral induction,silking and physiological maturity are predicted by the model. The calibration and the validation of these models are based on the observations performed for ten years (1987-1996) by the phenological monitoring network of Emilia-Romagna. After the calibration,models are underbiased of less than 2 days for all phases,except floral induction,not directly observed in the field,while root mean square error (rmse) ranges from 5 to 8 days.

Sensitivity analysis shows that,for winter wheat,a delay of sowing has a scarce influence for the earing and the physiological maturity phases. In contrast,for maize a delay of sowing date strongly affects the dates of other phenological phases. The temperature increase leads to anticipate phenological events: for wheat,apex development takes place more early in season and,as a consequence,the apex development-maturity cycle becomes longer; for maize,phenological events have more sensitivity to sowing date than to the increase of temperature.

## U30 RESEARCH METHODS

1170 Bloch,Z. (Institute of Soil Science and Plant Cultivation,Pulawy (Poland). Dept. of Mathematics and Informatics Application) (1999) **Grain yields forecasting using adaptation methods.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 31-36.* 2 tables; 8 ref. Polish. (AGRIS 2000-014603).

The paper presents forecasting of grain yields: winter wheat,spring wheat,winter barley,spring barley and rye. The results of four different time series methods were compared: simple exponential smoothing,Brown's linear exponential smoothing,Hotl's linear exponential smoothing and Hellwig's method. Yields forecasts were compared with statistical yields. The best results were obtained by the Hellwig's method for all time series. Generally,relative errors ex post were lower than 10 percent.

1171 Gierdziwicz,M. (University of Agriculture,Krakow (Poland). Chair of Genetics and Methods of Improvement of Animals); Zajac,T. (University of Agriculture,Krakow (Poland). Dept. of Plant Detailed Cultivation) (1999) **Comparison of regression and logarithmic method of estimating relationship between crop yield of winter triticale and its structural components.** 3. All-Polish Conference IUNG on Crop Husbandry in Poland. Pulawy (Poland). 8-9 Jun 1999. *Pamietnik Pulawski (Poland) (no.114) p. 111-118.* 3 tables; 13 ref. Polish. (AGRIS 2000-014615).

Two methods of estimating the inflence of structural components on the crop yield of triticale - per surface unit and per ear were compared. To achive that purpose,the multiple regression model was used doing or not the logarithmic transformation of the variables. As a results of calculations it was concluded that grain yield per square unit was best described with the equation in which the number of ears per square unit,and the number of grains per ear was best described with the equation,in which number of grains per ear was taken into account,without logarithmic transformation.

1172 Kornarzynski,K.; Pietruszewski,S. (Akademia Rolnicza,Lublin (Poland). Katedra Fizyki) (1999) **Capillary-weighing method to measure the rate of water absorption by wheat grain.** *Inzynieria Rolnicza (Poland) (no.2) p. 71-77.* 5 fig.; 5 ref. Polish. (AGRIS 2000-014616).

Rate of water absorption by seed grain of wheat,Jasna cultivar,during swelling was measured. Water absorption was estimated by water weight changes recorded on a computer aided electronic balance. The water absorbed during soaking of grain was a function of either,soaking time and temperature. Proposed method to measure the rate of water absorption is a modification of a capillary potential method. At satisfactory accuracy it is simple in use and easy to repeat the measurements.

1173 Mossi,L.; Cattivelli,L.; Faccioli,P. (Istituto Sperimentale per la Cerealicoltura,Rome (Italy)); Fornasier,F.; Odoardi,M. (Istituto Sperimentale per le Colture Foraggere,Lodi,Milan (Italy)) (1998) **[Quick determination of quality of barley grain [Hordeum vulgare L.]].** *Informatore Agrario (Italy) v. 54(33) p. 55-57.* 1 table; 1 graph. Italian. (AGRIS 2000-006824).

Aalto, S. 1138
Abbott, LK. 1033
Abd El Hamid, M. 1064
Abd El Latif, M.A. 1064
Abd, El-Hady, EA. 1069
Abdellaoui, A. 739
Abdullah, AY. 985
Abe, T. 1038
Abid, A.R. 1039
Accerbi, M. 1070
Adachi, T. 721
Adamiak, E. 553
Adamiak, J. 553
Adamska, H. 401
Adesogan, AT. 992
Adhikari, C. 491
Adogla-Bessa, T. 992
Afzal, TM. 1038
Ahlandsberg, S. 740
Ahmad, A.N. 908
Ahmad, M. 706
Ahmad, R. 972
Ahmad, S. 706
Ahmadi, AA. 579
Ahmed, I. 921
Ahmed, M.h.A. 741
Ahmed, Z. 921
Ahokas, H. 568
Ahsan, M. 569, 631
Ahsan. M. 570
Aida, Y. 635
Akhtar, J. 665
Akula, A. 479
Akula, C. 479
Al Shabi, J.H.M.S. 571
Al-Yahya, SA. 902
Alaru, M. 417, 751
Alaviuhkola, T. 1000
Alberici, R. 867
Albrecht, SL. 827
Albrecht, V. 1052
Alghannam, A. 976
Algur, OF. 771
Ali, A. 972
Allam, M.A. 1071
Alliot, B. 880
Almas, K. 1039
Almas, R. 1039
Alvarez, RI. 844
Aman, P. 1115
Amarowicz, R. 1037
Ambolet, B. 941
Ambrosi, I. 403
Anamthawat-Jonsson, K. 572
Andersen, A. 537
Anderson, RL. 959
Anderssen, RS. 1095
Andersson, R. 1115
Andersson, RE. 1115
Ando, H. 1136
Andreu, P. 1072, 1083, 1110
Angas, P. 1024
Anikster, Y. 807
Anon. 397, 411, 573, 574, 575, 576
Antes, S. 1073
Appels, R. 707, 1124
Aragona, M. 577
Aragues, R. 1024
Arias, G. 456
Ariyarathne, HM. 697
Ariza, J. 1147
Arlorio, M. 1074
Armero, E. 1083
Armstrong, KC. 595
Arna, T. 626
Arora, VK. 463
Arru, L. 929
Asaad, F.A. 667
Ashbell, G. 1156
Asif, M. 578
Aslam, M. 665
Assad, MT. 579
Asseng, S. 418
Astakhova, NV. 782
Atia, A.A.M. 398
Attene, G. 929
Auda, M. 862
Aumaitre, A. 1001
Austin, RB. 419
Auti, AK. 492
Autio, K. 1115
Awan, NA. 1075
Ayub, M. 972
Azam, F. 440
Azim, A. 1146
Aziz, K. 663
Baalbaki, R. 1062
Baba, T. 609
Bachinger, J. 420
Backes, F. 1063
Badiyala, D. 513
Baenziger, PS. 697
Baghestani, A. 942
Baha, J. 593
Bahri, MH. 606
Bahrman, N. 580
Bai, GH. 581
Bai, YG. 961
Bailey, LD. 506
Bains, GS. 1092
Bains, NS. 711
Baker, SJ. 848
Bakker, J.G.M. 997
Bakula, J. 494
Balalic, I. 582
Baldi, P. 603
Balduini, C. 1090
Ball, BC. 421, 422
Balla, A. 409
Balmas, V. 849
Baranbas, B. 679
Barazani, O. 799
Barberi, P. 943
Barbot, J. 410
Barcellos, AL. 583
Barcelo, P. 686
Barman, K.K. 1026
Barnard, A. 903
Baron, C. 1163
Barraclough, PB. 768
Barreto, DE. 856
Barriga B, Patricio 584
Bartolini, D. 968
Basandrai, AK. 891
Basford, KE. 683
Bassi, K. 511
Basu, RN. 450
Bateman, GL. 850, 851
Batey, I. 1124
Bazin, SL. 1109
Baziramakenga, R. 942
Bean, BW. 904
Bech, L. 1086
Beck, MM. 999
Becker, D. 818
Becus, V. 630
Bedo, Z. 469, 810
Beer, M.U. 1076
Belicka, I. 585
Bell, AE. 1062
Bell, CE. 944
Bellanger, J. 1106
Bellini, L. 603
Belocchi, A. 429
Belton, P.S. 1059
Ben, Salem, M. 606
Benbella, M. 957
Bender, J. 916
Benella, M. 958
Benhamou, N. 852
Berard, P. 670, 1116
Bergthaller, W. 1052
Bernathova, T. 704
Bernaus, J.R. 889, 890
Berot, S. 1119
Bertelsen, J.R. 853
Bethke, PC. 605
Beutl, F. 443
Bhaglal, P. 800, 822
Bhardwaj, SC. 666
Bhatty, N. 1039
Bhullar, S. 822
Bhullar, SS. 800
Bhushan, L. 1015
Bhutta, W.M. 663
Biesaga-Koscielniak, J. 484
Billaud, C. 1077
Bisht, P.S. 1030
Black, AS. 1027
Black, CR. 808
Blackmer, TM. 840
Blackshaw, RE. 458
Blackwell, B. 1084
Blair, AM. 945, 973
Blanchard, A. 423
Blanco, A. 1117
Blecker, C. 409
Bloch, Z. 1166, 1167, 1170
Blum, A. 767
Blundell, MJ. 1129
Bochev, BV. 738
Bodson, B. 854, 881
Bogdanovic, D. 1020
Boggini, G. 1078
Boivin, P. 1077
Bollons, HM. 768
Bonafaccia, G. 1079
Bonciarelli, U. 586
Boone, K. 472, 473, 474
Borgen, A. 855
Borner, A. 639
Bostel, W. 1066
Botterbrodt, S. 1137
Bottner, P. 769
Bouhache, M. 957, 958
Bouvard, E. 956
Bowden, BA. 969
Brabant, P. 587, 670
Brancourt-Hulmel, M. 424, 1116
Brand, TS. 993
Brandini, R. 1078
Brandolini, A. 710
Branlard, G. 588
Brar, D.S. 830
Brar, S.S. 830
Brar, SS. 522
Braun, HJ. 770
Brennan, JP. 589
Briggs, KG. 801
Bronson, KF. 491
Brook, R. von 590
Brown-Guedira, G. 835
Brummer, J. M. 1040, 1080, 1141
Brummer, JM. 1069
Brunell, MS. 591
Bryce, JH. 1111
Bryngelsson, T. 896
Brzozowska, I. 831
Brzozowski, J. 831
Buchenauer, H. 893, 894
Buchner, W. 538
Bucur, E. 970
Bulcke, S. 472
Buleon, A. 1081
Bulot, S. 425, 493
Bulson, HAJ. 975
Buonocore, F. 747
Burnett, PA. 900
Bushnell, WR. 887
Bvochora, JM. 1159
Cabrera, A. 612
Caciagli, P. 867
Caekaert, A. 426
Cagirgan, MI. 932
Cai Shibing 592
Cakmak, I. 770
Cakmak, O. 770
Cakmakci, R. 771
Caldwell, S. 608
Calus, A. 472, 473, 474
Camargo, CEO. 432
Cameron-Mills, V. 745, 1086
Campariol, L. 427
Campbell, CG. 721
Candrakova, E. 494
Canestrale, R. 1090
Cantero Martinez, C. 1024
Cao Xuecheng 742
Cao Yang 592
Capillon, A. 399
Caredda, S. 802
Carmona, MA. 856
Carpenter, HC. 1095
Carre, P. 410
Carrubba, A. 562
Casada, ME. 976
Casas, AM. 622
Castagna, A. 788
Casulli, F. 610
Cattivelli, L. 1173
Cauchy, P. 946
Cavalli-Molina, S. 695
Cavallini, A. 905
Ceccarelli, S. 593
Cecchi, V. 429
Cecchini, C. 496, 1078, 1085
Chague, V. 594
Chalmers, KJ. 672
Chambers, J. 839
Champenois, Y. 1081
Chand, R. 463
Chang Wensuo 725
Charef, B. 707
Chaudhary, MI. 930
Chaudhry, A.U. 495
Chaure, P. 857
Che Yurong 716
Chelkowski, J. 869
Chen Fu 558
Chen Huimin 722
Chen Peidu 651, 714
Chen Qin 743
Chen Yongxuan 764
Chen, JP. 618
Chen, MH. 900
Chen, PD. 682
Chen, Q. 595, 744
Cheng Bingsong 742
Chiosi, E. 747
Chiron, H. 1116
Chmiel, M. 1018
Choi, D.H. 1082
Choi, IR. 858
Choi, U.K. 1082
Chowdhry, M.A. 578, 657, 663
Christensen, DA. 995, 998
Christoffel, A. 694
Chueca, M.C. 964
Chun, E.H. 1041
Chung, Y.G. 1082
Cilento, P. 620
Ciriciofolo, E. 496
Citron, G. 947
Ciudad, F. 622
Clarke, J.L. 859
Clarke, JM. 659
Classen, HL. 1148
Clement, C. 802
Cochrane, MP. 1124
Codianni, P. 596
Codoni, D. 496
Coetzee, J. 993
Coisson, JD. 1074
Collar, C. 1072, 1083, 1110
Collinge, D.B. 896, 901
Colonna, G. 747
Colonna, M. 599

Colonna, P. 1081, 1160
Combettes, B. 803
Comeau, A. 814
Commandeur, U. 860
Conciatori, A. 1085
Conner, RL. 595
Conyers, MK. 1027
Cook, RJ. 465
Cooper, M. 683
Corazza, L. 849
Corcuera, LJ. 844
Cortes, A. 660
Corticelli, C. 1090
Coudray, C. 1106
Couloume, B. 948
Crowley, DE. 795
Cui, W. 1084
Culot, J.P. 534
Cuq, B. 1163
Curry, JP. 551
Cussans, JW. 945
Cuvardic, M. 1020
Cvetkovic, T.V. 804
Czembor, H.J. 428
Czembor, HJ. 597, 868
Czembor, JH. 597, 598
D'Antuono, L.F. 599
D'Egidio, M.G. 496, 1078, 1085
Dabrowski, G. 1037
Dachev, Z. 500
Dahan, A. 594
Dahl, BL. 402
Dahroug, S.M. 949
Dai Junti 653
Dalgliesh, C. 690
Danicke, S. 994
Daniel, JA. 539
Danz, A. 1164
Dardevet, M. 588
Das, DK. 517
Datta, R. 614
David, J. 587
Davies, M.S. 619, 913, 914, 915
Davy, A. 745, 1086
De Keyzer, A. 941
De Neergaard, E. 879, 901
De Regh, H. 1163
De Villiers, N. 412
De, BK. 450
De, Blas, JC. 984
De, Camargo, MBP. 432
De, Carvalho, JLV. 1093
De, Castro, JL. 432
De, Froidmont, D. 702
De, Kerchove, G. 955
De, la, Torre, MJ. 1147
De, Moraes-Fernandes, MIB. 583
De, Nova, PG. 749
De, Ruiter, JM. 1087
De, Wolf, ED. 861
Debosschere, S. 472
DeLacy, IH. 683
Delatte, J.L. 1051
Deleens, E. 453
Delgado, R. 660
Dell'Aquila, A. 600
Della, Valle, G. 1081
Delogu, G. 867
Delwiche, SR. 772
Demidowicz, G. 1166, 1167
Demigne, C. 1106
Demotes-Mainard, S. 773
Dencic, S. 487, 636, 637, 674
Denery-Papini, S. 1104
Denisov, M.A. 1144
Denoo, A. 473
DePauw, RM. 659
Derycke, V. 862
Deshayes, G. 1104
Desiderio, E. 429, 496, 1085
Desserme, C. 1104
Devaux, P. 802
Devesa, A. 1110
Dhaliwal, HS. 614
Dhuyvetter, KC. 550
Di Fonzo, N. 596, 1078
Di prima, G. 610
Di, Fonzo, N. 1118
Di, Turi, M. 600
Dill-Macky, R. 863, 864
Dimitrijevic, M. 601
Ding Shouren 723, 724
Djokic, D. 497, 498, 804
Dobermann, A. 491
Dobrev, D. 865, 874
Domaradzki, K. 950
Dong Aihua 906
Dong Dengfeng 907
Dong Yonghua 430
Dong Zhaorong 535
Dong, YS. 656
Dos, Santos, HP. 403
Dreccer, M.F. 774
Duan Mingyuan 532
Duan Yuanlin 746
Dubcovsky, J. 627, 650
Dubert, F. 484
Dudits, D. 679
Dudler, R. 694
Durand, A. 993
Durante, M. 905
Dvoracek, V. 1113
Dworakowski, T. 431
Eckstein, P. 649
Edwards, CA. 1042
Eenpuu, R. 832
Eichacker, LA. 786
Eisele, J.A. 951
Eker, S. 770
El Bawab, A.M.O. 667
El Ghamry, M.A. 866
El Kady, F.A. 499
El Kashlan, I.H. 1064
El Saify, N. 1019
El Sayed, A.A. 667
El Shazly, L. 1064
El Shirbeeny, A. 1071
El-Enein, RA. 606
El-Samahy, SK. 1069
Elizalde, B.E. 1053
Ellis, RP. 602, 606, 691
Elmorjani, K. 1061
Elonen, P. 524
Elwinger, K. 1011
Emam, Y. 579
Empilli, S. 710, 1090
Endo, TR. 668
Engelke, F. 1043
Engle, DA. 1112
Enjalbert, J. 587
Enno, T. 677
Ens, EW. 1109
Eom, I.T. 1049
Epstein, E. 787
Ercoli, L. 775, 785
Escorial, C. 964
Escriva, C. 1110
Espinosa H, Rodrigo Mauricio 776
Evans, JO. 959
Every, D. 1088
Evon, P. 1119
Faber, A. 1166, 1167
Facchiano, AM. 747
Faccini, N. 867
Faccioli, P. 603, 1173
Fagnano, M. 790
Fahima, T. 594
Fahmy, F.A.H. 398
Fairbairn, SL. 1148
Fairclough, RJ. 1098
Falisse, A. 854
Fan Jun 748
Fang Xianwen 592
Fang, JM. 1149
Fares, C. 1078
Faris, JD. 604
Fath, A. 605
Faye, A. 1116
Fecenko, J. 515
Fedak, G. 595
Feher, A. 679
Feillet, P. 1089
Felder, R. 1044
Feldman, M. 807
Felicio, JC. 432
Feng Chaonian 737
Feng Guanglong 805
Feng Qing 806
Fenn, DYK. 659
Ferraresi, A. 1090
Feucht, D. 952
Fickler, J. 1091
Filipiak, K. 433
Filipov, Kh. 500
Fillion, N. 1076
Filloux, A.M. 1045
Finckh, MR. 868
Finney, PL. 1092
Finy, P. 679
Fish, L. 693
Fish, LJ. 690
Fisher, DJ. 995
Fliessbach, A. 1021
Folkins, T. 400
Folling, L. 896
Foote, TN. 690
Fornara, M. 429, 496
Fornasier, F. 1173
Forssell, P. 1160
Forster, BP. 602, 606, 691
Fossey, A. 826
Fotyma, E. 501
Fotyma, M. 502
Fouquin, G. 408
Fowler, DB. 434, 435
Fowler, P. 1149
Fraignier, MP. 777
Francisci, R. 1079
Franck, F. 993
Francl, LJ. 861
French, R. 488, 858
Frey, P. 883
Friebe, B. 607
Friedel, J.K. 503
Friedman, J. 799
Frielinghaus, M. 420
Fritts, DA. 837
Fritz, AK. 608
Froud-Williams, RJ. 444, 953
Fuentealba A, Juan 584
Fujita, K. 930
Fukushima, M. 1114
Furusho, M. 609
Gabel, D. 503
Gacek, ES. 868
Gahoonia, TS. 504
Galantini, JA. 436, 455
Galiba, G. 638
Galli, V. 1079
Gallo, G. 610
Galraith, H. 1002
Galterio, G. 596, 1078
Gambhir, PN. 923
Gan, YT. 445
Gao Jiyin 939, 940
Garcia Baudin, J.M. 964
Gareis, M. 1065
Garello, G. 611
Garz, J. 527
Gateau, I. 588
Gauci, CS. 1033
Gaudin, S. 1160
Ge Yaxin 652
Gebremedhin, B. 437
Genc, Y. 778
Gennadios, A. 756
Genot, B. 954
Gerendas, J. 815
Germani, R. 1093
Gerstenkorn, P. 416, 1068, 1102
Ghabour, S.K. 438
Ghani, A. 908
Ghorbel, D. 1094
Ghosh, D. 1028
Gianinazzi, S. 888
Gianinazzi-Pearson, V. 888
Gianoli, E. 833
Gibson, G. 955
Gibson, LR. 909
Gierdziwicz, M. 1171
Gilbert, S. 1059
Gilchrist, L. 735
Gill, BS. 604, 607, 682, 693, 835
Gill, KS. 697
Ginanni, M. 943
Giraud, A. 1116
Gjetting, S. 896
Glazek, M. 834
Gobelman-Werner, K. 718
Gobert, L. 956
Godbillot, L. 1046
Godden, D. 589
Godet, F. 878
Gohier, J.M. 963
Goldringer, I. 587
Golinski, P. 869
Gomah, A.M. 920
Gontard, N. 1161, 1163
Gonzalez, MJ. 612
Goodchild, A. 593
Gooding, MJ. 931, 1075
Gordon, DC. 602, 691
Gorham, J. 932
Gorny, AG. 613
Gorski, T. 736
Gosal, KS. 530
Gosal, SS. 711
Goschl, T. 396
Gotta, P. 867
Govedarica, M. 505
Graham, RD. 778
Graille, J. 1162
Grama, A. 594
Grando, S. 593
Grant, CA. 506
Gras, PW. 1095
Graybosch, RA. 1150
Gregersen, P.L. 896
Gregoire, D. 702
Gregorova, H. 439
Gregory, PJ. 931
Gresle, E. 1047
Grewal, HK. 1096
Grewal, TS. 614
Grienenberger, JM. 803
Gristina, L. 562
Gu, YH. 452
Guan Guilan 816
Guckert, A. 514
Gueguen, J. 410, 1061
Guera, A. 749
Guilbaud, L. 580
Guilbert, S. 1163
Gulnaz, A. 440
Guo Fangqing 910
Guo Wenshan 737
Guo Xiupu 1165
Guo, G. 1150
Gupta, PK. 615
Gupta, R.A. 1028
Gupta, S.P. 1022
Gupta, SK. 616
Gurr, SJ. 848, 857
Gut, A. 911
Gyimes, E. 933, 1036
Hac, L. 1130
Haen, KM. 604
Haesaert, G. 862
Hague, T. 973
Haji, HM. 617
Hakala, K. 912
Halaj, P. 547
Hamachi, Y. 609
Hamal, A. 957, 958
Hamid, A. 442
Hammes, W.P. 1060
Hamza, M.A. 1064
Han, F. 618
Handley, LL. 602, 691
Handreck, G. 1048
Hanif, M. 619, 913, 914, 915
Hansen, TB. 509
Haque, N. 1007
Harada, O. 1145
Harb, MY. 985
Hare, RA. 662, 1131
Hariri, D. 580
Harjit-Singh. 614
Harker, KN. 458

Hartmann, F. 862
Harvey, A. 480
Harvey, TL. 835
Harwood, WA. 620
Hatchett, JH. 607
Haunold, E. 798
Havlin, JL. 550
Hayes, P. 735
Hayes, PM. 810
He Chenxia 722
He Jianhua 737
He Juemin 653
He Zhichang 728
Hebbar, KB. 750
Hein, GL. 858
Hejlesen, C. 980, 981
Helal, E. 1064
Helio, R. 912
Helm, JH. 441, 900
Hen, Y. 1156
Hennig, U. 1009
Henriksen, B. 870
Henry, R. 479
Herger, P. 798
Hertel, C. 1060
Hikida, Y. 1038
Hill, AS. 1129
Hill, J. 996
Hilpert, M. 639
Hira, CK. 1096
Hobbs, PR. 491
Holland, JM. 845
Hong, SS. 779
Hong, T. 779
Hooshmand Rad, P. 1011
Horikoshi, R. 668
Hornby, D. 850
Hruschka, WR. 772
Hu Aitang 937
Hu Bingmin 974
Hu Fushun 648
Hu Mengyin 554
Huang Lifen 1023
Huang, L. 807
Hubbard, LJ. 413
Hudak, C. 916
Hudec, J. 507, 780
Huiping, C. 1151
Hulasare, RB. 979
Hullebroeck, M.L. 954
Hunt, LA. 617
Hussain, A. 808
Hussein, T.S.T. 621
Huth, W. 860
Hwang, S.Y. 1049
Hylander, L. 508
Ibanoglu, E. 1050
Ibanoglu, S. 1050
Igartua, E. 622
Iglesias, JO. 436, 455
Ignaczak, JC. 403
Ikeda, M. 917
Ilari, J.L. 1160
Iliev, F 987
Illiano, G. 747
Immonen, S. 481
Inborr, J. 997
Ingelin, ME. 1134
Ingle, R. 973
Invernizzi, C. 610
Iqbal, J. 440
Ishihara, A. 668
Isla, R. 1024
Islam, AKMR. 623
Ismail, B. 1062
Ito, K. 635
Ivanovski, M. 624
Iveges, M. 674, 675, 676
Ivezic, J. 601
Iwaki, K. 625
Iwamura, H. 668
Iwanchysko, P. 998
Izydorczyk, MS. 1097
Jaama, E. 417, 751
Jaaskelainen, M. 626
Jackson, R. 1131
Jadczyszyn, T. 502
Jamjod, S. 918
Janda, T. 671
Jane, J. 1133
Jang, E.H. 1132
Jansson, C. 740
Jarak, M. 505
Jaroni, D. 999
Jasieniuk, M. 959
Jaskulski, D. 809
Jastrzebska, M. 831
Javed, F. 510
Jayas, DS. 819, 979
Jeffers, HC. 1112
Jegasothy, H. 1098
Jensen, KB. 836
Jensen, LS. 509
Jeon, YA. 763
Jeong, M.S. 1082
Jeroch, H. 994, 1004
Jestin, L. 580
Jeuffroy, MH. 773
Ji, W.D. 1082
Ji, WQ. 595
Jia, JZ. 656
Jiang Chunzhi 646
Jiang, H. 779
Jimenez, L. 1147
Jimenez, M. 627
Jodaugiene, D. 552
Johansson, L. 508
John, A. 510
Johnson-Flanagan, AM. 801
Johnston, MR. 598
Johnston, PA. 678
Jonczyk, K. 543
Jones, MJ. 540
Jones, P. 661
Jones, PA. 973
Jones, RK. 863
Jones, RL. 605
Jong, SK. 721
Jonsson, LMV. 817
Jorhem, L. 919
Joshi, DK. 923
Juskiw, PE. 441
Kabir, G. 698
Kaczmarek, Z. 869
Kaeppler, SM. 697
Kalendar, R. 626
Kaloosh, A.A. 920
Kandil, M.M. 920
Kaneko, T. 635
Kang Minghui 828
Kantar, F. 771
Kaptur, P. 869
Karamac, M. 1037
Karele, I. 757
Karhunen, J. 1000
Karim, MA. 442
Karr, GS. 1152
Karsai, I. 810
Kasai, T. 1114
Kasearu, P. 417, 751
Kasha, KJ. 713
Kataria, N. 511
Kataria, RK. 511
Kato, K. 625, 628, 629
Kaukoranta, T. 912
Kawai, S. 781
Kawatra, BL. 1096
Kazemekas, O. 630
Kazemekiene, B. 630
Kebede, Z. 959
Kehl, B. 1066
Keller, B. 650
Kempf, H. 443
Keya, EL. 1099
Khairallah, S. 637
Khalid, M. 510, 631
Khaliq, I. 578, 631
Khan, A. 555
Khan, A.S. 632, 633
Khan, IA. 634
Khan, M.A. 871
Khan, MY. 1007
Khan, R. 760
Khan, R.U. 555
Khan, S.G. 555
Khatkar, BS. 1062
Khera, KL. 463
Kiecana, I. 869
Kihara, M. 635
Kilian, A. 618
Kim, C.K. 1100
Kim, J.H. 991
Kim, M.K. 982
Kim, Y.J. 1082
Kim, Y.S. 1135
Kindler, SD. 836
Kiplagat, OK. 801
Kipp, B. 1101
Kisana, N.S. 921
Kishan, J. 990
Klechkovaskaya, EA. 872
Klechkovskaya, EA. 873
Klein, KK. 400
Kleinhofs, A. 618, 735, 761
Klima, K. 541
Klimov, SV. 782
Kling, C.I. 1102
Knezevic, D. 624, 640, 673
Knox, RE. 659
Knutson, BL. 1057
Ko, Y.S. 1135
Kobiljski, B. 582, 636, 637, 674
Kobrehel, K. 777
Kocsy, G. 638
Koh, B.K. 1103, 1132
Kohler, B. 811, 1077
Kolev, K. 865, 874
Kollner, B. 924
Kondic, A. 482, 696
Kong Xiangsheng 1165
Konzak, CF. 489
Kordas, L. 812
Kordas, R. 812
Koreish, E.A. 920
Koreleski, J. 1010
Kornarzynski, K. 1172
Korol, AB. 594
Korres, NE. 444
Korschens, M. 512
Korzun, L. 642
Korzun, V. 639, 678
Kostecki, M. 869
Kostic, M. 498
Kostic, M.A. 497
Kostova, Z. 1154
Kottenhagen, MJ. 825
Kovacevic, B. 640
Kozdoj, J. 484
Kozelov, L. 987
Kraljevic Balalic, M. 601, 636
Kramer, J. 1063
Kranz, E. 813
Krasowicz, S. 736
Krause, GHM. 924
Kreft, I. 1079
Kristensen, B.K. 752
Kuburovic, M. 640, 673
Kudrna, D. 618, 735
Kuhn, M. 1128
Kuht, J. 542
Kujawski, M. 1010
Kukula, S. 433
Kulik, D. 494
Kulmala, J. 708
Kulshrestha, G. 960
Kumar, J. 1025
Kumar, PK. 641
Kumar, S. 513, 522
Kumlehn, J. 813
Kundu, S. 1026, 1029
Kuno, H. 625
Kunze, R. 639
Kunzel, G. 642, 678
Kuraszkiewicz, R. 548
Kurban, H. 930
Kurth, J. 718
Kus, J. 543, 736
Kushnak, GD. 838
Kussovska, VN. 738
Kuwajima, K. 781
Kuzmicki, J. 431
Kwasna, H. 851
Kwiatkowska, J. 549
Kynast, RG. 607
Laffranque, J.P. 946
Lafiandra, D. 747
Lafond, GP. 445
Lahnstein, J. 1109
Lahuta, LB. 765
Lampi, AM. 1138
Landriscini, MR. 436, 455
Lang, L. 810
Langenberg, WG. 488
Langridge, P. 672
Lapierre, H. 658
Larhnim, A. 739
Laroche, A. 595
Larre, C. 1104
Latre, J. 862
Launay, B. 1094
Laur, U. 417, 751
Laurinen, P. 1000
Lazar, MD. 926
Lazzeri, PA. 686
Le Botlan, D. 1160
Le, Gouis, J. 580
Le, Page-Degivry, MT. 611
Leal, C. 702
Leaver, JD. 996
Leblanc, J. 946
Lebreton, Y. 1001
Lecomte, C. 424
Ledoux, DR. 1010
Lee, CH. 763
Lee, H.J. 1100
Lee, HK. 875
Lee, K.S. 1041
Lee, Y.T. 1135
Lefebvre, J. 1104
Legere, A. 961
Lehmann, BE. 911
Leinonen, KS. 1105
Leister, D. 718
Lemieux, C. 942
Lendini, M. 496
Lennartz, B. 876
Lepage Carlotti, B. 399
Lepiece, D. 962
Leroux, GD. 942
Leroy, P. 707
Lesemann, DE. 880
Leterrier, J.L. 963
Levrat-Verny, MA. 1106
Li Demin 727
Li Dequan 935, 936
Li Fangdong 556, 557, 753, 783
Li Haobing 643, 644
Li Hesheng 746
Li Honglian 731
Li Lanzhen 877
Li Suoping 645
Li Xingpu 646
Li Xinhua 647
Li Xiuqing 762, 1107
Li Yaxing 533
Li Yuqin 648
Li Zhongyi 722
Li, CD. 649
Li, Z. 1124
Liang Juhua 446
Lijavetzky, D. 650
Lim, S.T. 1132
Limaux, F. 514
Limpert, E. 878
Lin Qi 754
Lindhauer, M.G. 416, 1068, 1108
Lindup, S. 480
Lingard, J. 413
Linhares, AG. 456
Liotta, C. 610
Liszewski, M. 447
Liu Chaohui 651
Liu Jiandong 755
Liu Jiangchang 983
Liu Jianling 784
Liu Shiping 1023
Liu Youliang 743
Liu, C. 536
Liu, DJ. 682
Liu, YL. 744
Liu, Z. 735
Lizardo, R. 1001
Login, A. 765
Lomovic, S. 804

Lonsdale, D. 480
Lopez, F. 1147
Lopez, HW. 1106
Lorenzini, G. 788
Lorz, H. 813, 818
Lotti, C. 1117
Lourdin, D. 1160
Lozek, O. 515
Lu Menggu 652
Lu Xiao 762
Luebeck, P.S. 879
Luik, A. 832
Lukaszewski, AJ. 591
Lukow, OM. 1134
Luo Hongbin 653
Luthar, Z. 654
Lutman, PJW. 945
Lyngs Joergensen, H.J. 879
Lyon, DJ. 959
Lysenko, ED. 1145
Lyshede, OB. 504
Ma Chuanxi 655
Ma Junyong 648
Ma Wenshi 922
Ma, JX. 656
Mabood, S.F. 760
MacGregor, AW. 1097, 1109
MacGregor, EA. 1109
Maciorowski, R. 927
Mackowiak Cz. 451
Macri, LJ. 1109
Macuha, P. 448, 449
Maddens, K. 473
Maes, O. 814
Maggiore, T. 516
Mahal, M.S. 830
Maheswari, M. 923
Mahfouz, H. 438
Mahmood, N. 657
Mahmoud, W.H. 1019
Maiksteniene, S. 1016
Maiorana, M. 544
Mair, V. 1079
Majid, A. 921
Malesevic, M. 1020
Malicki, L. 545, 546
Malik, M.A. 632
Malyshev, S. 639, 678
Mameli, L. 610
Mancini M.C. 414
Mancini, M.C. 407, 415
Mandal, AK. 450
Mandal, UK. 517
Mandebvu, P. 1002
Mangat, GS. 711
Mangavel, C. 410, 1061
Manninen, OM. 483
Manohar, RS. 1125
Manquian T, Nimia 584
Mao, L. 718
Marcinska, I. 484
Marcoz, C. 588
Marie-Jeanne, V. 880
Marin, J.P. 889, 890
Mariotti, M. 775, 785
Markovics, E. 1035
Marletto, V. 1169
Marschner, P. 815
Martelli, A. 1074
Martin, C. 1003, 1005
Martin, TJ. 835
Martinez, JC. 1083
Martinez-Anaya, MA. 1072, 1110
Martini, AM. 593
Martini, B. 588
Martorana, M. 1085
Martyniuk, S. 451
Masar, S. 692
Maserti, B. 905
Masoni, A. 775, 785
Mastari, J. 658
Mateos, GG. 984
Mathlouthi, M. 1046
Matsuki, J. 1126
Matsumoto, T. 618
Matsuoka, Y. 669
Matuz, J. 1035
Maxwell, BD. 959
Mazzola, M. 452
McAndrew, DW. 458
McCafferty, KA. 1111
McCaig, TN. 659
McCartney, D. 995, 998
McCracken, KJ. 1009
McDonald, GK. 778
McEvoy, JDG. 1009
McKinnon, JJ. 995, 998
McLeod, JG. 659
McReath, A. 962
Medel, P. 984
Meeus, P. 854, 881
Mehmood, R. 495
Meister, A. 642
Meng Fanjin 766
Meng Songdong 816
Meng, E. 589
Menke, M. 678
Menkovska, M. 624
Menzies, JG. 882
Meo, A.A. 908
Merah, O. 453
Mersinkov, N. 454
Mesi, M. 466
Messmer, M. 719, 720
Meszaros, K. 810
Meulen, J. van der 997
Meyer, D. 1108
Meyer, U. 924
Meynard, JM. 424, 514
Michael, M. 593
Michalet-Doreau, B. 1003, 1005
Michaux-Ferriere, N. 777
Michels, GJ. 837
Michon, T. 1061
Miedaner, T. 1067
Miglierina, AM. 436, 455
Mihaljev, I. 675, 676
Miklovicova, M. 704
Milevoj, L. 842
Miller, J. 916
Miller, SD. 959
Miller, TE. 690
Millet, E. 807
Milosev, D. 518, 519
Milosevic, N. 505
Milovanovic, M. 640
Milovanovic, M.S. 804
Minella, E. 456
Minelli, M. 599
Minnick, TJ. 925
Minoia, C. 610
Miot, S. 883
Miranda, T. 964
Mishra, KN. 520
Mishra, SN. 520
Mitic, N. 485
Mitra, A. 488
Mitsunaga, T. 1136
Mitsuyama, T. 761
Mityko, J. 679
Miura, H. 628
Mizuta, K. 609
Mladenov, N. 680, 681
Modgil, R. 978
Moisan, L. 480
Molbak, L. 820
Molin, S. 820
Mollenhauer, S. 523
Moller, K. 521
Moller, M. 486
Momcilovic, V. 681
Monneveux, P. 453
Montoya, JL. 622
Moore, G. 690
Morell, M. 1124
Mori, N. 705
Mori, S. 758
Morishita, DW. 959
Morrill, WL. 838
Morris, CF. 1112
Morroll, SM. 718
Mossi, L. 1173
Motte, J. 1051
Moudry, J. 1113
Mrowczynski, M. 834
Msatef, Y. 957, 958
Muehlbauer, GJ. 887
Mueller, A. 1153
Mueller, KH. 969
Mugambi, PM. 1099
Mujahid, M.Y. 921
Mujeeb-Kazi, A. 660
Mujica Paz, H. 1163
Mukai, Y. 707
Mulholland, BJ. 808
Mullarkey, M. 661
Muller, B. 786
Muller, K. 878
Muller, K. J. 457
Muller, KH. 952
Munns, R. 662
Munzing, K. 1052, 1068
Murai, K. 705
Muramatsu, Y. 1114
Murdoch, AJ. 1075
Musselman, RC. 925
Mustafa, AF. 995, 998
Mustafa, S.Z. 921
Muwalla, MM. 985
Muzzi, G. 650
Mykkanen, AH. 626
Mykkanen, HM. 1105
Nabi, G. 526
Nabi, T.G. 663
Nadeau, P. 814
Naesi, M. 1157
Nagarajan, S. 923
Nakagawa, K. 625
Nakamura, C. 705
Nakamura, H. 664
Nakamura, T. 712, 713
Nakanishi, H. 758
Nanda, GS. 711
Narang, RS. 522, 530
Nasi, M. 1000
Nasorri, V. 943
Nasr, S.M. 1168
Natali, L. 905
Navushchanov, S. 454
Nawaz, S. 665
Nayar, SK. 666
Neftel, A. 911
Nejedlik, P. 823
Nerozzi, F. 1169
Neskovic, M. 485
Neumann, H. 1040
Nevo, E. 594, 708
Newman, JC. 458
Newton, AC. 606, 848
Ng, PKW. 1070
Nguyen, HT. 767
Nicholson, P. 898
Nicolas, J. 1077
Nicole, M. 852
Nielsen, NE. 504, 509
Nigul, L. 986
Nikiforuk, J. 1084
Nikolic, R. 485
Nikolov, I. 987
Nikus, J. 817
Nilsson, M. 1115
Nishizawa, NK. 758
Niu Liyuan 884
Noaman, M.M. 667
Nokes, SE. 1057
Nomura, T. 668
Norido, F. 1090
Northam, FE. 959
Novaro, P. 1078
Novembre, G. 1085
Novent, O. 965
Nozdrovicky, L. 547
Nuttall, M. 898
O'Donovan, JT. 458
O'Hara, RB. 898
Obolevica, D. 490
Ochal, M. 545
Odoardi, M. 1173
Oerke, E.C. 876
Oger, R. 823
Ogg, AG. 959
Ognjanovic, R. 804
Ohm, H. 581
Ohnishi, Y. 669
Oji, Y. 761
Olesen, A. 896
Oljaca, M. 1012
Olk, DC. 491
Oloffs, K. 1004
Orlando, D. 947
Orlov, PA. 818
Orosz, G. 638
Orson, JH. 973
Osborne, BG. 1131
Osler, GHR. 1033
Osuna, M.D. 966
Oury, FX. 670, 1116
Owen, E. 992
Ozdemir, A. 770
Paczkowski, L. 401
Padalino, L. 1118
Padovan, S. 610
Paek, J.E. 982
Paikaray, RK. 520
Paillard, S. 587
Pal, SK. 467, 529
Paldi, E. 671
Paliwal, J. 819
Paluch, F. 404
Palumbo, M. 496, 1078
Palys, E. 548, 549
Pan Tingguo 983
Pan Weihuai 906
Pandey, AK. 459
Pandey, P.C. 1030
Pang Chunming 646
Pang Huancheng 558
Panicucci, A. 788
Pannu, PPS. 614
Pansu, M. 769
Panuallah, GM. 491
Papendick, RI. 465, 563
Paquot, M. 409
Parker, GD. 672
Parker, JP. 421
Parrett, AM. 1042
Partanen, K. 1157
Parveen, S. 665
Parylak, D. 559
Pascale, S. de 790
Pasmionka, I. 1018
Pasqualone, A. 1117
Pasquini, M. 610
Passarella, S. 1118
Pastore, D. 1118
Pasuquin, E. 491
Patience, JF. 1148
Paulech, P. 885
Paulsen, GM. 909
Pauly, J. 420
Pavlekic, S. 1012
Pavlovic, M. 640, 673
Pawar, VS. 492
Pecchioni, N. 867, 929
Pecio, A. 501
Pecsvaradi, A. 798
Pedersen, IS. 509
Peiniau, J. 1001
Pekaric Nadj, N. 482
Pelossier, R. 948
Peltonen, S. 886
Penlov, D. 1154
Perez, I. 1147
Perry, JN. 845
Peruzzi, A. 943
Peschke, H. 523
Petr, J. 460
Petrovic, S. 601, 674, 675, 676
Peusha, H. 677
Peyre, J. 880
Philippe Roussel, C. 1162
Philippeau, C. 1003, 1005
Philipps, L. 975
Piccinni, G. 837, 904, 926
Pichon, M. 1116
Pickering, RA. 678
Piech, M. 927
Pieruccetti, F. 788
Pietola, L. 524
Pietruszewski, S. 1172
Piironen, J. 1010, 1157
Piironen, V. 1138
Pilipavicius, V. 561
Pilosof, A.M.R. 1053
Pina, M. 1162

Pineau, F. 1119
Pinon, J. 883
Piorr, H. P. 405
Planchot, V. 1081
Pluchard, P. 670
Podstawka Chmielewska, E. 545, 546, 549
Pogna, N.E. 596
Polcyn, J. 928
Ponya, Z. 679
Popineau, Y. 410, 1061, 1104, 1119
Popova, M.M. 461
Popovic, V. 466
Porfiri, O. 496, 599
Porta-Puglia, A. 577
Portero-Larragueta, E. 839
Potschke, L. 1048
Pourhadji, A. 579
Poutanen, KS. 1105
Powell, W. 602
Prabhasankar, P. 1120
Prado, J.L. de 966
Prado, R.A. de 966
Prakash, M. 1121, 1122, 1123
Prakash, V. 459
Prasad, K. 459
Prashar, M. 666
Premachandra, GS. 930
Prestloekken, E. 1155
Prestlokken, E. 1006
Preston, KR. 1145
Pritsch, C. 887
Prom, L. 735
Prosser, O. 839
Provenza, FD. 1008
Przulj, N. 680, 681
Puchta, H. 639
Puhakka, J. 997
Purnomo, E. 1027
Qi Lili 714
Qi, LL. 682
Qiao Ruiqing 717
Qiao, CG. 683
Quail, K. 1143
Qureshi, R.H. 665
Quynh, NT. 726
Raccach, M. 1054
Rachovska, G. 684
Radanovic, Z. 505
Radojevic, R. 1012
Raffaelli, M. 943
Rafi, MM. 787
Rafique, S. 988
Rahman, MS. 442
Rahman, S. 707, 1124
Rahmatullah 526
Rajalakshmi, D. 1121
Rajaram, S. 688
Ram Kala 1022
Raman, S. 1029
Ramesh, B. 615
Ramos, C. 820
Ran Yili 685
Ranieri, A. 788
Rao, PH. 1120, 1122, 1123, 1125, 1127
Rapparini, G. 967, 968
Raschke, K. 811
Rasco-Gaunt, S. 686
Rashid, A. 555
Rathjen, AJ. 672
Rau, D. 929
Raudonius, S. 552
Ravary, Z. 579
Ravi, R. 1123, 1125
Rayment, P. 1055
Rayssiguier, Y. 1106
Razafindralambo, H. 409
Read, JS. 1159
Reader, SM. 690Rebetzke, GJ. 662
Rebetzke, GJ. 662

Recous, S. 514
Reddy, I. 1056
Redl, A. 1161, 1163
Reekmans, S. 862
Reents, H.J. 521
Regmi, AP. 491
Rehman, ZU. 977
Reinbrecht, C. 1067
Reis, EM. 856
Remesy, C. 1106
Remmelg, H. 687
Ren Lijuan 892
Rengel, Z. 789
Renman, G. 508
Rerkasem, B. 918
Reynolds, MP. 688
Reynolds, TL. 821
Rezanoor, HN. 898
Richter, K. 689
Ridder, ER. 1057
Ridderstolpe, P. 508
Ridgway, C. 839
Ridla, M. 989
Riedell, WE. 840
Riedo, M. 911
Ries, M. 542
Riley, A. 686
Rinaldi, VEA. 1070
Ritchie, RM. 422
Roberts, JA. 808
Roberts, MA. 690
Robin, S. 773
Robinson, D. 602, 691
Robinson, J. 481
Roder, MS. 594
Roeb, G.W. 794
Roelfs, AP. 583, 864
Rola, H. 950
Romagosa, I. 622
Rong, JK. 807
Ronin, YI. 594
Rosas, V. 660
Rosell, RA. 436, 455
Ross Murphy, S.B. 1055
Ross, SM. 620
Rossnagel, BG. 649
Rousset, M. 1116
Roy, S. 756
Ru Zhengang 884
Ruggiero, C. 790
Ruiz-Lozano, JM. 888
Rush, CM. 837, 926
Russell, JR. 602
Ruza, A. 490, 757, 791
Rybczynski, JJ. 488
Rychtarik, J. 449, 462, 692
Rzozi, S.B. 957, 958
Sabater, B. 749
Sachan, R.S. 1030
Saha, PK. 491
Saha, R. 923
Sahoo, B. 1007
Saini, JP. 525
Sakaguchi, T. 758
Sakai, H. 1114
Salado, S. 984
Salahieh, H. 593
Salam, A. 578
Salim, M. 526
Salimath, PV. 1127
Salisbury, CD. 904
Sallih, Z. 769
Salmon, DF. 441
Samuels, R. 978
Sanchez, A.C. 410
Sanders, G. 472, 474
Sandhu, BS. 463
Sandhu, KS. 463
Saneoka, H. 930
Sangwan, RS. 802
Santel, HJ. 952, 969
Santori, A. 849
Saraswat, ML. 1007
Sarkar, S. 1017
Sarma, RN. 693
Sarno, R. 562
Saroch, K. 513
Sasaki, T. 618, 1126
Sathish, P. 740
Sattelmacher, B. 815
Savage, A.W.J. 1055
Savilahti, H. 626
Sawada, S. 628
Saxena, DC. 1127
Sayre, KD. 688
Scebba, F. 759
Scheideler, SE. 999
Scheld, K. 1164
Scheller, E. 464Schillinger, WF.
Schillinger, WF. 465, 563
Schlegel, AJ. 550
Schliephake, W. 527
Schluentz, EJ. 1058
Schmid, JE. 719, 720
Schmidt, A.S. 1013, 1014
Schmidt, O. 551
Schober, T. 1128
Schoene, P. 876
Schoener, F.J. 1004
Schofield, JD. 1062
Schubert, I. 678
Schulman, AH. 626
Schulze, H. 1009
Schulze-Lefert, P. 718
Schweizer, P. 694
Scoles, GJ. 649
Scott, A. 421
Scrimgeour, CM. 691
Sears, RG. 607
Sebastiani, L. 759
Seefeldt, S. 959
Segarra, J. 889, 890
Seib, PA. 1056
Seifers, DL. 835
Selbach, A. 695
Senge, C. 1048
Seog, H.M. 1135
Sereni, L. 610
Sesek, S. 482, 487, 696
Shadarevian, S. 1062
Shah, MM. 697
Shah, N.A. 760
Shah, S.A.H. 631
Shah, WH. 977
Shahid, MA. 698
Shahin, S.I.M. 699
Shan Yongnian 477
Shaner, G. 581
Shang Zhenqing 430
Sharma, BK. 891
Sharma, K.L. 1025
Sharma, P.K. 1015, 1028
Sharma, PC. 615
Sharma, SN. 517
Shashidhar, NS. 819
Shelton, DR. 1150
Shen Xiaorong 733, 892
Shepherd, KW. 623
Sher, A. 633
Shewe, G. 818
Shewry, P.R. 1055, 1059
Shi Jiping 430
Shi Mingwang 884
Shi Yan 528, 754
Shimabukuro, R.H. 966
Shiota, K. 930
Shirley, NJ. 1109
Siebert, R. 639
Signoret, PA. 880
Sigvald, R. 823
Siljander-Rasi, H. 1000
Silva, MSE. 456
Silvestri, N. 943
Siman, G. 508
Simard, RR. 814, 942
Simon, O. 994
Simone, S. 1118
Simpson, DJ. 745, 1086
Singh, A.P. 1017
Singh, CM. 513
Singh, D. 616
Singh, G. 517
Singh, K. 711
Singh, M. 1026, 1029
Singh, MK. 467, 529
Singh, N.P. 1030
Singh, P. 800, 822, 990
Singh, R. 1025
Singh, Rajwant 830
Singh, RD. 459
Singh, S.K. 1017
Singh, S.P. 1022
Singh, S.R. 1017
Singh, SB. 960
Sinha, SK. 750
Siniscalco, A. 610
Sissons, MJ. 1129, 1130, 1131
Sissons, SA. 1131
Sivertsen, T.H. 823
Skerik, J. 460
Skerritt, JH. 1129, 1130
Skirvin, KW. 827
Skrabanja, V. 1079
Slanina, P. 919
Smale, M. 589
Smedegaard Petersen, V. 879
Smith, CJ. 1027
Smith, JN. 898
Smith, ML. 486
Snape, JW. 620, 690, 693
Sniady, R. 796
Socha, A. 765
Sodkiewicz, T. 700
Sodkiewicz, W. 824
Soegaard, H. 793
Sohn, A. 880
Soldatini, GF. 788
Somers, DA. 887
Son, D.H. 1082
Son, H.S. 1132
Song Jianming 792
Song, Y. 1133
Sopena, A. 889, 890
Sorensen, MB. 745
Sorensen, VM. 969
Souffrant, WB. 1009
Spallacci, P. 516
Spanu, P. 857
Spina, A. 610, 747
Spokiene, N. 552
Springer, TL. 836
Srinivasa Rao, Ch. 1031
St-Pierre, CA. 814
Stadnik, MJ. 893, 894
Staffelbach, T. 911
Stahlman, PT. 959
Stahr, K. 503
Stamp, P. 719, 720
Stanca, A.M. 603
Stancevicius, A. 552
Stankov, I. 701
Stankova, P. 701
Starcevic, Lj. 1020
Stefan, S. 970
Steffe, JF. 1058
Steffenson, B. 618, 735
Stehle, P. 1164
Stehli, L. 638
Steinmann, H.H. 971
Stenger, DC. 858
Steyer, S. 702
Stojanovic, J. 498
Stol, W. 418
Straub, J.A. 1060
Stumpe, H. 527
Su Shuiqua 983
Subba Rao, A. 1031
Subedi, KD. 931
Subrahmanyam, NC. 641
Suchy, J. 1134
Sue, M. 668
Sueyoshi, K. 761
Sugimoto, T. 761
Sun Benpu 564
Sun Dongfa 703
Sun, CX. 740
Sun, GL. 594
Sun, RC. 1149
Sun, XZS. 1152
Sung, J.E. 1135
Suoniemi, A. 626
Surdzhijska, S. 1154
Suri, V.K. 1032
Svec, M. 704
Svendsen, I. 745, 1086
Swanson, T. 396
Swiatkiewicz, S. 1010
Swinton, SM. 437
Szakacs, G. 1156
Szalai, G. 638, 671
Szubzda, B. 812

Szucs, P. 810
Szunics, L. 895
Szymczyk, R. 1166, 1167
Tadic, L. 466
Tagawa, A. 1114
Tahir, M. 921
Tajiri, H. 669
Takeda, K. 635
Takeda, Y. 1136
Takkar, P.N. 1026, 1029
Takumi, S. 705
Tallevi, G. 968
Talouizte, A. 739
Tandrup Poulsen, T. 896
Tang Yulan 897
Tang Zhangcheng 910
Tang, H. 1136
Tanni, R. 524
Tano, F. 516
Tanveer, A. 972
Tao Xun 841
Tariq, M. 760
Tatham, A.S. 1055, 1059
Tawakoul, H.M.L. 406
Taylor, IB. 808
Tebayashi, S. 668
Tenkanen, M. 1013
Terzi, V. 603
Terziev, Zh. 1154
Testin, RF. 756
Tewari, JP. 875, 900
Thabet, F.M. 1019
Thakur, R. 467, 529
Thakur, SR. 525
Thebo, P. 1011
Thiele, M. 689
Thievin, M. 1061
This, D. 606
Thomas, PL. 882
Thomas, WTB. 606
Thompson, A. 962
Thompson, CR. 550
Thomsen, A.B. 1013, 1014
Thordal Christensen, H. 879, 896, 901
Thorgeirsson, H. 793
Tian Jichun 792
Tilahun, Y. 437
Tillett, ND. 973
Tillmann, P. 1137
Timmermann, BN. 844
Tisova, V. 704
Tiwana, US. 530
Toivo, J. 1138
Toker, C. 932
Tomkinson, J. 1149
Tong Weixing 906
Toojinda, T. 735
Tothne Lokos, K. 468, 706
Toufeili, I. 1062
Trapani, P. 562
Trdan, S. 842
Treciokas, K. 552, 565
Trevathan, L.E. 871
Tripathi, A.K. 1029
Troccoli, A. 596
Trono, D. 1118
Trunova, TI. 782
Tsunewaki, K. 669
Tu Xiuliang 974
Tuberosa, R. 606
Tuhkanen, E. 912
Tully, T. 1054
Tuppi, K. 1000
Turkington, TK. 875, 900
Turner, AS. 898
Turner, M. 707
Turpeinen, T. 708
Tutwiler, R. 593
Ubavic, M. 505
Uggla, A. 1011
Unbehend, G. 1080
Urek, G. 843
Uzik, M. 709
V"lcheva, D. 454
Vaccino, P. 710, 1090
Vagujfalvi, A. 638
Vale, G. 929
Valenti, D. 1118
Van, Bergen, S. 825
Van, der, Meulen, RM. 825
Van, Keulen, H. 418
Van, Vliet, PCJ. 1033
Vance, CP. 887
Vandaele, A. 472, 473, 474
Vandenbulcke, J. 472, 474
Vanpeteghem, J. 473, 474
Varshney, RK. 615
Vashegyi, A. 798
Vaughn, KM. 926
Veha, A. 933, 1035, 1036
Velicka, R. 565
Velozo, JA. 844
Verma, T.S. 1032
Verma, UN. 467, 529
Verma, V. 711
Veseth, RJ. 563
Vicient, CM. 626
Vida, G. 895
Vida, Gy. 469
Vijand, M. 751
Vilich, V. 899
Vill, P. 470
Villalba, JJ. 1008
Viron, H. 947
Virzi, N. 1078
Vita, P. de 1078
Vitagliano, C. 759
Vivar, H. 735
Von, Well, E. 826
Vrinten, PL. 712, 713
Wachter, GA. 844
Wada, T. 629
Wadile, SC. 492
Walburger, AM. 400
Waldenstedt, L. 1011
Wan Luzhang 471
Wan Ping 714
Wang Feng 716
Wang Huanzhong 715
Wang Hui 685
Wang Minqi 1158
Wang Pei 716
Wang Shouzheng 731
Wang Shuwen 734
Wang Weiping 816
Wang Wenzheng 762
Wang Xianze 1139
Wang Xuqing 1140
Wang Yuefu 531, 934
Wang Zhenlai 1158
Wang Zhifen 566
Wang, M. 825
Wang, X. 536
Warner, RL. 761
Watanabe, K. 1136
Watanabe, N. 770
Webster, JPG. 413
Wei Dongbin 528, 754
Wei Jingfang 652
Wei Wenxue 532
Wei Yunzong 717
Wei, FS. 718
Weidner, S. 1037
Weigel, HJ. 916
Weinberg, ZG. 1156
Weipert, D. 1141
Weisz, J. 1076
Weller, CL. 756
Wellmann, A. 952
Welsh, JP. 975
Wendel, JF. 807
Weremko, D. 991
Westra, P. 959
White, NDG. 979
Whitkus, R. 591
Wicker, T. 650
Wicki, W. 719, 720
Wicks, GA. 959
Wieneke, J. 794
Wieser, H. 1073, 1101, 1142
Wikiera, A. 1010
Wilczynski, W. 812
Willenbrink, J. 924
William, MDHM. 660
Wilson, DL. 607
Wilson, WW. 402
Winder, L. 845
Wing, R. 650, 718
Winzeler, M. 719, 720
Wirth, S. 420
Wise, RP. 718
Wisniewska, H. 869
Wittouck, D. 472, 473, 474
Wobeto, C. 403
Woidemann, A. 1013
Wojciechowski, W. 475, 476, 796
Wolfe, M. 975
Wolfe, MS. 868
Woo, SH. 721
Wood, P.J. 1076
Wood, PJ. 1084
Woods, S. 882
Wootton, M. 1098
Worland, A.J. 675, 676
Worrall, WD. 608
Wright, D. 569
Wu Hanzhang 764
Wu Yuye 935
Wuest, SB. 827
Wyatt, C. 999
Xi, K. 900
Xia Guangmin 722
Xia Jingyuan 846
Xiao Jianfu 723, 724
Xie Lingqin 725
Xu Changcheng 936
Xu Chiming 532
Xu Langlai 806
Xu Qiuming 533
Xu Xiangyang 828
Xu Zirong 1158
Xu, CC. 763
Xu, DQ. 779
Yaduraju, NT. 960
Yamaguchi, O. 609
Yamamori, M. 726
Yamamoto, K. 618
Yamanishi, T. 917
Yang Huiwu 877
Yang Sijun 727
Yang Wannian 728
Yang Zhimin 937
Yang, CH. 795
Yang, J.S. 1100
Yao Jingxia 643, 644
Yasui, T. 1126
Ye Xianrong 477
Yen, Y. 697
Yin, YL. 1009
Yoshida, T. 609
Yoshikawa, R. 609
Yoshimura, E. 758
Yoshino, M. 609
You, M. 536
Young, FL. 563
Younis, R.A.A. 729
Yu Hanshou 764
Yu Hongxin 730, 938
Yu Huazhong 728
Yu Zhenwen 528
Yuan Hongxia 731
Yuan Junshui 645
Yun, SH. 1143
Zajac, T. 1171
Zalewski, K. 765
Zamuner, E. 534
Zarychta, M. 433, 502
Zawieja, J. 796
Zecevic, V. 640, 673
Zein, F.I. 499
Zhang Boxi 477
Zhang Cuizhen 797
Zhang Henggan 727
Zhang Heying 535
Zhang Jianhua 936
Zhang Jingjuan 733
Zhang Jingyu 728
Zhang Jiuganng 717
Zhang Leqing 732
Zhang Miaoxia 1165
Zhang Shigong 939, 940
Zhang Yimin 764
Zhang Yuqiong 535
Zhang Zhimeng 829
Zhang Zhisheng 732
Zhang, H. 536
Zhang, JX. 767
Zhang, L. 488
Zhang, WH. 744
Zhang, XQ. 649
Zhao Degang 766
Zhao Huijie 877
Zhao Peng 748
Zhao Shijie 935
Zhao Yinhuai 714, 734
Zheng Shaojian 937
Zheng, MY. 489
Zhou Jianming 910
Zhou Jun 533
Zhou Miaoping 733, 892
Zhou Wenchun 734
Zhou Zhiguo 478
Zhou, F. 901
Zhou, RH. 656
Zhu, H. 735
Zhuang Hengyang 1023
Zieba, S. 451
Zijlstra, RT. 1148
Zinoni, F. 1169
Zittermann, A. 1164
Zofajova, A. 709
Zou Qi 742, 936
Zou Wanhe 685
Zsoldos, F. 798
Zuppiroli, M. 407, 414, 415
Zvauya, R. 1159
Zyla, K. 1010

ABA 766, 808, 825
ABA LEVELS 611
ABILITY 961
ABIOTIC STRESS 602, 606
ABSCISIC ACID 440, 479, 800, 821, 822
ABSCISIC ACID (ABA) 808
ABSCISIC ACID BIOSYNTHESIS 611
ABSORPTION 798, 1164
AC TRANSPOSASE TRANSCRIPT LEVEL 705
ACARI 835
ACCLIMATION 912
ACCUMULATION 739, 761, 782, 814
ACETIC ANHYDRIDE 1152
ACETYLATION 1149, 1152
ACID 1001, 1118, 1149, 1156
ACID CONTENT 942
ACID PHOSPHATASE 451, 760, 1010, 1157
ACIDIC RED SOIL 520
ACIDIFICATION 1027
ACTION MECHANISM 488
ACTIVATED OXYGEN SPECIES 759
ADAPTABILITY 629
ADAPTATION 487, 593, 602, 613, 625, 1170
ADDITION LINE 623
ADDITION LINES 595
ADDITIVES 1125
ADHESION 1094
ADJUSTMENT 930
ADJUVANTS 862
ADP GLUCOSE PYROPHOSPHORYLASE 1124
ADPGLUCOSE PYROPHOSPHORYLASE 1124
ADULT PLANT RESISTANCE 583
ADVENTITIOUS ROOTS 805
ADVERTISING 1076
AEGCY 959
AEGILOPS 675, 676, 724
AEGILOPS CYLINDRICA HOST. AEGCY, JOINTED GOATGRASS 959
AEGILOPS TAUSCHII 770
AEGILOPS VENTRICOSA 723
AERATION 976, 1015, 1057
AERIAL PARTS 928
AEROBIC STABILITY 992, 1156
AESTIVUM 721
AESTIVUM L. 481
AETIOLOGY 867
AFFECTING DIET SELECTION 1008
AFLATOXINS 1066
AFRICA 411, 540
AGAROSE GEL ELECTROPHORESIS 1098
AGENT 670
AGING 528, 806
AGRICULTURAL CROPS 924
AGRICULTURAL ORIGINS 597
AGRICULTURAL SOIL 1027
AGRICULTURAL SOILS 911
AGRICULTURAL WASTES 983
AGRICULTURE 911
AGROBACTERIUM TUMEFACIENS 722, 740
AGROECOSYSTEMS 551
AGROFORESTRY 560
AGROMYZIDS 537
AGRONOMIC CHARACTERS 427, 429, 433, 573, 574, 575, 576, 596, 599, 640, 646, 652, 717, 737, 921, 1078
AGRONOMIC PERFORMANCE 419, 591
AGROPYRON 656
AGROPYRON CRISTATUM 836
AGROPYRON INTERMEDIUM 595, 634
AIR POLLUTANTS 788, 916
AIR TEMPERATURE 871
AIR VELOCITY 1038
AIR WATER INTERFACE 409
ALBINISM 922
ALFALFA 551
ALGAE 419
ALKALINE PHOSPHATASE 451
ALLELIC VARIATION 664, 1129, 1130
ALLELOCHEMICALS 799, 899
ALLELOPATHY 799, 809, 928, 942
ALLOPLASMIC LINES 818
ALOPECURUS 974
ALPHA AMYLASE 605, 939, 1109, 1125, 1145
ALPHA GLUCOSIDASES 649
ALPHA TOCOPHEROL 1118
ALTERNARIA ALTERNATA 1018
ALTERNATE HOSTS 836
ALTERNATING CURRENT FIELD 679
ALTERNATIVE AGRICULTURE 405, 420, 1063
ALTITUDE 1107
ALUMINIUM 448, 449, 906
ALVEOGRAPH 1116
AMARANTH 1099
AMARANTHUS 439
AMBIENT OZONE 924
AMINO ACID SEQUENCE 1086
AMINO ACID SEQUENCES 1101
AMINO ACIDS 439, 464, 532, 745, 752, 814, 831, 1006, 1009, 1073, 1091, 1154, 1155
AMMIAD 807
AMMONIA 506, 794, 993
AMMONIA CONCENTRATION 998
AMMONIA VOLATILIZATION 514
AMMONIATED WHEAT STRAW 990
AMMONIUM 798, 815
AMPHIPLOID 572
AMPLIFIED POLYMORPHIC DNA 695
AMYLASE 649, 1081
AMYLASE DEFICIENCY 635
AMYLASE THERMOSTABILITY 635
AMYLOPECTIN 1056, 1081, 1098, 1126, 1133
AMYLOPECTINS 1133
AMYLOSE 1056, 1081, 1098, 1136
AMYLOSE CONTENT 726
ANAEROBIOSIS 929
ANALYTICAL METHODS 590, 1060, 1065, 1137
ANDROGENESIS 489, 696, 706, 802, 825
ANGIOSPERMS 708
ANGSTROM RESOLUTION 1109
ANIMAL FEEDING 988, 1039
ANIMAL GROWTH PROMOTERS 986
ANIMAL POPULATION 846
ANIMAL PRODUCTION 515
ANION CHANNEL 758
ANNUAL FORAGE 441
ANOXIA 929
ANTAGONISM 876, 899
ANTHER CULTURE 487, 489, 696, 716, 818
ANTHER CULTURE METHODS 802
ANTHERS 696
ANTHESIS 617
ANTIBIOTIC EFFECT 486
ANTIBODIES 1129, 1130
ANTIMICROBIAL PROTEINS 886
ANTIOXIDANT ENZYMES 759
ANTIOXIDANT RESPONSES 638
APHID TRANSMISSION 658
APHIDS 844
APICES 758
APPLICATION DATE 493, 881, 941, 946, 948, 958, 963, 967, 968
APPLICATION RATES 447, 451, 475, 476, 495, 496, 497, 500, 510, 526, 535, 544, 559, 632, 796, 908, 941, 950, 954, 958, 963, 967, 968, 1168
APPLICATION TIME 509
APPROPRIATE TECHNOLOGY 1144
APULIA 544
ARABIC BREAD 1062
ARABIC BREAD QUALITY 1127
ARABIDOPSIS HYPOCOTYLS 811
ARABIDOPSIS THALIANA 504
ARABINOGALACTAN PROTEINS 713
ARABINOXYLANS 1084
ARBITRARY PRIMERS 606
ARBUSCULAR MYCORRHIZAL FUNGUS 551
ARGENTINA 411
ARID SOILS 430
ARM 682
ARRHENATHERUM ELATIUS 1016
ARTHROPODA 846
ARTHROPODS 537
ARTIFICIAL INOCULATION 720
ARTIFICIAL SELECTION 629
ARTIFICIAL WETTING 824
ASA 744
ASCOPHYLLUM NODOSUM 486
ASCORBATE OXIDASE 1088
ASCORBIC ACID 806, 925
ASH CONTENT 496, 1044, 1048
ASIA 411
ASPEN FLAKEBOARD 1152
ASPERGILLUS 1157
ASPERGILLUS FLAVUS 1018
ASPERGILLUS NIGER 1010
ASSAY 659
ASSIMILATES 924
ASSOCIATION 583, 666
ASTERACEAE 708
ATMOSPHERIC CO2 916
ATPASE 743
AUSTRALIA 411
AUSTRIA 416
AUTOCLAVE TREATMENT 999
AUXIN 489
AUXIN REGULATED GENE 713
AVAILABILITY 789, 998, 1010
AVENA 573, 576, 870
AVENA BARBATA 807
AVENA FATUA 458, 949
AVENA FATUA L 953, 961
AVENA SATIVA 404, 414, 428, 541, 553, 736, 812, 967

AVENA SATIVA L 1084
AVENA SATIVA L., OAT 961
AVENA SATIVA L., OATS 942
AVERMECTINS 841
AWASSI EWES 985
AZADIRACHTA INDICA 891
AZOTOBACTER 1019
BAC LIBRARY 650
BACILLUS MEGATERIUM 816
BACILLUS MEGATERIUM VAR. PHOSPHATICUM 771
BACILLUS POLYMYXA 771
BACKCROSS 735
BACKCROSS QTL ANALYSIS 606
BACKCROSSING 655
BACTERIA 486, 815, 1041
BACTERIAL ARTIFICIAL CHROMOSOME 650
BACTERIAL COMMUNITIES 795
BAKERY INDUSTRY 464
BAKERY PRODUCTS 464, 1043, 1128
BAKING 1043, 1070, 1073, 1080, 1099, 1145
BAKING CHARACTERISTICS 428, 464, 469, 689, 751, 1035, 1036, 1045, 1073, 1080, 1108, 1128, 1141
BAKING WHEAT BREAD 1069
BALANCE 996, 1164
BAMMV GENETIC DIVERSITY 580
BAR 488
BARE PATCH 465
BARLEY (HORDEUM VULGARE) 749
BARLEY ANTHER CULTURE 825
BARLEY COLEOPTILE CELLS 694
BARLEY CULTIVARS 504
BARLEY GRAIN 1002
BARLEY GRAINS 611
BARLEY HORDEUM VULGARE 604
BARLEY MILDEW 878
BARLEY NONSTARCH POLYSACCHARIDES 1084, 1097
BARLEY POWDERY MILDEW 886
BARLEY ROOT 758
BARLEY ROOTS 820
BARLEY SEEDING RATE 458
BARLEY STARCHES 1133
BARLEY STRAW 989
BARLEY VARIETIES 695
BARLEY VARIETY 1005
BARLEY YELLOW DWARF 595
BARLEY YELLOW DWARF LUTEOVIRUS 867
BARLEY YELLOW DWARF VIRUS (BYDV PAV) 702
BARLEY YELLOW MOSAIC DISEASE 609
BARLEY YELLOW MOSAIC VIRUS 685
BARRIER PROPERTIES 756
BASIC PROTEIN 747
BAVARIA 521
BAYMV 580
BEEF CATTLE 995
BEER FOAM 1086
BEERS 1051
BEHAVIOR 1095, 1126
BELGIUM 472, 473, 474, 854, 862, 962
BENOMYL RESISTANCE 898
BERLIN 523
BETA 1076, 1141
BETA AMYLASE 635, 745
BETA GLOBIN GENE 679
BETA GLUCAN 1087
BETA GLUCANASE 999
BETA TUBULIN 857
BETA VULGARIS 512, 538, 541, 553, 970, 1016, 1018
BETULA 1014
BILE COMPOSITION 1105
BINDING APOPROTEINS 786
BIOACCUMULATION 937
BIOASSAY 942
BIOASSAYS 966
BIOAVAILABILITY 1106
BIOCATALYSTS 1162
BIOCHEMICAL CHANGES 977
BIOCHEMICAL MARKER 656
BIOCHEMISTRY 1162
BIODEGRADABILITY 1155
BIODIVERSITY 396, 597
BIOFUMIGATION 1033
BIOLISTIC TRANSFORMATION 802
BIOLISTICS 480
BIOLOGICAL ANALYSIS 571
BIOLOGICAL COMPETITION 562, 974
BIOLOGICAL CONTROL 876
BIOLOGICAL CONTROL ORGANISMS 876
BIOLOGICAL DEVELOPMENT 621
BIOLOGICAL DIFFERENCES 1035
BIOLOGICAL NITROGEN FIXATION 771
BIOLOGICAL PROPERTIES 831
BIOLOGY 691
BIOMASS 405, 441, 455, 503, 557, 560, 769, 774, 908, 1021
BIOMASS N 1027
BIOMETRY 454
BION (R) 893, 894
BIOPOLYMERS 410, 1059, 1061, 1160, 1161, 1163
BIOSYNTHESIS 758
BIOTYPES 500, 1130
BISCUITS 1052
BITE DIMENSIONS 1008
BITE RATE 1008
BLACK CHERNOZEM 455
BLACK RUST 666
BLIGHTS 870
BLOOD LIPIDS 1105
BLUEGRASS BILLBUG 836
BLUMERIA (ERYSIPHE) GRAMINIS 878
BLUMERIA GRAMINIS F. SP TRITICI 893, 894
BLUMERIA GRAMINIS F.SP HORDEI 848
BODY WEIGHT 985
BOMBARDMENT 740
BONDED AND UNBONDED WATER 1095
BONE MEAL 1091
BONE TURNOVER 1164
BONUSES 399
BORON 931
BORON DEFICIENCY 918
BOTRYTIS CINEREA 876
BOUND PHENOLIC ACIDS 1077
BRAN 983, 997, 1044, 1091, 1158
BRANCHING ENZYME I 1124
BRANCHING ENZYMES IIA 712
BRANDENBURG 405
BRASSICA KABER (DC.) L. C. WHEELER SINAR, WILD MUSTARD 942
BRASSICA NAPUS 475, 476, 543, 555, 591, 764, 774, 825, 1018, 1137
BRASSICA OLERACEA 970
BRAZIL 411
BREAD 1040, 1041, 1043, 1049, 1060, 1080, 1081, 1104, 1106, 1110, 1125
BREAD MAKING QUALITY 664, 747, 1092
BREAD QUALITY 1099
BREAD WHEAT 583, 615, 625
BREADBAKING 1070
BREADMAKING 710, 1040, 1060, 1069, 1072, 1110, 1145
BREADMAKING QUALITY 1062
BREAK CROPS 1033
BREEDING METHODS 428, 716
BREEDING PROGRAM 711
BREEDING TRIALS 683
BREWING 426, 428
BREWING INDUSTRY 603
BROILER 994
BROILER CHICKENS 1011
BROILERS 1010
BROMUS 957, 958
BROMUS STERILIS 953
BROWN RUSTS 666
BTH 893, 894
BUENOS AIRES 534
BUFFALO CALVES 990
BULBOSUM METHOD 609
BULK 979
BULK DENSITY 455, 517
BYDV PAV 658
BYMOVIRUS 880
C 13 NMR SPECTROSCOPY 1097
C BANDS 642
CADMIUM 919, 937, 982, 1165
CALCAREOUS SOILS 770, 778
CALCIUM 746, 747, 758, 821, 999, 1106, 1157, 1164
CALCIUM AVAILABILITY 1096
CALCIUM HYDROXIDE 1007
CALLUS 482, 483, 484, 485, 716
CALLUS INDUCTION 479, 489
CALMODULIN GENES 821
CALORIES 978
CALORIMETRY 1072
CAMPESTRIS PV MANIHOTIS 852
CANADA 411, 416, 864
CANADIAN WHEATS 1070
CANNABIS SATIVA 891
CANOLA 1037
CANOPIES 840
CAP 399
CAPILLARY MICROINJECTION 679
CARABIDS 537, 832
CARBOHYDRATE 1042
CARBOHYDRATE FERMENTATION 1042
CARBOHYDRATE METABOLISM 909, 929
CARBOHYDRATE STORAGE 924
CARBON 455, 512, 769, 1021
CARBON DIOXIDE 774, 793, 912, 916, 980, 981
CARBON DIOXIDE PRODUCTION 902
CARBON MINERALISATION 769
CARBOXYLASE 912
CARCASS 1002
CARCASS COMPOSITION 1158
CAROTENOIDS 710, 927
CASSIA FISTULA 891
CATALASE 759, 806, 877
CATALYTIC DOMAIN 626
CATCH CROPPING 521
CATECHOL 659
CATTLE 998, 1007, 1008
CATTLE SLURRY 509

CDNA 635, 713
CELL 813
CELL CULTURE 652
CELL DIFFERENTIATION 716
CELL MEMBRANE STABILITY 801
CELL MEMBRANES 1165
CELL VOLUME 708
CELL WALL POLYSACCHARIDES 1001
CELL WALLS 777
CELLS 480, 643, 644, 686, 713, 761, 900, 915, 923
CELLULASE PRODUCTION 1057
CELLULOSE 1149
CELLULOSES 1141
CEPHIDAE 838
CEREAL 1037, 1098
CEREAL APHIDS 833, 845
CEREAL CHROMOSOME 604
CEREAL CROPS 399, 404, 408, 423, 425, 427, 431, 433, 447, 475, 476, 493, 501, 502, 553, 559, 561, 573, 576, 587, 588, 736, 796, 812, 823, 834, 847, 870, 941, 946, 947, 948, 950, 956, 958, 963, 964, 965, 968, 1170, 1171
CEREAL FIBER 1105
CEREAL FLOURS 464, 710
CEREAL LEGUME INTERCROPPING 551
CEREAL PRODUCTS 1066, 1100
CEREAL PROTEIN 464, 596
CEREAL STARCHES 1126, 1133, 1136
CEREALS 404, 420, 436, 464, 524, 565, 590, 770, 869, 894, 909, 942, 1043, 1044, 1048, 1063, 1067, 1096, 1137
CHAETOMIUM 876, 899
CHARACTERISATION 1088
CHARACTERIZATION SYSTEM 772, 933
CHARACTERS 629, 680
CHELATOR 789
CHEMICAL COMPOSITION 464, 496, 586, 741, 751, 796, 992, 1090, 1113, 1128, 1173
CHEMICAL CONTROL 834, 847, 867, 871, 893, 967
CHEMICAL FALLOW 445
CHEMICAL MEDIATED INDUCED RESISTANCE 852
CHEMICAL REACTIONS 1060
CHEMICOPHYSICAL PROPERTIES 962, 1046, 1061, 1132, 1135, 1161
CHEMISTRY 1063, 1137, 1162
CHENOPODIACEAE 928
CHENOPODIUM 972
CHERNOZEMS 1020
CHERRY OAT APHID 833
CHICKENS 994, 999, 1010
CHILLING TEMPERATURE 638
CHILLING TOLERANCE 759
CHINA 411, 762, 983
CHINESE 664
CHITINASE 764, 859
CHITOSAN 764
CHLAMYDOMONAS REINHARDTII 786
CHLORIDES 665
CHLORMEQUAT 524
CHLOROPHYLL 661
CHLOROPHYLL CONTENT 916
CHLOROPHYLL FLUORESCENCE 763, 840
CHLOROPHYLLS 430, 535, 742, 757, 791, 877, 885, 927, 936
CHLOROPLAST GENES 669
CHLOROPLASTS 788, 803
CHOICE OF SPECIES 667
CHOLESTEROL 1105, 1138
CHROMATIN STRUCTURE 604
CHROMOSOMAL CONTROL 1130
CHROMOSOMAL EFFECTS 738
CHROMOSOMAL LOCATION 594, 606, 639
CHROMOSOME 711, 738
CHROMOSOME 4 602
CHROMOSOME 5 598, 707
CHROMOSOME 5A 628, 638
CHROMOSOME 5H 628
CHROMOSOME ELIMINATION 641
CHROMOSOME IDENTIFICATION 612
CHROMOSOME NUMBER 643
CHROMOSOME PAIRING 651
CHROMOSOME SUBSTITUTION 627
CHROMOSOME TRANSLOCATION 723
CHROMOSOMES 629, 642, 672, 678, 690, 707, 724, 813
CICER ARIETINUM 555
CITRIC ACID 1010
CL CHANNELS 811
CLADOSPORIUM CLADOSPORIOIDES 1018
CLASSIFICATION 772, 839, 1108
CLAY SOILS 1016
CLEANING 1068
CLEANING EQUIPMENT 1068
CLIMATE 431, 736, 823, 870, 1102, 1166, 1167
CLIMATIC FACTORS 599, 871, 1102, 1107
CLONING 650
CMS LINES 616
CO2 EXCHANGE 782
COARSE GRAINS 1011
COCHLIOBOLUS HETEROSTROPHUS 879
COCHLIOBOLUS SATIVUS 926
COLD 671, 903
COLD ACCLIMATION 759, 763
COLD HARDENING 638
COLD STRESS 802
COLEOPTILES 752
COLI GLYCOGEN SYNTHASE 712
COLLOIDS 1046
COLON 1042
COLONIZATION 577
COLOR ANALYSIS 819
COLORIMETRIC PROCEDURE 1098
COLOUR 746, 1044, 1085, 1090, 1102
COMBINE HARVESTERS 466, 1012
COMBINING ABILITY 670, 725, 734
COMMINUTION 1048
COMMON BUCKWHEAT 721
COMMON WHEAT 583, 639, 642, 669, 690, 705, 712, 835, 1113
COMMON WHEATS 1129
COMPACTED SOIL 808
COMPACTION 421, 422
COMPARATIVE GENETICS 628
COMPARATIVE MAPPING 693
COMPETITION 458, 883, 942
COMPETITIVE 942
COMPETITIVE ABILITY 961
COMPLETE NUCLEOTIDE SEQUENCE 669
COMPLEXES 1098
COMPONENTS 524, 720, 735, 810, 926, 1001, 1126
COMPOSTING 1099
COMPOSTS 510
COMPOUND FEEDS 1153
CONCENTRATES 996, 1155
CONDITIONING RESISTANCE 598
CONDUCTING POLYMERS 839
CONSERVATION TILLAGE 563
CONSTRUCTION 634
CONSUMERS 1043
CONSUMPTION 406, 411, 502, 1043, 1080
CONTAMINATION 1063, 1065, 1066, 1067
CONTINUOUS CROPPING 1021
CONTINUOUS PROCESSES 1044
CONTROLLED BURNING 544
CONTROLLING FLOWERING TIME 602, 606, 622, 628
CONVENTIONAL TILLAGE 552
CONVERSION 814
CONVOLVULUS ARVENSIS 972
COOKING 1102
COPIA 626
COPPER 801
CORN 436, 961, 995, 1005, 1010, 1056
CORN ZEA MAYS 959
COST ANALYSIS 401
COST BENEFIT ANALYSIS 871
COSTS 403, 967
COUNTS 845
CPA 658
CRASSULACEAN ACID METABOLISM 925
CRESTED WHEATGRASS 453
CRITERION 1094
CROP BALANCE 551
CROP DOMESTICATION 597
CROP LOSSES 867, 929, 1067
CROP MANAGEMENT 405, 408, 425, 426, 496, 574, 575, 736, 867, 967
CROP RESIDUE 522
CROP RESIDUES 544, 548, 559, 1020
CROP RESPONSES 916
CROP ROTATION 436, 455
CROP SIMULATION MODEL 418
CROP WEED INTERFERENCE 959
CROP YIELD 404, 407, 408, 411, 416, 417, 428, 429, 431, 433, 447, 451, 461, 468, 476, 490, 495, 496, 501, 502, 510, 512, 516, 519, 526, 543, 544, 546, 553, 555, 559, 561, 562, 567, 569, 574, 575, 582, 586, 596, 599, 630, 631, 633, 637, 640, 657, 663, 681, 736, 757, 791, 796, 831, 854, 881, 908, 921, 943, 946, 950, 957, 959, 971, 1017, 1028, 1032, 1166, 1167, 1170, 1171
CROPPING SYSTEMS 405, 538, 942, 971, 1029, 1030, 1032
CROPS 773, 953, 970, 1018, 1166
CROSS LINKED PROTEIN 848
CROSS LINKING 1077
CROSSBREEDING 443, 590
CROSSES 711
CRUDE EXTRACT 719
CRUDE FIBRE 439, 1146
CRUDE LEAF EXTRACTS 891
CRUDE PROTEIN 439, 464, 553, 727, 1091, 1146
CRYSTALLINE 1126
CUCUMBER 777
CUCUMBER PLANTS 852
CUCURBITA 794
CULMORUM 581, 869
CULTIVAR 617, 1087
CULTIVAR DESCRIPTION 434, 435
CULTIVAR FRONTANA 887
CULTIVAR IDENTIFICATION 1117

CULTIVAR MIXTURES 868
CULTIVARS 525, 536, 580, 625, 664, 688, 726, 744, 773, 893, 894, 930, 1079, 1094, 1148
CULTIVATED BARLEY 606
CULTIVATION 401, 411, 472, 473, 474, 542, 552, 559, 585, 953, 1063, 1067, 1102
CULTURAL CONTROL 538, 838, 867, 943
CULTURAL METHODS 472, 473, 474, 830, 1140
CULTURE 800, 814
CULTURE MEDIA 471, 716
CULTURE SYSTEM 1042
CULTURED IMMATURE EMBRYOS 484, 488
CUTTING MANAGEMENT 513
CYANIDE PRODUCTION 799
CYCLES 1069
CYCLING 405, 503, 512
CYSTATHIONINE GAMMA SYNTHASE 781
CYTOKININS 894
CYTOPLAMIC MALE STERILITY 728
CYTOPLASM 675, 676
D GENOME 662
DACTYLIS GLOMERATA 1018
DAIRY COWS 1005, 1006, 1155
DAMAGE 836, 837, 838, 859, 903
DASYPYRUM VILLOSUM 682
DATA COLLECTION 842, 843
DATABASES 405
DATE OF APPLICATION 514
DAUCUS CAROTA 713
DAYLIGHT 762
DEBRANCHING ENZYME 649
DECISION AID 959
DECISION MAKING 420, 871
DECLINE 953
DECOMPOSITION 769
DECONTAMINATION 1070
DEFENCE GENES 886
DEFENCE MECHANISMS 752, 859, 901
DEFENSE RESPONSE 694
DEFENSE RESPONSES 852
DEFICIENCY 770
DEFICITS 424
DEGRADATION 649, 960, 1151
DEHYDROASCORBIC ACID 1088
DEHYDROGENASE COMPLEX 749
DELETERIOUS RHIZOBACTERIA 799
DELETION LINES 693
DELIGNIFICATION 1147
DELTA C 13 602, 691
DELTA N 15 691
DEMAND 407, 415
DENITRIFICATION 421, 422
DENMARK 853
DENSITY 845, 1015
DENSITY EFFECTS 868
DENSITY LIPOPROTEIN CHOLESTEROL 1105
DEOXYNIVALENOL 735, 863, 869
DEPENDENT PROTEIN KINASE 747
DEPENDENT REGULATION 811
DEPOSITION 848, 900, 930
DEPTH 445, 552, 827, 1015
DERIVATIVES 612
DESERT SOILS 741
DESICCATION TOLERANCE 765, 1111
DESIGN 850, 1057
DESIGNATION 895
DETERIORATION 979
DETOXIFICATION 925
DEVELOPING GRAIN 1088
DEVELOPING RICE ENDOSPERM 1124
DEVELOPMENTAL RHEOLOGY 1095
DEVELOPMENTAL STAGES 599, 854, 881
DEW 871
DIACETYL TARTARIC ESTERS OF MONOGLYCERIDES 1125
DIAGNOSIS 436
DIALLEL CROSSING 578, 633, 657, 706
DICLOFOP 966
DICOTYLEDONS 941, 948, 968
DIET 982, 1158
DIETARY FIBER 1042, 1105, 1148, 1164
DIETARY FIBRES 1076, 1141
DIETETIC FOODS 1144
DIETS 998, 1000, 1002, 1009, 1096
DIFFERENT STRATEGIES 758
DIFFERENT TEXTURE 509
DIFFERENTIAL SCANNING CALORIMETRY 1072
DIFFERENTIAL TOLERANCE 904
DIFFERENTIATION 580
DIFFUSION 756
DIGESTA 998
DIGESTIBILITY 984, 987, 991, 992, 993, 996, 1000, 1004, 1007, 1039, 1154, 1155, 1157
DIGESTIBLE ENERGY 1148
DIGESTION 1001, 1003, 1006, 1009, 1076
DIGESTIVE SYSTEM 997, 1011
DIGITAL IMAGE ANALYSIS 819
DIMENSIONAL STABILITY 1152
DIMENSIONS 1047
DIRECT SEEDING 961
DIRECT SOWING 478
DISCRIMINATION 612, 819
DISEASE 452, 850, 868, 883, 1164
DISEASE CONTROL 472, 473, 474, 689, 847, 868, 886, 897, 1067
DISEASE RESISTANCE 428, 443, 454, 610, 673, 685, 689, 699, 704, 731, 732, 849, 855, 865, 866, 867, 874, 876, 877, 884, 886, 892, 896
DISEASE RESISTANCE LOCUS 650
DISEASE SURVEYS 897
DISEASES 432, 861
DISPERSAL 861, 878
DISSOCIATION DS 705
DISTILLERS BY PRODUCTS 995, 998
DISTORTED SEGREGATION 483
DISTRIBUTION 845
DIURAPHIS NOXIA 836
DIURAPHIS NOXIA HOMOPTERA 836
DIURNAL 925
DIURNAL VARIATION 779
DIVERGENT SELECTION 718
DIVERSE WHEAT POPULATIONS 868
DIVERSITY 396, 589, 593, 597, 622, 695, 795
DNA 588, 590, 591, 603, 608, 620, 641, 650, 678, 679, 690, 705, 857, 905, 929, 1060, 1100
DNA DELIVERY 686
DNA FINGERPRINTING 571
DNA MARKERS 483
DNA METHYLATION 641
DNA MICROSATELLITES 1117
DNA POLYMERASE 626
DORMANCY 1037
DOSE RESPONSE RELATIONSHIP 924
DOUBLE STRAND BREAKS 604
DOUBLED HAPLOID 481, 609
DOUBLED HAPLOID PRODUCTION 802
DOUBLED HAPLOIDS 711
DOUGH 1094, 1112, 1125, 1127, 1145
DOUGH COMPOSITION 1069
DOUGH FREEZING 1069
DOUGH FUNCTIONALITY 1083
DOUGH MIXING 1095
DOUGH PROPERTIES 1129
DOUGH RHEOLOGICAL CHARACTERISTICS 1125
DOUGH RHEOLOGY 1099
DOUGHS 1059, 1071
DRIS 436
DROUGHT 563, 631, 691, 908, 921, 932
DROUGHT RESISTANCE 648, 701, 767, 934
DROUGHT STRESS 667, 800, 822, 936
DRUG PLANTS 1144
DRY MATTER 912, 1087
DRY MATTER ACCUMULATION 909
DRY MATTER CONTENT 501, 516, 553, 646, 742, 927, 951, 1166
DRY SEED TREATMENT 450
DRY TEMPERATE 525
DRYING 976
DRYLAND CROPPING SYSTEMS 550
DRYLAND WHEAT 463
DS EXCISION 705
DUPLICATIONS 700
DURABLE RESISTANCE 583
DURATION 424, 442
DURUM WHEAT 660, 1092, 1117, 1118, 1130
DWARFS 646, 714, 734
DYES 1102
DYNAMICS 953
EAR 773
EAR EMERGENCE TIME 629
EAR PRIMORDIA DEVELOPMENT 625
EARLINESS PER SE GENE 628
EARLY MATURING 609
EARLY WEANED PIGS 1001
EARS 834, 909
EASTERN AUSTRALIA 1033
ECHINOCHLOA CRUS GALLI 959
ECOGEOGRAPHICAL DIFFERENTIATION 625
ECOLOGICAL AGRICULTURE 460
ECOLOGICAL AND CONVENTIONAL BARLEY FIELD 832
ECOLOGY 405, 420, 457, 464, 503, 521, 1021
ECONOMIC ANALYSIS 398, 405, 834
ECONOMIC COMPETITION 415
ECONOMIC THRESHOLD 959
ECONOMIC THRESHOLDS 458
ECONOMICS 459
ECONOMICS OF PROPERTY RIGHTS 396
ECOSYSTEMS 1003
EDDY COVARIANCE 793
EDIBLE FILMS 410, 1163
EDIBLE FUNGI 471
EFFICIENCY 491, 502, 683, 735, 847, 876, 881, 941, 946, 947, 948, 954, 956, 957, 958, 962, 963, 965, 968, 1009
EFFLUX 739
EGG CELL 679
EGG CELL SOLATION 721
EGYPT 398, 406, 667, 920, 1019
EIMERIA MAXIMA 1011
EIMERIA TENELLA 1011
ELASTICITY 1055
ELECTROMAGNETIC FIELD 482
ELECTRON MICROSCOPY 900

ELECTRON TRANSPORT 749, 763
ELECTRONIC NOSE 839
ELECTRONICS 1044
ELECTROPHORESIS 664, 729, 745, 748, 922, 1074, 1128
ELECTROPORATION 654
ELEMENT ACTIVATOR AC 705
ELICITOR MEDIATED RESISTANCE 852
ELICITORS 886
ELIMINATION 641
ELONGATION 440
ELYMUS REPENS 965
ELYTRIGIA CAESPITOSA 595
ELYTRIGIA ELONGATA 656
EMBRYO 440, 803
EMBRYO CULTURE 485, 645
EMBRYO DORMANCY 611
EMBRYO SAC 721
EMBRYOGENESIS 713, 825
EMBRYONIC DEVELOPMENT 485
EMBRYOS 488, 620, 686, 814, 825
EMERGENCE 458, 632, 827, 953, 959
EMILIA ROMAGNA 1090, 1169
EMISSION 421
EMISSIONS 911
EMMER TRITICUM DICOCCOIDES 594
EMMER WHEAT 807
EMULSIFIERS 409, 1049, 1069, 1083
END USE QUALITY 627
ENDOGENOUS N FLOW 1009
ENDOSPERM 588, 649, 745, 814, 1115
ENDOSPERM CHARACTER 1126
ENDOSPERM DAMAGE 824
ENERGETICS 467
ENERGY 993, 994, 995
ENERGY BALANCE 1007
ENERGY CONSUMPTION 545
ENERGY METABOLISM 986
ENERGY SAVING 1038
ENERGY SOURCE 1003
ENERGY VALUE 1004
ENGLAND 898
ENRICHMENT 912
ENTEROBACTER 1066
ENTEROCOCCUS 1066
ENTIRE MALE LAMBS 1002
ENVIRONMENT 489, 930, 1087
ENVIRONMENT INTERACTION 1116
ENVIRONMENTAL CONTROL 622
ENVIRONMENTAL FACTORS 431, 433, 496, 544, 574, 823, 1140
ENVIRONMENTAL IMPACT 516
ENVIRONMENTAL NITRATE 761
ENVIRONMENTAL TEMPERATURE 518, 519, 806
ENVIRONMENTS 453, 593, 1043
ENZYMATIC DEPHOSPHORYLATION 1010
ENZYMATIC HYDROLYSIS 1013, 1014
ENZYME 1001
ENZYME ACTIVITIES 924
ENZYME INHIBITION 1118
ENZYME PREPARATIONS 1004
ENZYME SUPPLEMENTATION 994, 1009
ENZYMES 603, 984, 1001, 1013, 1052, 1072, 1110, 1158
ENZYMIC ACTIVITY 430, 505, 528, 535, 603, 728, 741, 742, 746, 760, 764, 806, 877, 939, 997, 1162
EPIDEMICS 850, 868, 883
EPIDEMIOLOGY 849, 861, 867
EPIDERMIS 631, 752
EQUIPMENT 1044, 1048, 1052, 1137, 1155
EQUIPMENT CHARACTERISTICS 943
EQUIPMENT PERFORMANCE 943
ERIOPHYIDAE 835
EROSION 563, 597
ERYSIPHE GRAMINIS 597, 598, 752, 847, 857, 862, 886, 888, 889, 890, 893, 896
ERYSIPHE GRAMINIS F.SP HORDEI 848
ERYSIPHE GRAMINIS HORDEI 848
ESCHERICHIA COLI 650, 712, 820, 1086
ESTONIA 417, 542, 677, 687, 751, 986
ETEPHON 524
ETHANOL 995, 998, 1014
ETHANOLIC FERMENTATION 1159
ETHEPHON 524
ETHIOPIA 437
ETHYLENE 605, 780
ETIOPLASTS 749
EUROPE 411, 512, 823
EUROPEAN UNION 407, 414, 415, 416
EUROPEAN UNION COUNTRIES 397
EVALUATION 398, 405, 420, 457, 464, 503, 521, 1021, 1044, 1080, 1172
EVAPOTRANSPIRATION 536, 1017
EVOLUTION 641, 669, 708, 878, 883, 902
EVOLUTIONARY DIVERGENCE 669
EXOTHERMIC PROCESS 1095
EXPANDER TREATMENT 1006
EXPANSION 808
EXPERIENCE 1008
EXPERIMENTAL DESIGNS 683
EXPERIMENTATION 420, 457, 521, 534, 630, 927, 1021, 1024, 1048, 1080
EXPORTS 397, 407, 415
EXPOSURE 909
EXPRESSION 620, 635, 705, 749, 800, 821, 888, 893, 1086
EXTENSION ACTIVITIES 567
EXTENSION TESTING 1095
EXTRACT 1087
EXTRACT VISCOSITY 994
EXTRACTION 1149
EXTRACTION METHOD 509
EXTRACTS 681, 1076
EXTRUSION 984, 1001, 1052
EXTRUSION COOKING 984
EYESPOT 898
F SP HORDEI 597, 598, 694, 718, 848, 857, 886
F SP TRITICI 878, 893
F1 HYBRIDS 462, 643, 644, 717, 734
F1HYBRIDS 724
F2 HYBRIDS 462, 655, 724
FACTOR I 995
FAGOPYRUM ESCULENTUM MOENCH. 721
FALLOW 563
FARM INCOME 408
FARMER PARTICIPATION 593
FARMING SYSTEMS 399
FARMS 420, 431
FARMYARD MANURE 451, 472, 473, 474, 516, 1029, 1031
FAT TYPE 994
FATS 982
FATTENING 986, 1153
FATTY ACIDS 1120
FAVA BEAN 437
FECAL BACTERIA 1042
FECAL DIGESTIBILITIES 1001
FED INFANTS 1042
FEDERAL REPUBLIC OF GERMANY 416, 1080, 1102, 1108
FEED ADDITIVES 1004, 1157, 1158
FEED CEREALS 1153, 1155
FEED CONSTITUENTS 1006
FEED CONSUMPTION 1039
FEED CONVERSION EFFICIENCY 1039
FEED EFFICIENCY RATIO 978
FEED INTAKE 985
FEED PROCESSING 989, 1146, 1155
FEEDING 983
FEEDING BEHAVIOR 1008
FEEDING DAMAGE 840
FEEDING SITE 833
FEEDS 407, 586, 980, 981, 989, 991, 1004, 1154, 1173
FEEDSTUFFS 1006
FERMENTATION 989, 1005, 1042, 1054, 1106, 1159
FERREDOXIN NADP REDUCTASE 749
FERTILE CRESCENT 597
FERTILE TRANSGENIC BARLEY 620
FERTILE TRANSGENIC WHEAT 480, 686, 1124
FERTILISATION 911
FERTILISER 514
FERTILITY 724, 728
FERTILIZATION 421, 455, 515, 813, 951
FERTILIZATION FREQUENCY 711
FERTILIZER 418, 467
FERTILIZER APPLICATION 457, 472, 473, 474, 493, 496, 501, 502, 503, 521, 523, 531, 532, 534, 544, 757, 834, 908, 1017, 1021, 1026, 1030, 1031, 1032
FERTILIZER COMBINATIONS 831, 834
FERTILIZER LEVELS AND SOURCES 492
FERTILIZER TECHNOLOGY 521
FERTILIZERS 531, 797, 1028
FERULIC ACID 1037, 1077
FESTUCA PRATENSIS 912
FIBER 1000, 1003, 1152
FIBRES 1151
FIELD 691, 850, 911, 912
FIELD CAPACITY 490
FIELD CONDITIONS 769
FIELD EXPERIMENTATION 429, 431, 447, 451, 475, 476, 496, 501, 541, 542, 543, 546, 547, 548, 549, 559, 561, 567, 757, 834, 854, 862, 876, 943, 950, 956, 957, 958, 962, 965, 968, 971, 1085, 1168
FIELD GROWN WHEAT 453
FIELD SIZE 1168
FIELD SOWN 912
FIELD TRIALS 683
FIELDS 431
FILMS 1160
FINENESS 1000
FINLAND 568
FIR DRYING 1038
FIREFLY LUCIFERASE 480
FIRMNESS 1047, 1052
FISH 572
FISH MEAL 1091, 1153
FLAX RUST RESISTANCE 718
FLORET STERILITY 801
FLOUR 1070, 1083, 1099, 1115
FLOUR EXTRACTION 1093
FLOUR PENTOSANS 1127
FLOUR QUALITY 664
FLOUR SWELLING VOLUME 1124

FLOURS 532, 751, 1037, 1043, 1044, 1048, 1098
FLOW CYTOMETRY 708
FLOWERING 484, 528, 653, 870
FLOWERING TIME 693
FLUORESCENT PSEUDOMONADS 452, 799
FLURIDONE 611
FLUX 925
FOLIAR APPLICATION 494, 499, 831, 834
FOOD 839
FOOD ADDITIVES 1052, 1060, 1144
FOOD HYGIENE 1052
FOOD INDUSTRY 1160
FOOD PRODUCTION 411
FOOD TECHNOLOGY 603, 1039, 1144
FOOD WEBS 1033
FOODS 1063, 1077, 1138, 1163, 1173
FOOT ROT 851, 898
FORAGE 996
FORAGE QUALITY 441
FORAGING BEHAVIOR 1008
FORAGING BEHAVIOUR 1008
FORECASTING 834
FOREIGN GENE 740
FORMER YUGOSLAV REPUBLIC MACEDONIA 624
FORMS 769
FORMULATION 1083
FORMULATIONS 941, 947, 948, 956, 963
FOULING 1066
FOURIER DESCRIPTORS 819
FRACTIONATION 464, 691, 1062, 1128, 1147
FRACTIONS 1062
FRAGARIA VESCA 568
FRAGMENT LENGTH POLYMORPHISMS 615
FRAGMENTATION 605
FRAGMENTS 1129
FRANCE 397, 416, 426, 493, 573, 576, 847, 1040, 1047, 1051
FREEZE THAW STABILITY 1056
FREEZING 759
FREEZING RESISTANCE 782
FREEZING TOLERANCE 782
FRENCH BREAD BAKING 1116
FREQUENCY EFFECTS 868
FREQUENCY PLANT REGENERATION 479
FRIABILIN 707
FROST DAMAGE 903
FROST RESISTANCE 638
FROST TOLERANCE 638
FUEL ALCOHOL PRODUCTION 1159
FUELS 545
FUMARIA 972
FUNCTIONAL PROPERTIES 1127
FUNGAL DISEASES 443, 610, 689, 847, 849, 853, 870, 879
FUNGAL TRANSFORMATION 577
FUNGI 691, 859, 876, 900, 979, 983, 1013, 1074
FUNGI TAPESIA YALLUNDAE 898
FUNGICIDES 472, 473, 474, 834, 847, 850, 853, 854, 870, 871, 876, 881
FUNGITCIDES 470
FUNGUS 857
FUR BEARING ANIMALS 980, 981
FURFURAL 1014
FUSARIUM 849, 851, 870, 874, 892, 898, 899, 1067, 1068
FUSARIUM AVENACEUM 869
FUSARIUM EAR BLIGHT 898
FUSARIUM GRAMINEARUM 863
FUSARIUM HEAD BLIGHT 581
FUSARIUM HEAD BLIGHT (FHB) 735
FUSARIUM OXYSPORUM 901
GA 430, 714
GA(3) 440
GAEUMANNOMYCES 899
GAEUMANNOMYCES GRAMINIS 851
GAEUMANNOMYCES GRAMINIS VAR. TRITICI 850, 851
GALIUM APARINE 954, 962, 971
GALLSTONE FORMATION 1105
GAMMA GLIADINS 1119
GAMMA RADIATION 632
GAS CHROMATOGRAPHY 863
GAS EXCHANGE 453, 912, 916, 925
GAS SENSORS 839
GASES 1163
GASTROINTESTINAL MOTILITY 1155
GASTROINTESTINAL TRACT 1009
GATING MODES 811
GEESE 1154
GEL ELECTROPHORESIS 718
GELATINIZATION 1056, 1072, 1081, 1083, 1099, 1133, 1136
GELATION 1081
GELS 1081
GENE 480, 634, 650, 678, 686, 705, 857
GENE EFFECTS 680
GENE EXPRESSION 440, 740, 820, 852, 910
GENE INTERACTION 578, 657, 889
GENE INTROGRESSION 678
GENE LOCATION 627, 656
GENE LR34 583, 666
GENE MAPPING 623
GENE RICH REGIONS 642
GENE TAGGING 615
GENE TRANSFER 654
GENES 489, 590, 598, 608, 618, 625, 646, 654, 674, 677, 699, 703, 704, 714, 730, 734, 795, 803, 866, 1074, 1101
GENETIC ANALYSIS 483, 629, 810
GENETIC CONTROL 656, 697
GENETIC DISTANCE 601
GENETIC DIVERSITY 602, 807
GENETIC ENGINEERING 567, 590, 603, 730, 929, 1061
GENETIC INHERITANCE 624, 651, 696, 703, 714, 725
GENETIC LINKAGE MAP 615
GENETIC MAPPING 594
GENETIC MAPS 603, 729, 929
GENETIC MARKERS 603, 606, 929
GENETIC PARAMETERS 582, 601, 681, 699, 729
GENETIC RELATIONSHIPS 695
GENETIC RESISTANCE 855, 889, 890, 896
GENETIC RESOURCES 587
GENETIC STABILITY 636
GENETIC TRANSFORMATION 654, 733
GENETIC VARIABILITY 695
GENETIC VARIATION 504, 570, 571, 582, 584, 636, 652, 684, 1060
GENETICS 588, 602, 621, 654
GENOME 618, 641, 669, 735, 803, 1101
GENOME MAPPING 615
GENOME SIZE 708
GENOMES 656, 693, 729
GENOMIC COMPOSITION 595GENOTYPE 1003, 1116
GENOTYPE 1003, 1116
GENOTYPE BY ENVIRONMENT INTERACTION 593
GENOTYPE ENVIRONMENT INTERACTION 663
GENOTYPE X ENVIRONMENT INTERACTION 617
GENOTYPES 449, 479, 498, 504, 580, 584, 599, 603, 610, 631, 657, 667, 695, 701, 770, 866, 929, 931, 938, 964, 1126, 1173
GENOTYPIC DIFFERENCE 931
GENOTYPIC DIFFERENCES 789
GEOGRAPHICAL VARIATION 635
GERMANY 420, 457, 464, 503, 876, 924, 951, 971, 1065
GERMINABILITY 586, 762, 812, 929
GERMINABITITY 450
GERMINATED BARLEY 745, 1086
GERMINATING MAIZE SEEDS 887
GERMINATION 440, 490, 506, 542, 611, 619, 809, 812, 826, 928, 939, 940, 1037, 1086, 1169, 1172
GERMPLASM 597, 607, 835
GERMPLASM COLLECTIONS 602
GIBBERELLA 732, 897
GIBBERELLA ZEAE 863, 1018
GIBBERELLIC ACID 605
GISH 595
GLIADIN LOCI 1129
GLIADINS 1104
GLOBAL INVENTORY 911
GLOMUS MOSSEAE 888
GLU 1 1129
GLUCANS 1004, 1076, 1141, 1173
GLUTAMATE AMMONIA LIGASE 746
GLUTATHIONE 638
GLUTATHIONE DEHYDROGENASE 1088
GLUTEN 409, 410, 496, 1049, 1053, 1055, 1059, 1062, 1078, 1092, 1127, 1128, 1161, 1162, 1163
GLUTEN DENATURATION 1122
GLUTEN INDEX 1083
GLUTEN PROTEIN FRACTIONS 1119
GLUTENIN SUBUNIT ALLELES 1116
GLUTENIN SUBUNIT COMPOSITION 664, 1092
GLUTENIN SUBUNITS 807, 1129, 1130
GLUTENINS 596, 1059, 1061, 1073
GLUTENS 1095
GLYCEROL 781
GLYCEROL MONOSTEARATE 1125
GLYCINE MAX 970, 1029, 1031
GLYCINEBETAINE 930
GLYCINEBETAINE ACCUMULATION 930
GLYCOSIDASES 997, 1004
GOLD CYTOCHEMISTRY 852
GOLDEN PROMISE 606
GOSSYPIUM 478, 554, 558, 564, 566, 841, 846
GRADIENT GEL ELECTROPHORESIS 795
GRADING 412
GRAIN 424, 428, 429, 438, 496, 500, 501, 536, 544, 562, 574, 575, 586, 588, 624, 637, 681, 736, 760, 800, 814, 819, 831, 834, 870, 919, 976, 1036, 1047, 1077, 1085, 1090, 1115, 1137, 1144, 1167, 1170, 1171, 1172, 1173
GRAIN CROPS 757, 791

GRAIN DEVELOPMENT 909
GRAIN DORMANCY 611
GRAIN FILLING PERIOD 680
GRAIN GROWTH 418, 442
GRAIN HARDNESS 707, 726
GRAIN LEGUMES 521
GRAIN PROTEIN 418, 1087
GRAIN PROTEIN COMPOSITION 1116, 1134
GRAIN QUALITY 436, 524
GRAIN SIZE 1087
GRAIN SOFTNESS PROTEIN 1124
GRAIN SORGHUM 550
GRAIN YIELD 432, 445, 524, 525, 617, 688, 773, 778, 801, 893, 894
GRAINS 1037, 1148
GRAMINE 844
GRAMINEAE 941, 968, 1016
GRAMINEARUM 863, 869
GRAMINIS VAR TRITICI 850, 851
GRASS SILAGE 996
GRASSES 628, 836
GRASSLAND SOILS 455
GRAZING SHEEP 1008
GREAT PLAINS 550
GREECE 416
GREEN FLUORESCENT PROTEIN 820
GREEN FLUORESCENT PROTEIN IMAGING 679
GREEN MALT ENDOPROTEINASES 1086
GREEN MANURES 505, 1016
GREEN PLANT REGENERATION 481
GREEN PLANTS 802
GREENBUG HOMOPTERA 840
GREENHOUSES 866, 927
GROSS MARGINS 405, 408
GROSS RETURN 403
GROUNDWATER RECHARGE 539
GROUP 2 627
GROUP 3 CHROMOSOMES 697
GROUP 4 682
GROUP 5 672
GROUP 7 CHROMOSOMES 634
GROWING MEDIA 448
GROWING PIGS 1000, 1001
GROWING SEASON 524
GROWTH 422, 424, 467, 499, 504, 510, 526, 560, 564, 617, 632, 646, 657, 688, 773, 785, 798, 805, 815, 816, 823, 829, 894, 902, 912, 915, 917, 920, 924, 927, 928, 961, 995, 1002, 1019, 1024, 1027, 1041, 1057, 1087, 1165, 1166, 1167
GROWTH HABIT 625
GROWTH INHIBITORS 965
GROWTH PERIOD 646, 653
GROWTH PROMOTION 799
GROWTH RATE 514
GROWTH STAGES 536, 768
GROWTH TEMPERATURE 763
GSH 744
GSP 1 707
GUARD CELLS 811
GUS EXPRESSION 577, 686
GUS GENE 577
GUT MORPHOLOGY 999
GUT VISCOSITY 999
H BULBOSUM 641
HALOPHYTES 662
HAPLOID FORMATION 641
HAPLOIDY 487
HARD WHEAT 416, 429, 544, 610, 849, 1044, 1066, 1078, 1085, 1090, 1102
HARDNESS 1093, 1116
HARROWS 943
HARSH MEDITERRANEAN ENVIRONMENTS 602
HARVEST INDEX 495, 582, 636, 725, 804
HARVESTING 561
HARVESTING DATE 599, 870
HARVESTING LOSSES 466
HEAD BLIGHT 581, 887
HEADING 653, 703, 775, 1167, 1169
HEADING DATE 629
HEALTH 1043, 1076
HEALTH FOODS 464, 1144
HEALTH PROTECTION 1141
HEAT 661
HEAT STRESS 661, 749, 1087
HEAT TOLERANCE 923
HEAT TREATMENT 1052
HECTOLITER WEIGHT 1093
HEDTA 789
HEIGHT 574, 575, 582, 633, 646, 652, 663, 673, 674, 737, 921
HELIANTHUS ANNUUS 970
HEMICELLULOSE 1013, 1014
HEMICELLULOSE B ACETATE 1149
HENAN 828
HERBAGE INTAKE 1008
HERBICIDE 832, 953
HERBICIDE CHLORSULFURON 770
HERBICIDE ISOPROTURON 960
HERBICIDE RESISTANCE 458
HERBICIDE SAFENERS 963
HERBICIDES 549, 834, 927, 941, 946, 947, 948, 949, 950, 954, 956, 957, 958, 962, 963, 964, 965, 966, 967, 968, 970
HERBITCIDES 470
HERITABILITIES 824
HERITABILITY 453, 629, 680
HETEROSIS 616, 624, 633, 670, 717, 734
HEXAPLOID BREAD WHEAT 1101
HEXAPLOID WHEAT 612, 656, 707
HEXAPLOID WHEATS 594, 726
HEXAPLOIDY 663, 684
HIGH FIBER 1164
HIGH LIGHT 661
HIGH M R 1101
HIGH MOLECULAR WEIGHT GLUTENINS 747
HIGH TEMPERATURE 442, 661
HIGH TEMPERATURE STRESS 923
HIGH YIELDING VARIETIES 640, 673
HIGHER PLANT CHLOROPLASTS 749
HIGHER PLANTS 758
HIGHLANDS 586
HIGHLY NOMADIC SPECIES 878
HISTOCYTOLOGICAL ANALYSIS 692
HISTOPATHOLOGY 1064
HISTORY 855
HMW GLUTENIN SUBUNITS 1101
HOMOEOLOGOUS CHROMOSOMES 634
HOMOEOLOGOUS GROUP 3 642, 707
HOMOEOLOGOUS PAIRING 738
HOMOEOLOGOUS QTL 628
HOMOGENEOUS SYSTEM 1149
HOMOLOGOUS RECOMBINATION 604
HOMOPTERA 579, 608, 845
HOMOSERINE 781
HOPS 603
HORDEIN 745
HORDEIVIRUS 867
HORDEUM 461, 823, 870, 879, 901, 954, 963, 1107
HORDEUM BULBOSUM 678
HORDEUM BULBOSUM L 711
HORDEUM CHILENSE 612
HORDEUM SPONTANEUM 606, 691, 708
HORDEUM SPONTANEUM POPULATIONS 606
HORDEUM VULGARE (BARLEY) 808
HORDEUM VULGARE ENDOSPERM 1084
HORDEUM VULGARE L 479, 580, 602, 622, 626, 744, 758, 789, 802, 810, 815, 1136
HORDEUM VULGARE L. 580, 932, 1087
HORDEUM VULGARE L., BARLEY 961
HORDEUM VULGARE SSP VULGARE 695
HOSTS 843
HOUR 1088
HOUSHUN 609
HUBEI 532
HULL LESS 979
HULL LESS BARLEY 1136
HULLED 979
HUMAN LARGE INTESTINE 1042
HUMANS 1105
HUMIDITY 1044, 1052, 1137
HUMUS 512, 538
HYBRID BARLEY 616
HYBRID POPLAR 925
HYBRID WHEAT 670
HYBRIDIZATION 572, 585, 647, 655, 660, 677, 678, 692, 711
HYBRIDS 424, 484, 493, 572, 595, 612, 624, 687, 690, 725
HYDRATION 450, 1053, 1095
HYDRAULIC CONDUCTIVITY 517
HYDRIC BALANCE 432
HYDROCOLLOIDS 1083
HYDROGEN PEROXIDE 638, 743, 901, 1077
HYDROLASES 1060
HYDROLYSATE PREPARATION 1006
HYDROLYSIS 506
HYDROPHILIC EDIBLE FILMS 756
HYDROPHOBICITY 1162
HYDROPONICS 569
HYDROXAMIC ACID GLUCOSIDE 817
HYDROXAMIC ACIDS 668
HYGIENE 1066
HYGROSCOPICITY 1172
IAA 430, 440
IBA 440
IDENTIFICATION 452, 580, 590, 591, 594, 595, 605, 608, 648, 650, 658, 672, 690, 695, 731, 747, 843, 1128
ILEAL 1001
IMAGE ANALYSIS 820
IMBIBITION 827
IMMATURE INFLORESCENCE 484
IMMOBILISATION 679
IMMOBILIZATION 509
IMMUNOASSAY 1129
IMMUNOBLOTTING 1130
IMMUNOLOGY 1063
IMPORTS 397, 407, 415, 416, 1103
IMPROVED PLANT REGENERATION 802
IMPROVEMENT 688, 770
IN ORGANELLO LABELLING 803
IN SITU 597
IN SITU HYBRIDIZATION 612, 642, 678, 718
IN SITU INCUBATION 1027

IN VITRO 679, 813, 1010, 1042
IN VITRO CULTURE 899
IN VITRO DIGESTIBILITY 992
IN VITRO EXPERIMENTATION 567
IN VITRO FERTILIZATION 721, 813
IN VITRO PHOSPHORYLATION 747
IN VITRO REGENERATION 485, 487
IN VITRO SELECTION 719
IN VIVO 763, 858
IN VIVO EXPERIMENTATION 1155
INCOMPLETE BLOCK 683
INCORPORATION 544
INCREASING APOPROTEIN STABILITY 786
INDIA 411
INDUCED RESISTANCE 868, 879, 883, 886, 887, 893, 894
INDUCED RESPONSES 833
INDUCTION 777
INFANT FOOD 1039
INFECTION 504, 867, 870, 888, 900
INFECTION FREQUENCY (IF) 848
INFECTIOUS INVITRO TRANSCRIPTS 858
INFESTATION 549, 553, 950, 978, 979, 1063, 1066, 1067, 1068
INFILTRATION 547
INFILTRATION RATE 517
INFLORESCENCE 484
INFLORESCENCES 592
INFLUX 739, 917
INFRARED SPECTROPHOTOMETRY 1044, 1090, 1137, 1173
INGREDIENTS 1153
INHERITANCE 578, 591, 608, 613, 657, 680, 720
INHIBITION 747, 764, 798
INHIBITORS 506, 1109
INOCULANTS 1156
INOCULATION 850, 879, 1029
INORGANIC FERTILIZERS 512
INPUTS 403
INSECT 979
INSECTICIDES 834
INSENSITIVITY 629, 810
INSERTION 858
INSITU HYBRIDIZATION 595, 612, 718, 820
INSULIN 1105
INTAKE RATE 1008
INTEGRATED CONTROL 957
INTEGRATED PLANT PRODUCTION 423, 971, 1021
INTERACTION 1116
INTERCROPPING 439, 475, 476, 543, 555, 556, 557, 558, 559, 562, 753, 783
INTERGENERIC HYBRIDIZATION 645
INTERNATIONAL TRADE 397, 414, 416
INTERSPECIFIC HYBRIDIZATION 596, 641, 643, 644, 723
INTESTINAL VISCOSITY 994
INTESTINE 1106
INTESTINES 997, 1155
INTRASPECIFIC VARIATION 708
INTRODUCED VARIETIES 454, 865, 874
INVESTMENT ANALYSIS 437
INVIGORATION 450
ION CHANNELS 811
ION EXCHANGE 665
ION SPECIATION 789
ION UPTAKE 798
IONS 569
IRON 770, 789
IRON ABSORPTION 1106
IRON AVAILABILITY 1096
IRON DEFICIENCY 758, 781
IRRADIATION 632, 647
IRRIGATED RICE 491
IRRIGATION 399, 463, 467, 536, 717, 741
IRRIGATION RATES 531
IRRIGATION SCHEMES 754
IRRIGATION WATER 1024
ISCHEMIC HEART DISEASE 1105
ISOENZYMES 1077
ISOFLAVONOID ACCUMULATION 888
ISOGENIC LINES 660, 688
ISOGENIC WHEAT LINES 886
ISOPROTURON 966
ISOTHIOCYANATES 1033
ISOXABEN 571, 621
ISOZYME 695
ISOZYMES 580, 777
ISRAEL 598, 602, 807
ITALY 407, 414, 415, 416, 429, 516, 567, 574, 575, 599, 610, 849, 1040, 1078, 1085
JAPANESE NOODLE QUALITIES 1126
JAPANESE NOODLES 726
JAPANESE VARIETY 664
JIANGSU 592, 727
JORDAN 593
K/NA DISCRIMINATION 770
KANAMYCIN 938
KARYOTYPE 607, 698
KARYOTYPES 723
KEEPING QUALITY 1063
KERNEL HARDNESS 1092
KERNEL IDENTIFICATION 819
KERNEL NUMBER 773
KERNEL SIGNATURE 819
KERNEL WEIGHT 680
KERNELS 869, 1071
KINETIN 894
KNOX WHEAT 893
L ASCORBATE 1118
L CROSS 622
L CULTIVARS 695
L CV IGRI 802
L EM THELL 615
L ENDOSPERM 1136
L. 697
LABELED N 15 UREA 514
LABORATORY ANIMALS 1039
LABORATORY EXPERIMENTATION 809, 812, 834, 906, 964, 965, 1172
LABORATORY EXPERIMENTS 1073
LACTATING COWS 996, 1003, 1005
LACTIC ACID BACTERIA 1054
LACTOBACILLI 1072, 1110
LACTOBACILLUS BUCHNERI 1156
LACTOBACILLUS PLANTARUM 1156
LACTUCA SATIVA 718
LAMBS 1008
LAMINARIA HYPERBOREA 486
LAND MANAGEMENT 405, 420, 457, 464, 503
LAND USE 431
LAND VARIETIES 592, 710, 727
LANDRACES 593, 597, 598, 625
LANGUEDOC ROUSSILLON 399
LARGE BOWEL 1164
LARGE CHAINS 747
LARGE DEFORMATIONS 1062, 1095
LASER RADIATION 804
LASER SCANNING MICROSCOPY 820
LATE VARIETY 442
LATIUM 496
LATVIA 417, 490, 542, 552, 561, 565, 585, 630, 677, 687, 751, 757, 791
LAYER 999
LAYER CHICKENS 1004
LAYING HENS 999
LEACHING 516, 521
LEAF 793
LEAF AREA 535, 631, 663, 737, 809, 834, 927
LEAF CONDUCTANCE 925
LEAF ELONGATION 808
LEAF EXPANSION 930
LEAF POSITION 894
LEAF RUST RESISTANCE 615, 666, 672, 678, 770
LEAF SENESCENCE 661
LEAVES 430, 699, 737, 743, 759, 765, 775, 785, 788, 792, 806, 844, 848, 884, 900, 912, 927, 935, 936, 1018
LEGISLATION 516
LEGUMINOSAE 475, 476
LEMNA 781
LENGTH 504, 805
LENGTH CDNA CLONE 858
LEPTOSPHAERIA NODORUM 879
LEYMUS 572
LIFE CYCLE 790, 951
LIGASES 748
LIGHT 556, 739, 746, 761, 776
LIGHT HARVESTING COMPLEX 786, 788
LIGNIN 886, 1149
LIGNINS 1014, 1141
LIME 520
LIMIT DEXTRINASE 1109
LINES 598, 608, 697, 735, 844
LINKAGE 618, 672
LINKAGE MAP 604, 642, 697
LIPID CONTENTS 1056
LIPID PEROXIDATION 450, 1165
LIPID TRANSFER PROTEIN 713, 1086
LIPIDS 782, 1120
LIPOXYGENASE 1118
LIQUID FERTILIZERS 507, 528, 780
LIQUID INTERFACES 1119
LIQUID MANURES 457, 516
LITHUANIA 552, 561, 565, 630, 1016
LITTER DECOMPOSITION 1033
LIVER 1064
LMW SUBUNITS 1130
LOAM SOILS 512
LOCALIZATION 800, 822, 888
LOCATION 697, 1117
LOCI 622, 693, 735
LOCUS 690, 726, 888
LODGING 574, 575
LODGING RESISTANCE 454
LOESS SOILS 512
LOLIUM MULTIFLORUM 516
LOLIUM PERENNE L 551
LOLIUM RIGIDUM 966
LOMBARDY 867, 1090
LONG TERM 479
LONG TERM EXPERIMENTS 527
LOPHOPYRUM ELONGATUM 656
LOW DEGREE OF DISUBSTITUTION 1115
LOW INPUT 1113
LOW INPUT BREEDING 613
LOW INPUTS 460
LOW M(R) SUBUNITS 1104

LOWER NORMANDY 408
LR34 666
LUCIFERASE 480
LUMBRICIDAE 515, 551
LUNGS 1064
LUPIN 993
LUPINS 778
LUTEOVIRUS 658
LV SEM XMA 758
LYASES 748
LYSINE 654, 1091, 1153
MACHINE VISION 819
MAGNESIUM 1106
MAGNETIC FIELD 742, 812
MAGNETIC RESONANCE SPECTROSCOPY 1133
MAIZE 483, 669, 679, 740, 761, 808, 917, 930, 984, 1003, 1005, 1067, 1091
MAIZE ENDOSPERM 1124
MAIZE SEEDLINGS 638, 759
MAIZE STARCHES 1056
MAJOR GENES 628
MAKING QUALITY 1083, 1145
MALE INFERTILITY 653
MALT 407, 603, 649, 681, 1051, 1065, 1144, 1173
MALTING BARLEY 408, 423, 425, 426, 454, 575, 586, 603, 609, 1051, 1065, 1137
MALTING QUALITY 616, 649
MANAGEMENT 455, 517, 522
MANGANESE DEFICIENT CONDITIONS 778
MANGANESE EFFICIENCY 789
MANIPULATION 611
MANNITOL 802, 825
MANURE 509
MAP 483, 580, 649, 650, 678, 682, 693
MAPPING 483
MAPPING GENES 483
MAPS 634
MARCHES (ITALY) 496
MARKER 620
MARKER ASSISTED SELECTION 615, 649, 672
MARKERS 608, 693, 695, 707
MARKETING 407, 415, 1043
MATHEMATICAL MODELS 974, 1169
MATRICARIA 962
MATRICARIA PERFORATA 542
MATURATION 657, 703, 715, 725, 775, 921
MATURAZIONE BIOLOGICA 1169
MATURITY 680, 1167
MEASUREMENT 541, 545, 547, 1044, 1045, 1128, 1137, 1172
MEASURING INSTRUMENTS 1047
MEASURING PLANT 837
MEAT MEAL 1091
MECHANICAL IMPEDANCE 808
MECHANICAL PROPERTIES 1152
MECHANISM 1081
MEDIA 818, 1057
MEDITERRANEAN CLIMATE 562
MEDITERRANEAN REGION 597
MEDITERRANEAN TYPE ENVIRONMENT 536
MEIOSIS 644, 724
MEIOTIC ABNORMALITIES 623
MEIOTIC RECOMBINATION 604
MEMBRANE 811
MEMBRANE INTEGRITY 923
MEPIQUAT 524
MERCURY 905
MERISTEM 913, 914
MERISTEMS 915
MESOPHYLL 752
MESOPHYLL PROTOPLASTS 679
MESSENGER RNA 713, 761
MESSENGER RNAS 694
METABOLIC ACTIVITY 820
METABOLISM 739, 769
METABOLITES 899
METABOLIZABLE ENERGY 1148
METAL 789
METALLOTHIONEIN 821
METEOROLOGICAL ELEMENTS 562, 785
METEOROLOGY 585, 1169
METHANE PRODUCTION 1007
METHIONINE 758, 781, 1091
METHODOLOGY 1027
METHODS 543, 545, 546, 547, 548, 549, 1040, 1052, 1067, 1128, 1162, 1171, 1172
METHYLATION 641
MICE 1064
MICRO INJECTION 679
MICROBIAL BIOMASS 769
MICROBIAL ECOLOGY 1021
MICROBIAL FLORA 420, 505, 1018, 1021
MICROBIAL MEDIATED INDUCED RESISTANCE 852
MICROBIAL PHYTASE 1010
MICROBIAL POPULATIONS 1003
MICROBIAL PROPERTIES 1021
MICROBIOLOGICAL ANALYSIS 889, 890
MICROBIOLOGY 1063
MICROCLIMATE 564
MICRODOCHIUM NIVALE 898
MICROFLORA 486
MICROINJECTION 679
MICRONIZATION 984
MICRONUTRIENT 789
MICRONUTRIENT FERTILIZERS 499, 532
MICROORGANISMS 795, 1063, 1066
MICROPROJECTILE 488
MICROPROJECTILE BOMBARDMENT 480, 488, 686
MICROSATELLITE 649, 672
MICROSATELLITE MARKERS 594
MICROSPORA 654
MICROSPORE 713
MICROSPORE CULTURE 818, 825
MICROSPORE EMBRYOGENESIS 481
MILDEWS 704, 884, 896, 901
MILK 996, 1054
MILK PRODUCTION 985
MILLED STREAMS 1120
MILLING 1000, 1044, 1048, 1066, 1068, 1080, 1108, 1137
MILLING YIELD 672
MILLS 1068
MINERAL CONTENT 416, 1044, 1048, 1141
MINERAL METABOLISM 1157
MINERALISATION 1033
MINERALIZATION 503, 509, 1033
MINERALIZATION RATES 1027
MINERALS 1106
MINIMUM TILLAGE 870, 1027
MINISATELLITE CORE SEQUENCES 615
MINKS 980, 981
MINNESOTA 863
MISMATCH REPAIR GENES 639
MITES 839, 1033
MITOCHONDRIA 803
MITOCHONDRIAL 669
MIXED CROPPING 478, 554, 564, 566, 846
MIXING 1048, 1052, 1153
MIXOGRAPH 1062
ML A LOCUS 598
MLO RESISTANCE 848, 888
MODEL 424, 683, 793, 911, 945
MODELLING 418, 769
MODELS 823, 828, 871, 959, 1170
MODIFICATION 1056
MODULATION 739
MOISTURE 617, 772, 979, 1081
MOISTURE CONTENT 935, 976, 1047
MOISTURE SHELLED CORN 902
MOISTURE SORPTION 1152
MOISTURE STRESS 801
MOLAR RATIOS 1096
MOLDBOARD 539
MOLECULAR BIOLOGY 603, 671
MOLECULAR BREEDING 606
MOLECULAR CHARACTERIZATION 695, 1129
MOLECULAR CLONING 1086
MOLECULAR GENETIC MAPS 672, 707
MOLECULAR GENETICS 590
MOLECULAR MARKERS 594, 606, 615
MOLECULAR STRUCTURE 1056
MOLECULAR WEIGHT 1059, 1073, 1076, 1084
MOLECULAR WEIGHT (MW) 1084
MOLECULAR WEIGHT SUBUNITS 1101,1130
MOLYBDENUM 532
MONILIFORMIN 869
MONITORING 867, 1078
MONOCLONAL ANTIBODIES 1130
MONOCULTURE 544, 559
MONOVARIETAL SEMOLINA 1117
MOROCCO 957, 958
MORPHOLOGICAL CHARACTERS 580
MOSAIC VIRUS BAMMV 580
MOULDS 1063, 1066, 1067
MOUNTAIN SOILS 541
MOUSE OOCYTES 679
MOVEMENT 845
MUCOUS MEMBRANE 1011
MUGINEIC ACID 781
MUGINEIC ACID FAMILY PHYTOSIDEROPHORES 758
MULCH 511
MULCHING 446, 543
MULTIPLE STRESS INTERACTION 916
MULTIPLICATIVE MODEL 670
MUTAGENS 684
MUTANT 932
MUTATION 632
MUTATIONS 857
MUTS 639
MYCELIUM 899
MYCORRHIZAE 784
MYCORRHIZAL 815
MYCOTOXIN 1070
MYCOTOXINS 870, 1018, 1063, 1066, 1067
MYOSUROIDES HUDS SEEDS 953
N 513, 522
N 15 509, 551
N 15 ISOTOPE 798
N 15 ISOTOPE DILUTION TECHNIQUE 1009
N 15 ISOTOPE TECHNIQUE 1009
N 15 LABELLING 527

N 15 STABLE ISOTOPE TRACER 551
N 2 FIXATION 551
N AGRONOMIC EFFICIENCY 491
N BANDING 612
N EFFICIENCY 527
N IMMOBILIZATION 509
N LEACHING 509
N LOSS 527
N PHYSIOLOGICAL EFFICIENCY 491
N RECOVERY EFFICIENCY 491
N TERMINAL SEQUENCE 1129, 1130
N UPTAKE EFFICIENCY 514
N USE EFFICIENCY 509
N2O 421
NA+/H+ ANTIPORT 744
NACL 930
NAD(P)H PLASTOQUINONE OXIDOREDUCTASE COMPLEX 749
NARROW SENSE EARLINESS 629
NATURAL ENEMIES 846
NATURAL SELECTION 708
NDH GENES 749
NEAR ISOGENIC LINES 615
NEMATODA 538
NEMATODES 452, 1033
NEOVOSSIA (TILLETIA) INDICA 891
NEPAL 931
NET PHOTOSYNTHESIS 925
NET RETURN 403
NEUTRAL DETERGENT FIBER 998
NICOTIANA 752
NICOTIANAMINE 758
NIGHTTIME 925
NITRATE 509, 514, 524, 691, 739, 761, 815, 894, 917
NITRATE REDUCTASE 746, 761
NITRATES 420, 521, 543, 794
NITRIC OXIDE FLUX 911
NITRIFICATION 911, 1027
NITRITE REDUCTASE 761
NITRITE TOXICITY 798
NITROGEN 420, 445, 455, 464, 494, 501, 503, 509, 511, 512, 514, 516, 521, 523, 525, 527, 613, 691, 739, 769, 773, 774, 775, 785, 791, 815, 911, 912, 1033, 1155
NITROGEN CONTENT 420, 464, 497, 498, 503, 516, 521, 775, 785
NITROGEN DEFICIENCY 815
NITROGEN DYNAMICS 418
NITROGEN FERTILIZATION 894
NITROGEN FERTILIZERS 438, 451, 472, 473, 474, 493, 495, 496, 497, 498, 500, 510, 515, 518, 519, 523, 533, 535, 544, 562, 775, 785, 908, 1017, 1026, 1168
NITROGEN FIXATION 405, 420, 521, 1029
NITROGEN METABOLISM 792, 794
NITROGEN MINERALIZATION 491, 524
NITROGEN RETENTION 1000
NITROGEN SOURCES 802
NITROGEN TRANSFER AMONG PLANTS 551
NITROGEN UPTAKE 418
NITROUS OXIDE 421
NMR 1115
NMR SPECTROSCOPY 1084
NO TILL 539, 961
NO TILLAGE 455, 537, 1027
NON FOOD INDUSTRIES 1162
NON PROTEIN NITROGEN 978
NON RACE SPECIFIC RESISTANCE 888
NON STARCH POLYSACCHARIDE 1001
NONCOMPETITIVE 942
NONLINEAR REGRESSION 458, 959
NONPHOTOSYNTHETIC TISSUES 749
NOODLE COLOR 627
NOODLE DUALITY 726
NOODLE QUALITY 726
NORTH AMERICA 411
NORTHWEST MEXICO 688
NORWAY 870
NPK FERTILIZERS 447, 475, 476, 502, 559, 796, 1020
NUCLEAR 489, 803, 818
NUCLEAR DNA CONTENT 708
NUCLEAR MAGNETIC RESONANCE 923
NUCLEOLAR DEVELOPMENT 813
NUCLEOLI 826
NUCLEOTIDE 1101
NUCLEOTIDE SEQUENCE 588, 800, 822
NUMBER 773
NUTRIENT AVAILABILITY 405, 523, 1021, 1025, 1026
NUTRIENT DIGESTIBILITIES 999
NUTRIENT DIGESTIBILITY 994
NUTRIENT MANGEMENT 530
NUTRIENT SOLUTIONS 906
NUTRIENT TRANSPORT 497, 498, 775, 784, 794
NUTRIENT UPTAKE 498, 510, 523, 526, 584, 775, 784, 785, 794, 796, 797, 1022, 1031
NUTRIENT UTILIZATION 990
NUTRIENTS 516, 520, 984, 988, 989, 1004, 1157
NUTRITION 917, 1006
NUTRITION PHYSIOLOGY 464, 1076, 1141
NUTRITIONAL REQUIREMENTS 495, 1028
NUTRITIVE VALUE 464, 469, 585, 1148
NYLON BAG TECHNIQUES 1006
NYLON BAGS METHODS 1006
O LOCUS 848
OAT 979, 993, 1084
OAT BRAN 1105
OATS 404, 414, 524, 999, 1076, 1144, 1155
OBLIGATE BIOTROPHS 857
OCEANIA 411
OCHRATOXIN 1063, 1065, 1066
OIDIUM 610
OILS 1137
OILSEED RAPE 524
ON FARM CONSUMPTION 1153
ON FARM RESEARCH 437
ON FARM TRIALS 540
OPEN TOP CHAMBER 912
OPEN TOP CHAMBERS 916, 924
OPTICAL PROPERTIES 936
ORCHARD SOILS 452
ORGANIC ACIDS 748
ORGANIC AGRICULTURE 457, 464, 503, 521, 951, 1021
ORGANIC CARBON 455, 1027
ORGANIC COMPOUNDS 507
ORGANIC FARMING 919
ORGANIC FERTILIZERS 451, 508, 512, 516, 1019, 1021
ORGANIC MATTER 455, 491, 512, 910, 1016, 1063, 1137
ORGANIC MATTER INTAKE 993
ORGANIZATION 572, 669
ORGANOLEPTIC ANALYSIS 1049, 1132
ORGANOMINERAL FERTILIZERS 503
ORIENTAL NOODLES 659
ORYZA 879
ORYZA SATIVA 510, 798, 830, 1023, 1030, 1151
ORYZA SATIVA L 479, 1124
OSMOREGULATION 767
OSMOTIC ADJUSTMENT 767, 930
OSMOTIC PRESSURE 631, 790
OSMOTIC STRESS 802, 910, 920, 935, 939, 940
OUTDOOR ENVIRONMENT 861
OVERALL AND ILEAL APPARENT DIGESTIBILITY 1009
OVERCOME 658
OVEREXPRESSED PROTEIN 880
OXALATE OXIDASE 694
OXALATES 901
OXIDANTS 1069
OXIDATION 1013, 1073
OXIDATIVE CROSS LINKING 694
OXIDATIVE STRESS 638
OXIDOREDUCTASES 451, 901
OXYGEN 1077, 1160
OXYGEN DEFICIENCY 486
OXYGEN EVOLVING COMPLEX 786
OZONE 916, 924
OZONE FUMIGATION 788
PACIFIC NORTHWEST 452, 465, 563
PACKAGING 1163
PACKAGING MATERIALS 1163
PAIRING REGULATOR GENE 690
PALATABILITY 980, 981
PANCREAS 984
PAPILLA FORMATION 694
PAPILLAE 900
PARAMETER ESTIMATION 959
PARAMETERS 1062
PARASITES 1011
PARASITISM 838
PARASITOIDS 845
PARENTAL EFFECTS 738
PARENTAL GENOMES 612
PARENTS 653, 670, 717
PARTIAL AMPHIPLOID 595
PARTIAL RESISTANCE 581, 583
PARTICIPATORY PLANT BREEDING 593
PARTICLE BOMBARDMENT 488, 620, 686
PARTICLE GUN 620
PASSAGE RATE 998
PASTA 1066, 1102
PASTA INDUSTRY 1066
PASTING 1099
PASTURE 993
PATCH CLAMP 811
PATHOGEN RESISTANCE 718
PATHOGENESIS RELATED PROTEINS 887
PATHOGENICITY 452, 889, 890
PATHOGENS 859, 869, 879, 901
PATHOTYPES 878, 895
PATTERN 845
PATTERNS 845, 1087
PAULOWNIA 556, 557, 753, 783
PCR 603, 860
PCR MARKERS 642, 678
PEAS 630, 1137
PECTINASE 1010
PEDIGREE 695
PEDIOCOCCUS PENTOSACEUS 1054
PELSHENKE 1116
PENETRATION 848
PENICILLIUM 1018

PENNISETUM AMERICANUM 479
PENNISETUM GLAUCUM 1022
PENNISETUM PURPUREUM SCHUM 825
PENTOSANASE 999
PENTOSANS 1004
PEPPER CAPSICUM ANNUUM 815
PEPTIDES 752, 806, 922
PERCENTAGE 489
PERCOLATION RATE 517
PERFORMANCE 670, 994, 996, 999, 1005, 1134
PERFORMANCE LIQUID CHROMATOGRAPHY 1129, 1130
PERILLA FRUTESCENS 1100
PERMEABILITY 756, 923, 1160, 1163, 1165
PEROXIDASE 749, 759
PEROXIDASES 535, 752, 806, 884, 1165
PEROXIDE 759
PEST 836
PEST CONTROL 552, 841
PEST INSECTS 841, 846
PEST RESISTANCE 730
PESTICIDAL PROPERTIES 967
PESTICIDE SELECTIVITY 948
PESTICIDE SPECIFICITY 947
PESTICIDES 831, 870
PESTS OF PLANTS 823
PH 448, 449, 806, 906, 917, 937
PH1 634
PH1 LOCUS 639
PHAEOSPHAERIA AVENARIA 861
PHAEOSPHAERIA NODORUM 861
PHASEOLUS VULGARIS 924
PHENOLIC ACIDS 1037, 1141
PHENOLIC COMPOUNDS 942
PHENOLOGY 823, 1169
PHENOLS 886
PHENOTYPES 601
PHENYLALANINE AMMONIA LYASE 886
PHENYLALANINE AMMONIA LYASE (PAL) 886
PHOSPHATE 1106
PHOSPHATE FERTILIZERS 510, 526, 533, 534, 544, 1031
PHOSPHATE UPTAKE 504
PHOSPHOLIPID 1133
PHOSPHORUS 508, 526, 584, 613, 775, 784, 785, 937, 991, 1025, 1157
PHOSPHORUS CONCENTRATION 778
PHOSPHORYLASE 1157
PHOTO RESPIRATION 782
PHOTOINHIBITION 776, 779
PHOTOINTERPRETATION 1044
PHOTOMORPHOGENESIS 749
PHOTOPERIOD 622, 629
PHOTOPERIOD SENSITIVITY 810
PHOTOPERIODICITY 728
PHOTORESPIRATORY PATHWAY 792
PHOTOSENSITIVITY 728
PHOTOSYNTHESIS 453, 661, 715, 755, 763, 774, 776, 779, 783, 788, 791, 793, 924, 932, 935
PHOTOSYSTEM 2 REACTION CENTRES 779
PHOTOSYSTEM II 763, 788
PHOTOSYSTEMS 792
PHYLLOSPHERE 1018
PHYLOGENY 669
PHYSICAL DISTRIBUTION 591
PHYSICAL MAP 604, 718
PHYSICAL STATE 923
PHYSICO CHEMICAL PROPERTIES 978
PHYSICOCHEMICAL PROPERTIES 1097, 1133
PHYSIOLOGICAL RESPONSES 925
PHYSIOLOGY 800
PHYTASE 1010, 1157
PHYTATE 1096, 1106
PHYTATES 1157
PHYTIC ACID 1096, 1106, 1157
PHYTOALEXINS 899
PHYTOPHTHORA 577
PHYTOSIDEROPHORE 781
PHYTOSIDEROPHORE RELEASE 789
PHYTOTOXIC BACTERIA 799
PHYTOTOXICITY 913, 914, 942, 970, 972, 1018
PICEA ABIES 638
PICEA ABIES L 925
PIEDMONT 867
PIG 1001
PIG PERFORMANCE 1000
PIG SLURRY 509
PIGLET NUTRITION 984
PIGLETS 1158
PIGMENT COMPOSITION 786
PIGMENTATION 927
PIGS 984, 1000, 1148
PIGWEED AMARANTHUS 959
PILOT FARMS 420, 457, 464, 503, 521, 1021
PILOT SCALE PREPARATION 1119
PISUM SATIVUM 521, 562
PISUM SATIVUM L. 712
PLACEMENT 445
PLAINS 586
PLANNING 420
PLANT 453, 491, 669, 1118
PLANT ANATOMY 632, 823, 1171
PLANT ARCHITECTURE 735
PLANT BIOTECHNOLOGY 567, 590, 603, 929
PLANT BREEDERS 443
PLANT BREEDING 407, 427, 443, 457, 567, 574, 575, 587, 588, 590, 596, 603, 610, 647, 671, 710, 732, 867, 929, 1051, 1067, 1128
PLANT COMPETITION 868
PLANT CONDITION 823
PLANT DEVELOPMENTAL STAGES 454, 478, 804, 823, 1169
PLANT DISEASE RESISTANCE 718
PLANT DISEASES 553, 689, 823, 834, 867, 1067
PLANT EMBRYOS 482, 485, 645, 733
PLANT ESTABLISHMENT 496, 586
PLANT EXTRACTS 809, 928
PLANT GROWTH 662
PLANT GROWTH PROMOTING RHIZOBACTERIA 799
PLANT GROWTH STIMULANTS 812
PLANT GROWTH SUBSTANCES 477, 780, 816, 831, 834, 907
PLANT HABIT 574, 575
PLANT HEIGHT 628, 810
PLANT MATERIAL 769
PLANT MITOCHONDRIA 803
PLANT MORPHOLOGY 481
PLANT NUTRITION 502, 516, 796
PLANT PATHOGEN INTERACTION 577
PLANT PATHOGENS 878, 895
PLANT PATHOLOGY 853
PLANT PHYSIOLOGY 566
PLANT PRODUCTION 404
PLANT PROTEIN 1162
PLANT REGENERATION 489, 818
PLANT REQUIREMENTS 523
PLANT RESISTANCE 836
PLANT RESPONSE 496, 516, 544, 575, 823, 907, 943
PLANT RESPONSES 916
PLANT ROOT PATHOGENS 820
PLANT SOIL RELATIONS 420, 503, 796
PLANT WATER RELATIONS 753, 754, 796, 934
PLANTING DATE 838
PLANTING PATTERN 459
PLANTS 440, 480, 501, 600, 605, 613, 620, 661, 668, 679, 686, 691, 708, 740, 788, 789, 813, 821, 845, 888, 1063
PLASMA 1164
PLASMA GLUCOSE 1105
PLASMIDS 654
PLASTID ULTRASTRUCTURE 802
PLASTIDS 885
PLASTOQUINONE POOL 749
PLOTS 850
PLOUG 470
PLOUGHING 475, 476, 537
POA ANNUA 1018
POLAND 401, 404, 428, 431, 433, 447, 501, 502, 545, 546, 548, 549, 553, 736, 831, 834, 927, 950, 1166, 1167, 1170, 1171
POLICIES 406
POLLEN EMBRYOGENESIS 713, 818, 821
POLLEN STERILITY 801
POLLUTION 925
POLYACRYLAMIDE GELS 591, 608
POLYGONUM 843
POLYMERASE CHAIN REACTION 615, 1074, 1117
POLYMORPHISMS 634
POLYMYXA 685
POLYPEPTIDE 1109
POLYPHAGOUS PREDATORS 537
POLYPHENOL OXIDASE 627, 659
POLYSACCHARIDE DEGRADING ENZYMES 1003
POLYSACCHARIDES 1009, 1141, 1148, 1149
PONTICUM 595
POPULATION 650, 693, 697
POPULATION DENSITY 974
POPULATION DYNAMICS 843, 961, 971
POPULATION STRUCTURE 846, 1171
POPULATIONS 452, 597, 672, 807, 845, 851, 878, 883, 1033
POROSITY 422
POSTHARVEST TECHNOLOGY 548
POSTPRANDIAL VARIATIONS 1003
POT EXPERIMENTATION 559, 796
POTASSIUM 613, 665, 758, 798, 917, 1031
POTATO STARCH 1136
POTATO VIRUS Y 858
POTATOES 404, 538, 919
POTYVIRUS 858
POTYVIRUSES 867
POULTRY 994
POWDERY MILDEW 609, 614, 848, 868, 878, 888, 893, 894
POWDERY MILDEW FUNGUS 694
POWDERY MILDEW RESISTANCE 678
PPB 593
PRATYLENCHUS CRENATUS 843

PRECIPITATION 762
PRECOCITY 574, 575, 586, 703, 715
PREDATORS 845
PREDICTION 1092
PREFERENCE 1008
PREHARVEST APPLICATION 831
PREHARVEST SPROUTING 412
PRETREATMENT 802, 825
PRICE STABILISATION 413
PRICES 401, 406, 407, 414, 415
PRIMARY INFECTION 848
PROANTHOCYANIDIN 1159
PROCESSING 416, 1043, 1044, 1048, 1102, 1137
PROCESSING QUALITY 588, 1051, 1059
PRODUCTION 416
PRODUCTION DATA 397, 407, 414, 415, 429, 573, 1085
PRODUCTION FACTORS 431, 433
PRODUCTION POSSIBILITIES 406, 575, 736
PRODUCTIVITY 450, 599, 1015, 1033
PRODUCTS 1048, 1052, 1066, 1080
PROEMBRYOS 814
PROFILE 1006
PROFITABILITY 401, 407, 415, 555, 834, 1043
PROGENY 585, 687
PROJECT EVALUATION 405
PROLAMIN GENES 1104
PROLAMINES 1061, 1128
PROLINE 877, 910
PROMOTER 858
PROSPECTS 688
PROTEASES 939
PROTEIN 618, 661, 782, 995, 1005, 1006, 1009, 1086, 1129, 1148
PROTEIN COMPLEXES 786
PROTEIN CONTENT 415, 429, 496, 544, 585, 586, 588, 710, 762, 831, 1047, 1078, 1085, 1090, 1091, 1107, 1108, 1173
PROTEIN EFFICIENCY RATIO 978
PROTEIN FILMS 756
PROTEIN FUNCTIONALITY 1092
PROTEIN ISOLATES 1039
PROTEIN KINASE C 747
PROTEIN METABOLISM 1155
PROTEIN PIGMENT COMPLEXES 788
PROTEIN QUALITY 469, 1155
PROTEIN SEQUENCE 1109
PROTEIN STRUCTURE 1109
PROTEINS 410, 416, 528, 532, 571, 585, 621, 729, 752, 765, 777, 782, 792, 987, 1044, 1052, 1055, 1061, 1073, 1077, 1103, 1104, 1126, 1128, 1130, 1137, 1153, 1154, 1155
PROTOPLAST 721
PROTOPLASTS 605, 620, 652, 811, 813
PROVENANCE 1091
PROXIMATE COMPOSITION 710, 987, 1040, 1091, 1154
PSEUDOCERCOSPORELLA HERPOTRICHOIDES 577, 682, 847, 898
PSEUDOMONAS FLUORESCENS 795, 815, 816, 820, 852
PSEUDOMONAS PUTIDA GR12 2 799
PUCCINIA HORDEI 866
PUCCINIA RECONDITA 583, 610, 699, 847, 871
PUCCINIA RECONDITA F. SP TRITICI 583
PUCCINIA RECONDITA TRITICI 666
PUCCINIA STRIIFORMIS 594, 656, 847
PULLULANASE 1109
PULSED AMPEROMETRIC DETECTION 1056
PUNJAB 830
PURIFICATION 605, 649, 713, 745, 747, 817, 1086, 1088, 1109
PURITY 1078
PUROINDOLINE 707
PYRENOPHORA TERES 879
PYRENOPHORA TRITICI REPENTIS 861
PYRICULARIA ORYZAE 879
PYTHIUM ULTIMUM 852
Q(10) 798
QTL 693, 810
QTL MAPPING 672, 735
QTLS 628
QUALITY 415, 416, 425, 428, 429, 431, 439, 457, 462, 490, 496, 544, 574, 586, 590, 599, 624, 640, 655, 661, 670, 672, 673, 681, 710, 727, 777, 1040, 1043, 1044, 1045, 1048, 1049, 1052, 1063, 1067, 1071, 1078, 1080, 1085, 1090, 1093, 1103, 1108, 1112, 1118, 1128, 1137, 1139, 1140, 1142, 1173
QUALITY ASSURANCE 426
QUALITY ATTRIBUTES 1134
QUALITY CONTROLS 1044, 1137
QUALITY TEST 1092
QUANTITATIVE APPROACH 698
QUANTITATIVE DETERMINATION 1142
QUANTITATIVE RESISTANCE 581QUANTITATIVE TRAIT LOCI 483,
QUANTITATIVE TRAIT LOCI 483, 602, 606

QUANTITATIVE TRAITS 672, 1116
QUATERNARY AMMONIUM 930
QUINONES 1077
R&D 396
RACE SPECIFIC RESISTANCE 888
RACES 864
RADIATION 755, 773, 1100
RAIN 475, 476, 870, 871
RAINFALL 463
RAINFED FARMING 667, 717
RAPD 695
RAPD MARKERS 580, 594
RAPDS 580
RAPESEED 565
RAPESEED MEAL 1091
RAPID IDENTIFICATION 1074
RAPID MITE DETECTION 839
RAPID PRODUCTION 488
RAPID VISCO ANALYSER 1123
RAPID VISCO ANALYZER 726
RAT 1042
RATIONS 986, 987, 1153
RATS 982, 1039
RAW MATERIALS 409, 1091
READTHROUGH PROTEIN 658
RECOGNITION 690
RECOMBINANT 678
RECOMBINANT INBRED LINES 1116
RECOMBINATION 598
RECOMBINATION FREQUENCIES 634
RECOVERY 514, 527, 1009
RECTANGULAR HYPERBOLIC MODEL 959
RECURRENT SELECTION 709
RECYCLING 508
RED WINTER WHEAT 607
REDUCTASE ACTIVITY 638, 739
REDUCTION 739, 1067, 1106
REESEI 1057
REGENERATION 483, 484, 813, 821
REGION 658
REGIONAL ACCOUNTING 405
REGIONAL PLANNING 405
REGIONS 693
REGISTRATION 428, 607
REGULATES ACCUMULATION 786
REGULATIONS 407, 415
RELATIVE HUMIDITY 871
RELATIVE TIME 458, 959
RELATIVE WATER CONTENT (RWC) 848
REOVIRIDAE 867
REQUIREMENT 625, 629
RESEARCH 417, 565, 585, 757, 823
RESEARCH NETWORKS 429, 1085
RESEARCH PROJECTS 405
RESIDUAL EFFECT 529
RESIDUES 421, 422
RESISTANCE 591, 614, 618, 620, 634, 666, 682, 840, 844, 857, 869, 878, 893, 894
RESISTANCE BREEDING 720
RESISTANCE GENE 658
RESISTANCE GENES 597, 598
RESISTANCE MECHANISMS 836
RESISTANCE TO CHEMICALS 938, 956, 964, 966
RESISTANCE TO INJURIOUS FACTORS 429, 592, 906, 929, 1067
RESOURCE MANAGEMENT 587
RESPIRATORY CHAIN 803
RESPIRATORY COMPLEX 749
RESPONSE SURFACE ANALYSIS 1083
RESPONSES 622, 888, 909, 912
RESTRICTION 641
RETENTION 1070
REVERSE TRANSCRIPTASE ACTIVITY 626
RFLP 572, 634, 639, 672, 892
RFLP ANALYSIS 483
RFLP MAPPING 639
RFLP MARKERS 598
RFLP VARIATION 622
RHEOLOGICAL BEHAVIOR 1062
RHEOLOGICAL PROPERTIES 409, 410, 496, 586, 599, 710, 1046, 1052, 1053, 1055, 1056, 1059, 1062, 1071, 1072, 1073, 1083, 1088, 1090, 1094, 1108, 1128, 1161
RHEOLOGY 1094, 1122, 1123, 1134
RHIZOCTONIA 452
RHIZOCTONIA CEREALIS 898
RHIZOCTONIA ROOT ROT 465
RHIZOCTONIA SOLANI 731
RHIZOMES 965
RHIZOPLANE 815
RHIZOSPHERE 504, 769, 771, 784, 816, 1015
RHIZOSPHERE MICROORGANISMS 799, 815
RHOPALOSIPHUM PADI 833, 844
RIBOSOMAL DNA INTERNAL TRANSCRIBED SPACERS IDENTIFICATION 1074
RIBOSOMAL GENES 572
RIBOSOMAL RNA 826
RIBOSOMAL RNA GENES 572
RICE 529, 618, 628, 650, 693, 982, 1151
RICE CULTIVAR 479
RICE ORYZA SATIVA 615
RICE PLANTS 705
RICE SEEDS 1086
RICE WHEAT CROPPING 530

RICE WHEAT SYSTEM 522
RISK 870
RNA 626, 658
ROLLING 1048
ROMANIA 413, 970
ROOT 739, 942
ROOT ACTIVITY 769
ROOT CAP 913, 914
ROOT COLONIZATION 815
ROOT ELONGATION 799
ROOT EXUDATES 942
ROOT FEEDING 551
ROOT FUNGI 851
ROOT GROWTH 808
ROOT HAIRS 504, 913, 914
ROOT ROT 452
ROOT TO SHOOT COMMUNICATION 808
ROOT VEGETABLES 404
ROOT ZONE ACIDITY 798
ROOTING 906
ROOTS 440, 528, 548, 551, 744, 781, 790, 794, 915, 1024
ROTATION 436
ROTATIONAL CROPPING 447, 451, 461, 501, 521, 538, 543, 545, 546, 547, 548, 549, 552, 553, 565, 830, 1016, 1022
RRN LOCI 641
RUMEN CONTENTS 1003
RUMEN DIGESTION 1155
RUMEN INCUBATION 1006
RUMEN METABOLISM 998
RUMEN METABOLITES 993
RUMEN MICROORGANISMS 1155
RUMEX 972
RUMINAL FERMENTATION 1003
RUMINANTS 993, 995, 1006, 1155
RUNOFF 539, 541
RUSSIAN FEDERATION 411
RUSSIAN THISTLE 563
RUST RESISTANCE GENE 594
RUSTS 610, 699, 866, 871, 877
RYE 404, 414, 572, 612, 639, 682, 687, 778, 869, 919, 986, 994, 999, 1037, 1043, 1055, 1067, 1073, 1080, 1091, 1101, 1108, 1137, 1141, 1153
RYE BREAD 1105
RYE FLOUR 1073, 1080, 1108, 1141
RYE NONSTARCH POLYSACCHARIDES 1127
RYEGRASS 551, 992
RYMOVIRUS 858
SACCHAROMYCES CEREVISIAE 1074
SALICYLATES 940
SALICYLIC ACID 886
SALICYLIC ACIDS 939, 940
SALINE SOIL 569
SALINITY 440, 526, 569, 570, 619, 662, 665, 741, 913, 914, 932, 1024
SALIX 1014
SALMONELLA 1066
SALT STRESS 744, 930
SALT TOLERANCE 448, 449, 570, 606, 619, 691, 913, 914, 940, 1024
SALT TOLERANT 744
SAMPLING 501, 547, 1078
SANDY SOILS 457, 495, 512, 559
SAPROPHYTISM 853
SARDINIA 496
SASKATCHEWAN 445
SAWFLY 838
SCAB 581, 735, 863, 869
SCABS 732, 897
SCALING 793
SCENEDESMUS OBLIQUUS 786
SCHEME 793
SCHIZAPHIS GRAMINUM 844
SCIRPOPHAGA INCERTULAS 830
SCLEROTINIA SCLEROTIORUM 764
SCUTELLAR TISSUES 488
SDS SEDIMENTATION TEST 1092
SEASONAL VARIATION 638
SEAWEED SUSPENSIONS 486
SECALE 956, 963
SECALE CEREALE 404, 414, 420, 431, 472, 473, 474, 573, 576, 619, 687, 736, 782, 913, 967, 1170
SECALE CEREALE L. 639
SEDIMENTATION 1137
SEED 490, 573, 630, 687, 812, 1029, 1172
SEED CLEANERS 1012
SEED DEVELOPMENT 611
SEED DORMANCY 611
SEED FILLING 519, 828, 829
SEED HARVESTERS 490
SEED MIXTURES 630
SEED PRIMING 486
SEED PRODUCTION 407, 653
SEED RATE 467
SEED SIZE 468
SEED STORAGE PROTEIN 664
SEED TREATMENT 440, 742
SEED WEIGHT 652, 734, 762
SEEDBED PREPARATION 475, 476
SEEDBORNE ORGANISMS 855
SEEDLING GROWTH 799
SEEDLING TOXICITY 506
SEEDLINGS 430, 645, 652, 739, 742, 746, 787, 794, 798, 800, 822, 844, 928, 935, 940, 1165
SEEDS 519, 804, 928, 939, 1111
SEGMENTS 612
SEGREGATION DISTORTION 735
SELECTABLE MARKER 686
SELECTION 567, 590, 603, 648, 655, 680, 683, 688, 699, 719, 720, 929
SELECTION CRITERIA 454, 684, 701
SELECTION INDEX 709
SEMIARID CLIMATE 562
SEMIARID REGION 436
SEMOLINA 416, 1044, 1048, 1066
SEMOLINA BLEACHING 1118
SENESCENCE 605, 853
SENSITIVITY 611
SENSORY TESTING 1099
SEPARATING 1041, 1128
SEPTORIA 847, 862, 876
SEPTORIA NODORUM 719, 720
SEPTORIA TRITICI 893, 894
SEQUENCE 618, 858, 880
SEQUENCES 807, 851, 1104, 1117
SESAMUM INDICUM 1100
SEVERITY 864, 868, 883
SEWAGE 508
SHADING 560
SHARP EYESPOT 898
SHEAR 1104
SHEEP 985, 988, 993, 1002, 1007, 1008
SHELF LIFE 1110
SHOOT 440, 524
SHOOT GROWTH 798
SICILY 496, 562
SIDE EFFECTS 954
SIEVING 1048, 1068
SIGNAL TRANSDUCTION 761
SILAGE 989, 992, 1002, 1156
SILICON 797
SILICON ABSORPTION 787
SIMULATION 418
SIMULATION MODELS 405, 516, 785, 1166, 1167
SINAPIS ALBA 543, 548
SINAR 942
SINGLE 721, 813
SINGLE KERNELS 772
SITE FACTORS 405, 457, 512, 823
SITOBION AVENAE 842, 845
SIZE 1087
SLOPING LAND 541
SLOVAK REPUBLIC 547
SLOVENIA 842
SLOW RELEASE N FERTILIZERS 529
SLUGS 537
SMALL FARMS 433
SMALL GRAINS 441
SMALL INTESTINE 1005
SMELL 1082
SMUTS 855
SO2 788
SODICITY 662
SODIUM 662, 665, 798, 940
SODIUM AZIDE 684
SODIUM BISULFITE 1070
SODIUM CHLORIDE 910, 913, 914, 915, 939
SODIUM STEAROYL LACTYLATE 1125
SOFT WHEAT 406, 415, 610, 655, 1047, 1090
SOFT WHEAT TRAITS 1092
SOFTNESS PROTEIN 707
SOIL 418, 421, 422, 431, 437, 440, 445, 463, 505, 506, 514, 524, 527, 563, 768, 771, 795, 837, 850, 904, 953
SOIL AGGREGATION 517
SOIL AMENDMENTS 1021
SOIL BIOLOGY 420, 1021
SOIL BORNE BACTERIA 799
SOIL BORNE PATHOGENS 852
SOIL CHEMICOPHYSICAL PROPERTIES 475, 512, 544, 552, 736, 1021
SOIL CHEMISTRY 559, 1021
SOIL COMPACTION 559
SOIL DEFICIENCIES 521
SOIL EROSION 437
SOIL FERTILITY 405, 433, 503, 512, 521, 538, 544, 559, 1020, 1021, 1023, 1030, 1032
SOIL MANAGEMENT 512, 516, 521, 1021
SOIL MICROBIAL BIOMASS 509
SOIL MICROBIAL BIOMASS N 509
SOIL MICROORGANISMS 559
SOIL NITROGEN 418
SOIL ORGANIC MATTER 769
SOIL PHOSPHORUS 504
SOIL POLLUTION 1165
SOIL PORE SYSTEM 559
SOIL PRODUCTIVITY 522
SOIL PROFILES 1017
SOIL SALINITY 1024
SOIL SORPTION 534, 561
SOIL TEMPERATURE 465
SOIL TESTING 503, 543, 547, 1016, 1021
SOIL TEXTURE 533
SOIL TREATMENT 542
SOIL TYPES 870, 1025, 1028
SOIL WATER 550

SOIL WATER BALANCE 790
SOIL WATER CONTENT 533, 554, 559, 754, 796, 805
SOIL WATER POTENTIAL 790
SOIL WATER RETENTION 554
SOIL WATER STRESS 848
SOILBORNE ORGANISMS 899
SOILS 851, 919
SOLANUM TUBEROSUM 404, 512, 521, 823, 970, 1018
SOLANUM TUBEROSUM L 712
SOLAR RADIATION 871
SOLID ASSOCIATED MICROORGANISMS 1003
SOLID STATE FERMENTATION 1057
SOLUBILITY 1052, 1076, 1162
SOLUBLE FIBER 1105
SOLUBLE NONSTARCH POLYSACCHARIDES 1115
SOLUBLES 995
SOLUTIONS 1163
SOMATIC EMBRYOGENESIS 479, 488, 489, 713
SORBITOL 1160
SORGHUM BICOLOR 516
SORGHUM GRAIN 1003, 1005
SORPTION 1052
SORPTION ISOTHERM 756
SORPTION ISOTHERMS 756
SOURCE SINK RELATIONS 782
SOURDOUGH 1054, 1110
SOUTH AFRICA 412, 903
SOUTH AMERICA 411
SOUTH DAKOTA 840
SOUTHERN HIGH PLAINS 536
SOWING 542
SOWING DATE 420, 423, 438, 1169
SOWING RATES 417, 420, 423, 438, 951
SOWING TIME 442
SOYBEAN GLYCINE MAX 959
SOYBEAN LIPOXYGENASE 1 1118
SOYBEAN MEAL 1006, 1010, 1091, 1153
SOYBEANS 1060, 1162
SOYFOODS 1082
SP HORDEI 878
SP RADICIS LYCOPERSICI 852
SPACING 564
SPAIN 416
SPATIAL 845
SPATIAL ANALYSIS 683
SPATIAL ARRANGEMENT 459
SPECIFICITY 419, 745, 1129
SPECIFYING RESISTANCE 595
SPECTROMETRY 755
SPECTROSCOPY 772
SPELT WHEAT 1113
SPIKE GROWTH 773
SPIKELET NUMBER 810
SPIKELETS 518, 578, 663, 675, 870
SPIKES 578, 636, 637, 663, 676, 775, 1067SPIN SPIN RELAXATION 923
SPIN SPIN RELAXATION 923

SPLEEN 1064
SPONTANEOUS DOUBLING 481
SPONTANEUM 598
SPRAYING 430, 477, 870
SPRING BARLEY 458, 524, 833, 848, 961
SPRING CEREALS 961
SPRING CROPS 397, 408, 425, 428, 431, 433, 447, 451, 454, 472, 473, 474, 501, 512, 553, 561, 646, 674, 736, 809, 823, 834, 928, 946, 950, 963, 1166, 1167, 1170
SPRING OAT 961
SPRING WHEAT 440, 445, 489, 607, 629, 688, 894, 923, 926, 961
SPRING WHEATS 1092
SPROUTING 592
SPROUTING RESISTANT 611
SR2 666
SSR 602
STABILITY 670, 1069, 1116
STABLE EXPRESSION 480
STABLE TRANSFORMATION 488
STALING 1072, 1081
STANDARDIZING 1166, 1167
STAPHYLINIDS 537
STARCH 588, 726, 984, 994, 1005, 1008, 1046, 1052, 1071, 1072, 1081, 1083, 1098, 1099, 1127, 1135, 1145, 1160
STARCH ACETATE 1149
STARCH DIGESTION 1005
STARCH GRANULES 649
STARCH INDUSTRY 1046
STARTER CULTURES 603
STARTERS 1072, 1110
STARVATION 815
STATE TRANSITION 779
STATISTICAL CORRELATIONS 1116, 1134
STATISTICAL DATA 502
STATISTICAL METHODS 433, 501, 502, 548, 549, 562, 831, 1071, 1168, 1170, 1171
STEERS 995, 998, 1005
STELLARIA 954, 962
STEM 773
STEM RUST 666, 886
STEMS 582, 689, 737, 775, 785
STEPPES 461
STERILITY 623, 918, 931
STICKINESS 1094
STIMULI 482, 804
STOMACH 997
STOMATA 631
STOMATAL CONDUCTANCE 793, 932
STONE TERRACES 437
STOOL OUTPUT 1042
STORAGE 426, 902, 976, 979, 1053, 1065, 1069, 1072
STORAGE ORGANS 712
STORAGE PROTEINS 664, 745, 747
STORAGE STRUCTURES 978
STORAGE TEMPERATURE 977
STORED PRODUCTS 980, 981
STORED RAPESEED 979
STORED WATER 463
STRAINS 1074
STRATIFICATION 1027
STRAW 438, 667, 1014
STRAW MULCHES 446
STREAK MOSAIC VIRUS 595, 835
STRENGTH 1092, 1094
STREPTOMYCES HYGROSCOPICUS 799
STRESS 613, 617, 661, 691, 744, 759, 808, 827, 837, 840, 916, 929, 930
STRESS INDUCED ACCUMULATION 800, 822
STRESS TOLERANCE 613, 700
STRESS TREATMENT 481
STRIPE RUST 594, 656, 868, 883
STRUCTURE 1084
STUBBLE 445
SUBFRACTIONS 1062, 1104
SUBSIDIES 407
SUBSTANCES 942
SUBSTITUTION LINE 656
SUBSTITUTIONS 697
SUBSTRATE DEPTH 1057
SUBSTRATE UTILIZATION PATTERNS 795
SUBUNITS 1101
SUCCESSION 1033
SUDDEN RELIEF 848
SUGAR BEET 538, 553, 771
SUGAR BEET PULP 1001, 1002
SUGARS 782, 814, 910
SULFUR DIOXIDE 788
SULPHUR 1073
SUNFLOWER PLANTS 808
SUPERFAMILY 1086
SUPEROXIDE DISMUTASE 535, 759, 877, 884, 1165
SUPEROXIDE DISMUTASES 759
SUPPLEMENTARY FEED 993
SUPPLEMENTATION 1010
SUPPLEMENTED DOUGHS 1072
SUPPLY 407, 415
SUPPRESSION 851, 942
SURFACE ACTIVE AGENTS 972, 1162
SURFACE CULTIVATION 541
SURVEYS 405, 420, 457, 464, 502, 503, 521
SUSTAINABILITY 405, 1021
SUSTAINABLE AGRICULTURE 771
SWARD 1008
SWEDEN 508
SWEEPS 539
SWEET SORGHUM 1159
SWELLING 1052
SWELLING POWER 726
SWINE 983, 986, 991, 997, 1148, 1153, 1157
SWISS MODEL 1109
SWITZERLAND 1021
SYMPTOMS 849, 867, 929
SYNTENY 615, 618
SYNTHETIC PEPTIDES 1129
SYNTHETIC WHEATS 770
SYRIA 593
SYSTEM 418, 436, 577, 744
SYSTEMIC ACQUIRED RESISTANCE 852, 886
SYSTEMS 422, 445
T ARARATICUM 614
T DICOCCUM 614
T DURUM 614
T1BL.1RS TRANSLOCATION 660
TACK 1094
TAKE ALL 850, 851, 1033
TAKE ALL DECLINE 850
TAKE ALL FUNGUS 851
TAPESIA 898
TECHNICAL PROPERTIES 496, 586, 603, 1090, 1102
TECHNOLOGY 433, 541
TEMPERATURE 471, 611, 617, 622, 680, 716, 762, 776, 782, 827, 870, 979, 1052, 1053, 1054, 1087, 1094, 1095, 1108, 1159
TEMPERATURE EFFECT 611
TEMPERATURE RESISTANCE 640, 671, 673, 776
TEMPERATURES 759
TEMPORARY PARTIAL BREAKDOWN 848
TENEBRIONIDAE 1064
TESTING 701, 970

TESTS 579, 1116
TETRAPLOID WHEAT 627
TETRAPLOIDY 568
TEXTURAL SOIL TYPES 545, 546, 547
TEXTURE 1052, 1103, 1132
THERMOSTABILITY 923
THERMOTOLERANCE 661
THIN LAYER 1038
THINOPYRUM INTERMEDIUM 595
THOUSAND KERNEL WEIGHT 1093
THRESHERS 466
THRESHING 466
THRIPS 537
THYLAKOIDS 788, 922
TIGRAY 437
TILLAGE 538, 542, 543, 544, 545, 546, 547, 548, 549, 552, 943, 957
TILLAGE SYSTEMS 455
TILLERING 510, 633, 657, 663
TILLETIA CARIES 855, 885
TIME 810
TIME CONCENTRATION 924
TISSUE 480, 620, 777, 923
TISSUE CULTURE 479, 480, 482, 713
TISSUE CULTURES 479
TOBACCO 705, 749
TOBACCO MESOPHYLL PROTOPLASTS 713
TOBACCO TNT1 RETROTRANSPOSON 626
TOLERANCE 600, 661, 702, 770, 824, 909, 917
TOLERANCE TO ZINC DEFICIENCY 789
TOMATO 658, 822
TONOPLAST H+ ATPASE 744
TONOPLAST H+ PPASE 744
TOXICITY 917, 954, 1063, 1064, 1066, 1067
TOXICOLOGY 941, 956, 962
TOXIN RESISTANCE 719
TOXINS 1067
TRACE ELEMENTS 559, 1022
TRACKING 813
TRACTOR 422
TRAITS 625, 688
TRANS THYLAKOID MEMBRANE PROTON GRADIENT 779
TRANSCRIPT ACCUMULATION 887
TRANSDUCTION PATHWAYS 761
TRANSFORMATION 620, 679, 857
TRANSFORMED PEA ROOTS 852
TRANSGENE 488
TRANSGENIC CALLUS 705
TRANSGENIC PLANTS 603, 722, 730, 859, 896, 929
TRANSGENIC RICE 740
TRANSGENIC TOBACCO PLANTS 886
TRANSGENIC WHEAT 488
TRANSIENT 480
TRANSIENT ASSAY 705
TRANSIENT EXPRESSION 686
TRANSIENT FLOW SAMPLING 839
TRANSIENT GUS EXPRESSION 686
TRANSLATION ELONGATION 786
TRANSLOCATION 591
TRANSLOCATION WHEATS 1094
TRANSLOCATIONS 682
TRANSMITTANCE 772
TRANSPIRATION 753, 790, 793, 932
TRANSPIRATION EFFICIENCY 453
TRANSPLANTING 478
TRANSPORT 422, 787
TRANSPORT PATHWAY 814
TRANSPOSITION 626
TRANSPOSON 705
TRANSVERSE RELAXATION TIME 923
TRENDS 823
TRICHODERMA 1157
TRICHODERMA LONGIBRACHIATUM 1057
TRICHOTHECENES 1067
TRICHOTHECIUM 1018
TRIFOLIUM REPENS L 551
TRITICALE 579, 835, 1037
TRITICALES 472, 473, 474, 1067, 1091, 1137
TRITICALES (PRODUCT) 427, 1154
TRITICEAE 690
TRITICI 894
TRITICUM AESTIVUM (L.) 759
TRITICUM AESTIVUM (SPRING WHEAT) 924
TRITICUM AESTIVUM L 480, 483, 484, 488, 604, 613, 615, 625, 629, 694, 707, 712, 726, 813, 818, 887, 917, 924, 925, 931, 1101, 1124
TRITICUM AESTIVUM L. 434, 435, 719, 720, 773, 923, 1056
TRITICUM AESTIVUM L., WHEAT 942, 961
TRITICUM AESTIVUM L., WINTER WHEAT 959
TRITICUM DICOCCOIDES 594, 807
TRITICUM DICOCCUM 414, 596
TRITICUM DURUM 399, 416, 429, 469, 496, 544, 562, 573, 576, 596, 610, 723, 724, 849, 865, 899, 943, 956, 957, 963, 967, 968, 1044, 1078, 1085, 1090, 1102
TRITICUM MONOCOCCUM 414, 650, 710, 770
TRITICUM SP. 659
TRITICUM SPELTA 414, 464, 599, 1079, 1128
TRITICUM SPP. 1074
TRITICUM TURGIDUM 662
TRITICUM TURGIDUM DICOCCOIDES 627
TRITORDEUM 964
TRUE PROTEIN 978
TRUNCATULA CV JEMALONG 993
TRYPSIN INHIBITOR 1109
TURGIDUM VAR DICOCCOIDES 807
TURGOR 790
TURKEY 416, 1040
TURNOVER 527
TUSCANY 775, 785, 943
TWO AND SIX ROWED HORDEUM VULGARE L., BARLEY 942
TY1 626
TYROSINE 659
TYROSINE PHOSPHORYLATION 761
UBIQUITIN PROMOTER 740
UKRAINE 411, 461, 1144
ULTRASTRUCTURE 782, 852
ULTRAVIOLET RADIATION 776
UMBRIA (ITALY) 496, 586
UNITED STATES 836, 840, 864, 1092
UNSATURATED FATTY ACIDS 747
UPTAKE 739, 905
UPTAKE OF NUTRIENTS 492
UREA 499, 894, 927, 1007, 1146
UREA SUPPLEMENTATION 990
UREASE 451
UREASE INHIBITOR 506
URIC ACID 978
USA 411, 416
USE EFFICIENCY 463
UTILIZATION EFFICIENCY 613
UTTAR PRADESH 1017
VACUOLES 752
VALIDATION 418
VAPOR PHASE 1152
VARIATION 918
VARIATION COEFFICIENTS 824
VARIETIES 407, 423, 427, 428, 443, 448, 457, 460, 461, 464, 466, 485, 495, 496, 500, 526, 567, 569, 570, 571, 573, 574, 575, 576, 578, 586, 590, 596, 599, 603, 610, 619, 621, 630, 632, 633, 648, 663, 665, 667, 685, 689, 699, 711, 715, 731, 732, 760, 773, 776, 849, 867, 892, 908, 913, 914, 915, 921, 927, 934, 966, 1040, 1051, 1067, 1071, 1078, 1090, 1102, 1108, 1128, 1132, 1139, 1173
VARIETY 1115
VARIETY TRIALS 429, 464, 472, 473, 474, 496, 567, 574, 575, 586, 599, 610, 710, 849, 874, 1085
VARIETY TRIALSFUSARIUM 865
VARIETY YIELD TRIALS 683
VECTOR 835
VECTORS 740, 867
VEGETABLES 630, 841
VEGETATION 757, 791
VEGETATIVE PERIOD 791
VENETO 1090
VENTILATORS 1012
VENTURIA INAEQUALIS 887
VERNALIZATION 487, 622, 625, 628, 629, 766, 810
VERNALIZATION REQUIREMENT 625
VERONICA 954
VERTISOLS 1029, 1031
VERY HIGH GRAVITY 1159
VESICULAR ARBUSCULAR MYCORRHIZA 504
VESICULAR ARBUSCULAR MYCORRHIZAE 920
VFA PRODUCTION 1009
VICIA FABA 447, 545, 546, 548, 549
VICIA HIRSUTA 951
VICIA SATIVA 972
VIOLAXANTHIN DEEPOXIDATION 763
VIROSES 867
VIRULENCE 864, 878
VIRUS STRAINS 860
VISCOELASTIC MATERIALS 1094
VISCOSITY 1052, 1055, 1108, 1115
VITAL MARKER 740
VITAMIN D STATUS 1164
VITIS VINIFERA 876
VIVO 1010
VOLATILITY 1082
VOLTAGE REGULATION 811
VOLUME 541, 1128
VOLUNTARY INTAKE 993
VOLVARIELLA 471
VOMITOXIN 1070
VULGARE L 597
VULGARE L CROSS 628
WALES 898
WALL STRUCTURAL PROTEINS 694
WASTE UTILIZATION 516
WASTEWATER 508
WATER 932, 1046, 1052, 1083, 1087, 1094, 1145
WATER CONSERVATION 754

WATER CONTENT 1072
WATER DOUGH 1088
WATER ECONOMY 419
WATER EROSION 541
WATER EXTRACTABLE RYE ARABINOXYLAN 1115
WATER FLOW 418
WATER HOLDING CAPACITY 554, 1172
WATER POTENTIAL 430, 790
WATER RELATIONS 800, 808, 925, 930
WATER SENSITIVITY 486
WATER SOLUBLE 1 >3 1084
WATER SOLUBLE PENTOSANS 1127
WATER STABLE AGGREGATE 517
WATER STORAGE 550
WATER STRESS 801, 848
WATER UPTAKE 790
WATER USE 1087
WATER USE EFFICIENCY 453, 606
WATER VAPOUR 1052
WATERLOGGING 665, 907, 929
WAXY (WX) PROTEIN 726
WAXY ENDOSPERM CHARACTER 726
WAXY PROTEIN 712
WAXY STARCH 1056
WEANING 1001
WEED 470
WEED COMPETITION 961
WEED CONTROL 398, 549, 552, 553, 565, 941, 946, 948, 949, 950, 951, 954, 956, 957, 958, 962, 963, 965, 967, 968, 970, 971, 972
WEED CONTROL EQUIPMENT 943
WEED DENSITY 959
WEED MANAGEMENT 458
WEEDING 943
WEEDS 537, 542, 549, 559, 561, 565, 809, 941, 942, 943, 946, 948, 956, 958, 963, 965, 967, 968, 972
WEIGHT 544, 574, 575, 586, 1047, 1078, 1090, 1148
WEIGHT GAIN 988, 1039, 1158
WEST ASIA 540
WETHERS 987
WHEAT (WINTER) 434, 435, 617
WHEAT AND INDIAN MUSTARD INTERCROPPING 459
WHEAT BETA D GLUCAN 1084
WHEAT BRAN 1042, 1057, 1164
WHEAT BREAD 1105
WHEAT BY PRODUCTS 1009
WHEAT CLASS 819
WHEAT CROP 418
WHEAT CULTIVAR MIXTURES 883
WHEAT CULTIVARS 801, 961
WHEAT DWARF VIRUS 860
WHEAT FLOUR 1040, 1045, 1052, 1054, 1060, 1064, 1066, 1072, 1073, 1080, 1094, 1108, 1110, 1122, 1123, 1139, 1141
WHEAT FLOUR DOUGH 1083, 1095
WHEAT FLOUR DOUGHS 1134
WHEAT FLOURS 1062, 1145
WHEAT GENOTYPE 432
WHEAT GENOTYPES 698
WHEAT GERM AGGLUTININ 800, 822
WHEAT GLUTEN 756, 1104
WHEAT GRAINS 977
WHEAT GROWTH 778
WHEAT HOMOEOLOGOUS GROUP 2 627
WHEAT KINASE 747
WHEAT LEAVES 605
WHEAT MIDDLINGS 999
WHEAT ROOTS 758
WHEAT RYE HYBRIDS 738
WHEAT RYE TRANSLOCATION 660
WHEAT SCAB 863
WHEAT SEEDLINGS 739
WHEAT SOUR DOUGHS 1110
WHEAT SOYBEAN CROPPING 520
WHEAT SPINDLE STREAK MOSAIC VIRUS 880
WHEAT STRAW 471, 985, 1007, 1013, 1146, 1149, 1151, 1152
WHEAT STUBBLE 993
WHEAT TRITICUM 721
WHEAT TRITICUM AESTIVUM 458, 825
WHEAT YIELD COMPONENTS 436
WHITE BREAD 1072
WHITE CLOVER 551
WHITE PAN BREAD 1081
WHOLE 998
WHOLE CROP WHEAT 992, 996
WHOLEWHEAT FLOUR 1106
WILD BARLEY 606, 708
WILD EMMER 594
WILD OAT INTERFERENCE 458
WINDS 871
WINTER 921, 1092
WINTER BARLEY 422
WINTER CROPS 397, 401, 405, 417, 420, 428, 431, 461, 466, 472, 473, 474, 475, 476, 487, 497, 498, 501, 503, 512, 518, 519, 521, 523, 532, 559, 573, 576, 640, 648, 652, 673, 674, 684, 716, 717, 736, 751, 754, 757, 766, 796, 804, 805, 812, 823, 828, 831, 834, 853, 854, 862, 876, 881, 899, 927, 936, 941, 946, 947, 948, 950, 951, 956, 962, 963, 966, 971, 1021, 1063, 1170, 1171
WINTER HABIT 625
WINTER RYE 441, 527
WINTER TRITICALE 441
WINTER WHEAT 418, 419, 484, 513, 514, 527, 537, 539, 550, 581, 591, 680, 759, 773, 799, 801, 824, 838, 840, 887, 893, 923, 1116
WINTERHARDINESS 810
WOMEN 1105
WOOD 1014, 1147
WORLD 397, 407, 415
WORLD MARKETS 407, 411, 414
WORT 1144
WORT N 1087
WOUNDED WHEAT LEAVES 852
WSSMV 880
X RAY ANALYSIS 1109
X TRITICOSECALE 481
XANTHAN 1083
XANTHOPHYLL CYCLE 763, 779, 788
XANTHOPHYLLS 936
XYLANASE 1009, 1057
YEAR EFFECT 824
YEAST 626, 690, 1069
YEAST SACCHAROMYCES CEREVISIAE 604
YEASTS 1066, 1074
YELLOW DWARF VIRUS 634
YELLOW MEAL WORM 1109
YELLOW RUST 594, 656
YIELD 418, 421, 422, 459, 465, 467, 491, 511, 513, 524, 530, 550, 602, 680, 767, 838, 883, 893, 924, 959, 961
YIELD COMPONENTS 428, 438, 495, 535, 569, 601, 633, 637, 663, 673, 675, 676, 681, 737, 810, 1171
YIELD ELABORATION 670
YIELD FACTORS 405, 433
YIELD FORECASTING 405, 1170
YIELD LOSS 840, 926
YIELDS 420, 439, 443, 446, 457, 460, 462, 477, 494, 499, 500, 503, 507, 521, 531, 533, 538, 556, 584, 646, 648, 655, 667, 754, 771, 853, 907, 920, 974, 1023
YR15 STRIPE RUST RESISTANCE GENE 594
YUGOSLAVIA 466, 637, 640, 673
ZEA MAYS 516, 543, 708, 711, 763, 784, 843, 937, 970, 1020, 1032, 1169
ZEA MAYS L 705
ZEARALENONE 766, 1066, 1070
ZELENY 1116
ZERO 422
ZERO TILLAGE 458, 961, 1023
ZINC 789, 1165
ZINC AVAILABILITY 1096
ZINC DEFICIENCY 770
ZINC EFFICIENCY 770, 789
ZN CONTENT 778
ZN DEFICIENCY 778
ZN EFFICIENCY 778, 789
ZYGOTE DEVELOPMENT 813

## How to obtain the full texts of documents

### 1. Recommendations to scientists:

First determine whether your local library or another library in your country can provide you with a copy of the document you want.

Most authors keep small stocks of reprints of their own publications, and they are usually prepared to respond to a polite request from a fellow scientist. This can be sent on a postcard with a return (institutional) address. In addition, many of the AGRIS input centers have a document delivery service. Your librarian may write and request a photocopy, for which you will often be charged the direct photocopy and mailing cost.

If your librarian is unable to find the document you want, you could send us the document delivery coupon which is included in each copy of *Literature Update on Wheat, Barley and Triticale*. This coupon enables you to ask the CIMMYT or ICARDA library to supply one or two items for your personal research or study. CIMMYT and ICARDA make no charge for this limited service, but the coupons should be used only as a last resort.

Because of copyright regulations, photocopies of entire publications (eg., complete books) cannot be provided.

see Document Delivery Coupon, last page

### 2. Recommendations to librarians:

Make any effort to get access to, as well as collaborate in, *Union Catalogs of Serials*, covering the journal holdings of the libraries in your country or region.

Order a copy of the *Union Catalog of Serials in International Agricultural Research Centers* (available in electronic format from ICRISAT-India[1]).

Establish good working relationships with other librarians and be as helpful as possible in providing document delivery services from the collection you hold.

Make your managers aware of the importance of having your own collection effectively organized, with back copies available for document delivery, with access to a photocopy machine and some funds to provide requested copies of your documents.

Contact the AGRIS input center of your country to make sure that relevant publications of your institution are registered in AGRIS, as well as in your national or regional agricultural database.

Obtain the addresses of all AGRIS input centers and AGLINET libraries (CIMMYT may provide these on request).

There are other useful reference tools that help you to locate the addresses of institutions, such as *Agricultural Information Resource Centers: A World Directory*, published by IAALD[2] and CTA[3]; the *Tropical Agriculture Information Sources* published by CTA.

---

[1] International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh 502324, India

[2] International Association of Agricultural Information Specialists (IAALD)

[3] Technical Centre for Agricultural and Rural Cooperation, P.O.B. 380, 6700 AJ Wageningen, Netherlands

# CIMMYT ADDRESSES

(October 2000)

**Headquarters**

CIMMYT
Apdo. Postal 6-641
06600 México, D.F.
**MEXICO**
Email: cimmyt@cimmyt.org
Web: http://www.cimmyt.org
Telefax: (52) 5804 7558/58047559

**Other CIMMYT Offices**

CIMMYT
P.O. Box 6057, Gulshan
Dhaka-1212
**BANGLADESH**
Email: cm@cimmyt.bdmail.net
Telefax: 880(2) 8823516

CIMMYT
c/o ANAPO
Casilla 2305
Santa Cruz
**BOLIVIA**
Email: cimmyt@bibosi.scz.entelnet.bo
Telefax: 591(3) 427194

CIMMYT
c/o Chinese Academy of Agricultural Sciences
No. 30 Baishiqiao Road
Beijing 100081
**P.R. CHINA**
Email: zhhe@public3.bta.net.cn
Fax: 86(10) 68918547

CIMMYT
c/o CIAT
Apdo. Aéreo 67-13 Cali
**COLOMBIA**
Email: c.deleon@cgiar.org
Telefax: 57(2) 4450025

CIMMYT
Apdo. Postal 55
2200 Coronado
San José,
**COSTA RICA**
Email: gsain@iica.ac.cr
Telefax: (506) 2160281

CIMMYT
P. O. Box 5689
Addis Ababa
**ETHIOPIA**
Email: cimmyt-ethiopia@cgiar.org
Telefax: 251(1) 611892/614645

CIMMYT
12 Calle 1-25 Zona 10
Edificio Geminis,
Torre Norte 16 Nivel, Of. 1606
Apdo. Postal 231-A
Guatemala
**GUATEMALA**
Email: cimmyt@ns.guate.net
Telefax: (502) 3353407

CIMMYT
IARI Campus (NBPGR Building)
Pusa, New Delhi 110012
**INDIA**
Email: cimmyt@vsnl.com
Telefax: 91(11) 5820800

CIMMYT
P.O. Box 374
Almaty 480000
**KAZAKSTAN**
Email: cimmyt@astel.kz
Telefax: 7(3272) 282551

CIMMYT
ICRAF House
United Nations Avenue, Gigiri
P.O. Box 25171
Nairobi
**KENYA**
Email: cimmyt-kenya@cgnet.com
Telefax: 254(2) 522879/524001

CIMMYT
Bunda College of Agriculture
P.O. Box 219
Lilongwe 3
**MALAWI**
Email: bkamanga@malawi.net
marphiri@hotmail.com
Telefax: (265) 277364/277251

CIMMYT
P. O. Box 5186, Lazimpat
Kathmandu
**NEPAL**
Email: cimkat@mos.com.np
phobbs@mos.com.np
Telefax: 977(1) 419352

Universidad Nacional Agraria
La Molina
c/o CIMMYT
Apartado 456
Lima 1
**PERU**
Email: mbarandiaran@lamolina.edu.pe
m.barandiaran@cgiar.org
Telefax: 51(1) 3493136

CIMMYT
c/o IRRI
P.O. Box 3127 MCPO
Makati City 1271
**PHILIPPINES**
Email: m.george@cgiar.org
r.gerpacio-irri@cgiar.org
Telefax: 62(2) 7612404/2406

CIMMYT
c/o ICARDA
P. O. Box 5466
Aleppo
**SYRIA**
Email: m.nachit@cgiar.org
Telefax: 963(21) 2213490/5744622

CIMMYT
P.O. Box 9-188
Bangkok 10900
**THAILAND**
Email: svasal@cgiar.org
cimmyt-bangkok@cgiar.org
Telefax: 66(2) 5614057

CIMMYT
P. K. 39 Emek
06511 Ankara
**TURKEY**
Email: cimmyt-turkey@cgiar.org
h.j.braun@cgiar.og
Telefax: 90(312) 2878955

CIMMYT
CC 1217
Montevideo
**URUGUAY**
Email: cimmyt@inia.org.uy
Telefax: 598(2) 9028522/9023633

CIMMYT
c/o IFPRI
2033 K Street
Washington, DC 20006
**USA**
Email: m.smale@cgiar.org
Telefax: 1(650) 8336631

CIMMYT
The University of Zambia
School of Agricultural Sciences
P.O. Box 32379
10101 Lusaka
**ZAMBIA**
Email: mmwala@agic.unza.zm
Telefax: 260(1) 250587

CIMMYT
P. O. Box MP 163
Mount Pleasant
Harare
**ZIMBABWE**
Email: cimmyt-zimbabwe@cgiar.org
k.pixley@cgiar.org
Telefax: 263(4) 301327/334168

# ICARDA ADDRESSES

(December 1999)

**Headquarters**

ICARDA
P.O. Box 5466
Aleppo
SYRIA
Phone:(963)(21)2213433/2213477
Fax:(963)(21)2213490/2225105

**Regional Offices**

ICARDA
15 G. Radwan Ibn El-Tabib Str.
P.O. Box 2416, Cairo
EGYPT
Phone:(20)(2)5724358/5725785/5735829
Fax:(20)(2)5728099

Agricultural Research, Education & Extension
Organization (AREEO), Ministry of Agriculture
Tabnak Avenue, Evin
P.O. Box 19835-111, Tehran
IRAN
Phone:(98)(21)2400094
Fax:(98)(21)2401855

ICARDA
P.O. Box 950764
Amman 11195
JORDAN
Phone:(962)(6)5525750/5538602/5517561
Fax:(962)(6)5525930

ICARDA
Dalia Building, 2nd Floor
Bashir El Kassar Street
P.O. Box 114/5055, Beirut
LEBANON
Phone:(961)(1)813303
Fax:(961)(1)804071

ICARDA
c/o CIMMYT
P.O. Box 6-641
06600 Mexico, D.F.
MEXICO
Phone: (52)58042004
Fax: (52)58047559/58047558

ICARDA
B.P. 6299, Rabat-Institute, Rabat
MOROCCO
Phone:(212)(7)682909/675496
Fax:(212)(7)675496

ICARDA c/o CIP
Av. La Universidad S/N La Molina
Apartado 1558 - Lima 12
PERU

Phone:(51)(1)3496017/3495783
Fax:(51)(1)3595638

ICARDA
B.P. 435, El Menzah 1
1004 Tunis
TUNISIA
Phone:(216)(1)232207/767829
Fax:(216)(1)751666

ICARDA
P.K. 39 Emek
06511 Ankara
TURKEY
Phone:(90)(312)2873595/-96/-97
Fax:(90)(312)2878955

ICARDA-APRP
P.O. Box 13979
Dubai
UNITED ARAB EMIRATES
Phone:(971)(4)2957338
Fax:(971)(4)2958216

ICARDA
P.O. Box 4564
Tashkent 700000
UZBEKISTAN
Phone:(998)(71)1375259/1375270
Fax:(998)(71)1207125

ICARDA/AREA
Yemen Program
P.O. Box 87334
Dhamar
YEMEN
Phone:(967)(6)500767/500684
Fax:(967)(6)509418/505538

# Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information center/library (see "How to obtain the full text of documents" in this publication).

Send your request to either:
CIMMYT-Document Delivery Service, Apdo. 6-641, 06600 Mexico, D.F., MEXICO, or
ICARDA-Rachis Document Delivery Service, P.O. Box 5466, Aleppo, SYRIA

Please send me a reprint/photocopy of the following document listed in *Literature Update on Wheat, Barley, and Triticale* for purposes of personal study or research:

Volume No./Year _____ Entry Number _____ Author _____

Title _____

Source _____

Year _____ Pages _____ AGRIS Number (if available) _____

Write your name/address on the reverse of this coupon.


# Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information center/library (see "How to obtain the full text of documents" in this publication).

Send your request to either:
CIMMYT-Document Delivery Service, Apdo. 6-641, 06600 Mexico, D.F., MEXICO, or
ICARDA-Rachis Document Delivery Service, P.O. Box 5466, Aleppo, SYRIA

Please send me a reprint/photocopy of the following document listed in *Literature Update on Wheat, Barley, and Triticale* for purposes of personal study or research:

Volume No./Year _____ Entry Number _____ Author _____

Title _____

Source _____

Year _____ Pages _____ AGRIS Number (if available) _____

Write your name/address on the reverse of this coupon.

# Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information center/library (see "How to obtain the full text of documents" in this publication).

Send your request to either:
CIMMYT-Document Delivery Service, Apdo. 6-641, 06600 Mexico, D.F., MEXICO, or
ICARDA-Rachis Document Delivery Service, P.O. Box 5466, Aleppo, SYRIA

Please send me a reprint/photocopy of the following document listed in *Literature Update on Wheat, Barley, and Triticale* for purposes of personal study or research:

Volume No./Year _____ Entry Number _____ Author _____

Title _____

Source _____

Year _____ Pages _____ AGRIS Number (if available) _____

Write your name/address on the reverse of this coupon.

My name and institutional address are:

_____

_____

_____

_____

_____

_____ _____

Date Signature

My name and institutional address are:

_____

_____

_____

_____

_____

_____ _____

Date Signature

My name and institutional address are:

_____

_____

_____

_____

_____

_____ _____

Date Signature

ISSN 1405-1672