

Literature Update on Wheat, Barley, and Triticale



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CIMMYT



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CONTENTS

	Page
Preface	iv
Sample Entries	vi
Notes to Readers	vi
Citations and Abstracts	1
Author Index	99
Keyword Index	105
How to Obtain the Full Text of Documents	120
CIMMYT Addresses	121
ICARDA Addresses	122

Subject Headings and Reference Numbers

	Ref. No.		Ref. No.
Agricultural Economics and Policies	670-672	Handling, Transport, Storage and	
Production Economics	673	Protection of Agricultural Product	1366-1339
Organization, Administration and		Handling, Transport, Storage and	
Management of Agricultural		Protection of Plant Product	1340-1341
Enterprises or Farms	674-675	Animal Feeding	1342-1371
Agro-Industry	676-677	Animal Ecology	1372
Trade, Marketing and Distribution	678-680	Animal Physiology - Nutrition	1373-1380
International Trade	681	Energy Resources and Management	1381
Crop Husbandry	682-752	Water Resources and Management	1382
Plant Propagation	753-757	Soil Chemistry and Physics	1383
Seed Production	758-763	Soil Biology	1384-1388
Fertilizing	764-817	Soil Fertility	1389-1390
Irrigation	818-822	Meteorology and Climatology	1391
Soil Cultivation	823-848	Food Science and Technology	1392-1438
Cropping Patterns and Systems	849-885	Food Processing and Preservation	1439-1459
Plant Genetics and Breeding	886-1051	Food Contamination and Toxicology	1460-1463
Plant Ecology	1052-1069	Food Composition	1464-1492
Plant Structure	1070-1074	Food Additives	1493-1495
Plant Physiology and Biochemistry	1075-1102	Feed Processing and Preservation	1496-1497
Plant Physiology - Nutrition	1103-1111	Feed Contamination and Toxicology	1498
Plant Physiology - Growth and		Feed Composition	1499-1501
Development	1112-1208	Processing of Agricultural Wastes	1502-1503
Plant Physiology - Reproduction	1209-1210	Physiology of Human Nutrition	1504
Pests of Plants	1213-1234	Diet and Diet - Related Diseases	1505
Plant Diseases	1235-1303	Protection of Plants - General Aspects	1211-1212
Miscellaneous Plant Disorders	1304-1318	Mathematical and Statistical Methods	1506-1507
Weeds	1319-1335		

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.



Roger Rowe
Acting Director General, CIMMYT



Adel El-Beltagy
Director General, ICARDA

Sample Entries

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

1 → 172 Reynolds, MP.; Sayre, KD.; Vivar, HE. (1994) INTERCROPPING ← 4
 2 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* ← 6
 7 *Science*. 123(Part 2):175-183. English [CIMMYT WHEAT PROGRAM ← 8
 LISBOA 27 APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

b) Sample entry retrieved from AGRIS (journal article)

1 → 69 Alizaga, R. (Costa Rica Univ., San Jose (Costa Rica). Centro para ← 2
 Investigaciones en Granos y Semillas); Sterling, F.; Herrera, J. (1992) ← 8
 4 → [Evaluation of the vigor in maize seeds and its relationship with the ← 3
 behaviour in the field]. *Evaluacion del vigor en semillas de maiz y su* ← 5
 relacion con el comportamiento en el campo. *Agroñomia Costarricense* ← 6
 7 (Costa Rica) v. 16(2) p. 203-210. 20 ref.; graf. Spanish . (AGRIS 94- ← 9
 116456).

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

1 → 1 Gonzalez Estrada, Adrian (INIFAP. C.E. Valle de Mexico. Ap. Postal 10, ← 2
 Chapingo, Mex. 56230 (Mexico)) (1992) [Economic aspects of agricultural ← 8
 3 research in relation to the production of wheat in Mexico]. *Aspectos* ← 4
 economicos de la investigacion agricola en el cultivo del trigo en Mexico. ← 5
 6 → {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 ← 7
 9 → 94-114649).

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

E10 AGRICULTURAL ECONOMICS AND POLICIES

670 Alston, J.M.; Gray, R.; Sumner, D.A. (1994) THE WHEAT WAR OF 1994. *Canadian Journal of Agricultural Economics-Revue Canadienne d'Economie Rurale*. 42(3):231-251. English. [UNIV CALIF DAVIS DAVIS, CA 95616 USA].

Following the signing of the 1989 Canada-United States Free Trade Agreement, sales of Canadian wheat to the United States grew rapidly. This resulted in a series of trade disputes, culminating in an investigation by the U.S. International Trade Commission (USITC) into the impacts of U.S. imports of Canadian wheat on the U.S. wheat farm program. A USITC finding of "material interference" would have led to a recommendation to implement tariffs or quantitative restrictions against Canadian wheat under Section 22 of the U.S. farm program legislation. The U.S. Department of Agriculture (USDA) claimed such material interference, but the U.S. flour millers, pasta makers and grain handlers, along with Canadian grain industry interests, testified that the true effects of imports are in the order of one-tenth of the effects claimed by the USDA. USITC staff analysis led to intermediate estimates of effects. This study explores the impacts of Canada-U.S. wheat trade on U.S. wheat prices and program costs, explains some of the differences in measured effects, and reports the outcome of the dispute. [References: 56].

671 Carter, C.A. (1994) THE ECONOMICS OF A SINGLE NORTH AMERICAN BARLEY MARKET - A REPLY. *Canadian Journal of Agricultural Economics-Revue Canadienne d'Economie Rurale*. 42(3):413-419. English. [UNIV CALIF DAVIS DAVIS, CA 95616 USA].

This reply is in response to comments made in the November 1993 issue of this Journal [CJAE 41: 271-81] in the invited paper series on the economics of a continental barley market. At that time, the editors regretfully did not allow authors of invited papers to review or respond to the invited comments. [References: 9].

672 Pick, D.; Webb, A.; Dusch, E.; Gudmunds, K. (1994) QUANTITATIVE ASSESSMENT OF UNITED-STATES WHEAT PERFORMANCE FOR QUALITY CHARACTERISTICS. *Canadian Journal of Agricultural Economics-Revue Canadienne d'Economie Rurale*. 42(3):273-290. English. [US ECON RES SERV WASHINGTON, DC 20250 USA].

Quality of U.S. grain exports has been a contentious issue over the past decade. Nowhere is the issue more hotly debated than for wheat. At the core of the debate has been the ability of Canada to command a premium for its wheat in foreign markets. Buyers' perceptions of quality have been suggested as an explanation, but empirical evidence on the quality attributes responsible for this country-of-origin premium has been limited to hedonic pricing studies. This paper quantifies purchasers' perceptions of the relative importance of quality characteristics for the world's major importing countries. This is done by calculating three indices. The attainment index measures how well buyers' perceptions of the importance of the characteristic matches buyers' perceptions of how well it is being supplied. The supply index measures buyers' perceptions on how well a characteristic is being supplied. The demand index measures how important the buyers perceive a particular characteristic to be. Then buyers' perceptions of the performance of U.S. and Canadian wheats are evaluated, given the perceived importance of each characteristic, and related to previous empirical results. Finally, these results are compared for alternative groupings of importing countries. [References: 13].

E16 PRODUCTION ECONOMICS

673 Khan, B.R. (Arid Zone Research Inst., Quetta (Pakistan)); Thomson, E.F.; Rodriguez, A.L. (Arid Zone Research Inst., Quetta (Pakistan). ICARDA, MART/AZR Project Office) (1992) AZRI research plans for 1992/93. MART/AZR project: high elevation research in Pakistan: research report no. 77. International Center for Agricultural Research in the Dry Areas, Aleppo (Syria); USAID, Washington (USA); Arid Zone Research Institute, Quetta (Pakistan). AZRI. Tables; ref. 89 p. English. (AGRI 95-010931).

E20 ORGANIZATION, ADMINISTRATION AND MANAGEMENT OF AGRICULTURAL ENTERPRISES OR FARMS

674 Biggs, S.D.; Farrington, J. (1993) Farming systems research and the rural poor: a political economy approach. *Journal of farming systems research-extension (USA)* v. 3(2) p. 59-82. references. English. (AGRI 95-000701).

675 Wahl, T.I.; O'Rourke, A.D. (1994) The economics of sprout damage in wheat. *Agribusiness: an international journal (USA)* v. 10(1) p. 27-41. references. English. (AGRI 95-010996).

E21 AGRO-INDUSTRY

676 Anon. (1994) [Wheat starch producing factory put into operation in Saxony-Anhalt]. *EBS setzt auf Ostdeutschland. Agra-Europe (Germany); Laenderberichte* v. 35(20) p. 14-16. German. (AGRI 95-000834).

677 Petrova, I. (Institut po Z'meni khрани i Furazhna Promishlenost, Kostinbrod (Bulgaria)) (1993) [Method for semolina producing from small durum wheat samples]. *Metod za poluchavane na gris ot malki probi tv'rda pshenitsa. Selskostopanska Akademiya, Sofia (Bulgaria). Rasteniye "dri Nauki (Bulgaria); Plant Science* v. 30(7-8) p. 14-16. 1 ill., 1 table; 10 ref. Bulgarian. (AGRI 95-011101).

E70 TRADE, MARKETING AND DISTRIBUTION

678 Allen, E.; Harwood, J. (1992) Why the drop in winter wheat seedlings? *Agricultural outlook (USA) (no. 183)* p. 15-16. English. (AGRI 95-011325).

679 Hasenkamp, D. (1994) [Ten millions hectoliters (of wheat beer) and no end. On the continual rise of wheat beer]. 10 Millionen Hektoliter und kein Ende. Der unaufhaltsame Aufstieg des Weizenbieres. *Biergrosshandel (Germany)* v. 46(12) p. 455-458, 460. 8 ill. German. (AGRI 95-001039).

680 Koncos, P. (Ministerstvo Podohospodarstva Slovenskej Republiky, Bratislava (Slovak Republic)) (1994) [1994 purchase quotas and guaranteed price for food wheat in Slovakia]. *Zasady zalohoveho nakupu psenice potravinarskej z urody roku 1994. Informacie Ministerstva Podohospodarstva Slovenskej Republiky (Slovak Republic)* v. 22(5) p. 9. Slovak. (AGRI 95-011336).

E71 INTERNATIONAL TRADE

681 Whitwell, G. (University of Melbourne (Australia)) (1993) International wheat marketing in the post-war period: an Australian perspective on the era of discriminating buyers. *The rise and fall of mass marketing. Tellow, R.S.; Jones, G. (eds.)* p. 162-182. Routledge. 13 ref. English. (AGRI 95-011472).

F01 CROP HUSBANDRY

682 Adary, A.H.; Kadir, M.A.; Al Fahady, M.Y. (Mosul Univ. (Iraq). Coll. of Agric.) (1992) [The effect of sowing date and planting rate on agronomic characteristics of triticale under limited rainfall conditions]. *Ta't'i:r mawa:3id al-zira:3iyyat wa mu3dala:t al-bid'a:r 3ala al-s'ifat al-h'aqliyah fi: al-qamh" al-s'ilami: tah"at al-z'uruf al-'di:miah mah"adudah al-'am'a:r. Mij'alat 'iba' li'abh'a:t" al-zira:3iyyat (Iraq); Ipa Journal of Agricultural Research* v. 2(no.1) p. 1-9. 4 tables; 5 ref. Arabic. (AGRI 95-001232).

Three sowing dates and three planting rate of 80, 160 and 240kg/ha were used with the triticale. The planting rate of 240kg/ha gave the highest yield and the highest biological yield for the two seasons, respectively. Planting triticale during November gave the highest grain

yield, biological yield, harvest index, number of heads/m² and kernels/head.

683 Amsal Tarekgegne (1994) Yield Potential of Rainfed Wheat in the Central Highlands of Ethiopia. Alemaya University of Agriculture (Ethiopia). 19 tables; 3 fig.; 157 ref. 151 p. English. (AGRIS 95-001329).

684 Anon. (1994) [Improvement of the world coarse grain production expected]. Erholung der Welt-Großgetreideerzeugung in Aussicht. *Agra-Europe (Germany)*; *Markt und Meinung* v. 35(23) p. 17-21. 2 tables. German. (AGRIS 95-001284).

685 Anon. (1994) [Summer barley cultivation. Central points are North Bavaria, Thuringia and Saxony]. Sommergerste: Schwerpunkte in den Regionen bleiben. Nordbayern, Thüringen und Sachsen nach wie vor Anbauzentren. *dlz. Die landwirtschaftliche Zeitschrift fuer Produktion - Technik - Management (Germany)* v. 45(3) p. 52. 1 ill. German. (AGRIS 95-001272).

686 Barasebwa, Liberate (ISAR, Butare (Rwanda)) (1994) Wheat Production and Research in Rwanda: Constraints and Sustainability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 37-41. CIMMYT. 2 tables; 6 ref. English. (AGRIS 95-001244).

Wheat was introduced in Rwanda during the 1930s, and remained a secondary crop with yields below 1 t/ha. In the last 10 years, wheat research has developed improved varieties and management techniques, increasing yield potential to 3.5 t/ha under experimental conditions and to 1.5 t/ha under small-holder conditions. Wheat production and constraints are discussed on the basis of Rwanda's agro-ecological zones.

687 Barasits, T.; Tomcsanyi, A. (1994) CHARACTERISING THE EFFECT OF SEED RATE ON YIELD COMPONENTS OF WINTER AND SPRING BARLEY VARIETIES BY DIFFERENT FUNCTIONS. *Növénytermelés*. 43(5):387-401. Hungarian. [CEREAL RES INST RES STN H-9761 TAPLANSZENTKERESZT HUNGARY].

The effect of seed rate on the yield components of winter and spring barley varieties was studied in 1988-91 in a range of 25-1200 germ/m². This effect was approached by linear, second order, power, logarithm and hyperbolic functions and it was examined which one of these functions described it best from agronomic standpoint. The results obtained were analysed not only in themselves but it was also examined how they influence the correlation of seed dose/yield suggesting a hyperbolic function, as the authors already reported in a former paper. The followings were concluded: The change in ear number can be best characterized by hyperbola, according to this the ear density settles at the level appropriate for the ecological conditions at a relative low seed rate. The change in ear mass can be exactly described also by negative power and negative linear functions. Consequently on the effect of densified plant number, the ear mass gradually decreases. The thousand-grain-mass often did not change in the interval examined, in some cases however it showed a slight depressive character. Therefore the opinion of the authors is that the plant density modifies the thousand-grain-mass only in a small degree. On account of the considerable stability in thousand-grain-mass, the decline in ear mass is caused first of all by the decrease of grain/ear component /ear size/. A contradiction appeared at the simultaneous examination of the above described changes in yield components and the hyperbolic yield change treated in length in a former paper: on the basis of hyperbolic ear density and decreasing ear mass, at higher seed rates a yield depression would be expected. This depressive tendency was not shown by the authors' experiments. The attention was called to this phenomenon - the interrelated paradox of yield elements. Further studies are needed to release the contradiction.

688 Beese, G. (Saechsische Landesanstalt fuer Landwirtschaft, Nossen (Germany)) (1994) [Cultivation of spring wheat, spring barley and Avena sativa. Spring grain in upward trend?]. Zur Anbauwuertigkeit von Sommerweizen, Sommergerste und Hafer: Sommergetreide im Aufwind? *Neue Landwirtschaft (Germany)* (no.2) p. 42-43. 2 tables. German. (AGRIS 95-001237).

689 Bekele Geleta; Amanuel Gorfu; Getnet Gebeyehu (IAR, Addis Abeba (Ethiopia)) (1994) Wheat Production and Research in Ethiopia: Constraints and Sustainability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 18-25. CIMMYT. 4 tables; 8 ref. English. (AGRIS 95-001241).

Ethiopia is the largest producer of wheat in sub-saharan Africa with an estimated area of 750 thousand ha currently under wheat production, and a projected potentially suitable area of 1.3 million ha. Wheat is a staple food in Ethiopian diets, and spring bread and durum wheats are the dominant species grown in the country. The national mean wheat grain yield is low due to suboptimal crop management practices. Almost all wheat in Ethiopia is produced under rainfed conditions although there has been some developmental research on irrigated production. Rainfed wheat is cultivated by both small-scale peasant farmers and large-scale state farms. Ethiopia is not self-sufficient in wheat; to bridge the gap, wheat has been designated as one of the high priority commodity crops for improvement through research. Since the inception of wheat research in the country, several varieties have been disseminated to farmers with a recommended production package. A substantial gap has been observed between yields on research stations and on farmers' fields primarily due to inefficient transfer of technology and the lack of necessary inputs for wheat production. The major technical constraints limiting wheat production are the lack of disease resistant and high yielding varieties adapted to a range of environments, poor crop management practices, the unavailability or inadequacy of crop production inputs, and the lack of credit systems. Current strategy is focused on the development of an effective national research and technology generation system coupled with an efficient extension and adoption mechanism that would lead to national self-sufficiency in food production, including wheat.

690 Castelli, F.; Devoti, P. (Istituto Sperimentale per il Tabacco, Scafati, Salerno (Italy)) (1993) [Bright tobacco in continuous cropping and in two year rotations with wheat - barley and barley+soybean at two fertilizer input levels]. Il tabacco Bright in coltura continua e in rotazioni biennali con frumento - orzo e orzo+soia a due livelli di fertilizzazione. *Agricoltura Ricerca (Italy)* v. 15(151-152) p. 43-53. 10 tables; 16 ref. Italian. (AGRIS 95-012009).

691 Chastain, TG.; Ward, KJ.; Wysocki, DJ. (1995) STAND ESTABLISHMENT RESPONSES OF SOFT WHITE WINTER WHEAT TO SEEDBED RESIDUE AND SEED SIZE. *Crop Science*. 35(1):213-218. English. [OREGON STATE UNIV DEPT CROP & SOIL SCI CROP SCI BLDG 107 CORVALLIS, OR 97331 USA].

The adoption of soil-conserving management systems in dryland soft white winter wheat (*Triticum aestivum* L.) production areas is limited by concerns that seedbed residues contribute to suboptimal stand establishment. Field trials were seeded in 1990 (Trial 1) and 1991 (Trial 2) near Pendleton, OR, to ascertain seedbed crop residue, seed size, and cultivar effects on emergence, early growth and development, and yield of soft white winter wheat. Seedbeds were much drier in Trial 2 than in Trial 1. Seed-soil contact was probably reduced in high residue cover, but emergence rate was reduced by seedbed residue in Trial 2 only when seed zone water content was <120 g kg⁻¹. Consequently, plant growth and development were responsive to seedbed residues only in Trial 2. Final stand density and grain yield were not sensitive to seedbed residue level in either trial. Seed size had no effect on laboratory germination, but seedlings from large seed emerged more rapidly in the field. Plants grown from large seed were taller, heavier, and had more tillers than plants grown from small seed. Planting large seed had no effect on grain yield in Trial 1, but plants grown from large seed produced 4.2% greater grain yield than from small seed in Trial 2. Cultivar performance was determined by genetic potential, seed size, and seed quality, and was not differentially influenced by seedbed residue level. Emergence was influenced by coleoptile length which differed among cultivars, but coleoptile length was not related to seed size. Higher levels of seedbed surface residues required to reduce soil erosion in dryland crop production systems do not reduce stand establishment or yield of soft white winter wheat. [References: 27].

692 Convertini, G.; Rizzo, V.; Maiorana, M.; Di Bari, V. (Istituto Sperimentale Agronomico, Bari (Italy)) (1993) [Ploughing in of durum wheat crop residues with different nitrogen and phosphorus levels. 2: Effects on main parameters of soil fertility]. *Interramento dei residui vegetali di frumento duro in monosuccessione con dosi crescenti di azoto e fosforo. 2: Effetti su alcuni parametri della fertilità del suolo. Agricoltura Ricerca (Italy) v. 15(151-152) p. 77-82. 3 tables; 4 graphs; 22 ref. Italian. (AGRS 95-011726).*

693 Degler, H. (1993) [Quantifying the temporal course of the remission of wheat canopies in the visible spectral range and the near infrared under consideration of the influence of soil]. *Quantifizierung des zeitlichen Verlaufs der Remission von Weizenbeständen im sichtbaren Spektralbereich und nahen Infrarot unter Berücksichtigung des Bodeneinflusses. Archives of agronomy and soil science (Germany) v. 37(3) p. 171-179. 7 ill.; 7 ref. German. (AGRS 95-001238).*

694 Dekov, D.; Kolev, T. (Institut po Pamuka i Tv'rdata Pshenitsa, Churpan (Bulgaria)); Belcheva, S.; Ivanova, I.; Nenkova, D. (1993) [Effect of some growth regulators on the productivity and on the quality of durum wheat var Zagorka]. *Vliyanie na nyakoi rastezhni regulatori v'rkh produktivnosta i kachestvoto na tv'rdata pshenitsa sort Zagorka. Selskostopanska Akademiya, Sofia (Bulgaria). Rasteniev' dni Nauki (Bulgaria); Plant Science v. 30(7-8) p. 10-13. 4 tables; 15 ref. Bulgarian. (AGRS 95-011723).*

695 Ding Zhengrong; Zhang Fengming; He Xiong (Xinjiang Academy of Agricultural Sciences, Urumqi (China)) (1993) Benefit analysis of one ton grain output/mu of intercropping wheat and maize in Hetian River valleys, Xinjiang [China]. *Xinjiang Agricultural Sciences (China) (no. 4) p. 139-141. 6 tables. Chinese. (AGRS 95-001322).*

696 Ercoli, L. (Scuola Superiore di Studi Universitari e di Perfezionamento S. Anna, Pisa (Italy)); Masoni, A.; Mariotti, M. (Pisa Univ. (Italy). Dipartimento di Agronomia e Gestione dell'Agroecosistema) (1993) [Comparative analysis of the growth and development pattern of wheat (*Triticum aestivum* L.) - rye (*Secale cereale* L.) and triticale (*Triticosecale Wittmack*)]. *Confronto tra i modelli di accrescimento e di sviluppo del frumento (Triticum aestivum L.) - della segale (Secale cereale L.) e del triticale (Triticosecale Wittmack). Agricoltura Ricerca (Italy) v. 15(149) p. 27-36. 3 tables; 9 graphs; 10 ref. Italian. (AGRS 95-011718).*

697 Ficher, R.A. (CIMMYT, Mexico D.F. (Mexico)) (1994) The Sustainability Debate and Wheat Science in Australia, Developing Countries and CIMMYT. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 4-17. CIMMYT. 3 tables; 2 fig.; 14 ref. English. (AGRS 95-001240).*

The debate about sustainability in agriculture, while overlooking the major indirect contribution of wheat scientists to the conservation of the resource base of agriculture, has rightly highlighted the need for explicit attention to this resource base. Major wheat farming systems, increasingly important for feeding mankind, provide an appropriate focus about which to pursue this issue. Valuable lessons are provided by examination over the last 130 years of wheat farming in Australia. Through cycles of failure and research-driven recovery, it has evolved towards greater sustainability. Heavy investment in basic and applied research, a good proportion of skilled farmers, and reasonably sound economics were critical. By contrast, many wheat systems in developing countries, while growing in productivity, appear to have threatened sustainability. Some irreversible natural resource degradation is obvious in the form of soil erosion, over pumping from aquifers, and massive salinization; other hopefully reversible, degradation is probably widespread. More research specifically targeting soil and water issues is needed, along with decentralized multicommodity and multidisciplinary NARS research centers having a strong commitment to regional farming systems and an all-pervading sustainability perspective. Traditionally, the CIMMYT Wheat Program has worked globally with germplasm and other technical

products of broad applicability. Over time, we have inevitably become concerned about our impact upon, and the evolution of, major wheat cropping systems in the developing world. Some five years ago, we began collaborative research on natural resource issues in the vast and dominating rice-wheat cropping system of South Asia. Despite our being a global crop center, the rice-wheat research model appears successful, and has revealed specific complementarities with our traditional more crop-specific research activities. Could CIMMYT play a similar role in other major wheat cropping systems of developing countries?

698 Fiez, TE.; Miller, BC.; Pan, WL. (1994) WINTER WHEAT YIELD AND GRAIN PROTEIN ACROSS VARIED LANDSCAPE POSITIONS. *Agronomy Journal. 86(6):1026-1032. English. [WASHINGTON STATE UNIV DEPT CROP & SOIL SCI PULLMAN, WA 99164 USA].*

Winter wheat (*Triticum aestivum* L.) yield varies greatly among landscape positions in the Palouse region of eastern Washington, yet N fertilizer is typically applied uniformly. Varying N fertilizer rates within fields to match site-specific N requirements can increase fertilizer use efficiency; however, spatially variable N management programs are limited by their ability to predict site-specific yield potentials and the resultant N requirements. The objective of this study was to ascertain the role of yield components and soil properties in determining soft white winter wheat grain yield and protein when N application rates are varied among landscape positions. Nitrogen fertilizer (0 to 140 kg N ha⁻¹) was fall-applied on footslope, south-backslope, shoulder, and north-backslope landscape positions at each of two farms in 1989 and in 1990. Grain yield among landscapes varied by up to 55% in 1990 and by up to 33% in 1991. Landscape position grain yields increased by 199 kg ha⁻¹/(cm precipitation + soil water reduction) ($r(2) = 0.51$) and by 706 kg ha⁻¹ per 100 spikes m⁻² ($r(2) = 0.76$). Grain protein concentration among landscapes increased by 2.7 g kg⁻¹ per each increase of 10 kg residual soil NO₃-N ha⁻¹ ($r(2) = 0.82$). The large differences in grain yield among landscape positions may justify spatially variable N application. Improved N management should favorably reduce soft white winter wheat protein concentrations by minimizing high residual N levels as well as improve net returns and reduce environmental degradation. The basis for this improved N management may be site-specific field estimates calculated from soil water availability and spike density [References: 31].

699 Gerowitt, B. (Goettingen Univ. (Germany). Forschungs und Studienzentrum Landwirtschaft und Umwelt); Adner, A. (1994) [Examples of computer aided decision making]. *Beispiele fuer computergestuetzte Entscheidungshilfen. (Integrated plant production); (Systems of sustainable plant production, grounding, experience, developments - arable farming, vegetables, fruits, hops, grassland). Dierks, R.; Heitefuss, R. 2. Auflage p. 215-230. BLV Verlagsgesellschaft. 9 graphs, 3 tables; 20 ref. German. (AGRS 95-001236).*

700 Giorgio, D. de; Stelluti, M.; Rizzo, V. (Istituto Sperimentale Agronomico, Bari (Italy)) (1993) [Study on root system of sunflower submitted to two different agrotechnical input levels in rotation with wheat durum (in Apulia)]. *Studio dell'apparato radicale del girasole in rotazione con il frumento duro e sottoposto a due livelli di input agrotecnici (in Puglia). Agricoltura Ricerca (Italy) v. 15(151-152) p. 113-123. 9 tables; 4 graphs; 17 ref. Italian. (AGRS 95-011751).*

701 Giref Sahile; Abate Tedla (1993) Effects of weeding practices on grain and straw yield of durum wheat under traditional and improved seedbed preparation on Vertisols in the Ethiopian highlands. 5. *Annual Conference of the Crop Science Society of Ethiopia; Addis Ababa (Ethiopia); 2-3 Feb 1993. ILCA, Addis Ababa (Ethiopia). ILCA. 2 tables; 5 ref. Presented paper. 7 p. English. (AGRS 95-011585).*

The effects of six different hand weeding practices under two seedbed methods of Vertisols on the grain and straw yield of durum wheat were studied at Debre Zeit, Ethiopian medium altitude site. The improved seedbed method which was a broadbed and furrow system (BBF) had a significantly higher yield in both grain and straw of durum wheat compared with the traditional seedbed method (flat). In fact, the BBF effect on the grain and straw yield was 49 percent and 22 percent, respectively over the traditional flat. The different weeding practices after plant emergence showed significantly increased wheat straw yield over the non-weeding practice. However, such effect difference was not

detected on wheat grain yield. In addition, the various broad leaf and grass weeds of durum wheat under medium altitude site on Vertisol have been identified and presented.

702 Girma Getachew; Abate Tedla; Seyoum Bediye; Amaha Sebsibe; Aschalew Tsegahun; Kahsay Berhe (1993) Research review on improvement and utilization of barley straw. *Barley Research Review and Strategy Workshop; Addis Ababa (Ethiopia); 16-19 Oct 1993*. ILCA, Addis Ababa (Ethiopia). ILCA. 11 tables; ref. Presented paper. 21 p. English. (AGRIS 95-011586).

There is a substantial under utilization of barley straw as animal feed in Ethiopia. The major constraints on the use of barley straw as animal feed are low nutrient content, low voluntary intake, poor digestibility, straw use for other purposes and inavailability of storage facility. The low nutritive value could be upgraded to support increased animal production. There are a number of factors that affect the quality of barley straw. Some of these are variety of the crop, environmental condition under which barley is grown, management of the crop, stage of harvest and post harvest handling of the straw. Very limited work has been done on barley straw production quality assessment, improvement and utilization as animal feed in Ethiopia. This paper presents review of previous research work on barley straw quality improvement and utilization in the country. Most of the results presented in this paper are the outcome of different experiments that require further work to make a coherent and valid conclusion.

703 Girma Getachew; Abate Tedla; Seyoum Bediye; Amaha Sebsibe; Aschalew Tsegahun; Kahsay Berhe (1993) Research strategy for barley straw quality improvement and utilization. *Barley Research Review and Strategy Workshop; Addis Ababa (Ethiopia); 16-19 Oct 1993*. ILCA, Addis Ababa (Ethiopia). ILCA. Presented paper. 7 p. English. (AGRIS 95-011943).

Since human and livestock population are rearing the maximum carrying capacity of the Ethiopian highlands, research should concentrate on more intensive systems that produce higher yields of protein and energy. Shortage of feed is one of the major factor limiting livestock production in the highlands. Cereal crop residue, particularly barley straw is one of the available feed resource for livestock during dry season. However the utilization is limited because of its poor nutritive value. There has not been sufficient work on improving the quality of barley straw and its utilization as animal feed. Emphasis will be given to assess implications of a more widespread use of barley straw as livestock feed and possibilities of improving nutritional value. Research efforts will be directed to develop methodologies by which the utilization of this resource could be improved. Priority areas of research are identified for barley straw quality improvement and utilization. Strategy of research including objective, expected output and plan of action for short, medium and long term are presented.

704 Graser, S. (Landesanstalt fuer Ernaehrung, Muenchen (Germany)); Steinhauser, H. (1994) [Malting barley market gets under pressure]. Braugerste: Noch kaum Vorvertraege. Braugerstenmarkt kommt unter Druck. *dlz. Die landwirtschaftliche Zeitschrift fuer Produktion - Technik - Management (Germany) v. 45(3) p. 50-51*. 3 ill. German. (AGRIS 95-001581).

705 Gromova, Z.; Dancak, I. (1995) THE TRITICALE YIELD IN DEPENDENCE ON THE SOWING METHOD AND FERTILIZATION. *Rostlinna Vyroba. 41(1):5-10*. Czech. [UNIV AGR NITRA A HLINKU 2 NITRA 94976 SLOVAKIA].

The task of this work was to study the influence of environment and anthropogenic elements on predication and reduction of triticale yield elements with regard to the variety specification and environmental protection in interaction to the rate and quality of production. Field polyfactorial trials were established in the years 1990 to 1993 on plots of VEB-AF-VSP in Nitra located in Dolna Malanta in climatically mild dry area. The variety used was the Dagro and newly-breed varieties KS-12 and UH-127, seed rate 6 mil. germinating seeds per square hectare, three seeding methods and three fertilization ways. The highest structure of determined yield elements, the highest number and weight before harvest, the whole number of main culm spikes and productive shoots, productive spikelets, spike grains number, spike grains weight, 1.000-

grain weight (in grams) and that is why the highest yields (in tons per hectare) were achieved by newly-breed varieties of triticale in interaction to the sowing method (drill coulter point) by application of organic fertilizers - the effectiveness coefficient was by 1.20 to 2.30 (455 to 900 Sk). Within the framework of the plant material used the most flexible in our conditions was the newly-breed variety UH-127 with the highest grain yield (7 tons per hectare) in the first and other methodologically modified years. KS-12 did not react to the arid conditions of the year 1993 by higher yield (+0, 6 tons per hectare) in comparison to the UH-127. Yield elements are reduced by the sowing rate and they achieved with 6 mil. germinating grains per hectare 61 to 66 %, with 4 mil. germinating grains per hectare 50 to 58 % plant reduction. By the influence of the weather (arid year 1993) plants were reduced from sowing date to the harvest from 65 to 70 % and 56 to 61 % of them are reduced from the germination period to the harvest. From the point of view of cultural practices used the participation of variety 11.98 %, fertilization 50.12 % and that of sowing method 37.90 % on the yield was important. By testing potential and actual spike productivity the best results were achieved by both newly-breed varieties on the level of combination of fertilizers (manure and fertilizer). Results have confirmed that it is possible to eliminate differences in the yield of grains in cultivars by good production system.

706 Guivarch, J.P. (1993) [Conditions for emergence of "micro channels". A case study (production of specified cereals)]. Conditions d'emergence d'une microfilliere. Etude de cas [production de cereales specifiees]. *Agricultural practices and water quality. Elaboration of a research and development project concerning a hydromineral perimeter, 1989-1992. Agriculture et qualite des eaux. Diagnostic et propositions pour un perimetre de protection. Programme de recherches 1989-1992. Anon. p. 228-250*. INRA. French. (AGRIS 95-001260).

707 Gumisiriza, G.; Wagoire, W.; Bungutsiki, B. (Wheat and Barley Development Project, Jinja (Uganda)) (1994) Wheat Production and Research in Uganda: Constraints and Sustainability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 51-56. CIMMYT. 7 ref. English. (AGRIS 95-001246).

Following the introduction of wheat into Uganda at the beginning of this century, it has been grown at altitudes above 1500 m by small-scale producers mainly for home consumption. Production technologies have not changed much over several decades. Research into the use of high yielding varieties, fertilizer and other modern management practices did not start until the mid 1970s, and results from these efforts are yet to influence traditional farming practices. There is currently a drive in Uganda to generate technology to increase wheat production, as consumption of this crop, and, therefore, its demand has increased, especially in the urban centers. In addition to the traditional highland growing areas, efforts are being made to assess wheat performance in the mid-altitude, non-traditional areas, ranging between 1000 and 1500 m a.s.l. This paper discusses wheat production levels and technologies over the recent past in Uganda as well as the progress and problems associated with the current endeavor to increase production.

708 Hammed, M.Y. (Univ. of Mosul. Coll. of Agric. and Forestry (Iraq)) (1993) [Factor analysis in bread wheat]. Al-Tah"lil: al-3a:mill: fi: h"unt"at al-h"ubaz. Mij"alat zira:3ah al-ra:fidi:n (Iraq); *Mesopotamia Journal of Agriculture v. 25(no.3) p. 53-57*. 2 tables; 14 ref. Arabic. (AGRIS 95-001326).

Three varieties saberbeg, aras and Nowri 70 and levels of nitrogen fertilizer 0, 40 and 80 kg N/ha were used in this investigation. The phenotypic correlation coefficients between studied characters were estimated and showed significant values. A factor analysis based on grain yield and other traits showed three groups to be the most important yield components.

709 Harrison, DF.; Cameron, KC.; Mdaren, RG. (1994) EFFECTS OF SUBSOIL LOOSENING ON SOIL PHYSICAL PROPERTIES, PLANT ROOT GROWTH, AND PASTURE YIELD. *New Zealand Journal of Agricultural Research. 37(4):559-567*. English. [LINCOLN UNIV DEPT SOIL SCI POB 84 LINCOLN NEW ZEALAND].

Subsoil loosening of an 8-year-old dryland pasture soil (Templeton silt loam) at either of two depths (27 or 47 cm) resulted in a significant ($P < 0.1$) decrease ($>10\%$) in soil bulk density and a concomitant increase in soil porosity compared with undisturbed soil. The hydraulic conductivity of the loosened soil was significantly ($P < 0.05$) greater than that of the undisturbed soil, reflecting the increased pore continuity within the depth of loosening. These more rapid drainage rates resulted in a drier soil profile at the start of spring, 10 months after subsoil loosening. These improved soil physical conditions permitted more rapid root growth and the development of a more extensive pasture root system with a significantly ($P < 0.1$) greater (36%) root length below 30 cm depth. Subsoil loosening resulted in significant increases in pasture production over the first 3 months of spring (August-October). [References: 37].

710 Jaervenpaeae, Markku (1992) [Influence of harvesting technique on the germination capacity of spring wheat]. Korjuuteknikaan vaikutus kevaetvehnaen itaevyyteen. *Tyotetohoseuran julkaisu* (Finland); no. 327 108 p. Tyotetohoseura. 139 ref. Finnish. (AGRIS 95-011716).

711 Josephides, C. (Agricultural Res. Inst., Nicosia (Cyprus)) (1994) Macedonia: a new high yielding and high quality durum wheat cultivar. *Technical Bulletin (Cyprus)*; no. 163 6 p. 4 tables; 2 illus. 10 ref. English. (AGRIS 95-011724).

This new variety originated from a cross of Vic, introduced from North Dakota, and Karpasia, a variety selected earlier and presently grown in Cyprus. It has stronger gluten and more yellow pigment than Karpasia.

712 Karanja, Daniel D.; Pinto, J.M. (N.P.B.R.C., Private Bag, Njoro, (Kenya)) (1994) Wheat Production and Research in Kenya: Constraints and Sustainability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 26-31. CIMMYT. 2 fig.; 15 ref. English. (AGRIS 95-001242).

Kenya imports half of its domestic wheat requirements. Demand continues to outstrip domestic supply leading to escalating imports. The challenge facing the country is to aggressively step up local production and dampen imports by switching to wheat blends. Although research has provided numerous improved varieties and complementary recommendations, production continues to be dismal. The production structure changed from exclusively large-scale to dual large- and small-scale production systems, both in high- and marginal-potential regions. This shift poses a great challenge to researchers to provide appropriate wheat production technologies, especially to small-holders and those in marginal environments. The ability of research to respond to the growing demand of the wheat industry is hampered by inadequate research funds and facilities, and lack of research continuity. These problems limit the capacity of research to provide a continuous stream of desired technologies for improved and sustainable wheat production, and thus, require urgent attention.

713 Karczmarczyk, S.; Koszanska, E.; Sciazko, D.; Roy, M. (Akademia Rolnicza, Szczecin (Poland)) (1993) [Changes of some physiological processes and yield of winter wheat and triticale under the influence of sprinkling irrigation and nitrogen fertilization. Pt. 2. Activity of some enzymes and yield of winter wheat and triticale]. *Przebieg niektórych procesow fotosyntetycznych oraz plonowanie pszenicy ozimej i pszenizyta pod wplywem deszczowania i nawozenia azotem. Cz. 2. Aktywnosc niektórych enzymow oraz plonowanie pszenicy ozimej i pszenizyta*. *Acta Agrobotanica (Poland)* v. 46(1) p. 31-38. 4 tables; 7 ref. Polish. (AGRIS 95-011722).

Both sprinkling irrigation and high doses of nitrogen enhanced the activity of nitrate reductase and peroxidase and slightly that of acid phosphatase. Sprinkling irrigation and intensive nitrogen fertilization significantly increased the crops of winter wheat and triticale.

714 Karczmarczyk, S.; Koszanski, Z.; Podsiadlo, C. (Akademia Rolnicza, Szczecin (Poland). Katedra Podstaw Produkcji Roslinnej i Nawadniania Roslin) (1993) [Changes of some physiological processes and yield of winter wheat and triticale under the influence of sprinkling irrigation and nitrogen fertilization. Pt. 1. Chlorophyll and carotenoid content in some organs winter wheat and triticale]. *Przebieg niektórych procesow*

fizjologicznych oraz plonowanie pszenicy ozimej i pszenizyta pod wplywem deszczowania i nawozenia azotem. Cz. 1. Zawartosc chlorofilu i karotenoidow w niektórych organach pszenicy. *Acta Agrobotanica (Poland)* v. 46(1) p. 15-30. 6 fig., 3 tables; 16 ref. Polish. (AGRIS 95-011721).

The results obtained show that the applied treatments (nitrogen and sprinkling irrigation) significantly increased the yield of dry matter of the tested organs, and their chlorophyll and carotenoid content. Compared to winter wheat a higher concentration of the pigments was found in triticale. Sprinkling irrigation in high nitrogen fertilization inhibited the process of pigment decomposition of and hence the time of photosynthetic activity of the tested plants was extended.

715 Kjer, I.; Meier Ploeger, A.; Vogtmann, H. (1994) [Hops and barley from ecological cultivation. Quality and influence on the raw-, intermediate and finished products in brewing]. *Hopfen und Gerste aus oekologischem Anbau. Qualitaet und Einfluss auf die Roh-, Zwischen- und Endprodukte der Bierherstellung*. *Brauwelt (Germany)* v. 134(12) p. 462-469. 6 ill., 4 tables; 36 ref. German. (AGRIS 95-001270).

716 Knauer, N. (1994) [Agricultural ecosystems in conventional and integrated plant production]. *Agrarökosysteme im konventionellen und im integrierten Landbau. (Integrated plant production); (Systems of sustainable plant production, grounding, experience, developments-arable farming, vegetables, fruits, hops, grassland)*. Dierks, R.; Heitfuss, R. 2. Auflage p. 19-31. BLV Verlagsgesellschaft. 10 graphs; 23 ref. German. (AGRIS 95-001199).

717 Lejina, B. (Latvian Scientific Research Institute of Agriculture, Skriveri (Latvia)) (1993) [Influence of specific grain weight on the yield and crop rotation productivity]. *Labibu ipatsvara ietekme uz razu un augseku. Latvijas Lauksaimnieks (Latvia) (no.5)* p. 14-17. 5 tables. Latvian. (AGRIS 95-011652).

Five six-field crop rotations have been investigated on sod podzolic loam soil at Skriveri Experimental Farm of Institute of Agriculture beginning with 1969. The specific grain weight was from 33-100. The effect of preceding crops and of crop rotation specific weight on the yields have been analysed and are shown in tables. The yields of different grain crops have been compared.

718 Leslie, J. (1993) Stresses on wheat attacked from many angles. *South Dakota farm and home research (USA)* v. 44(1) p. 5-7. English. (AGRIS 95-011710).

719 Leslie, J. (1993) Wheat research team in spotlight for freeze-resistance breakthrough. *South Dakota farm and home research (USA)* v. 44(1) p. 8-9. English. (AGRIS 95-011711).

720 Li Famun; Zhu Kezhuang; Yang Xiangdong (Shaanxi Provincial Academy of Agricultural Sciences, Yangling (China)) (1993) Effect of mafanite for increasing the yields of wheat and corn. *Shaanxi Journal of Agricultural Sciences (China)* (no. 4) p. 34-35. 4 tables, 3 ref. Chinese. (AGRIS 95-001323).

721 Li Ruping; Ye Qinfu (Xinjiang Division No.7 of Land Reclamation Troop, Kuitun (China). Inst. of Agricultural Sciences) (1993) Reasonable planting density of winter wheat Kuldong No.4. *Xinjiang Agricultural Sciences (China)* (no. 4) p. 147-149. 3 tables. Chinese. (AGRIS 95-001330).

722 Luehe, H.; Haensel, A. (1994) [Land sort trials 1993: Spring grain]. *Landessortenversuche 1993: Sommergetreide. Neue Landwirtschaft (Germany) (no.2)* p. 34, 36. 4 tables. German. (AGRIS 95-001292).

723 Mahler, R.L.; Guy, S.O. (1992) Winter barley. *Current information series (USA)*; no. 954 4 p. English. (AGRIS 95-001276).

724 Maiorana, M.; Rizzo, V.; Di Bari, V.; Convertini, G. (Istituto Sperimentale Agronomico, Bari (Italy)) (1993) [Ploughing in of durum wheat crop residues with different nitrogen and phosphorus levels. 1: Effects on yield and quality of grain]. *Interramento dei residui vegetali di frumento duro in monosuccessione con dosi crescenti di azoto e fosforo. 1: Effetti sulle componenti quantitative e qualitative della*

produzione. *Agricoltura Ricerca (Italy)* v. 15(151-152) p. 69-76. 2 tables; 4 graphs; 21 ref. Italian. (AGRIS 95-011725).

725 Makke, A. (Estonian Agricultural Univ., Tartu (Estonia). Dept. of soil management and plant products technology) (1994) [The influence of biological basic elements on the yield of barley]. *Odra saagi kujunemise bioloogilised alused. Proceedings of M.Sc. and Ph.D. candidates of Estonian Agricultural University (Estonia)* v. 2 p. 11-16. 3 ref. Estonian. (AGRIS 95-001268).

The experiments showed that a nitrogen fertilizer induced the formation of 1.8 more shoots, but in case of late sowing 9 to 12% of sprung up plants perished. On a very late sowing the number of productive shoots per square metre decreased depending on the variety by 3 to 17 shoots per each day of delayed sowing. The contribution of ancillary sprouts to the formation of the yield was 18.3 to 53.6%. On the ground of dispersion analysis of the yield data we can conclude that development and productivity of barley were most influenced by weather conditions in a particular year 35.4%. A nitrogen fertilizer, sowing date and joint influence of a year and sowing time affected the yield to the extent of 18.1%, 11.9% and 18.7% respectively. A variety exerted a relatively small effect on the yield of barley (1.5%).

726 Mirali, N.; Nabulsi, I. (1994) ACCUMULATION OF DRY MATTER AND NITROGEN IN THE DEVELOPING SEEDS OF HIGH PROTEIN MUTANT LINES OF TRITICUM-AESTIVUM (L) PRODUCED BY THE IAEA. *Cereal Research Communications*. 22(4):381-388. English. [ATOM ENERGY COMMISS SYRIA DEPT RADIAT AGR POB 6091 DAMASCUS SYRIA].

Accumulation patterns of dry matter and nitrogen in the developing seeds of nine mutant lines produced by the IAEA and their mother line Mex22A T.aestivum (L.) were studied. The experiments were grown for 2 years under rainfed conditions. Significant differences were found among the lines in all studied characters except for final seed weight. High rates of accumulation of dry matter and nitrogen were associated with a short period of accumulation. However, the two lines with the highest N rate accumulation were also very late in flowering and therefore had the lowest yield per plant, presumably due to higher sterility resulting from higher temperatures at anthesis. All other mutant lines had a higher seed nitrogen percentage than the mother line without any reduction in seed weight. This was primarily due to higher rates of N accumulation. Six of the mutant lines had comparable yield/plant and were higher than the mother line in N yield/plant. It was concluded that early flowering genotypes with higher N rates of accumulation should be sought to avoid the high sterility that occurs with high temperatures at anthesis.

727 Moshiringwani, N.A. (Crop Breeding Institute, Harare (Zimbabwe)); Mtisi, E. (1994) Wheat Production and Research in Zimbabwe: Constraints and Sustainability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 65-77. CIMMYT. 3 tables; 4 fig.; 41 ref. English. (AGRIS 95-001248).

Wheat in Zimbabwe is grown mainly as an irrigated winter crop on large-scale farms. The effect of breeding research over the period 1969 to 1991 has been the continual increase of yield potential (1.2 percent/year) and yield dependability of the new cultivars through incorporation of desirable yield responses to environmental change, resistance to lodging and disease. There was an increase in the range of adaptability of wheat especially with regards to response to irrigation management, and tolerance of warmer areas and/or pre-harvest rain. Agronomic practices suitable for irrigated wheat have been developed. Tillage management technologies that enable farmers to reduce costs were introduced. More recently, deficit irrigation management practices were developed, allowing farmers to use less water per unit area and to expand total area. Work on rainfed wheat and wheat production using residual soil moisture is continuing. Promising varieties for rainfed conditions have been developed. Management practices suitable for economic production of rainfed wheat now need to be emphasized. Technology generation efforts have improved farm yields and total production of irrigated wheat, but the production of wheat over the period 1969 to 1991 has increased at a lower rate than consumption. It is hoped that the positive

effects of research efforts, the national irrigation fund, the general drive by government to develop national water reservoirs, trade liberalization, and incentive producer prices might lead to self-sufficiency for wheat in the short to medium term. In the long term, it may not be possible to expand irrigated wheat production to match consumption. Thus, it will be necessary to supplement irrigated wheat production with production from rainfed or residual soil moisture areas.

728 Muyanga, Samson (Mt. Makulu Central Research Station, Chilanga (Zambia)) (1994) Wheat Production and Research in Zambia: Constraints and Sustainability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 57-64. CIMMYT. 4 tables; 2 fig.; 7 ref. English. (AGRIS 95-001247).

This paper reviews trends in wheat research and production in Zambia, highlighting the successes, bottle-necks, and future plans of the wheat research program. Zambia, generally, is experiencing a rapid increase in wheat consumption and production. The importation of wheat to supplement consumer demand is declining due to increased domestic production levels and new government policies. With liberalized economic policies, the future of wheat research and production seems to be bright. The Zambia Seed Company now faces competition from seed companies in neighboring countries. The producer price of wheat has sharply increased, implying that more farmers will venture into wheat production while the registered wheat growers may expand their current production area. Wheat production in Zambia is characterized by low yield levels as a result of the following constraints: low management levels, disease, poor soils, lack of foreign exchange, inadequate extension services, and poor loan facilities.

729 Nyaki, A.S. (Selian A.R.J., Arusha (Tanzania)) (1994) Wheat Production and Research in Tanzania: Constraints and Sustainability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 42-50. CIMMYT. 4 tables; 11 ref. English. (AGRIS 95-001245).

Wheat research and production in Tanzania from 1970 to the present is reviewed under the headings of wheat breedings, weed control, soil fertility practices and constraints. Reductions in both national and donor support for wheat research have resulted in curtailed national research programs in the last two years. It is hoped that support from NOGs and end-users will increase in the future to facilitate the necessary level of wheat research in Tanzania.

730 Onofrii, M.; Tomasoni, C.; Borrelli, L. (Istituto Sperimentale per le Colture Foraggere, Lodi (Italy)) (1993) [Comparison among cereal-forage cropping systems - at two input levels - in the irrigated plain of Lombardy. 1: Quantity-quality productions]. Confronto tra ordinamenti cerealicolo-foraggeri - sottoposti a due livelli di input agrotecnico - nella pianura irrigua lombarda. 1: Produzioni quanti-qualitative. *Rivista di Agronomia (Italy)* v. 27(3) p. 160-172. 8 tables; 6 graphs; 31 ref. Italian. (AGRIS 95-001599).

731 Pearson, CH. (1994) PERFORMANCE OF FALL- AND SPRING-PLANTED DURUM WHEAT IN WESTERN COLORADO. *Agronomy Journal*. 86(6):1054-1060. English. [FRUITA RES CTR 1910 L RD FRUITA, CO 81521 USA].

Several years of fall planting of spring types (non-vernalization requiring) of durum wheat (*Triticum turgidum* L., durum group) in small-grain cultivar performance tests in western Colorado have resulted in high grain yields with no observed plant stand losses. Comparison studies between fall and spring plantings of durum wheat have not been conducted. Field studies were conducted during 1988-1989, and 1990 at the Colorado State University Fruit Research Center near Grand Junction to determine plant response of durum wheat cultivars to planting dates, and to study grain yield and yield component relationships of durum wheat cultivars when planted in the fall, early spring, and late spring. Fall- and early spring-planted durum wheat generally had higher grain yields, test weights, kernel mass, and were taller than late spring-planted wheat. Fall-planted durum had fewer kernels per spikelet than wheat in

spring plantings and a lower seed N concentration than durum in the late spring planting. Kernels per spikelet and kernel mass had the most consistent and highest direct correlations with grain yield. Our findings indicate that the potential exists to increase the productivity and widen the adaptation of durum wheat by identifying favorable temperate locations and using appropriate planting dates. Winter durum (vernalization-requiring) cultivars developed for the USA would be useful in widening the adaptation and increasing the productivity of this class of wheat. [References: 15].

732 Petkov, P. (Institut po Echemika, Karnobat (Bulgaria)); Petkov, S. (1993) [Priboj, a new triticale cultivar (Bulgaria)]. Priboj - nov sort tritikale (Bulgaria). Selskостopanska Akademiya, Sofia (Bulgaria). *Rastenievъdni Nauki (Bulgaria); Plant Science v. 30(7-8) p. 82-84. 5 tables; 10 ref. Bulgarian. (AGRI 95-011632).*

733 Petraitis, V.; Surkus, J.; Masauskas, V.; Dabkevicius, Z.; Lazauskas, S.; Bogaciovas, V.; Brazauskas, R.; Baneviciene, Z.; Jonikas, V. (Lithuanian Institute of Agriculture, Dotnuva (Lithuania)) (1993) [Intensive winter wheat cultivation on light loamy soils]. Intensyvus ziemių kviečių auginimas vidutinio sunkumo priemolio dirvoje. *Agronomija (Lithuania); A collection of Research Articles (no.72) p. 24-38. 2 tables. (Lt). (AGRI 95-001161).*

In 1986-1988 in the Experimental Farm of the Lithuanian Institute of Agriculture farm-technological trials were conducted to investigate the intensive technology of winter wheat cultivation with the objective to obtain grain yield of 55-60 dt/ha and more. Three technologies were tested: conventional (up to 1985) and two new ones-intensive with permanent tramlines on the sowing and intensive with unsown permanent tramlines. It was concluded that it is expedient to use intensive winter wheat cultivation technologies on light loamy soils of the Republic.

734 Qin Zhenjing (Staff Univ., of Jiangsu Provincial Agriculture and Land Reclamation Bureau, Huaiyin (China)) (1993) Mechanized planting technique of rice and wheat high-quality combination. *Journal of Hunan Agricultural College (China) (suppl. 1) p. 17-24. 7 tables, 7 ref. Chinese. (AGRI 95-001298).*

735 Rakotonnamannana; Randrianivoarivony, J.M.; Randriantalamana, R.A. (FIFAMANOR, Antsirabe (Madagascar)) (1994) Wheat Production and Research in Madagascar: Constraints and Sustainability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 32-36. CIMMYT. 2 tables; 5 ref. English. (AGRI 95-001243).*

Wheat is grown in Madagascar at altitudes ranging from 1200 to 1800 m a.s.l. in two seasons: 1) during the rainy season from January to May, and 2) during the dry season under irrigation in paddy fields from May to November. An outbreak of stem rust (*Puccinia graminis*) was experienced from 1985 to 1987; all released wheat varieties were susceptible, but new varieties with high levels of resistance were introduced in 1987. During the last three years, stem rust has not been a problem because all varieties released by FIFAMANOR, from CIMMYT segregating materials, have a high level of resistance. In 1990, after a period of drought in the country, wheat experienced a heavy attack of leaf rust (*Puccinia recondita*). Although infection before heading was observed in most areas, yield losses were low in the highlands, but were reported to be high at low altitudes. All available materials were screened for leaf rust resistance in 1990 and 1991, and resistant materials have been released. At the present time, ten varieties of wheat and two varieties of triticale are grown by farmers. As far as sustainability of wheat production is concerned, wheat is competitive with other crops regarding actual prices, but is very sensitive to fertilizer price increases. Sustainability of rainfed wheat production on the hills depends on the availability of aluminum tolerant materials and an appropriate cropping system. Zero tillage combined with leguminous cover crops appears promising.

736 Ramos, J.M.; Marretto, J.; Delmoral, M.B.G.; Delmoral, L.F.G. (1994) RESPONSE OF TRITICALE GRAIN YIELD AND YIELD COMPONENTS TO NUMBER OF CUTTINGS IN A

MEDITERRANEAN ENVIRONMENT. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau. 173(2):106-112. English. [UNIV GRANADA FAC CIENCIAS DEPT BIOL VEGETAL E-18001 GRANADA SPAIN].*

In six field experiments conducted over 2 years, the effect of one or two cuttings on grain yield of triticale (*x Triticosecale* Wittmack) were investigated. In addition, the relationships between triticale grain yield its components were analysed. Grain yield of the uncut plots invariably exceeded the plots with one or two cuttings, regardless of the environment or year. The reductions in grain yield caused by one cutting ranged from 27% to 60% under rainfed conditions and 18% to 20% under irrigation. With two cuttings the reduction was 45% to 70% for rainfed, and 35% to 48% for irrigated conditions. The yield components which most influenced grain yield of triticale under cutting treatment were the number of ears m⁻² in all six experiments and the number of grains per ear under rainfed conditions. At the rainfed sites in 1989 cuttings diminished the number of ears m⁻² mainly by increasing plant mortality. Nevertheless, at the rainfed sites of 1990 and at the irrigated site of both years, the reduction in the number of ears m⁻² with cuttings was due principally to a lower survival of tillers per plant. [References: 17].

737 Raso, E.; Crini, M. (Florence Univ. (Italy). Dipartimento di Agronomia e Produzioni Erbacee) (1993) [The effect of different inputs of nitrogen and of a nitrification inhibitor on three cultivars of soft wheat (*Triticum aestivum* L.)]. Effetto di input diversi di azoto e di un inibitore della nitrificazione su tre cv di frumento tenero (*Triticum aestivum* L.). *Agricoltura Ricerca (Italy) v. 15(149) p. 37-52. 14 tables; 2 graphs; 43 ref. Italian. (AGRI 95-011719).*

738 Ruhland, W.; Hanhart, H. (1994) [Fertilization and plant protection of triticale]. So bringt Triticale Erfolg. Bestaende im Fruhjahr massvoll fuehren. *dlz. Die landwirtschaftliche Zeitschrift fuer Produktion - Technik - Management (Germany) v. 45(3) p. 44-49. 8 ill., 2 tables. German. (AGRI 95-001231).*

739 Schneeberger, Walter (1993) [Bread grain contracts, contract renunciation and crop rotation promotion in the gross margin calculation]. Brotgetreidekontrakte, Kontraktverzichtsaktion und Fruchtfolgefoerderung in der Deckungsbeitragsrechnung. *Der Foerderungsdienst (Austria) v. 41(10) p. 277-281. German. (AGRI 95-011589).*

740 Seibel, W. (1993) [The quality of the German wheat-harvesting, 1993]. Die Qualitaet der deutschen Weizenerte 1993. *AID-Informationen fuer die Agrarberatung (Germany) v. 1(4) p. 5-8. 8 tables. German. (AGRI 95-001174).*

741 Sorrentino, G.; Nirno, M. de; Maurantonio, G.; Paoletta, G.; Codianu, P.; Li Destri Nicosia, O. (Istituto Sperimentale per la Cerealcoltura, Rome (Italy)) (1994) [Effects of the irrigation on durum wheat (*Triticum durum* Desf.) in droughty environment (Apulia)]. Influenza dell'irrigazione sulla produzione del frumento duro (*Triticum durum* Desf.) in ambiente siccitoso (Puglia). *Rivista di Agronomia (Italy) v. 28(2) p. 102-108. 6 tables; 2 graphs; 14 ref. Italian. (AGRI 95-011728).*

The research was carried out at Foggia in the period 1985/86, 1987/88, 1989/90 on seven durum wheat varieties ("Appulo", "Capeiti 8", "Latino", "Adamello", "Produra", "Creso" and "Karel"). Besides the non irrigated test five water regime applications were used. Water was supplied at aising, boot and after flowering stages. Watering volumes were calculated for restore to field capacity a soil layer deep 12 cm (T sub(2)), 24 cm (T sub(3)), 36 cm (T sub(4)), 48 cm (T sub(5)) and 60 cm (T sub(6)) respectively. The results showed a strong influence of the thermo-raining trend on all the characters investigated except for the plant height. In the droughty year but with favourable temperatures (1990) the irrigation effect was extremely positive. The interactions between water regime and variety were highly significative. The best results were obtained with the most recently varieties released.

742 Sun Benjin; Li Xiuyun; Zhang Baomin (Binzhou Prefectural Inst. of Agricultural Sciences, Shandong (China)) (1994) Effects of plastic sheet mulching on the ecological environment in late wheat fields. *Chinese*

Journal of Ecology (China) v. 13(1) p. 1-8. 5 ill., 6 tables, 8 ref. Chinese. (AGRIC 95-001233).

743 Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) (1994) *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993.* CIMMYT. 327 p. English. (AGRIC 95-001239).

744 Tanner, D.G. (CIMMYT, Nairobi (Kenya)); Amanuel Gorfu; Maiana, M.P.; Negusie Tadesse (1994) *A Collaborative Research Agenda to Develop Sustainable Wheat Production Technologies for East Africa. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa.* Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 229-240. CIMMYT. 22 ref. English. (AGRIC 95-001249).

Very few studies have been conducted in the tropical highlands of Eastern Africa to examine the long-term effects of wheat crop management practices on the farming community's natural resource base. To generate information on sustainable wheat production technology specific to this zone, an informal collaborative research network has been formed amongst several national research institutions in East Africa and the CIMMYT/CIDA Eastern Africa Cereals Project. Recently initiated, strategic research trials are focused on crop rotations, conservation tillage and straw management practices for wheat production in both mechanized and ox-plow cropping systems. This paper discusses the design of several representative long-term trials, and the relevant crop and soil parameters being measured.

745 Tekalign Mamo (Alemaya University of Agriculture, Debre Zeit (Ethiopia)); Abate Tedia (ILCA, Addis Ababa (Ethiopia)); Teklu Erkosa (1993) *The effect of undersowing wheat with clovers on wheat grain yield, total crop residue yield, and nutritive value of straw and fodder grown on Vertisol in Ethiopia. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993.* ILCA, Addis Ababa (Ethiopia). ILCA. 3 fig., 2 tables; 6 ref. Presented paper. 15 p. English. (AGRIC 95-011948).

Field studies were conducted at various Vertisol sites between 1987-1989 in order to assess the effects of clover undersowings on grain, straw, total crop residue, biomass and nutritive value of straw and fodder of several wheat varieties. Results showed that clover mixtures in association with wheat varieties did not cause significant wheat grain yield reductions but the system increased significantly the total fodder yield compared with the straw produced by wheat varieties grown in pure stands. Furthermore, the growth of clovers in combination with wheat varieties increased significantly CP and IVOMO contents of total fodder (wheat straw plus clovers), suggesting that high quality crop residue can be achieved by growing clovers with wheat. In addition, NDF content was reduced in the wheat straw/clover combination, confirming that the quality of straw from wheat varieties grown in pure stand is inferior to that of the total fodder from the wheat/clover intercropping. On-farm studies are now being conducted in order to verify the improvement in total crop residue production and also the quality of wheat crop residue as the result of the clovers association and to demonstrate to the farmer that the improved system would improve livestock performance in mixed farming systems in the Ethiopian highlands.

746 Thiel, W. (Landwirtschaftskammer Weser Ems, Oldenburg (Germany)); Lueschen, G. (1994) *[Winter barley - variety trials in Lower Saxony]. Sortenpruefungen Wintergerste - In der Marsch geringere Ertraege.* Landwirtschaftsblatt Weser-Ems (Germany) v. 141(34) p. 20-25. 1 ill., 3 tables. German. (AGRIC 95-001271).

747 Wang Bingkui; Jin Ziyu; Zhao Miaozhen (Zhejiang Provincial Academy of Agricultural Sciences, Hangzhou (China). Inst. for Application of Atomic Energy) (1993) *Effect of MET on formation and vigor of wheat roots.* Acta Agriculturae Nucleatae Sinica (China) v. 7(3) p. 129-133. 3 ill., 2 tables, 24 ref. Chinese. (AGRIC 95-001320).

Effect of MET on the formation and vigor of roots of wheat seedlings were studied. The results showed that 50-200 ppm MET inhibited vertical

elongation of roots, increased root shoot ratio and enhanced the formation and vigor of roots. But MET had no effect on the dry weight of roots. In the mean time, the activity of peroxidase was decreased and the proportion of assimilates in roots was increased by MET treatment compared with the control.

748 Workneh Negatu; Mwangi, Wilfred; Tesfaye Tesema (1994) *Cultural Practices and Varietal Preferences for Drum Wheat by Farmers of Ada, Lume and Gimbichu Weredas of Ethiopia. Research Report Surries (Ethiopia); no. 1 35 p.* Alemaya University of Agriculture. 27 tables; 3 fig.; 12 ref. English. (AGRIC 95-001328).

749 Yu Fengyi; Zhou Hongjie; Zhang Ping (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. for Application of Atomic Energy) (1993) *Biological effect of paclobutrazol to growth of wheat before winter.* Journal of Nuclear-Agricultural Sciences (China) v. 14(1) p. 41-43. 6 tables, 5 ref. Chinese. (AGRIC 95-001234).

750 Zhao Wencheng (Fukang County Station of Agrotechnical Extension, Xinjiang (China)) (1993) *Sowing rate of winter wheat and its calculation formula in Fukang County, Xinjiang (China).* Xinjiang Agricultural Sciences (China) (no. 4) p. 150-151. 5 tables. Chinese. (AGRIC 95-001331).

751 Zimmermann, H. (1994) *[Is the quality of malting barley not more interesting?]. Ist Braugerstenqualitaet nicht mehr von Interesse?* Brauwelt (Germany) v. 134(12) p. 482-484. 2 tables. German. (AGRIC 95-001269).

752 Zimmermann, H. (1994) *[Malting wheat from Saxony]. Brauweisen aus Sachsen.* Brauwelt (Germany) v. 134(16) p. 700-701. German. (AGRIC 95-001235).

902 PLANT PROPAGATION

753 Holm, P.B.; Knudsen, S.; Mouritzen, P.; Negri, D.; Olsen, F.L.; Roue, C. (1995) *REGENERATION OF THE BARLEY ZYGOTE IN OVULE CULTURE. Sexual Plant Reproduction. 8(1):49-59.* English. [CARLSBERG RES LAB 10 GAMLE CARLSBERG VEJ DK-2500 COPENHAGEN DENMARK].

An ovule culture technique has been established for barley that allows the regeneration of plants from zygotes. An average of 1.3 plantlets per ovule could be regenerated from more than 60% of the cultured ovules and about 75% of the regenerated plantlets developed into normal, fertile plants. The same regeneration frequencies were obtained in intact ovules and in ovules where the two integuments had been removed from the micropylar region. Unfertilized ovules and ovules where the fertilized eggs had been destroyed by a microinjection needle did not give rise to embryo-like structures. Plants could be regenerated from the zygote at the same frequency at developmental stages from immediately after fertilization until the formation of bicellular embryos. This tissue culture system appeared to be largely independent of genotype since similar regeneration frequencies were obtained in two different barley cultivars, Igri and Alexis, that in anther and microspore culture behave differently. The same technique has also been applied successfully in the wheat cultivar Waiter. [References: 29].

754 Salmenkalliomarttila, M.; Kauppinen, V. (1995) *EFFICIENT REGENERATION OF FERTILE PLANTS FROM PROTOPLASTS ISOLATED FROM MICROSPORE CULTURES OF BARLEY (HORDEUM VULGARE L.). Plant Cell Reports. 14(4):253-256.* English. [VTT BIOTECHNOL & FOOD RES POB 1505 SF-02044 ESPOO FINLAND].

Cultures of isolated microspores of barley (*Hordeum vulgare* L. cv. Kymppi, an elite cultivar of malting barley) were used for isolation of protoplasts. The protoplasts were cultured embedded in agarose. The plating efficiency varied from 0.002% to 0.015%. Several hundred green plants were regenerated from the cultures. Plantlets regenerated from protoplasts were potted in soil within 4-5 months of collecting the spikes for microspore culture and the first plants are now setting seed. [References: 19].

755 Struck, C.; Rohringer, R.; Heitefuss, R. (1994) ISOLATION AND LECTIN-BINDING PROPERTIES OF BARLEY EPIDERMAL AND MESOPHYLL PROTOPLASTS. *Canadian Journal of Botany-Revue Canadienne de Botanique*. 72(11):1688-1691. English. [UNIV KONSTANZ FAK BIOL LEHRSTUHL PHYTOPATHOL D-78434 CONSTANCE GERMANY].

Protoplasts from primary leaves of barley (*Hordeum vulgare* L.) were obtained by enzymatic digestion and fractionated by discontinuous density gradient centrifugation to yield highly enriched fractions of mesophyll and epidermal protoplasts. A characterization of both protoplast types resulted in a clear differentiation of the outer protoplast surfaces. The protoplasts were examined for affinity to various lectins by agglutination tests and by labeling with lectin-fluorescein isothiocyanate conjugates. Both types of protoplasts agglutinated with soybean lectin. Fluorescein isothiocyanate-labeled soybean lectin was uniformly distributed on the protoplast surface. Mesophyll protoplasts, but not protoplasts from the epidermis, were agglutinated by Concanavalin A. Both types of protoplasts exhibited fluorescence labeling with Concanavalin A-fluorescein isothiocyanate conjugate. This label often showed a patchy distribution on the protoplast surface. Tetragonolobus lectin and beta-D-glucosyl Yarrow artificial antigen agglutinated mesophyll but not epidermal protoplasts. One of three tested monoclonal antibodies with specificity for arabinogalactans had affinity to the surface of mesophyll and epidermal protoplasts. [References: 19].

756 Willingham, NM.; Lloyd, JC.; Raines, CA. (1994) MOLECULAR CLONING OF THE ARABIDOPSIS THALIANA SEDOHEPTULOSE-1, 7-BIPHOSPHATASE GENE AND EXPRESSION STUDIES IN WHEAT AND ARABIDOPSIS THALIANA. *Plant Molecular Biology*. 26(4):1191-1200. English. [UNIV ESSEX DEPT BIOL WIVENHOE PK COLCHESTER CO4 3SQ ESSEX ENGLAND].

We report here the isolation and nucleotide sequence of genomic clones encoding the chloroplast enzyme sedoheptulose-1, 7-bisphosphatase (SBPase) from *Arabidopsis thaliana*. The coding region of this gene contains eight exons (72-76 bp) and seven introns (75-91 bp) and encodes a polypeptide of 393 amino acids. Unusually, the 5' non-coding region contains two additional AUG codons upstream of the translation initiation codon. A comparison of the deduced *Arabidopsis* and wheat SBPase polypeptide sequences reveals 78.6% identity. Expression studies showed that the level of SBPase mRNA in *Arabidopsis* and wheat is regulated in a light-dependent manner and is also influenced by the developmental stage of the leaf. Although the *Arabidopsis* SBPase gene is present in a single copy, two hybridizing transcripts were detected in some tissues, suggesting the presence of alternate transcription start sites in the upstream region. [References: 39].

757 Yakovleva, G.M.; Dudich, D. (1993) [Differences in metabolism of polyamines and effect of 1-aminooxy-3-aminopropane in wheat cells (*Triticum monococcum* L.) growing on agar or liquid medium]. *Razlichiya v metabolizme poliaminov i ehfekt 1-aminooksi-3-aminopropana v kletkakh pshenitsy (Triticum monococcum L.), rastushchikh na agare ili v zhidkoj srede. Fiziologiya rastenij (Russian Federation) v. 40(5) p. 791-796. 21 ref. Russian. (AGRI 95-012061).*

FO3 SEED PRODUCTION

758 Berezkin, A.N.; Terekhin, M.V.; Berezkina, L.L. (1993) [Effect of barley seed (fungal) contamination on seed quality produced at different farms in different environments (Moscow district, Russian Federation)]. *Vliyanie infitsirovannosti semyan yachmenya boleznyami na ikh posevnye kachestva v zavisimosti ot ehkologii i urovnya vnutrikhozyajstvennogo semenovodstva. Izvestiya Timiryazevskoj sel'skokhozyajstvennoj akademii (Russian Federation) (no.3) p. 84-91. 14 ref. Russian. (AGRI 95-012112).*

Seeds from the lots used for sowing on farms Kashirsky and Dmitrovsky districts of Moscow region were studied. It has been found that seeds of Zazersky 85 variety of barley are heavily contaminated by the agents of root rots. Fungi of helminthosporium genus are most widely spread. In seeds of more northern origin (Dmitrovsky district) total infestation is higher. In Moscow region fusarioses produce the most harmful effect on seed quality. At the same time, even with very high

contamination of seed by helminthosporiosis their seeding qualities may be not much lower. Moulds more often appear on non-viable seeds that lost their germinating power.

759 Kashyap, RK.; Chaudhary, OP.; Sheoran, IS. (1994) EFFECTS OF INSECTICIDE SEED TREATMENTS ON SEED VIABILITY AND VIGOUR IN WHEAT CULTIVARS. *Seed Science & Technology*. 22(3):503-517. English. [HARYANA AGR UNIV CCS CTR SEED TECHNOL HISAR 125004 HARYANA INDIA].

The present study was conducted to determine the effects of seed treatment with different insecticides and period of storage of treated seeds on standard germination, abnormal seedlings, ungerminated seed, vigour index and speed of germination in eight wheat cultivars. Significant (P less than or equal to 0.05) differences were observed among different cultivars, insecticides, period of storage of treated seed for all the parameters of germinability/viability and vigour. Cultivar Sonalika was most sensitive while HD 2329 was least sensitive to insecticidal seed treatments. Among the four insecticides, Formothion 20EC affected all the parameters of viability and vigour in most of the cultivars, especially in cv. Sonalika. Endosulfan treatment gave results comparable to the control. Storing the treated seeds for 7 days or more resulted in adverse effects. The majority of the treated ungerminated seeds at the time of final count (8th day), were found to be viable (TZ test) which suggests that this test may not be as optimal for heated seeds as it is for untreated ones. Procedures for germination testing of insecticide treated seeds should be studied in more detail. Also, the consequences of delayed germination due to insecticide seed treatment have been discussed.

760 Kashyap, RK.; Duhan, JC. (1994) HEALTH STATUS OF FARMERS SAVED WHEAT SEED IN HARYANA, INDIA - A CASE STUDY. *Seed Science & Technology*. 22(3):619-628. English. [HARYANA AGR UNIV CCS CTR SEED TECHNOL HISAR 125004 HARYANA INDIA].

Drill-box surveys were carried out for three years (1990 to 1992) to find out the health status of farmers' saved wheat seed in Haryana State, India. Seven insect species, both primary and secondary seed feeders, were found associated with the seed samples. Only 13.2% of samples were free from insect-pest infestation over the period. Depending upon the life cycle/feeding behaviour of the insect, the seed embryo or endosperm was damaged, resulting in rejection of 67.6% of samples on the basis of Indian Minimum Seed Certification Standards. Significant variation was observed in vigour index of seedlings emerged from insect-damaged embryo, endosperm or undamaged (healthy) seeds. While storing the seeds for next year, 72.2% of the farmers did not distinguish between seed and grain. The majority (54.8%) of the farmers did nothing to save the seed from insect-damage or to improve the quality of the insect infested seeds before sowing. Incidence and range (%) of seed infection due to seed borne diseases i.e. Karnal bunt (*Neovossia indica*), loose smut (*Ustilago segetum*) and black point (*Helminthosporium*, *Alternaria*; *Curvularia* spp.) were greater in humid than in dry zones of Haryana. Irrespective of climatic zones, 81.3, 54.7 and 16.2 per cent of samples were infected with black point, loose smut and Karnal bunt, respectively. More samples were rejected due to Karnal bunt (25.5%) and loose smut (70.8%) from the humid zone than from the dry zone (Karnal bunt: 3.1%; loose smut: 16.2%). This study highlights the importance of seed health in relation to seed quality in sub-tropical parts of the world.

761 Morenomartinez, E.; Vazquezbadillo, ME.; Navarrete, R.; Ramirezgonzalez, J. (1994) EFFECT OF FUNGI AND CHEMICAL TREATMENT ON VIABILITY OF MAIZE AND BARLEY SEEDS WITH DIFFERENT STORAGE CHARACTERISTICS. *Seed Science & Technology*. 22(3):541-549. English. [UNAM UNIGRAS APDO POSTAL 20 MEXICO CITY DF MEXICO].

In previous studies it had been demonstrated that some maize genotypes are better than others at maintaining their viability during storage. Also, it has been observed that barley seed is tolerant to the activity of storage fungi and can be stored for longer than maize seed. Consequently, it was considered important to study the effect of storage fungi and the protective effect of fungicides on the preservation of maize seeds tolerant and susceptible to loss of viability under adverse storage conditions. A comparative study between barley and maize, under similar storage conditions, was conducted to determine the effect of storage fungi on the loss of viability in seeds with differing storability. Therefore, six

lines of maize with contrasting storage characteristics were compared for storage longevity at 75% or 80% RH and 25 degrees C for 210 and 60 days, respectively. Seeds of the line 48 were tolerant and seeds of the line 53 were susceptible to viability loss, in both storage conditions. These two lines (48 and 53) were treated with the fungicide carbendazim-m, and stored at 80% RH and 25 degrees C. After 100 days storage, seeds of the tolerant line, untreated or treated with fungicide, had germination rates of 66% and 96%, respectively. Seed germination of the susceptible line, with and without fungicide treatment, decreased to 10% from the original 94%. These results revealed: a) the harmful effect of fungi and the protective effect of the fungicide carbendazim-m on the viability of the maize seed, and b) that the effectiveness of the fungicide largely depends on the maize genotype. In the comparative storage test between barley and maize, maize seeds of the variety V-524 and barley seeds of the variety Tlaxcala were used. The maize and barley varieties were stored for 45 days at 80% RH and 25 degrees C. The non-fungicide treated maize seeds were heavily invaded by fungi, and showed a reduction in germination, from 97% to 47%, while the treated maize seeds were free of storage fungi and 93% germinated. The untreated barley seeds, heavily infected by storage fungi, had similar germination to the treated seeds which were fungi-free. The germination of the barley seed, with and without storage fungi, was superior to that of the maize seed. These results indicated that barley seed has superior storage capability to maize, and that storage fungi do not play as drastic a role in the loss of seed viability in barley as in maize.

762 Stoyanova, SD. (1994) EXPRESSION OF GLIADIN IN A DOMINANT MUTATION OF WHEAT SEEDS. *Seed Science & Technology*. 22(3):477-484. English. [INST INTRODUCT & PLANT GENET RESOURCES BU-4122 SADOVA BULGARIA].

A dominant mutation was observed in an investigation of the genetic variation in gliadin biotypes during storage and regeneration of wheat seeds (cv. Sadovo 1). The mutant was established as a single plant in first generation (A1) wheat plants grown from aged seeds. Although it does not differ morphologically, the distinction can be visualized by electrophoretic analysis. The mutation is in a group of components which related to the gamma-gliadins. The dominant nature of the mutation was confirmed by statistical analysis of the segregation ratios in the third (A3) and fourth (A4) generations. Although the observed mutation appears after regeneration of wheat seeds following ageing treatment, it is suggested that it may be either ageing induced or spontaneous.

763 Wood, M. (1994) New seed separator gets the goatgrass out. *Agricultural research / (USA)* p. 22. English. (AGRIS 95-001855).

F04 FERTILIZING

764 Agola, A.H. (N.P.B.R.C., Njoro (Kenya)); Oduor, P.O.S. (1994) The Effects of Dap Fertilizer on Wheat Yield in Uasin Gishu District of Kenya. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Retional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 307. CIMMYT. English. (AGRIS 95-001956).

Diammonium phosphate (DAP) fertilizer has been suspected as a cause of low wheat yields in Uasin Gishu District due to its soil acidification property. Therefore, a study to determine the effects of DAP on grain yield and on soil properties was carried out on a farmer's field in Uasin Gishu. The treatments applied included combinations of two levels of DAP (100 and 200 kg/ha) two soil ameliorants (lime at 1 t/ha and manure at 5 t/ha wet weight), two levels of the non-acidifying fertilizer TSP (100 and 200 kg/ha), and Minjingu rock phosphate (10 t/ha). The combination of 100 kg/ha of DAP and 1 t/ha of lime significantly increased wheat grain yield. Manure or rock phosphate applied separately had negative but non-significant effects on grain yield; lime or TSP alone had no significant effect on grain yield. Application of DAP alone did not alter soil pH. However, DAP in combination with soil ameliorants increased both soil pH and exchangeable base levels.

765 Appel, T. (1994) RELEVANCE OF SOIL N MINERALIZATION, TOTAL N DEMAND OF CROPS AND EFFICIENCY OF APPLIED N FOR FERTILIZER RECOMMENDATIONS FOR CEREALS - THEORY

AND APPLICATION. *Zeitschrift fur Pflanzenernahrung und Bodenkunde*. 157(6):407-414. English. [UNIV GIESSEN INST PLANT NUTR SUDANLAGE 6 D-35390 GIESSEN GERMANY].

Optimal rates of N fertilizer depend mainly on three factors, (1) the total N demand of crops, (2) the amount of available N from sources other than applied N, and (3) the efficiency of fertilization in order to increase plant available N. Predictability and variability of each of these factors affect the precision of N fertilizer recommendations. In a theoretical approach the change of [crop N + extractable inorganic soil N] (CSN) in the N-fertilized cereals can be ascribed to two components, firstly an N rate independent and secondly a strongly N rate dependent one. This approach fits well when applied to an actual data set of N field trials on sandy soils in Hessa, Germany. The N rate dependent change of CSN was interpreted as apparent recovery of applied N indicating the efficiency of fertilization. Apparent recovery rates of applied N varied considerably between field sites and ranged from 33 % to 96 %. The N rate independent change of CSN was dominated by N mineralization, especially during the grain filling period (range 4 to 61 kg N ha⁻¹), and was significantly ($p < 0.001$) correlated with extractable soil organic N ($r = 0.65$, CaCl₂ extraction; $r = 0.51$, EUF-technique). The total N demand of the crops varied widely within each cereal species. For barley and rye the total N demand was closely correlated with the optimal grain yield. The results suggest that in order to improve N fertilizer recommendations the prediction of the total N demand as well as the prediction of the fertilizer efficiency is badly needed. The soil N mineralization appeared to be an important N source for cereals, which was independent from the applied N rate tests, which provide an index of mineralized soil N, merit therefore consideration for adoption into N fertilizer recommendations for cereals. [References: 29].

766 Asgelil Dibabe; Andualem Taye (IAR, Addis Abeba (Ethiopia)); Sahemedhin Sertsu (1994) A Phosphorus Calibration Study on Bread Wheat in Northwestern Ethiopia. 8. Regional Wheat workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 254-260. CIMMYT. 2 tables; 4 fig.; 9 ref. English. (AGRIS 95-001996).

As most areas in the northwestern region of Ethiopia exhibit low levels of available soil phosphorus, phosphorus calibration studies were conducted on bread wheat at the Adet R.C. for two consecutive years, both on black and red soils. One objective of the experiment was to determine the effects of different rates of applied phosphorus fertilizer on soil phosphorus levels and on grain yield of bread wheat. On both soils, there were significant yield differences amongst treatments and between years. The highest mean yields of 4.0 t/ha and 2.0 t/ha on red and black soils, respectively, were obtained with the application of 40 kg P/ha. There was a tendency for yield to increase with higher fertilizer rate. Regarding the effect of applied P on soil P, four methods of extraction clearly showed a direct relationship between applied P and soil P on both soils.

767 Avalakki, UK.; Strong, WM.; Saffigna, PG. (1995) MEASUREMENT OF GASEOUS EMISSIONS FROM DENITRIFICATION OF APPLIED NITROGEN-15 3. FIELD MEASUREMENTS. *Australian Journal of Soil Research*. 33(1):101-111. English. [TAMIL NADU AGR UNIV CTR PLANT MOLEC BIOL COIMBATORE TAMIL NADU INDIA].

Field experiments were conducted during autumn and winter (April-July) at four locations on Vertisol or Alfisol soils on the Darling Downs of Queensland in 1988 and 1989 to determine N-15 losses when soil was saturated after applications of N-15 labelled nitrate-N prior to sowing winter cereal crops. Losses of applied N-15 were quantified by either gas emission or mass balance measurements on microplots (0.043 m²) confined laterally to a depth of 110 or 260 mm. At each field location, two experiments were established, one on a soil containing little visible crop residue where winter cereal had been harvested the previous November and another site containing residues of a recently harvested sorghum crop. Because shallow (110 mm) confinement was found to be unsatisfactory for both gas emission and mass balance measurement of N-15 losses, comparison of the two methods was not applicable at one of the four field locations. Loss estimates for the six field sites by accumulating daily gas emissions averaged 80.7 +/- 33.4% (range 43-132%) of that

estimated by mass balance. Loss estimates from peak emission measurements were generally closer to that estimated by mass balance 100.8+/-39.9% (range 56-169%). Loss of applied N-15 (40 kg N ha⁻¹) when soils were saturated in April was several-fold more (19-29 kg N ha⁻¹) than that lost when soils were saturated in July (3.9-6.4 kg N ha⁻¹). Loss of N-15 following saturation during July 1988 was similar in magnitude to the quantity of N-15 apparently immobilized into soil organic forms (5.8-6.9 kg N ha⁻¹). Sorghum residues returned in March, or wheat straw added in December prior to a long period of dry weather, promoted loss of N-15 applied prior to soil saturation in April or July. Alternatively, where residues of a previous winter cereal had decomposed considerably, loss of applied N-15 was much lower than where sorghum residues had been added prior to saturations in April (15.3 cf. 28.6 kg N ha⁻¹) or July (3.9 cf. 6.4 kg N ha⁻¹). [References: 13].

768 Barasebwa, L.; Rutunga, V.; Kayonga, J.B.; Nkusi, J.B. (ISAR, Butare (Rwanda)) (1994) The Effects of Soil Amendment on Wheat Yield in the Zaire-Nile Crest Highlands. 8. Regional Wheat workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 247-253. CIMMYT. 2 tables; 6 ref. English. (AGRIS 95-001954).

A soil amendment study was conducted in Gakuta region of Rwanda during the 1990B and 1992A seasons to investigate the effects of soil amendment, and to determine optimum rates. Soil amendments included were lime (at 1.5, 3 and 4.5 t/ha) and NPK 17-17-17 (at 25, 50 and 75 kg/ha). Manure was applied at 10 t/ha as a blanket treatment. The results indicated a positive response to lime. Furthermore, there was no sign of nutrient deficiency on the treatments receiving lime. On the other hand, in the control plots, the few plants that germinated exhibited a yellowish appearance. Increasing rates of NPK at low rates of lime resulted in moderate yield increases. However, yield increased by 127 to 200 percent with NPK applied in combination with lime at 4.5 t/ha. Further studies are needed to determine whether varietal interaction is an important factor in response to soil amendments: variety adaptation trials in the same region demonstrated that some varieties had a yield potential of 2 to 3 t/ha compared to 1.3 t/ha for the variety K6661-19 used in this study.

769 Beer, E. (Landwirtschaftskammer Weser Ems, Oldenburg (Germany). Pflanzenschutzamt) (1994) [Examples of integrated plant production in arable farming - cultivar choice and mineral fertilizer application in winter cereals and its interactions with chemical plant protection]. *Sortenwahl und Mineraldüngung in Wechselwirkung zum chemischen Pflanzenschutz in Wintergetreide. (Integrated plant production); (Systems of sustainable plant production, grounding, experience, developments - arable farming, vegetables, fruits, hops, grassland)*. Dierks, R.; Heitefuss, R. 2. Auflage p. 258-273. BLV Verlagsgesellschaft. 7 graphs, 6 tables; 24 ref. German. (AGRIS 95-001938).

770 Bezzola, L.C.; Lopez, S.C.; Barbaro, N.O. (1994) EFFECTIVENESS OF DIFFERENT PHOSPHATIC FERTILIZERS MEASURED USING LABELLED SUPERPHOSPHATE AND PHOSPHORUS TAKEN UP BY PLANTS. *Fertilizer Research*. 39(1):31-37. English. [UCA FAC CIENCIAS AGR R FREIRE 183 RA-1426 BUENOS AIRES ARGENTINA].

The agronomic effectiveness of three P fertilizers (diammonium phosphate, rock phosphate and compost) was studied in a greenhouse experiment using wheat. A radioisotopic method, using triple superphosphate labelled with P-32, was used to evaluate the P in dried tops that was derived from i) the soil, ii) labelled superphosphate and iii) the fertilizer being studied. The ratio between P uptake from each fertilizer and P uptake from the soil was used to compare the effectiveness of the different fertilizers. P derived from diammonium phosphate was greater than P derived from the soil, except in one soil. P derived from rock phosphate was always lower than P derived from the soil. The effectiveness of compost depended on soil type. Compost can produce two kind of effects: i) a direct P contribution and ii) an indirect effect improving P uptake from the soil. The radioisotopic method can be used to study the effectiveness of fertilizers even when there are no differences in yield.

771 Bolland, M.D.A. (1994) EFFECT OF WATER SUPPLY ON THE RESPONSE OF WHEAT AND TRITICALE TO APPLICATIONS OF ROCK PHOSPHATE AND SUPERPHOSPHATE. *Fertilizer Research*. 39(1):43-57. English. [WESTERN AUSTRALIA DEPT AGR PLANT IND 3 BARMON HAY COURT S PERTH WA 6151 AUSTRALIA].

The effect of water supply on the response of wheat (*Triticum aestivum*) and triticale (*x Triticosecale*) to levels of freshly-applied rock phosphate and superphosphate, and the residues of these fertilizers applied 9 years previously in the field, was studied in three glasshouse experiments. The < 2 mm fraction of the top 10 cm of soil was used (1.8 kg soil per pot), and in one experiment, freshly-applied fertilizer was also added to the more acidic subsoil (10 to 20 cm). There were two water treatments: the soil was returned to field capacity by watering to weight, either daily (W1, adequate water) or weekly (W2, water stress). Yield of dried tops was used to calculate fertilizer effectiveness. The phosphorus (P) concentration in dried tops was used to determine critical P, which is the P concentration related to 90% of the maximum yield. Just before sowing, soil samples were collected to measure bicarbonate-extractable (soil test) P which was related to plant yield. Water stress reduced yields and maximum yield plateaus by 20 to 40%. Water stress reduced the effectiveness of all P fertilizers by between 20 to 60%, largely because of a reduction in the maximum yield potentials. In the field, water supply is seasonally dependent and it can affect the yield response of plants to freshly-applied rock phosphate and superphosphate and the residues of these fertilizers applied to the field in previous years. Relative to placing fertilizer in the topsoil, placing fertilizer in the subsoil improved effectiveness by about 26% for rock phosphate and 12% for superphosphate. The relationship between yield and P concentration in dried tops, and critical P, differed for W1 and W2. The soil test P calibration, which relates yield to soil test P, and the soil test P required to produce the same yield also differed for W1 and W2. Consequently critical P and soil test P calibrations depend on water supply, which in the field varies within and between growing seasons. This is so for freshly- and previously-applied rock phosphate and superphosphate.

772 Bonfil, D.J.; Pinthus, M.J. (1995) RESPONSE OF CHICKPEA TO NITROGEN, AND A COMPARISON OF THE FACTORS AFFECTING CHICKPEA SEED YIELD WITH THOSE AFFECTING WHEAT GRAIN YIELD. *Experimental Agriculture*. 31(1):39-47. English. [HEBREW UNIV JERUSALEM FAC AGR IL-76100 REHOVOT ISRAEL].

Chickpea yields in Israel are usually considerably lower than wheat yields under comparable conditions. This study aimed to examine the possible yield limiting factors in chickpeas. Increasing the availability of nitrogen during seed development by a pre-sowing application of nitrate or by nitrogen top dressing at the onset of flowering led to an increase in the percentage of nitrogen in the straw but had no significant effect on seed yield. Growth analysis of chickpeas and wheat grown in two adjacent field experiments revealed that during the fruiting period these crops accumulated similar amounts of dry matter. However, the proportion of total wheat dry matter accumulated in the wheat grains was twice the proportion of total chickpea dry matter accumulated in the chickpea seeds. It was concluded that the main intrinsic factor limiting the seed yield of chickpeas is the continuation of vegetative growth during the period of seed development, which reduces the amount of assimilate allocated to the seeds. [References: 10].

773 Brar, S.P.S.; Singh, B.; Singh, J.; Benbi, D.K. (1993) EFFECT OF LONG-TERM APPLICATION OF FERTILIZER AND CROP SEQUENCES ON PHOSPHORUS IN AN USTOCHREPT IN PUNJAB. *Tropical Agriculture*. 70(4):315-319. English. [PUNJAB AGR UNIV DEPT SOILS LUDHIANA 141004 PUNJAB INDIA].

The effect of fertilizer application and different crop sequences on the utilization, accumulation, and depletion of Olsen extractable P and other fractions of P in the soil after 10 cycles of cropping are reported. The apparent recovery of P declined in the sequence rice-wheat, rice-berseem, cotton-wheat, maize-wheat, groundnut-wheat, and pearl millet - berseem. Application of P increased Olsen extractable P in the soil profile under all the crop sequences. The increase was less under rice-based sequences. The differences in Olsen extractable P in the control (no NPK) and fertilizer treated plots were large up to upper 45, and beyond that the differences were small and decreased with depth. The P uptake by crops was

significantly related to Olsen extractable P in the 0-15 cm soil depth. [References: 18].

774 Brennan, R.F. (1994) THE RESIDUAL EFFECTIVENESS OF PREVIOUSLY APPLIED COPPER FERTILISER FOR GRAIN YIELD OF WHEAT GROWN ON SOILS OF SOUTH-WEST AUSTRALIA. *Fertilizer Research*. 39(1):11-18. English. [DEPT AGR ALBANY REG OFF ALBANY WA 6330 AUSTRALIA].

The residual effectiveness of copper (Cu) applied 18 to 21 years previously was estimated for grain yield of wheat. In one field experiment, current levels of Cu fertiliser were applied and its effectiveness was compared to that of the same level of Cu applied previously. The effects of nitrogen (N) fertiliser on the Cu concentration in the youngest emerged blade and in the grain, as well as the effects of N levels on the grain yield of wheat, were also studied. Where the recommended level of Cu fertiliser had been applied previously, its residual effectiveness depended on the soil type. On the grey sands over clay and gravelly sands over clay, the residual Cu would last approximately 20 years where wheat is grown in rotation with a legume crop (*Lupinus angustifolius* L.) and where N fertiliser is applied at high levels (92 kg N ha⁻¹). On the yellow brown sandy earths of the Newdegate district, the residual value was in excess of 30 years. When Cu levels in the soil are marginal, high levels of N applied to wheat crops grown on stubbles of legume crops (high soil N) could suffer from induce Cu deficiency which could reduce grain production. Critical concentrations of Cu in the youngest emerged blade of less than 1.2 mg Cu kg⁻¹ at Gs50-59 would indicate Cu deficiency. Cu concentrations of less than 1.1-1.2 mg Cu kg⁻¹ in the grain suggest that the wheat crop is marginally supplied with Cu. In both situations, Cu fertiliser needs to be applied before the next crop.

775 Camargo, C.E.O.; Felicio, J.C.; de Freitas, J.G. (Campinas Agronomic Institute, Sao Paulo (Brazil)) (1994) Evaluation of Wheat Cultivars for Phosphorus Efficiency on Acid Soils and in Nutrient Solution. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 289-297. CIMMYT. 7 tables; 5 ref. English. (AGRI 95-001955).

Phosphorus deficiency is one of the major limiting factors for wheat production under acid soil conditions. P deficiency can be overcome by: (a) the application of phosphorus fertilizer, and (b) the exploitation of genetic variability in the crop. Genetic manipulation of segregating populations to obtain cultivars adapted to medium or low soil phosphorus content, and with better P uptake efficiency and use is possible. The field screening of wheat cultivars under different levels of phosphorus fertilization permits the selection of genotypes which are more efficient at low levels of phosphorus, and also facilitates the evaluation of their response to higher levels of applied phosphorus. The efficiency of phosphorus utilization can be determined by weighing the aerial portion of 30 plants grown for 15 days in nutrient solution containing different concentrations of phosphorus. The Phosphorus Efficiency Ratio (PER) is calculated by dividing the shoot weight (Mg) by the content of phosphorus of the shoot (mg). The relationship between field experimentation and the nutrient solution technique to identify genotypes with higher phosphorus uptake efficiency is discussed.

776 Camberato, J.J.; Frederick, JR. (1994) RESIDUAL MAIZE - FERTILIZER NITROGEN AVAILABILITY TO WHEAT ON THE SOUTHEASTERN COASTAL PLAIN. *Agronomy Journal*. 86(6):962-967. English. [CLEMSON UNIV PEE DEE RES & EDUC CTR DEPT AGRON & SOILS ROUTE 1 BOX 531 FLORENCE, SC 29501 USA].

In southeastern Coastal Plain soils, little emphasis is placed on adjusting N fertilization of a crop based on the residual N left from the preceding crop because of the perception of coarse-textured surface soils, winter rainfall in excess evapotranspiration, and shallow-rooted crops. However, estimates of actual water surplus do not include a winter crop, which may reduce NO₃-N leaching, nor consider current tillage practices, which enable deep, rooting, and assimilation of subsoil NO₃-N. This study was conducted to determine the contribution of N applied to a maize (*Zea mays* L.) crop to the N supply of a subsequent winter wheat (*Triticum aestivum* L.) crop. Wheat was grown following maize fertilized

with, various rates of N and poultry litter on a Rains/Lynchburg sandy loam soil complex (fine-loamy siliceous, thermic Typic/Aeric Paleaquult) in 1990 and on a Noboco loamy sand (fine-loamy siliceous, thermic Typic Kandudult) in 1991. Maize fertilizer N increased soil NO₃-N at the time of wheat planting. Residual N increased wheat dry matter, N content, and grain yield. An increase in maize N rate of 134 kg N ha⁻¹ increased N supply to the subsequent wheat crop by approximately 15 kg ha⁻¹ and increased wheat grain yield by 0.8 Mg ha⁻¹. Poultry litter did not differ from fertilizer N in providing residual N to the wheat. This research demonstrates that previous crop fertilization rate may impact N supply to the subsequent crop, even on coarse-textured Coastal Plain soils. [References: 20].

777 Causarano, H. (DIA IAN, Caacupe (Paraguay)); Romero, A.; Wall, P.C. (1994) A Comparison of Four Methods of Measuring Soil Aggregate Stability. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 312-315. CIMMYT. 1 table; 1 fig.; 6 ref. English. (AGRI 95-001957).

After nearly four years of tillage and rotation treatments on an Ultisol in southeastern Paraguay, differences in aggregation of the top 10 cm of soil were clearly visible amongst treatments. Four methods were used to measure the stability of these aggregates: wet-sieving, immersion in an alcohol-water mixture, tensile strength, and a classification based on aggregate coherence in water. All methods coincided in the determination of the treatments with the most stable aggregates. However, the most significant separations amongst tillage and rotation treatments were achieved by the wet-sieving technique, followed by the alcohol-water mixture method. There was a highly significant correlation between the results of these two saturated stability based methods ($r=0.76$). Tensile strength, a non-saturated aggregate stability method, showed similar trends to wet-sieving with respect to tillage treatments, but differences were not significant. The Emerson classification technique divided samples into only two classes with nearly 90 percent of the samples falling into Class 5. Wet-sieving appeared to be the best method for distinguishing between tillage and rotation treatments based on their aggregate stability. The alcohol-water mixture method provided a good alternative in these soils, and, based on its simplicity and high correlation with wet-sieving, may be useful where laboratory facilities are limited.

778 Dimitrova, F.; Samaliev, A.; Nejкова Bocheva, E. (Institut po Pochvoznanie i Agroekologiya "N. Pushkarov", Sofia (Bulgaria)) (1994) [Effect of annual and supplying P-fertilization on the yield, phosphorus removal and soil P-status. I]. Efekt na ezhegodnoto i zapasyavashcho P torene v'rkhu dobiva, iznosa na fosfor i P status na pochvata. I. Selskостopanska Akademiya, Sofia (Bulgaria). *Pochvoznanie, Agrokhimiya i Ekologiya (Bulgaria); Soil Science Agrochemistry and Ecology v. 29(1-2) p. 13-16. 3 tables; 24 ref. Bulgarian. (AGRI 95-012209).*

779 Fricke, E. (Landwirtschaftskammer Hannover (Germany)); Baumgaertel, G. (1994) [Fertilization and irrigation]. Duengung und Beregnung. *Zuckerruebe (Germany) v. 43(4) p. 250-252. 2 ill., 3 tables. German. (AGRI 95-002066).*

780 Fuchs, W. (Halle Wittenberg Univ., Halle (Germany). Inst. fuer Acker und Pflanzenbau. Abt. Koernerfruechte); Mueller, A.; Haensel, A. R.; Schroeder, G. (1993) [Effect of nitrogen fertilization and growth regulator on the yield, yield components and grain quality of two-row winter barley]. Einfluss von Stickstoffduengung und Camposanbehandlung auf Ertrag, Ertragskomponenten und Kornqualitaet von zweizeiliger Wintergerste. *Archives of agronomy and soil science (Germany) v. 37(3) p. 203-209. 1 ill., 3 tables; 12 ref. German. (AGRI 95-001969).*

781 Gately, T.F. (1994) A NOTE ON UREA VERSUS CALCIUM AMMONIUM NITRATE FOR WINTER WHEAT. *Irish Journal of Agricultural & Food Research*. 33(2):193-196. English. [TEAGASC JOHNSTOWN CASTLE RES CTR WEXFORD IRELAND].

Urea and calcium ammonium nitrate (CAN; 275 g N/kg) were compared as sources of N for winter wheat in field experiments at a total of nine sites over a 3-year period. The rates of N used were 0, 50, 100, 150,

200 kg/ha and it was applied in two splits. The mean yield was 4.04 t/ha for the ON treatment. Mean yields (t/ha) for the CAN treatments were 5.92, 7.22, 7.83 and 8.16 following 50, 100, 150 and 200 kg N/ha, respectively. The corresponding yields with urea were 5.28, 6.71, 7.52 and 7.92 t/ha. The yield reductions (%) with urea compared to CAN were 10.8, 7.1, 4.0 and 2.9 at 50, 100, 150 and 200 kg N/ha, respectively. The drier the weather and the soil around the time of N application, the poorer was the performance of the urea relative to CAN. Grain protein content (at a moisture content of 150 g/kg) ranged from 79 to 100 g/kg and was significantly lower following urea than following CAN. It is concluded that, for winter cereals, CAN is a better source of N than urea.

782 Gill, M.A.; RAHMATULLAH.; Salim, M. (1994) GROWTH RESPONSES OF TWELVE WHEAT CULTIVARS AND THEIR PHOSPHORUS UTILIZATION FROM ROCK PHOSPHATE. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(3-4):204-209. English. [NATL AGR RES CTR LAND RESOURCE RES INST PK RD ISLAMABAD 45500 PAKISTAN].

Growth responses of 12 wheat cultivars and their phosphorus utilization were studied in a greenhouse. They were grown for 18 days in a solution containing rock phosphate as the phosphorus (p) source. Biomass of 26 day old plants of all the cultivars varied significantly whereas their shoot to root ratio stayed constant. The dry matter yield of all the 12 cultivars was significantly correlated with the p uptake ($r = 0.74$). Whereas the higher p uptake by all the cultivars was significantly ($P < 0.01$) related to the drop in the root medium pH, which was presumably owing to the H^+ efflux from their roots. The wheat cultivar Blue Silver proved to be the most efficient p user and therefore seems to have the highest potential of making best growth in soils with poor p availability among the 12 wheat cultivars under investigation. [References: 21].

783 Gospodinov, M.; Dimitrov, I. (Institut po Pshenitsata i Sl'nchogleda "Dobrudzha", General Toshevo (Bulgaria)) (1994) [Fertilization of wheat under different nutritive and water regimes of slightly leached chernozems at Dobrouja]. Torene na pshenitsata pri razlichen khraniteli i voden rezhim na slabo izluzhenite chernozemi v Dobrudzha. Selskостопанска Академия, Sofia (Bulgaria). *Pochtovoznanie, Agrokimiya i Ekologiya* (Bulgaria); *Soil Science Agrochemistry and Ecology* v. 29(1-2) p. 3-6. 1 ill, 4 tables; 16 ref. Bulgarian. (AGRIS 95-012196).

784 Guo Jianhua; Xing Zhu; Liu Yuheng (Hebei Academy of Agricultural Sciences, Shijiazhuang (China). Inst. of Soils and Fertilizers) (1993) Nitrogen transformation in soil and its uptake by winter wheat. *Acta Agriculturae Nucleatae Sinica* (China) v. 7(3) p. 163-167. 2 ill., 2 ref. Chinese. (AGRIS 95-001949).

785 Hansen, J.F.; Kjellerup, V. (1994) [SP Report, 14: The nutrition effect of phosphorus and sodium in sewage sludge and straw ash: Micro plot experiment (potassium, nutrition)]. SP rapport, 14: Goedningsvirkning af fosfor og kalium i slam og halmaske: Rammeforsøg. Statens Planteavlfsforsøg, Lyngby (Denmark). SP. 21 ill., 6 tables; 10 ref. 44 p. Danish. (AGRIS 95-001970).

786 Heyland, K.U. (Bonn Univ. (Germany). Inst. fuer Pflanzenbau) (1994) [Examples of integrated plant production in arable farming - stand management and mineral fertilizer application adapted to plant demands with special consideration of chemical plant protection]. Beispiele im Ackerbau - Bestandesfuehrung und bedarfsgerechte Mineralduengung unter Beachtung von Beziehungen zum chemischen Pflanzenschutz. (Integrated plant production); (Systems of sustainable plant production, grounding, experience, developments - arable farming, vegetables, fruits, hops, grassland). Dierks, R.; Heitefuss, R. 2. Auflage p. 251-258. BLV Verlagsgesellschaft. 2 graphs, 1 table; 11 ref. German. (AGRIS 95-001950).

787 Kettlewell, P.S.; Blouin, P.; Boulby, G.L. (Crop and Environment Research Centre, Harper Adams Agricultural College, Newport, Shropshire TF10 8NB (United Kingdom)) (1992) Evaluation of sucrose as a safener for foliar-applied urea in wheat. *Tests of Agrochemicals and Cultivars* (United Kingdom) (no.13) p. 84-85. 3 ref., Annals of Applied Biology 120 Supplement. English. (AGRIS 95-012197).

788 Li Junyi; Dong Helin; Liu Rongrong (Chinse Academy of Agricultural Sciences, Henan (China). Inst. of Cotton) (1994) Studies on balanced fertilization under cotton interplanted with wheat. *China Cottons* (China) (no. 1) p. 14-15. 4 tables, 7 ref. Chinese. (AGRIS 95-002046).

789 Lippold, H. (Saechsische Landesanstalt fuer Landwirtschaft, Leipzig (Germany). Inst. fuer Bodenkultur und Pflanzenbau); Matzel, W. (1993) [Balance of (15)N-labelled fertilizer doses to winter wheat - Influence on the mineralization and the uptake of soil nitrogen on a loamy sand soil and two loess loam soils]. Bilanz (15)N-markierter Duengergaben zu Winterweizen - Einfluss auf Mineralisierung und Aufnahme von Bodenstickstoff auf einem lehmigen Sandboden und zwei Loess-Lehmboeden. *Archives of agronomy and soil science* (Germany) v. 37(3) p. 229-235. 3 tables; 11 ref. German. (AGRIS 95-001953).

790 Liu Rongkun; Han Yang; Li Zhenzhen (Liaoning Univ., Shenyang (China). Dept. of Biology) (1993) The protective effect of phosphate buffer on SO₂ harmed wheat seedling. *Acta Botanica Sinica* (China) v. 35(9) p. 698-702. 3 ill., 2 tables, 5 ref. Chinese. (AGRIS 95-001998).

791 Luettinger, A.B. (Goettingen Univ. (Germany). Inst. fuer Pflanzenbau und Tierhygiene in den Tropen und Subtropen); Manske, G.G.B.; Behl, R.K.; Vlek, P.L.G. (1993) [Nutrient uptake of wheat varieties in dependence on vesicular arbuscular mycorrhiza and on total root length: Field researches in North India]. Naehrstoffaneignung von Weizensorten in Abhaengigkeit von VA Mykorrhiza und Gesamtwurzelaeenge: Felduntersuchungen in Nordindien. Oekophysiologie des Wurzelraumes; Borkheide (Germany); 30 Aug - 1 Sep 1993. (Proceedings of the 4th scientific workshop). Merbach, W. *Deutsche Landakademie "Thomas Muentzer", Borkheide* (Germany); Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion no. 4, p. 49-52. Selbstverlag. 2 ill., 1 table. German. (AGRIS 95-001951).

792 Mengel, K. (Justus Liebig University, Giessen (Germany). Inst. of Plant Nutrition) (1994) Scientific improvement by the electroultrafiltration (EUF) working group for the importance of organic soil nitrogen to ecological agriculture. International Institute for Beet Research 57th winter congress; Bruxelles (Belgium); 16-17 Feb 1994. IIRB 57th winter congress. Brussels (Belgium). 16-17 Feb 1994. IIRB 57e congrès d'hiver. Institut International de Recherches Betteravieres, Bruxelles (Belgium) p. 213-238. Institut International de Recherches Betteravieres. 7 ill.; 5 tables; 28 ref. English. (AGRIS 95-001948).

793 Muench, C. (Bonn Univ. (Germany). Agrikulturchemisches Inst.); Vorsatz, C. (1994) [Alternatives in nitrogen fertilization]. Effizientere N-Duengung nach dem CULTAN-Verfahren: Alternativen in der N-Duengung. *Neue Landwirtschaft* (Germany) (no.2) p. 48-50. 1 ill., 2 tables. German. (AGRIS 95-002082).

794 Nikitishen, V.I.; Dmitrakova, L.K.; Zaborin, A.V. (1993) [Efficient application of phosphorus fertilizers in agrocoenoses [grey forest soils]]. Effektivnoe primeneniye fosfornogo udobreniya v agrotsenozakh. *Pochtovozvedenie* (Russian Federation) (no.10) p. 90-96. 11 ref. Russian. (AGRIS 95-001971).

Results of 13 years-long field experiment on the effect of prolonged fertilization on the available phosphates content in 1m depth of the grey forest soil, on phosphorus consumption by plants and on crop yields are presented. The grey forest soil fertility in terms of phosphorus is peculiar by the increase of mobile phosphates with depth, which are better available for barley and clover and less available for winter wheat and maize. In order to raise the soil phosphate level to its optional low limit (10-12 mg/100g) the phosphates influx should equal 80 kg/ha P₂O₅ per 1mg/100g, not taking into account their removal with yields.

795 Oliveira, A.J. de (Instituto Nacional de Investigacao Agraria, Oeiras (Portugal). Estacao Agronomica Nacional) (1993) [Economic fertilisation tests on wheat (Portugal)]. Ensaio de adubacao economica do trigo. *Economic and technical research in agriculture, 1941-1992. Contribution for a better farm competition*. Oliveira, A.J. de; Carvalho, N.S. de (Instituto Nacional de Investigacao Agraria, Oeiras (Portugal). Estacao Agronomica Nacional) (comps.). Instituto de Estruturas Agrarias e Desenvolvimento Rural, Lisbon

(Portugal) p. 123-148. IEADR. 6 ill. 12 tables; 34 ref. Portuguese. (AGRI 95-001958).

796 Oliveira, A.J. de (Instituto Nacional de Investigação Agrária, Oeiras (Portugal). Estação Agronómica Nacional) (1993) [Productivity rates and profitability indices in fertilisation tests on the main crops (Portugal)]. Índices de produtividade e rentabilidade em ensaios de adubação das principais culturas. *Economic and technical research in agriculture, 1941-1992. Contribution for a better farm competition.* Oliveira, A.J. de; Carvalho, N.S. de (Instituto Nacional de Investigação Agrária, Oeiras (Portugal). Estação Agronómica Nacional) (comps.). Instituto de Estruturas Agrárias e Desenvolvimento Rural, Lisbon (Portugal) p. 217-226. IEADR. 2 graphs. 6 tables. Portuguese. (AGRI 95-001973).

797 Owuoché, J.O.; Mwangi, H.; Ooro, P.; Lelo, T. (N.P.B.R.C., Njoro (Kenya)) (1994) Characterization of Kenyan Wheat (*Triticum aestivum* L.) Cultivars for Tolerance to Acidic Soil. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa.* Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 310-311. CIMMYT. English. (AGRI 95-002005).

Pot experiments were conducted to screen Kenyan wheat (*Triticum aestivum* L.) genotypes on an acidic Ferralsol (pH 4.1 KCl) on the basis of root weight (RW) and shoot weight (SW). In the first experiment, cvs. Mbuni, K. Nyumbu, Kwale and Paka showed significantly higher mean RW 20 days after sowing, while the lowest root weights were observed on cvs. K. Leopard and Paa. In the second experiment, the main toxicity symptom observed was chlorosis on the first and the second leaves of cultivars Mbuni and Paa. However, symptoms on cv. Paa were also noted for the treatments with 4.15, 8.30, 12.45, and 16.6 meq CaCO₃/100 g soil, suggesting its sensitivity to acidic soil. Significant ($P < 0.1$) effects due to lime on SW and RW were observed on cv. Mbuni (tolerant) and Paa (sensitive). In addition, significant ($P < 0.1$) cultivar effects were observed for RW indicating differences in root weight between cultivars. At the rate of 8.30 meq/100 g soil (6.9 t/ha), cv. Mbuni increased RW by 150 percent of the control compared to a 250 percent increment observed on Paa. At the rate of 29.05 meq CaCO₃/100 g soil (24.1 t/ha), cv. Paa was capable of increasing RW by 300 percent of the control while cv. Mbuni increased RW by 83.3 percent. The result indicated that cv. Paa was sensitive to acidic Ferralic soils. Moreover, the two cultivars tested required different rates of lime to correct soil acidity. From the symptoms observed, toxicity emanating from the acidic soil could be due to manganese (Mn).

798 Panajotova, G.; Kolev, T. (Institut po Pamuka i Tv'rdata Pshenitsa, Chirpan (Bulgaria)) (1993) [Effect of the systematic mineral fertilization on the yield and quality of durum wheat grain]. Vliyanie na sistemnoto mineralno torenie v'rkhu dobiva i kachestvoto na z'rnoto ot tv'rda pshenitsa. Selskostopanska Akademija, Sofia (Bulgaria). *Rasteniev' dni Nauki (Bulgaria)*; *Plant Science* v. 30(7-8) p. 5-9. 3 ill., 2 tables; 14 ref. Bulgarian. (AGRI 95-012231).

799 Papakosta, DK. (1994) PHOSPHORUS ACCUMULATION AND TRANSLOCATION IN WHEAT AS AFFECTED BY CULTIVAR AND NITROGEN FERTILIZATION. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(3-4):260-270. English. [ARISTOTELIAN UNIV THESSALONIKI SCH AGR AGRON LAB GR-54006 THESSALONIKI GREECE].

To improve nutrient management strategies in wheat more information is needed about the interaction effects among nutrients in their uptake and redistribution in the plants, in relation to different genotypes. Therefore, two bread (T, *aestivum* L.) and two durum (T, durum Desf.) winter wheat cultivars were grown in the field for 2 years (1986, 1987) in a silty-clay soil under different nitrogen (N) levels, in Northern Greece. Nitrogen at a rate of 150 kg ha⁻¹ was applied before planting or 100 kg ha⁻¹ before planting and then 50 kg ha⁻¹ at early boot stage. Cultivar differences in phosphorus (p) concentration were observed only in vegetative parts but not in the grain. Maximum p accumulation was observed either at anthesis or at maturity. During grain filling dry matter and p accumulation in the grain followed almost the same pattern. Phosphorus translocation efficiency of the cultivars at the 2 years ranged from 70.7 to 84.3% and the amount of p in the grain derived from translocation 52 to 100%. Phosphorus translocation efficiency was weakly

correlated with p content in grain only in 1986, while phosphorus harvest index (PHI) was positively correlated with harvest index (HI) both years ($r = 0.82^{**}$ in 1986 and 0.75^{**} in 1987). Nitrogen application mainly affected p accumulation of the cultivars via its effect on biomass production. The split N application promoted slightly the p uptake in 1987 and this resulted in the reduction of both the contribution of the translocated p to the grain and the efficiency of p utilization for total biomass. Results indicated that p accumulation and translocation and the efficiency of p utilization in wheat were mainly determined by the genotype in relation to environmental condition of growth. [References: 16].

800 Peltonen, Jari (1992) Developmental stages of the apex used as a basis for supplemental nitrogen application in spring wheat production. Helsinki Univ. (Finland). *Kasvinviljelytieteen julkaisuja (Finland)*; no. 35 107 p. University of Helsinki. Bibliography p. 43-51. English. (AGRI 95-012230).

801 Podlesak, W. (1994) [On the time-dependent manganese requirement of winter rye and winter wheat]. Ueber den zeitlichen Mangan-Bedarf von Winterroggen und Winterweizen. *Archives of agronomy and soil science (Germany)* v. 38(1) p. 51-58. 2 ill., 2 tables; 11 ref. German. (AGRI 95-001992).

802 Rodriguez, D.; Santamaria, GE.; Pomar, MC. (1994) PHOSPHORUS DEFICIENCY AFFECTS THE EARLY DEVELOPMENT OF WHEAT PLANTS. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(1):69-72. English. [UNIV BUENOS AIRES FAC AGRON DEPT SUELOS AV SAN MARTIN 4453 RA-1417 CAPITAL EED ARGENTINA].

The effect of phosphorus nutrition on the development of wheat plants, was studied. Phosphorus deficiency increased the duration of the phyllochron when the concentration in shoots was less than 0.8%. Phosphorus concentration in shoots appeared to be a good indicator of the effect of plant phosphorus status on wheat development. [References: 8].

803 Roemer, W. (1994) [Phosphate fertilization: Beginning with grain fertilization]. Phosphatdüngung: Bodenvorräte nutzen. Bei der Getreidedüngung beginnen. *dlz. Die landwirtschaftliche Zeitschrift für Produktion - Technik - Management (Germany)* v. 45(2) p. 52-54. 3 ill., 7 tables. German. (AGRI 95-001972).

804 Rowland, IC.; Mason, MG.; Pritchard, IA.; French, RJ. (1994) EFFECT OF FIELD PEAS AND WHEAT ON THE YIELD AND PROTEIN CONTENT OF SUBSEQUENT WHEAT CROPS GROWN AT SEVERAL RATES OF APPLIED NITROGEN. *Australian Journal of Experimental Agriculture*. 34(5):641-646. English. [WESTERN AUSTRALIA DEPT AGR BARON HAY COURT S PERTH WA 6151 AUSTRALIA].

The responses of wheat to various rates of N fertilizer were compared following field peas (PW) or wheat (WW) in the previous year. Seventeen trials were carried out at 5 sites between 1986 and 1991. The trials were on medium- and fine-textured soils (clay loams or shallow duplex soils). The overall grain yield of PW appeared greater than WW in 11 trials [was significantly greater in 9 ($P < 0.05$)], and did not appear different in 6 trials. When no N was applied the yield advantage of PW was 41% (PW 1.91 t/ha cf. WW 1.37 t/ha). Quadratic response curves were fitted to all yield data. Rotation x N rate interaction was significant ($P < 0.05$) in 10 comparisons. In 5 trials, while there was a yield increase to N fertilizer with WW, the yields decreased with PW. In 3 trials while there was an increase with WW there was no response with PW or a reduction at higher rates of N. In the remaining 2 trials there were responses with both PW and WW, but this was greater for WW. The response curves in these 10 trials either converged and met, indicating that the difference between rotations was due to N availability, or converged but did not meet, indicating that N was important but did not explain the whole difference. Where there was no interaction between rotation and N rate the response curves were parallel. The type of response could not be predicted. It was not profitable to apply N fertilizer to wheat in the PW rotation in 11 of the 17 trials. The average yield advantage of PW over WW, in the absence of N was 540 kg/ha, while there was an average increase of 1.7% grain protein. [References: 10].

805 Ruppe, J.; Podlesak, W. (1994) [Investigations into the influence of air temperature, lighting intensity and relative atmospheric humidity on copper and manganese uptake via wheat shoots]. Untersuchungen zum Einfluss von Lufttemperatur, Beleuchtungsstärke und relativer Luftfeuchte auf die Aufnahme von Kupfer und Mangan über den Spross des Weizens. *Archives of agronomy and soil science (Germany)* v. 38(1) p. 41-49. 2 ill., 3 tables; 12 ref. German. (AGRIS 95-001952).

806 Samra, J.S.; Dhillon, S.S. (Punjab Agricultural University, Ludhiana (India). Department of Plant Breeding) (1993) Studies on the effect of different rates of balanced fertilization and agrostem on the productivity of irrigated wheat. *Journal of Research Punjab Agricultural University (India)* v. 30(1, 2) p. 13-14. 1 table; 2 ref. English. (AGRIS 95-002006).

807 Saric, M.R.; Jovic, B. (1993) [Biological potential of some cultivated plants in agrophytocenose depending on mineral nutrition]. Biološki potencijal gajenih biljaka u agrofotocenozi u zavisnosti od mineralne ishrane. Srpska akademija nauka i umetnosti. 69 tables; 65 ref. Text in cyrillic. 135 p. Serbian. (AGRIS 95-001974).

808 Selmen, A.A.K. (Mosul Univ. (Iraq). Coll. of Agric. and Forestry. Dept. of Field crops) (1993) [The effect of different levels of compound fertilizer on yield and yield component of wheat cultivars under rainfed conditions]. Ta'ir mustawyat muh'alifah min ala'samadah al-murakabah 3ala al-h'a'si wa mukawwatah liba3d 'la'ana'f al-h'unt'ah tah't al-z'arwf al-daymayah. Mij'alat Zira:3at al-ra:fidin (Iraq); Mesopotamia Journal of Agriculture v. 25(no.3) p. 59-66. 5 tables; 9 ref. Arabic. (AGRIS 95-001923).

This experiment was conducted to study the effect of four levels (0, 120, 160, and 200 kg/ha) of compound fertilizer on wheat cultivars (Saberbeg, Mexi-pak and Yecora rajo) under rain fed conditions for two successive seasons. The results indicated that the cultivar Yecora rajo gave the highest grain and biological yield in the first season while in the second season there was no significant differences between Yecora rajo and Mexi-pak in grain and biological yield but they outyielded Saberbeg. However Saberbeg has the tallest plants in both season. Application of fertilizer increased grain and biological yield, harvest index and some other yield components particularly, the highest levels.

809 Singh, V. (Raja Balwant Singh College, Agra (India). Department of Agricultural Chemistry and Soil Science) (1994) Nitrogen - copper relationship in wheat. *Indian Journal of Plant Physiology (India)* v. 37(1) p. 43-45. 2 tables; 6 ref. English. (AGRIS 95-012199).

810 Sowers, KE.; Miller, BC.; Pan, WL. (1994) OPTIMIZING YIELD AND GRAIN PROTEIN IN SOFT WHITE WINTER WHEAT WITH SPLIT NITROGEN APPLICATIONS. *Agronomy Journal*. 86(6):1020-1025. English. [WASHINGTON STATE UNIV DEPT CROP & SOIL SCI PULLMAN, WA 99164 USA].

Grain protein of soft white winter wheat (*Triticum aestivum* L.) produced in eastern Washington has increased above market-desired levels over the past decade, when subnormal precipitation and overfertilization contributed to excessive residual soil N levels. A field study was conducted over four site-years to (i) examine N effects on the yield-protein relationship of soft white winter wheat under high soil N conditions, (ii) determine if split N applications can maintain yield and reduce grain protein, and (iii) evaluate midseason grain analysis as a predictor of final grain protein. Nitrogen rates ranged from 0 to 140 kg N ha⁻¹; timing treatments were fall preplant N and spring topdressed or point-injected N. High yields (>5900 kg ha⁻¹) were produced without fertilizer N, and yield responses to N ranged from 0 to 22%. Fall N > 56 kg N ha⁻¹ increased yield in only one site-year; yields were reduced due to excess N fertilization in another site-year in conjunction with shallow N depletion and poor water extraction from deeper soil layers. In two of four site-years, yield increased with a 50% fall-50% spring point-injected N compared with 100% fall application at 84 kg total N ha⁻¹. Protein >100 g kg⁻¹ was produced in site-years where most soil N was depleted below the 90-cm depth; shallow N depletion was associated with lower protein. Grain N concentration at maturity was highly correlated with grain N concentration at the late milk and soft dough stages. Preharvest predictions of final grain protein may be useful in segregating grain at

harvest for marketing purposes. Under high residual soil N levels, reduced N rates and split N applications between fall and spring can maintain high yields and reduce grain protein. [References: 35].

811 Sowers, KE.; Pan, WL.; Miller, BC.; Smith, JL. (1994) NITROGEN USE EFFICIENCY OF SPLIT NITROGEN APPLICATIONS IN SOFT WHITE WINTER WHEAT. *Agronomy Journal*. 86(6):942-948. English. [WASHINGTON STATE UNIV DEPT CROP & SOIL SCI PULLMAN, WA 99164 USA].

Nitrogen use efficiency (grain weight per unit of N supplied from soil or fertilizer) can be reduced by overfertilization, suboptimal yields, and N losses. Nitrogen is typically fall-applied in eastern Washington for soft white winter wheat (*Triticum aestivum* L.) production, and is therefore subject to overwinter losses or accumulation in deep soil layers. Increasing grain protein levels of soft white winter wheat have been attributed in part to excessive N application rates and high residual N levels. Spring N applications were evaluated over four site-years as an option to all-fall applied N for reducing N inputs and improving N use efficiency, thereby allowing producers to maintain productivity while controlling grain protein. Five to six N rates ranging from 0 to 140 kg ha⁻¹ for the all-fall N applications were compared with fall-spring split applications of 84 to 140 kg total N ha⁻¹. Nitrogen was applied in the spring by topdressing (TD) or with a spoke-wheel point-injection (PI) system. A N-15 experiment was conducted at two locations during the second year to quantify N uptake from fertilizer and soil N. High preplant residual N conditions resulted in limited responses to added N. Nitrogen use efficiency was 26 to 44% lower in the 140 kg ha⁻¹ fall-applied N treatments than in the zero-N control. Reduced N use was related to N losses from the system and to decreased N utilization efficiency (grain weight produced per unit plant N). Spring-applied N, with point injection or topdressing, maintained or increased N use efficiency compared with equivalent all-fall N rates of 84 and 112 kg N ha⁻¹. More N-15-labeled fertilizer (7-16% more) was recovered with a split N application than with fall-applied N at the same total rate of 112 kg N ha⁻¹. At maturity, 68% of plant N was from soil sources with a split application, compared with 80% with an all-fall application. These results suggest spring-IV applications with point injection or topdressing can improve fertilizer N recovery and N use efficiency over preplant applications in dryland winter wheat. [References: 30].

812 Strel'nikov, V.N.; Lukin, S.M. (1993) [Recoupmnt of mineral fertilizers with winter wheat grain on sod-podzolic sandy loam acid soil]. Okupaemost' mineral'nykh udobrenij zernom ozlmoj pshenitsy na demovo-podzolistoj supeschanoj kisl'oj pochve. *Agrokimiya (Russian Federation)* (no.8) p. 40-44. 7 ref. Russian. (AGRIS 95-002007).

813 Uhlen, G. (1994) THE LEACHING BEHAVIOUR AND BALANCES OF NITROGEN AND OTHER ELEMENTS UNDER SPRING WHEAT IN LYSIMETER EXPERIMENT 1985-92. *Acta Agriculturae Scandinavica Section B-Soil & Plant Science*. 44(4):201-207. English. [AGR UNIV NORWAY DEPT SOIL & WATER SCI POB 5028 N-1432 AS NORWAY].

In a lysimeter study it was found that moderate rates of ammonium nitrate increased utilization percentages in spring wheat, and the leaching was 10% or less of added N. Over-optimal rates reduced utilization percentages and increased leaching to almost 50% of the highest doses. Late split application of calcium nitrate increased the percentage of N in grain. Furthermore, leaching of N was not reduced, but occurred somewhat later in the fall and winter seasons. Leaching of Cl⁻ was more rapid and that of SO₄(2-) was delayed relative to the leaching of NO₃⁻. Rather large negative N balances were obtained, also after over-optimal application rates, and total N content of the soil was reduced. Compared with the N0 treatment, differences in soil N residues amounted to 15-25% of added N in seven years. Gaseous losses had apparently taken place both from the added N and from soil N according to the total-N analysis. [References: 15].

814 Wang Kuibo; Yu Meiyang; Shen Xiuzheng (Shandong Provincial Academy of Agricultural Sciences, Jinan (China). Inst. for Application of Atomic Energy) (1993) The effect of dressing organic matter and inorganic fertilizer on soil fertility and nitrogen absorption of wheat. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(6) p. 289-293. 2 ill., 6 tables, 4 ref. Chinese. (AGRIS 95-001999).

815 Wang Xinzong; Xie Xiaoyu (Northwestern Agricultural Univ., Yangling, Shaanxi (China). Dept. of Agronomy) (1993) Increasing production benefit of foliage fertilizer on dry land wheat. *Shaanxi Journal of Agricultural Sciences (China)* (no. 5) p. 27-28. 4 tables. Chinese. (AGRI 95-002004).

816 Workneh Negatu (Alemaya University of Agriculture, Debre Zeit (Ethiopia). Debre Zeit Agricultural Research Center); Mwangi, W. (1994) An Economic analysis of the Response of Durum Wheat to Fertilizer: Implications for Sustainable Durum Wheat Production in the Central Highlands of Ethiopia. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 177-185. CIMMYT. 5 tables; 16 ref. English. (AGRI 95-002009).

Durum wheat farmers in the central highlands of Ethiopia apply less than the recommended rate of N and P nutrients for durum wheat. On-farm trials conducted for three years in the Ada and Akaki areas of the central highland revealed that the N-P recommendation (64 kg N-20.9 kg P per ha) gives a statistically significant and economically feasible increase in grain output under current production circumstances compared to the lower N-P rates commonly used by farmers. For sustainable durum wheat production, sustained use of fertilizer is essential which in turn requires a favorable socio-economic environment.

817 Zhang Baojun; Jiang Jiyun, Fen Beili (Northwestern Agricultural Univ., Yangling, Shaanxi (China). Dept. of Agronomy) (1993) Effect of fertilizer application to wheat at jointing stage on grain protein and its composition. *Shaanxi Journal of Agricultural Sciences (China)* (no. 4) p. 26-27. 2 tables, 3 ref. Chinese. (AGRI 95-002002).

F06 IRRIGATION

818 Majeed, A.; Stockle, CO.; King, LG. (1994) COMPUTER MODEL FOR MANAGING SALINE WATER FOR IRRIGATION AND CROP GROWTH - PRELIMINARY TESTING WITH LYSIMETER DATA. *Agricultural Water Management*. 26(4):239-251. English. [WASHINGTON STATE UNIV DEPT BIOL SYST ENGN PULLMAN, WA 99164 USA].

A computer model was developed to help formulating irrigation strategies for areas where use of saline waters of questionable quality may be an option for crop production. The model estimates salt and water balance in the soil profile and predicts crop growth in response to weather and irrigation and crop rotation management. Salinity effects on crop growth are simulated in the model through inclusion of osmotic potential in the determination of water uptake. However, it was found that osmotic potential alone did not explain reduced crop growth under heavy and frequent irrigation. Salinity effects on root permeability were found to satisfactorily explain reduced water uptake and growth under such conditions. The model was calibrated and tested for wheat and sorghum crops using one year's data from column lysimeters irrigated with water of varying qualities at the U.S. Salinity Laboratory at Riverside, California. The calibrated model was found to reasonably predict water use, soil salinity, and crop production of independent test lysimeters. Although the model appears to have potential for analyzing irrigation strategies in agricultural systems with salinity constraints, additional testing with field data will be required. [References: 21].

819 McMaster, GS.; Wilhelm, WW.; Bartling, PNS. (1994) IRRIGATION AND CULM CONTRIBUTION TO YIELD AND YIELD COMPONENTS OF WINTER WHEAT. *Agronomy Journal*. 86(6):1123-1127. English. [USDA ARS GREAT PLAINS SYST RES POB E FT COLLINS, CO 80522 USA].

Water is generally the limiting factor in U.S. Great Plains wheat (*Triticum aestivum* L.) production. With increasing demands for limited water, improving the efficacy of irrigation is critical. One technique is to irrigate during responsive stages of crop development, but few studies have examined this approach. This 2-yr study on a Nunn clay loam soil (fine, montmorillonitic, mesic Andic Argustoll) was designed to examine the effects of irrigation, based on stage of crop development, on winter wheat yield, yield components (on a plant basis), and specific culm

responses. In the first year, the treatments were control (dryland), and irrigation at late jointing. In the second year, the treatments were dryland, irrigation at late jointing, irrigation at anthesis, and irrigation at both late jointing and anthesis. Irrigation at late jointing or anthesis significantly increased grain yield and the most important yield component (spikes per plant), as well as spikelets per plant, number of kernels per plant, and kernel weight per plant. The increased spikes per plant in the irrigation treatments, particularly with late-jointing irrigation, was due to reduced tiller abortion. Increased yield was primarily due to the contribution of more secondary tillers (T10, T11, T24 T21, T34 and T31) that produced spikes. The contribution of main stems to the total yield decreased from 92% to at most 86% with irrigation, although the dry weight of main-stem spikes increased with irrigation. The contribution to total yield of the main yield-producing tillers, T1 and T2, decreased from 20 to 15% and 19 to 15%, respectively, with irrigation. As with main-stem spikes, irrigation also increased T1 and T2 spike dry weight. Therefore, the production of secondary spikes due to irrigation treatments was not at the expense of main stem or primary tiller spikes. If only one irrigation can be applied, irrigation at late jointing is recommended for central Great Plains conditions, due to its greater effect on tiller survival. This implies that developmental and physiological processes at late jointing are critical in determining final grain yield, and water stress should be avoided at this growth stage. [References: 31].

820 Mourya, B.M.; Yadav, R.D. (Jawaharlal Nehru Krishi Vishwa Vidyalaya, Raipur (India)) (1992) Performance of wheat crop under excess moisture and irrigation methods in shallow ground-water table. *Indian Journal of Agricultural Engineering (India)* v. 2(3) p. 208-213. 4 tables; 1 ill., 1 ref. English. (AGRI 95-002186).

821 Musick, JT.; Jones, OR.; Stewart, BA.; Dusek, DA. (1994) WATER-YIELD RELATIONSHIPS FOR IRRIGATED AND DRYLAND WHEAT IN THE US SOUTHERN PLAINS. *Agronomy Journal*. 86(6):980-986. English. [USDA ARS CONSERVAT & PROD RES LAB PO DRAWER 10 BUSHLAND, TX 79012 USA].

A climate with high evaporative demand and limited precipitation restrict yields of winter wheat (*Triticum aestivum* L.) grown in the semiarid U.S. southern High Plains. Stress effects can be avoided or minimized by management practices that increase soil water storage at planting or by application of irrigation water. We analyzed a 178 crop-year database of irrigated and dryland wheat data from Bushland, TX, to develop relationships that define the grain yield and water-use efficiency (WUE) response to a wide range in seasonal evapotranspiration (ET) associated with water deficits and to evaluate yield response to stored soil water at planting. The ET-grain yield relationship was determined as Linear, with a regression slope of 1.22 kg grain per m(3) ET above the ET threshold of 208 mm required to initiate grain yield. Maximum yields (>7.0 Mg ha(-1)) required 650 to 800 mm seasonal ET. Maximum yields observed in the combined database were 2.8 and 8.2 Mg ha(-1) for dryland and irrigated wheat, respectively. The Linear regression response of grain yield to soil water stored at planting, 1.57 kg m(-3), was significantly higher than the yield response to seasonal ET. Largely similar WUE values occurred over a wide range of seasonal ET within irrigated and dryland data sets; however, WUE values for irrigated wheat averaged about double the values for dryland wheat. A curvilinear relationship determined between WUE and yield emphasizes the importance of obtaining high yields for efficient water use. [References: 35].

822 Zhang Qigang; He Changyong; Wang Huaguo (Beijing Agricultural Univ. (China)) (1993) Studies on the effect of winter irrigation on wheat growth and N absorption by using 15 N tracer. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(4) p. 172-176. 2 ill., 8 tables, 4 ref. Chinese. (AGRI 95-002185).

F07 SOIL CULTIVATION

823 Bovolenta, S. (Bologna Univ. (Italy). Istituto di Meccanica Agraria) (1994) [Soil preparation - trials on combined equipments (Emilia-Romagna)]. *Preparazione del terreno - prove di attrezzi combinati (Emilia Romagna)*. *Macchine e Motori Agricoli (Italy)* v. 52(6) p. 19-23. 4 tables; 2 graphs; 13 ref. Italian. (AGRI 95-012373).

824 Cattle, SR.; Koppi, AJ.; Mcbratney, AB. (1994) THE EFFECT OF CULTIVATION ON THE PROPERTIES OF A RHODOXEROLF FROM THE WHEAT SHEEP BELT OF NEW-SOUTH-WALES. *Geoderma*. 63(3-4):215-225. English. [UNIV SYDNEY DEPT AGR CHEM & SOIL SCI SYDNEY NSW 2006 AUSTRALIA].

Adjacent cultivated and never-cultivated areas of land were compared for a variety of chemical and physical properties to determine the effect of traditional cultivation practices on an Australian Rhodoxerolf. Those properties which changed most as a result of clearing and cultivation were pH, electrical conductivity, organic carbon, nitrogen and profile macroporosity. These changes are due to various processes including soil mixing, fertilizing, crop-growing and an altered water balance. The heterogeneity of the sites was also investigated in order to ascertain the effect of cultivation on the natural variability of the soil. The cultivated soil was found to be much less diverse than the adjoining virgin soil. Whether this is of ultimate benefit to crops is open to conjecture. [References: 20].

825 Dinev, NS.; Natcheva, V. (1995) PLANT MINERAL COMPOSITION AND TOLERANCE TO LOW PH IN SPECIES OF TRIBE TRITICEAE. *Communications in Soil Science & Plant Analysis*. 26(1-2):223-235. English. [POUSHKAROV INST SOIL SCI & AGROECOL POB 1369 SHOSSE BANKA 7 BU-1080 SOFIA BULGARIA].

Mineral composition of straw in a number of species from Genera Aegilops, Triticum, and Dazypyrum (Tribe Trinceae) has been established under conditions of different soil pH. Nitrogen (N) content has strongly been influenced by ploidy level and has been maximal in diploids. Wild (T. boeoticum) and early cultivated (T. dicoccum) species surpassed domesticated ones T. monococcum and T. durum, respectively. Maximal phosphorus (P) values were shown in Ae. squarrosa and bread wheat cultivars-Chinese spring and Pliska grown on strongly acid soil. T. aestivum cultivars confirmed partially, previously reported effects of low pH on mineral composition. Diploids and tetraploids showed specific changes in elemental content. Progenitors of common wheat with genomes A (T. boeoticum and T. monococcum) and B (Ae. speloides), and D. villosus (V) accumulated more manganese (Mn), like the cultivars Chinese spring and Prostor. Ae. squarrosa (D genome) accumulated high aluminum (Al) concentrations in the straw. A iron (Fe):Mn ratio was used to characterize the effect of low pH on element content. [References: 19].

826 Dunker, RE.; Hooks, CL.; Vance, SL.; Darmody, RG. (1995) DEEP TILLAGE EFFECTS ON COMPACTED SURFACE-MINED LAND. *Soil Science Society of America Journal*. 59(1):192-199. English. [UNIV ILLINOIS DEPT AGRON 1102 S GOODWIN AVE URBANA, IL 61801 USA].

Federal law requires that surface-mined prime farmland be reclaimed and restored to premining productivity for row crops (Surface Mining Control and Reclamation Act, Public Law 95-87). In Illinois, reclamation must include soil horizon replacement (topsoil and subsoil) to a depth of 120 cm. Poor physical condition is the most limiting factor in reclamation in Illinois. The effects of five deep tillage implements (80-120-cm tillage depth) and two standard agricultural chisel plows (20-35-cm tillage depth) were evaluated for 6 yr. The seven tillage treatments were applied to a scraper-placed minesoil that had a high soil strength (2.5-3.5 MPa) throughout the reconstructed profile. A nearby tract of undisturbed Cisme silt loam (fine, montmorillonitic, mesic Mollic Albaqualf) was used as a prime farmland comparison. Crop yields for both corn (Zea mays L.) and soybean [Glycine mar (L.) Merr.] significantly increased with tillage depth. Average soil strength decreased and net water extraction increased with increasing depth of tillage. The 1.2-m-deep tillage treatments significantly reduced average 23- to 114-cm soil strength from 2.8 to 0.93 MPa. Significant correlation occurred between 23- to 114-cm average soil strength and 6-yr mean corn (-0.97** [significant at P = 0.01]) and 4-yr mean soybean (-0.92**) yields. Deep tillage successfully restored productivity; however, the depth of tillage necessary was influenced by initial levels of soil strength. [References: 26].

827 Gregorich, EG.; Carter, MR.; Angers, DA.; Monreal, CM.; Ellert, BH. (1994) TOWARDS A MINIMUM DATA SET TO ASSESS SOIL ORGANIC MATTER QUALITY IN AGRICULTURAL SOILS [Review]. *Canadian Journal of Soil Science*. 74(4):367-385. English. [AGR CANADA AGRIFOOD RES BRANCH OTTAWA ON K1A 0C6 CANADA].

Soil quality is a composite measure of both a soil's ability to function and how well it functions, relative to a specific use. Soil quality can be assessed using a minimum data set comprising soil attributes such as texture, organic matter, pH, bulk density, and rooting depth. Soil organic matter has particular significance for soil quality as it can influence many different soil properties including other attributes of the minimum data set. Assessment of soil organic matter is a valuable step towards identifying the overall quality of a soil and may be so informative as to be included in minimum data sets used to evaluate the world's soils. In this review, soil organic matter is considered to encompass a set of attributes rather than being a single entity. Included among the attributes and discussed here are total soil organic carbon and nitrogen, light fraction and macroorganic (particulate) matter, mineralizable carbon and nitrogen, microbial biomass, soil carbohydrates and enzymes. These attributes are involved in various soil processes, such as those related to nutrient storage, biological activity, and soil structure, and can be used to establish different minimum data sets for the evaluation of soil organic matter quality. [References: 156].

828 Horsch, D. (1994) [Examples of integrated plant production in arable farming - reduced soil tillage and adapted seeding technique and weed control with the Horsch-System]. Reduzierte Bodenbearbeitung, angepasste Saattechnik und Unkrautbekämpfung nach dem System HORSCH. (*Integrated plant production*); (*Systems of sustainable plant production, grounding, experience, developments -arable farming, vegetables, fruits, hops, grassland*). Dierks, R.; Heitefuss, R. 2. Auflage p. 273-281. BLV Verlagsgesellschaft. 1 ill., 4 graphs, 5 tables; 8 ref. German. (AGRI 95-002237).

829 Jiang, HY.; Sato, K. (1994) DNA BASE COMPOSITION OF BACTERIAL GROUPS DIFFERENTIATED BY A DIAGNOSTIC SCHEME USED FOR SOIL ISOLATES. *Soil Science & Plant Nutrition*. 40(4):675-681. English. [TOHOKU UNIV INST GENET ECOL SOIL MICROBIOL LAB AOA KU SENDAI MIYAGI 980 JAPAN].

830 Jiang, HY.; Sato, K. (1994) INTERRELATIONSHIPS BETWEEN BACTERIAL POPULATIONS ON THE ROOT SURFACE OF WHEAT AND GROWTH OF PLANT. *Soil Science & Plant Nutrition*. 40(4):683-689. English. [TOHOKU UNIV INST GENET ECOL SOIL MICROBIOL LAB AOA KU SENDAI MIYAGI 980 JAPAN].

831 Kreuz, E. (1993) [Influence of non-plough tillage of winter wheat and spring barley succeeding sugar-beet on bulk density in the ploughing layer of Calcic Chernozem and on the grain yield]. Der Einfluss pflugloser Bestellung von Winterweizen und Sommergerste nach Zuckerrueben auf die Trockenrohdichte in der Ackerkrume einer Loessschwarzerde sowie auf den Kernertrag. *Archives of agronomy and soil science (Germany)* v. 37(4) p. 257-265. 4 tables; 26 ref. German. (AGRI 95-002236).

832 Kulik, D. (1995) THE EFFECT OF SOME INTENSIFICATION FACTORS ON THE SPRING BARLEY YIELD. *Rostlinna Vyroba*. 41(1):1-4. Czech. [UNIV AGR NITRA A HLINKU 2 NITRA 94976 SLOVAKIA].

The polyfactorial field experiments were carried out in 1986 to 1990 at the University of Agriculture, Research Base in Nitra. The Base is located in warm corn-growing region, with soddyalluvial, gley, heavy clay-loam soils. The phosphorus and potassium contents in the soil were at the good level, pH/KCl 5.29 to 6.7; humus content 2.23 to 3.50 %. The weather conditions were quite different during the years of experiment, the amount of rainfall vegetation period varied from 152.7 mm to 223.2 mm and amount of average daily temperatures from 1, 794, 8 to 1, 914 degrees C. The aim of experiment was to evaluate some intensification factors (fertilization, forecrop, biological material) and simultaneously with it to keep them rational, particularly fertilization based on the balance of nutrients added and taken up, with respect to the yield. There were six combinations of fertilization, with and without respect to N-an in the soil. Four varieties were included in trials: Orbit, Bonus, Jaspis, Novum after two forecrops: winter wheat and silage corn. Planting rate was 4.5 mil. grains per hectare. The differentiation of weather conditions has occurred during ontogenesis in yield-forming components with respect to the resultant yield (Figs 1 to 4). The importance of forecrop has been reflected in experimental years, in our case, in favour of silage corn by 0.96 t.ha(-1)

on five years' average. The forecrop intensification effect can be seen the best at zero fertilization plots (variant 1), with 1.25 t.ha⁻¹ in favour of silage corn. Presented data also show the great effect of experimental year. After the winter wheat, due to year a grain yield variability was minimum 0.86 t.ha⁻¹ (1989 to 1990) and maximum 2.2 t.ha⁻¹ (1986 to 1990). The yields in the (1988 to 1989). After silage corn minimum 0.23 (1987 to 1990) and maximum 1.95 t.ha⁻¹ fertilized plots (variants 2 to 6) were higher compared to zero fertilization plots by 1.22 t.ha⁻¹ after wheat and by 0.87 t.ha⁻¹ after silage corn. At the locations similar to that of the Research Base and under similar agro-ecological conditions, the dose of 30 kg.ha⁻¹ nitrogen was shown to be sufficient, that means to use the monitoring of N-an in soil for rational fertilization respectively. The theoretical natural production (TNP) and real natural production (SNP) are objective criteria which enable to judge the work of agronomist and also enable to control the usage of fertilizers in order to protect environmental contamination. TNP and SNP were calculated after Spaldon (1988), Kulik (1993). TNP were balanced at 23.2 kg of grain which is related to the above-ground biomass uptake of 1 kg NPK nutrients. SNP represents the grain production with respect to 1 kg of NPK nutrients added through fertilization. Marginal values of SNP for tested barley varieties achieved 24.9 to 43.4 kg, what means that the yield amounted?ted to by 7.3 to 87.1 % more NPK nutrients than those added to the soil by fertilization and so environment was not contaminated.

833 Larney, FJ.; Izaurralde, RC.; Janzen, HH.; Olson, BM.; Solberg, ED.; Lindwall, CW.; Nyborg, M. (1995) SOIL EROSION - CROP PRODUCTIVITY RELATIONSHIPS FOR 6 ALBERTA SOILS. *Journal of Soil & Water Conservation*. 50(1):87-91. English. [AGR CANADA RES STN LETHBRIDGE AB T1J 4B1 CANADA].

Water and wind erosion are major soil degradation forces on the Great Plains of North America but their effects on soil productivity are not well quantified. Six experimental sites were established in Alberta in 1990-1991 to ascertain the effects of simulated erosion on soil productivity. Incremental depths of soil (0, 5, 10, 15, and 20 cm) were removed with an excavator. Highly significant relationships were found between the depth of desurfacing and subsequent spring wheat yields, showing that simulated erosion drastically reduced soil productivity. Treatment effects at an irrigated site followed the same trends as the dryland sites, illustrating that top-soils loss cannot be offset by adequate soil moisture. Our results show that the loss in returns caused by topsoil removal depends on (a) the particular depth increment of topsoil removed by erosion; (b) soil type; and (c) whether the soil is dryland or irrigated. [References: 27].

834 Modestus, W.K. (Selian Agricultural Research Institute, Arusha (Tanzania)) (1994) Minimum Tillage as an Alternative to Conventional Tillage for Wheat Production in Northern Tanzania. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 221-228. CIMMYT. 5 tables; 3 ref. English. (AGRI 95-002231).

Four minimum tillage systems were evaluated in terms of effective weed control during the fallow period, grain yield, and cost compared to the current practice of conventional mechanical tillage. The evaluation was conducted at two important wheat growing areas in northern Tanzania over a 3 year period at one location and for 2 years at the other location. Wheat yields under minimum tillage practices and conventional tillage did not differ significantly in any year. Effective fallow weed control was achieved by substituting mechanical tillage by pre-plant herbicides with residual activity (Stomp/Glean or Treflan/Glean), or by using non-selective herbicides (Roundup or Basta). Overall, the conventional practice was expensive compared to the minimum tillage practices. The results indicated that minimum tillage practices are a viable option for wheat production in Tanzania.

835 Negusie Tadesse; Seid Ahmed; Mengistu Huluka (Alemaya University of Agriculture, Debre Zeit (Ethiopia). Debre Zeit Agricultural Research Center) (1994) The Effects of Minimum Tillage on Weed Management and Yield of Durum Wheat in Central Ethiopia. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional*

Wheat Workshop for Eastern, Central and Southern Africa. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 241-246. CIMMYT. 2 tables; 15 ref. English. (AGRI 95-002242).

The use of minimum tillage, combining reduced tillage with herbicides for the management of weeds in durum wheat fields, was investigated at Debre Zeit, Ethiopia for 3 years. The grain yield obtained with minimum tillage (MT) was almost 50 percent lower than that of conventional tillage when MT was practised continuously on the same piece of land. Nevertheless, when MT was rotated with conventional tillage, it was found to be equally effective in suppressing weed populations and reducing the dry matter accumulation of weeds. Furthermore, the grain yield difference between the two treatments was non-significant. The herbicides 2, 4-D, Brittox, and MCPA, and one hand weeding were effective in controlling broadleaved weeds, irrespective of the tillage system. The merit of MT in durum wheat production, and its potential as a component of integrated weed management is discussed.

836 Okon, Y.; Labanderagonzalez, CA. (1994) AGRONOMIC APPLICATIONS OF AZOSPIRILLUM - AN EVALUATION OF 20 YEARS WORLDWIDE FIELD INOCULATION (Review). *Soil Biology & Biochemistry*. 26(12):1591-1601. English. [HEBREW UNIV JERUSALEM FAC AGR DEPT PLANT PATHOL & MICROBIOL IL-76100 REHOVOT ISRAEL].

By evaluating worldwide data accumulated over the past 20 years on field inoculation experiments with *Azospirillum*, it can be concluded that these bacteria are capable of promoting the yield of agriculturally-important crops in different soils and climatic regions. Various strains of *A. brasilense* and *A. lipoferum* have been used to inoculate cultivars of different species of plants. It is however difficult to accurately estimate the percentage of success due to *Azospirillum* inoculation. The data indicates 60-70% occurrence of success with statistically significant increases in yield of the order of 5-30%. Successful inoculation experiments appear to be those in which the researchers have paid special attention to the optimal number of cells of *Azospirillum* in the inoculant, using inoculation methods where the optimal number of cells remained viable and available to colonize the roots. Furthermore, experiments taking into consideration the potentialities and limitations of this technology have been better able to explain successes and failures. The different formulations (analogous to those of rhizobia) of the genus *Azospirillum*, irrespective of their form of application and their mode of action on the plant, are indeed inoculants. The term biofertilizer is not appropriate as it does not replace fertilizer but improves their utilization. We very strongly suggest the implementation by regulatory authorities of quality control on commercial *Azospirillum* inoculants. [References: 44].

837 Pucek, TR.; Pys, JB. (1994) THE NUTRITIVE VALUE AND YIELD OF WINTER WHEAT ON SULFUR-INDUSTRY RECLAIMED LANDS. *Acta Agriculturae Scandinavica Section B-Soil & Plant Science*. 44(4):230-235. English. [SIARKOPOL OBR RES & DEV CTR SULFUR IND PL-39405 TARNOBREZEG POLAND].

The chemical composition and yield of winter wheat cultivated on flotation tailings with a humus layer were analyzed. In spite of a high concentration of sulfate sulfur in the soil substitute, no excessive accumulation of total sulfur in wheat grain and straw was detected. A considerable deficiency of P in grain and straw was found. The crude and true protein contents, as well as the yield of crude protein in the grain, were positively correlated with the total sulfur content. The crude protein yield and true protein level were positively correlated with the N/S ratio. [References: 23].

838 Purnomo, E.; Black, AS. (1994) WHEAT GROWTH FROM PHOSPHORUS FERTILIZERS AS AFFECTED BY TIME AND METHOD OF APPLICATION IN SOIL WITH AN ACIDIC SUBSURFACE LAYER. *Fertilizer Research*. 39(1):77-82. English. [CHARLES STURT UNIV SCH AGR POB 588 WAGGA WAGGA NSW 2678 AUSTRALIA].

Using soils with an acidic subsurface layer, three glasshouse experiments were carried out to evaluate the effect of placement method and application rate of triple superphosphate (TSP) and North Carolina phosphate rock (NCPFR) on dry matter (DM) yields. Time of application of NCPFR on DM yield response of wheat was also studied. For Experiment 1, soil was collected in depth intervals of 0.2; 4-6; 6-8; and 8-10 cm from a

red earth (chromic luvisol). The treatments included two P sources (TSP and NCPR), three placement methods (broadcast, banded or mixed into the subsurface layer, 6-8 cm), and six application rates. In this P deficient soil with an acidic subsurface layer, there was relatively little effect of application method of TSP on wheat yield responses. The maximum dry matter yield responses for broadcast, band and mix application methods was 30, 42 and 50%, respectively. Responses to NCPR broadcast, band and mix methods were 20, 9 and 44%, respectively. Mixing NCPR into to acidic subsurface layer produced yields similar to those from TSP although a higher application rate of P as NCPR was needed to achieve this outcome. Treatments for Experiments 2 and 3 were time of application of NCPR (0 and 30 days before sowing) and rate of application of NCPR (0 and 40 mg P/pot). In Experiment 2 (same soil as Experiment 1) application of NCPR prior to sowing, resulted in higher Coldwell P concentration than when applied at sowing, but time of application had no effect on final DM yields. Experiment 3 used a red podzolic (chromic luvisol) soil which had a lower P-status, was more acid and had a lower exchangeable Ca^{2+} concentration than the red earth. Application of NCPR prior to sowing resulted in lower DM yield than when it was applied prior to sowing.

839 Romero, A. (DIA CRIA, Capitan Miranda (Paraguay)); Causarano, H.; Wall, P.C. (1994) Tillage and Rotation Effects on Aggregate Stability in Southeastern Paraguay. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 316-318. CIMMYT. 1 table; 2 fig. English. (AGRI 95-002230).

A tillage and rotation trial was initiated on an Ultisol in southeastern Paraguay during the winter of 1989. Main treatments compared direct seeding with conventional tillage (disc plow plus 2-3 disc harrowings), and sub-factors compared the traditional wheat-soybean cropping sequence with three crop rotations: two of two years duration (four crops) and one of three years duration (six crops). The wet-sieving method (Yoder 1936, modified) was used to measure aggregate stability in the fourth year of the trial. Aggregate stability for the no-tillage treatment was significantly greater than for conventional tillage in both the 0-5 cm and 5-10 cm horizons. Rotation treatments had significantly greater aggregate stability than the wheat-soybean sequence in the 5-10 cm horizon, with a similar trend evident in the 0-5 cm horizon.

840 Schmidt, C.P.; Belford, R.K. (1994) INCREASING THE DEPTH OF SOIL DISTURBANCE INCREASES YIELDS OF DIRECT DRILLED WHEAT ON THE SANDPLAIN SOILS OF WESTERN AUSTRALIA. *Australian Journal of Experimental Agriculture*. 34(6):777-781. English. [WESTERN AUSTRALIA DEPT AGR DIV POLICY ANAL & IND DEV BARON HAY COURT 5 PERTH WA 6151 AUSTRALIA].

We evaluated on sandplain soils in the northern wheatbelt of Western Australia in 1990 and 1991 the effect on wheat yields (*Triticum aestivum*) of increasing the depth of soil disturbance (4-40 cm) while direct drilling. These sandplain soils are easily compacted and eroded by wind, but yields after direct drilling with tined implements are frequently poorer than yields after cultivation. Direct drilling with a tined seeder was compared with: (i) direct drilling with a modified seeder on which the front 3 rows of cultivating tines could be lowered relative to the rear 3 rows of seeding tines; and (ii) with direct drilling followed immediately by deep ripping. Progressively increasing the depth of disturbance reduced soil strength and generally increased grain yields of wheat. Effects on yield were more pronounced in the wetter year of 1991 on an experimental site that had not been previously ripped; responses of 32 kg/ha for each centimetre increase in depth of disturbance were recorded. The highest yields followed deep ripping (3429 kg/ha), and the lowest yields followed minimal soil disturbance using narrow (5 cm) seeding tines working to seeding depth only (2144 kg/ha). These results confirmed that it is possible to use a modified direct drilling technique (thus retaining the advantages of timely sowing after rainfall and lowered risk of wind erosion) and raise yields above those normally expected from direct drilling on these soils. [References: 13].

841 Sidhu, A.S.; Sur, H.S. (1993) EFFECT OF INCORPORATION OF LEGUME STRAW ON SOIL PROPERTIES AND CROP YIELD IN A MAIZE-WHEAT SEQUENCE. *Tropical Agriculture*. 70(3):226-229.

English. [PUNJAB AGR UNIV DEPT SOILS LUDHIANA 141004 PUNJAB INDIA].

A field experiment was conducted on Samana sandy loam soil (Typic Ustochrept) for six years to evaluate the effect of summer moong straw (SMS) incorporation on crop yield and soil properties. After harvesting pods, SMS was incorporated seven days before sowing maize in summer moong maize - wheat sequence. Five levels of N (0, 50, 75, 100, and 125 kg N ha⁻¹) and two levels of N (80 and 120 kg N ha⁻¹) were applied to maize and wheat, respectively. Mineral N content was substantially higher in plots with SMS than without SMS during early growth of maize. SMS incorporation increased the N content of 60-day-old maize plants by 20%. Organic C, mineral N, and 0.5 M NaHCO₃ extractable P were 27, 12, and 16%, respectively, higher in SMS-amended plots than unamended plots after six years. SMS incorporation increased infiltration rate of 1.4 times and available water by 2 cm in the 180-cm-depth of soil profile. It decreased resistance to soil penetration. SMS incorporation resulted in significant increase in grain yield of maize at all levels of N. It decreased the number of barren plants and increased the number of cobs plant⁻¹, grain weight cob⁻¹, and 1000-grain weight. A residual effect of SMS incorporation on the succeeding wheat crop was also observed for all six years at the 80 kg N ha⁻¹ level and in the later three years at the 120 kg N ha⁻¹ level. [References: 14].

842 Steppuhn, H. (1994) SNOWCOVER RETENTION CAPACITIES FOR DIRECT-COMBINED WHEAT AND BARLEY STUBBLE IN WINDY ENVIRONMENTS. *Canadian Agricultural Engineering*. 36(4):215-223. English. [AGR CANADA RES BRANCH RES STN BOX 1030 SWIFT CURRENT SK S9H 3X2 CANADA].

Producers of non-irrigated wheat and barley in semiarid climates could make better use of their snow resources if they could estimate the quantities of snow that will be retained on their fields with stubble of different heights left after harvest. A search for a working relationship was conducted in Saskatchewan using the independent variables of stubble height, H, stem spacing, R, and stem diameter, B, to determine the length, L, of stubble which would extend above the surface of the snowcover at maximum capacity following windy snowstorms typical of the Prairies. A 1988-89 field experiment provided the data for calibrating possible equations based on snow transport and deposition concepts. The most promising equations were tested with data from 23 different sites. A semi-log function without R and B terms predicted L-values that compared most closely with field measurements. The differences between predicted and measured L averaged 0.52 cm, and led to a chi-square probability of 0.99 that a random sample would give no better fit. A final working equation calibrated with data from 47 sites offered the widest application for determining maximum snowcover retention capacities, D(max), with a precision of +/- 5% in windy environments: $D(\max) = H \cdot 0.853 \exp(0.0552H)$. [References: 23].

843 Studdert, G.A.; Wilhelm, W.W.; Power, J.F. (1994) IMBIBITION RESPONSE OF WINTER WHEAT TO WATER-FILLED PORE SPACE. *Agronomy Journal*. 86(6):995-1000. English. [UNIV NEBRASKA USDA ARS DEPT AGRON LINCOLN, NE 68583 USA].

Reduced temperature and increased bulk density associated with conservation tillage systems cause lower seed germination, seedling emergence, and early growth rates resulting in reduced plant stands. Prediction of the influence of soil condition on seed imbibition through simple soil measurements would help make agronomic decisions such as planting date and/or density. Our objectives were to evaluate the influence of soil water-filled pore space on winter wheat (*Triticum aestivum* L.) seed imbibition and to assess the possibility of describing the relationship through simple mathematical models. We measured the rate of water uptake by heat-killed wheat seeds at three levels of water-filled pore space (WFPS: 0.35, 0.60, and 0.85) and temperature (T: 278, 283, and 288 K) and two levels of bulk density (Pb: 1.25 and 1.40 Mg m⁻³) in a Sharpsburg silty clay loam topsoil. The model proposed in 1972 by Blacklow to estimate seed water content ($\theta(s)$) after imbibing water for time t, $\theta(s(t)) = (m + \theta t) - (m - \theta(s(0))) e^{-(qt)}$, was fitted to seed water content as a function of time and initial seed water content, $\theta(s(0))$. This equation adequately described the process of water absorption (for 18 treatment combinations, R(2) greater than or equal to 0.963). The model parameter 0 was related (R(2) = 0.88) to WFPS and rho(b), and q was related (R(2) = 0.78) to T and WFPS. The third

parameter, m , was significantly but weakly related ($P < 0.01$, $r(2) = 0.26$) to initial seed weight. We showed that easily measured soil properties and simple mathematical models can be used to predict wheat seed imbibition under a variety of soil conditions. [References: 38].

844 Sweeney, DW.; Moyer, J.L. (1995) LEGUME AND TILLAGE EFFECTS ON PRAIRIE SOIL NITROGEN AND PENETRATION RESISTANCE. *Communications in Soil Science & Plant Analysis*. 26(1-2):155-168. English. [KANSAS STATE UNIV AGR & APPL SCI SE AGR RES CTR POB 316 PARSONS, KS 67357 USA].

Legumes provide benefit in crop rotations, but data are limited on soil inorganic nitrogen (N) and soil strength responses to spring- or fall-seeded legumes as green manures for grain sorghum (*Sorghum bicolor* (L.) Moench) production on the prairie soils of the eastern Great Plains of the United States. With increased emphasis on conservation tillage, information is also needed on combining conservation tillage with the use of legume cover crops. This experiment was established to examine the effects of i) red clover (*Trifolium pratense* L.) and hairy vetch (*Vicia villosa* Roth.) as previous crops to grain sorghum compared with continuous grain sorghum, ii) reduced or no-tillage, and iii) fertilizer N rate on changes in soil inorganic N and soil strength. At two adjacent sites (Parsons silt loam; fine, mixed thermic Mollic Albaqualf) differing in initial pH and phosphorus (P) and potassium (K) fertility, soil nitrate-nitrogen ($\text{NO}_3\text{-N}$) was as much as fourfold higher following kill-down of red clover or hairy vetch than following continuous grain sorghum. At the higher fertility site, soil total inorganic N [TIN: sum of ammonium-nitrogen ($\text{NH}_4\text{-N}$) and $\text{NO}_3\text{-N}$] shortly following kill-down of red clover exceeded TIN following hairy vetch by more than 35% and that with continuous grain sorghum by 110%; however, at the lower fertility site, the trend for soil TIN to be higher following legumes was not significant. Tillage did not affect soil $\text{NO}_3\text{-N}$ levels in the spring following legume kill-down. However, subsequent soil $\text{NO}_3\text{-N}$ levels under no-tillage tended to be higher in the spring, but lower in the fall than with reduced tillage. Increases in soil TIN by legumes and fertilizer were related to grain sorghum yield, but likely were not the only factors affecting yield. Legumes and tillage used in grain sorghum production may also provide other non-N benefits as suggested by soil penetration resistance measured at the end of the study. [References: 33].

845 Tarafdar, J.C.; Marschner, H. (1994) EFFICIENCY OF VAM HYPHAE IN UTILISATION OF ORGANIC PHOSPHORUS BY WHEAT PLANTS. *Soil Science & Plant Nutrition*. 40(4):593-600. English. [CENT ARID ZONE RES INST JODHPUR 342003 RA]ASTHAN INDIA].

In a pot experiment wheat (*Triticum aestivum* L.) was grown under axenic conditions in two soils differing in organic matter and phosphorus contents. The pots were separated by 30 μm nylon nets and a 0.45 μm membrane into five compartments, a central one for root growth, two adjacent to the central compartment for hyphal growth and two outer ones for control. The treatments consisted of sterilized Soil, supply of organic (Na-phytate) or inorganic phosphorus (P) and of soil either non-inoculated or inoculated with *Glomus mosseae*. Shoot dry weight increased by mycorrhizal inoculation in the range between 2.2 and 4.5 g pot⁻¹ depending on the soil and treatment. Organic P was depleted by VA-mycorrhizal hyphae throughout the hyphal compartment (15 mm). The maximum depletion was 106 mg kg⁻¹ soil within a 0.5 mm distance from the root surface. The depletion of organic P depended on the soil type, hyphal length density, phosphatase activities and the amount, of organic P present in the system. The maximum hyphal contribution to the hydrolysis of organic P was concentrated in the zone within 3 mm from the root surface. In the mycorrhizal treatment, shoot concentrations of P, Cu, and Zn increased. In general, a slight decrease in the Mn and Fe concentrations was noticed. A significant increase in the concentration of K in the mycorrhizal plants was observed only in the presence of organic P. Calcium and Mg concentrations were not affected by mycorrhizal inoculation. The results obtained clearly demonstrated that VA-mycorrhizal phosphatase is effective in the hydrolysis of Wa-phytate and confirmed the important direct contribution of VAM hyphae to plant P, Cu, and Zn nutrition. [References: 39].

846 Wheeler, DM. (1994) EFFECTS OF GROWTH PERIOD, PLANT AGE AND CHANGES IN SOLUTION ALUMINIUM CONCENTRATIONS ON ALUMINIUM TOXICITY IN WHEAT. *Plant*

& Soil. 166(1):21-30. English. [NEW ZEALAND AGR PASTORAL RES INST LTD RUAKURA AGR RES CTR PRIVATE BAG 3123 HAMILTON NEW ZEALAND].

The effects of growth period (time between transplanting and harvesting), plant age at which aluminium (Al) was added to solution, changes in Al concentration, and solution culture techniques (monitoring and adjusting solution Al concentrations thrice weekly or weekly replacement of the solutions) were investigated using a low ionic strength (2.7×10^{-3} M) solution culture technique. The wheat (*Triticum aestivum* L.) cultivars Waalt (Al-tolerant) and Warigal (Al-sensitive), or the near isogenic lines bred from these cultivars (RR for the Al-tolerant line and SS for the Al-sensitive line) were grown. In all experiments and treatments, Al additions were required to maintain the nominal concentration. The decline in solution Al concentrations was partially attributed to formation of an Al-hydroxy-phosphate precipitate with an Al:P molar ratio of 2.8 to 4.0. Increasing the growth period from 14 to 28 days increased Al sensitivity in Warigal but not in Waalt. When plants were exposed to Al for the same time, increasing the age of the plants that Al was added to solution decreased sensitivity to Al. Differential Al tolerance between the two lines was evident when solutions were monitored thrice weekly or replaced weekly. However, the Al concentration required to reduce relative yield by a given amount when the solutions were replaced weekly was about twice that when the solutions were monitored. With a constant growth period of 28 days, increasing solution Al concentrations for 3 or more days resulted in decreased yields at harvest. The exact effect depended on the cultivar, plant part (tops or roots), when solution Al concentrations were increased and the duration of the increase. For example, increasing Al concentrations from 5 μM to 20 μM for 10 days reduced yield in the RR line by approximately 50% in the tops and 30% in the roots beyond the effect of 5 M but had no effect in the SS line due to yields already being low at 5 μM . Adding 10 μM Al to solution for 6 days at the beginning of the experiment reduced yield by 25% in the RR line and 50% in the SS line. In contrast, adding 10 μM Al for 6 days in the middle of the growth cycle had no effect on the RR line but reduced yield by approximately 25% in the SS line. These results show that growth period, the age of the plants at which Al is added and the technique used (monitored or weekly replacement) all need to be considered when comparing results from different experiments. These results also show that the Al concentrations in solution need to be regularly monitored in long term experiments. [References: 17].

847 Wraith, J.M.; Ferguson, A.H. (1994) SOIL TEMPERATURE LIMITATION TO WATER USE BY FIELD-GROWN WINTER WHEAT. *Agronomy Journal*. 86(6):974-979. English. [MONTANA STATE UNIV DEPT PLANT & SOIL SCI BOZEMAN, MT 59717 USA].

Modification of crop water use patterns in response to the held soil temperature regime has important agronomic and environmental implications. A 2-yr field study was conducted to ascertain how soil temperature modification influenced seasonal soil water depletion for a winter wheat (*Triticum aestivum* L.) crop near Bozeman, MT. Soil surface cover materials including clear plastic, white metal, and styrofoam were applied in the fall after germination and plant establishment. Soil temperature and water content profiles were monitored throughout the winter and spring growing seasons. Soil water depletion was significantly accelerated for those treatments having relatively warmer soil temperatures. Differences of up to 65 mm of cumulative soil water depletion were observed between warm and cool treatments during spring. Significant water extraction from a given depth within the soil profile did not occur until the soil temperature reached 10 to 11 degrees C during 1985. Repeated rainfall during 1986 obscured any relationship between minimum soil temperature and water uptake in the upper soil profile, but the same relationship as during 1985 was noted at greater depths. Although the nature of our field data does not allow determination of whether cold temperatures constrained root growth, root water uptake, or both of these processes, our field results substantiate conclusions drawn by other investigators using controlled-environment techniques. It is clear that cultural practices of climatic changes affecting seasonal soil temperature can impact soil water utilization by winter wheat in thermally limited growing areas. [References: 18].

848 Zagal, E. (1994) CARBON DISTRIBUTION AND NITROGEN PARTITIONING IN A SOIL-PLANT SYSTEM WITH BARLEY

(HORDEUM VULGARE L.), RYEGRASS (LOLIUM PERENNE) AND RAPE (BRASSICA NAPUS L.) GROWN IN A (CO₂)-C-14 ATMOSPHERE. *Plant & Soil*. 166(1):63-74. English. [SWEDISH UNIV AGR SCI DEPT SOIL SCI DIV PLANT NUTR & SOIL FERTIL POB 7014 S-75007 UPPSALA SWEDEN].

To examine the influence of plant-microorganism interactions on soil-N transformations (e.g. net mineralization, net immobilization) a pot experiment was conducted in a C-14-labelled atmosphere by using different (two annuals, one perennial) plants species. It was assumed that variation in below-ground, microorganism-available C would influence N transformations in soil. Plant species were fertilized (low rate) with N-15-labelled nitrogen and grown, during days 13 and 62 after germination, in a growth chamber with a C-14-labelled atmosphere. Nitrification was inhibited by using nitrapyrin (N-Serve). During the chamber period, shoots were harvested, and associated roots and soil were collected on two sampling occasions, e.g. after 4 and 7 weeks in the growth chamber. The distribution of net (%) assimilated C-14 was significantly affected by both plant and time factors, and there was a significant plant x time interaction. There were significant differences between plants in all plant-soil compartments examined as well as in the degree of the plant x time interaction. Differences in the C-14 distribution between plants were due to both interspecific and developmental variation. In general, when comparing N-15 and C-14 quantities between species, many of the differences found between plants can be explained by the differences determined in the weight of shoot or root parts. Despite the fact that amounts of C released were greater in ryegrass than in the other plant-treatments no unequivocal evidence was found to show that the effects of plant-microorganism interactions on soil-N mineralization were greater under ryegrass. Possible mechanisms accounting for the partitioning of N found among plant biomass, soil biomass and soil residues are discussed. [References: 55].

F08 CROPPING PATTERNS AND SYSTEMS

849 Ababneh, M.; Ayyadi, M. (National Center for Agricultural and Technology Transfer, Amman (Jordan)); Awawdeh, F.T. (Ministry of Agriculture, Amman (Jordan)) (1994) Effect of forage legumes on barley seed yield and lamb fattening on pasture legumes under rain-fed conditions in Jordan (*Hordeum vulgare*). Mashreq Workshop on Increased Productivity of Barley, Pastures and Sheep in the Critical Rainfall Zones; Amman (Jordan); 13-15 Dec 1992. *Crop and livestock improvement in Mashreq region: proceedings of the Mashreq workshop on increased productivity of barley, pastures and sheep in the critical rainfall zones [Hordeum vulgare]*. Haddad, N.; Tutwiler, R. (eds.) (ICARDA, Aleppo (Syria)). *International Center for Agricultural Research in the Dry Areas, Aleppo (Syria); United Nations Development Programme, Amman (Jordan); Arab Fund for Economic and Social Development, Safat (Kuwait)* p. 28-34. ICARDA. 2 Table; 1 fig., 7 ref. English. (AGRIS 95-012435).

850 Amanuel Gofu (IAR, Addis Abeba (Ethiopia)); Tanner, D.G.; Asefa Taa; Duga Debele (1994) Observations on Wheat and Barley Based Cropping Sequence Trials Conducted for Eight Years in Southeastern Ethiopia. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 261-280. CIMMYT. 13 tables; 1 fig.; 19 ref. English. (AGRIS 95-002306).

Cropping sequence trials were conducted from 1984-91 at 2 research sites representative of bread wheat (*Triticum aestivum* L. em Thell.) and barley (*Hordeum vulgare* L.) production zones in southwestern Ethiopia. At each site, 7 different cropping sequences were used: continuous small grain production was compared with 3 sequences consisting of wheat or barley grown 1 year out of 2 and 3 sequences with wheat or barley grown 2 years out of 3. The break crops were faba bean (*Vicia faba*), rapeseed (*Brassica napus* L.) and an oat (*Avena sativa* L.) and vicia (*Vicia dasycarpa* Ten.) forage mixture. Six different inorganic fertilizer levels were applied within each cropping sequence. Cropping sequence had a significant impact on the grain yields of both wheat and barley. Wheat grown after the faba bean or rapeseed break crops yielded, on average, 27 and 12 percent more grain than continuous wheat in the first and second cycle after the break crop, respectively. However, the impact of specific

break crops on the grain yield of wheat was inconsistent across years. A similar trend was observed for barley with corresponding increments of 37 and 17 percent, respectively. The lowest response of wheat and barley to nitrogen fertilizer occurred in the first cycle after a faba bean precursor. Continuous barley exhibited the highest yield response to nitrogen fertilizer. Cropping sequence had less impact than nitrogen fertilizer level on weed density, but eyespot incidence was significantly affected by both actors. The most profitable cropping sequence in both zones was faba bean grown in 3 year cycle with 2 crops of wheat or barley.

851 Andersen, A.; Olsen, C.C. (1994) [SP Report, 25: Catch crops in winter cereals]. SP rapport, 25: Efterafgroeder i vintersaet. Statens Planteavlssforsog, Lyngby (Denmark). SP. 12 tables; 4 ref. 18 p. Danish. (AGRIS 95-002317).

852 Andrejnska, I. (Kompleksna Obitna Stantsiya, Vidin (Bulgaria)) (1993) [Effect of some agrotechnical factors on the productivity of the wintering forage peas var. Mir, grown for the green mass]. Vliyanie na nyakoi agrotekhnicheski faktori v"rkhu produktivnostta na zimuvashch furazhen grakh sort Mir, otglezhdan za zelena masa. Selskostopanska Akademiya, Sofia (Bulgaria). *Rasteniev"dni Nauki (Bulgaria); Plant Science v. 30(7-8) p. 85-88. 3 tables; 12 ref. Bulgarian. (AGRIS 95-012455).*

853 Andrejnska, I. (Kompleksna Obitna Stantsiya, Vidin (Bulgaria)) (1993) [Effect of some agrotechnical factors on the wintering forage peas var. Mir]. Vliyanie na nyakoi agrotekhnicheski faktori v"rkhu dobiya na semena ot zimuvashch furazhen grakh sort Mir. Selskostopanska Akademiya, Sofia (Bulgaria). *Rasteniev"dni Nauki (Bulgaria); Plant Science v. 30(7-8) p. 89-93. 1 ill., 3 tables; 7 ref. Bulgarian. (AGRIS 95-012456).*

854 Baeumer, K. (Goettingen Univ. (Germany). Inst. fuer Pflanzenbau und Pflanzenzuechtung) (1994) [Integrated plant production - crop rotation design]. Gestaltung der Fruchtfolge. (Integrated plant production); (Systems of sustainable plant production, grounding, experience, developments - arable farming, vegetables, fruits, hops, grassland). Dierks, R.; Heitefuss, R. 2. Auflage p. 110-135. BLV Verlagsgesellschaft. 2 graphs, 14 tables. German. (AGRIS 95-002304).

855 Bhatnagar, G.S.; Sharma, G.L.; Chaplot, P.C. (1994) LONG-TERM EFFECT OF CONTINUOUS MAIZE (ZEA MAYS) WHEAT (TRITICUM AESTIVUM) CROPPING SYSTEM AND MANURING ON SOIL FERTILITY AND STABILITY IN CROP YIELD. *Indian Journal of Agricultural Sciences*. 64(12):821-823. English. [RAJASTHAN AGR UNIV AGR RES STN BANSWARA 327001 RAJASTHAN INDIA].

A long-term field experiment was conducted since rainy and winter seasons of 1978-79 to 1987-88 on a clay-loam soil, to evaluate the effect of continuous maize (*Zea mays* L.)-wheat (*Triticum aestivum* L. emend Fiori & Paol.) cropping system on soil fertility and stability in crop yield. Application of nitrogen 120 kg/ha and phosphorus 17.5 kg/ha to each crop significantly increased the grain yield of maize (2025 and 1803 kg/ha) and wheat (3112 and 2914 kg/ha) respectively. The fertilizer application resulted in building up the organic C, P and K status of the soil.

856 Campiglia, E.; Caporali, F. (Universita della Tuscia, Viterbo (Italy). Istituto di Agrotecnica) (1994) [Effect of lucerne (*Medicago sativa* L.) and inorganic and organic fertilization on the following crops sunflower (*Helianthus annuus* L.) and wheat (*Triticum aestivum* L.) [Latium]]. Effetto del prato di erba medica (*Medicago sativa* L.) e della concimazione minerale e organica sulle colture avvicendate di girasole (*Helianthus annuus* L.) e frumento tenero (*Triticum aestivum* L.) [Lazio]. *Rivista di Agronomia (Italy) v. 28(2) p. 79-86. 9 tables; 1 graph; 23 ref. Italian. (AGRIS 95-012470).*

The effect of preceding crops was studied on the crop sequence sunflower-wheat following a four-year lucerne meadow and a four-year annual crop sequence (sunflower, wheat, wheat, maize). In both cases crops were fertilized applying three types of dressing (organic, inorganic and 1/2 organic+1/2 inorganic), with the same amount of nutrients (N, P and K), and two weeding treatments (chemical weeding and no weeding). Generally, the residual effect of lucerne induced yield increases and marked weed control on both the crops that followed. The yield recorded on sunflower following lucerne was 60% higher than that recorded on

sunflower following the annual crop sequence. Among the yield components, both the number of seeds per head and the weight of 1000 seeds were positively influenced. A positive influence of lucerne was also recorded on wheat following sunflower (+6% in grain yield); wheat yield also depended on the type of fertilization applied, with growing increases induced by increasing proportion of the inorganic fertilizer. For both crops, the positive effect of lucerne was more marked where no weeding treatments had been applied, because the preventive control by lucerne on weeds was fully manifested.

857 Caporali, F.; Campiglia, E. (Universita della Tuscia, Viterbo (Italy). Istituto di Agrotecnica) (1993) [Research in low input cropping systems. Subterranean clover (*Trifolium subterraneum* L.) as living mulch and green manure in the wheat (*Triticum aestivum* L.) - sunflower (*Helianthus annuus* L.) [Latium]. Pt.1]. Innovazioni nella ricerca di sistemi colturali a bassi input. L'impiego del trifoglio sotterraneo (*Trifolium subterraneum* L.) come living mulch e sovescio nella rotazione frumento (*Triticum aestivum* L.) - girasole (*Helianthus annuus* L.) [Lazio]. Pt.1. *Rivista di Agronomia (Italy)* v. 27(3) p. 183-190. 9 tables; 2 graphs; 14 ref. Italian. (AGRIS 95-002361).

A two-year experiment was carried out to test the performance of a conventional cropping system (a wheat-sunflower rotation, which is common in Central Italy) in comparison with the same cropping system with subclover (*Trifolium subterraneum* L., cv. Mount Barker) as a living mulch in the wheat and as a green manure for the following sunflower. Results from the first cycle of rotation show that the intercropped wheat yielded only 7% less than the pure wheat, despite the halved sowing rate. This intercropped wheat performance was due to an increased (+44%) tillering index and a higher 1000-seed weight. Subclover green manuring affected sunflower grain yield positively, according to the amount of the aboveground biomass ploughed in. The increase in grain yield was 86 and 58% with total and partial green manuring, respectively. In the alternative cropping system, a decrease in weed growth (-20 and 35% in the wheat and in the sunflower, respectively) was recorded.

858 Caporali, F.; Campiglia, E. (Universita della Tuscia, Viterbo (Italy). Istituto di Agrotecnica) (1994) [Research in low input cropping systems. Subterranean clover (*Trifolium subterraneum* L.) as living mulch and green manure in the wheat (*Triticum aestivum* L.) - sunflower (*Helianthus annuus* L.) rotation. Pt.2]. Innovazioni nella ricerca di sistemi colturali a bassi input. L'impiego del trifoglio sotterraneo (*Trifolium subterraneum* L.) come "living mulch" e sovescio nella rotazione frumento (*Triticum aestivum* L.) - girasole (*Helianthus annuus* L.). Pt.2. *Rivista di Agronomia (Italy)* v. 28(1) p. 50-56. 10 tables. Italian. (AGRIS 95-002362).

A two-year experiment was carried out to test the performance of a conventional cropping system (a wheat-sunflower rotation, which is common in Central Italy) in comparison with the same cropping sequence with subclover (*Trifolium subterraneum* L., cv. "Mount Barker") as a living mulch in the wheat and as a green manure for the following sunflower. The subclover used as a living mulch in the wheat showed a good establishment and a good reseedling capacity, which allowed its plant density to be increased (+57%) in the wetter year in comparison with that recorded in the direct sowing condition. The subclover aboveground biomass ploughed in was largely influenced by the climatic conditions during the growing season. A positive correlation between the amount of subclover biomass ploughed in and the vegetative and productive characteristics of the sunflower was found. The subclover green manure also seems to positively influence the crop following the sunflower, i.e. the wheat with a subclover living mulch. In this case, the wheat overyielded (+9%) the wheat in pure stand, this performance being due to an improved tillering index, a larger number of seed per head and a higher 1000-seed weight.

859 Colbach, N.; Lucas, P.; Cavelier, N. (1994) INFLUENCE OF CROP SUCCESSION ON FOOT AND ROOT DISEASES OF WHEAT. *Agronomie*. 14(8):525-540. French. [INRA AGRON LAB F-78850 THIVERVAL GRIGNON FRANCE].

The consequences of different crop successions on foot and root diseases were analysed on a subsequent winter wheat crop managed identically, regardless of crop succession. At flowering, tillers and roots were assessed for eyespot (*Pseudocercospora herpotrichoides*), take-all

(*Gaeumannomyces graminis* var *tritici*) and sharp eyespot (*Rhizoctonia cerealis*). As a consequence, we can propose a simple model of the effect of the preceding crop and the 1 before that on the 3 diseases. This model is based on a crop classification into 3 groups: host, amplifying crop and non-host for take-all and sharp eyespot; and 'strong/weak' host, amplifying crop and non-host for eyespot. Whereas host crops tend to increase and non-host crops to decrease disease risk, amplifying crops (maize, ryegrass, etc) can only increase risk if they are associated with host crops.

860 Di Bari, V.; Rizzo, V.; Maiorana, M.; Giorgio, D. de; Rinaldi, M. (Istituto Sperimentale Agronomico, Bari (Italy)) (1993) [Productive responses of durum wheat included in annual and biennial cropping systems with or without catch-crop submitted to different levels of crop management inputs]. Variazioni produttive di frumento duro in avvicendamenti annuali e biennali sottoposti a differenti livelli agronomici con e senza [colture] intercalari. *Agricoltura Ricerca (Italy)* v. 15(151-152) p. 15-22. 5 tables; 2 graphs; 22 ref. Italian. (AGRIS 95-012446).

861 Fischer, T. (Zentrum fuer Agrarlandschafts und Landnutzungsforschung Muencheberg, Eberswalde (Germany). Inst. fuer Wald und Forstoeekologie) (1993) [Influence of winter wheat and winter rye on crop rotations with different portions of cereals on microbial biomass and seasonal carbon dynamics in the soil]. Einfluss von Winterweizen und Winterroggen in Fruchtfolgen mit unterschiedlichem Getreideanteil auf die mikrobielle Biomasse und die jahreszeitliche Kohlenstoffdynamik des Bodens. *Archives of agronomy and soil science (Germany)* v. 37(3) p. 181-189. 5 ill., 1 table; 10 ref. German. (AGRIS 95-002316).

862 Hald, A.B.; Pontoppidan, H.; Reddersen, J.; Elbek Pedersen, H. (1994) [Pesticide research, 6: Pesticide free zones in rotational crop fields: Flora and insects and yields: Agricultural trials 1987-92 (agroecosystems)]. Bekaempelsesmiddelforskning, 6: Sproejtefri randzoner i saedskiftemarken: Plante- og insektiv samt udbytter: landsforsoeg 1987-92. Miljoestyrelsen, Copenhagen (Denmark). Miljoestyrelsen. 22 ill., 41 tables; 109 ref. 157 p. Danish. (AGRIS 95-002299).

863 Harper, L.A.; Hendrix, P.F.; Langdale, G.W.; Coleman, D.C. (1995) CLOVER MANAGEMENT TO PROVIDE OPTIMUM NITROGEN AND SOIL WATER CONSERVATION. *Crop Science*. 35(1):176-182. English. [USDA ARS POB 555 WATKINSVILLE, GA 30677 USA].

Legumes are commonly used to provide nitrogen (N) for succeeding crops, but the net gain in N to the system is rarely measured. This study developed a N budget for a winter legume production system to estimate sources, sinks, and net system gain in N. Crimson clover (*Trifolium incarnatum* L.) reseeded from the preceding year and was killed with herbicide the following spring. A forage sorghum crop (*Sorghum vulgare* Pers.) was planted and harvested twice during the summer. Subplots were sampled at frequent intervals throughout the growing seasons for measurements of plant biomass and N content (leaves, stems, seeds, roots, and litter) and soil mineral N. During the clover growing season, soil N mineralization and leaching rates were estimated with an insitu chamber technique, and aerial ammonia (NH₃) transport measurements were made biweekly by micrometeorological techniques. Nitrogen in the clover crop increased until anthesis, and then declined slightly prior to desiccation with herbicides. Total N accumulated in the clover at desiccation was 323 kg N ha⁻¹ (28 in leaves, 81 in stems, 40 in seeds, 44 in surface-layer roots, and 130 in dead leaves and litter). Aerial NH₃ absorption by the clover was small during the growing season (0.18 kg N ha⁻¹) but NH₃ loss from the killed clover was also minimal (0.25 kg N ha⁻¹) and occurred during the period shortly after herbicide application. The summer sorghum crop took up 454 kg N ha⁻¹ over the course of two cuttings from the soil mineral and mineralized organic N resource plus atmospheric NH₃ and other atmospheric N inputs such as wet and dry deposition. Total N accumulated by the clover from N fixation, soil mineral N uptake, and NH₃ absorption provided the equivalent of 70% of N removed by the sorghum crop. [References: 37].

864 Holland, J.M.; Frampton, G.K.; Cilgi, T.; Wratten, S.D. (1994) ARABLE ACRONYMS ANALYSED - A REVIEW OF INTEGRATED ARABLE

FARMING SYSTEMS RESEARCH IN WESTERN EUROPE [Review]. *Annals of Applied Biology*. 125(2):399-438. English. [GAME CONSERVANCY TRUST FORDINGBRIDGE SP6 1EF HANTS ENGLAND].

Arable production has come under increasing economic and environmental pressures, especially in the last decade. These have derived from over-production, decreased farm incomes and a concern with the possible environmental effects of intensive pesticide use associated with such intensive cultivation. A number of long-term research programmes on integrated farming systems and their sustainability have recently been completed or are currently under way. In the UK, these include the 'Boxworth' project, 'SCARAB', 'TALISMAN', 'RISC', 'LINK Integrated Farming Systems', 'LIFE' and the demonstration-only programme 'LEAF'. These projects are reviewed in terms of their objectives, designs and results to date, and are compared with some parallel programmes in Germany, the Netherlands, Switzerland and France. [References: 112].

865 Holm, S. (1994) [Organic farming: fungal diseases and pests]. *Oekologisk planteavl: svampesygdomme og skadedyr. Statens Planteavlssforsoeg, Lyngby (Denmark). Groen Viden. Landbrug (Denmark); no. 140 6 p. SP. 12 ill., 6 tables. Danish. (AGRIS 95-002305).*

866 Kertikov, T. (Institut po Furazhite, Pleven (Bulgaria)) (1993) [Effect of the companion winter forecrops on the weediness of a grain - maize - barley rotation unit]. *Vliyanie na upl"tnyavashchite zimni predkulturi v"rkhu zaplevlyavaneto na posevite v seitooborotnoto zveno tsarevitsa za z"rno-echernik. Selskостopanska Akademiya, Sofia (Bulgaria). Rastenio"dni Nauki (Bulgaria); Plant Science v. 30(7-8) p. 155-158. 1 ill., 3 tables; 10 ref. Bulgarian. (AGRIS 95-012437).*

867 Kirkegaard, J.A.; Munns, R.; James, R.A.; Gardner, P.A.; Angus, J.F. (1995) **REDUCED GROWTH AND YIELD OF WHEAT WITH CONSERVATION CROPPING 2. SOIL BIOLOGICAL FACTORS LIMIT GROWTH UNDER DIRECT DRILLING.** *Australian Journal of Agricultural Research*. 46(1):75-88. English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

Wheat was grown in intact cores of soil removed from a field experiment in which seedlings had grown more slowly in direct-drilled soil than in cultivated soil. Experiments were conducted in controlled environments to resolve (1) whether shallower sowing of direct-drilled crops caused slower growth, (2) whether the soil factors causing the slower growth were physical or biological and (3) if biological, whether *Rhizoctonia solani* was the major pathogen. The conditions of the experiments removed possible constraints of water and nutrient supply but otherwise simulated the environment of wheat seedlings in southern Australia. Shallower sowing led to faster emergence and increased seedling growth, but irrespective of sowing depth, direct-drilled plants grew more slowly than plants in cultivated soil. Shoot growth of direct-drilled plants was 25-65% less than that of cultivated plants. These growth reductions were largely overcome by sterilizing the soil with gamma radiation or by fumigation with methyl bromide, indicating that biological factors were primarily responsible. *Rhizoctonia* was implicated as the cause of the reduced shoot growth when infection was severe (>3 on a 0-5 scale). There was no correlation between infection severity and shoot growth at moderate levels (<3) and significant reductions in shoot growth occurred in the absence of *Rhizoctonia*. These reductions were evident on the first leaf suggesting a direct influence on shoot growth rather than one mediated through inadequate uptake of water or nutrients. Infection of the germinating seed by *Pythium* spp. or the effects of phytohormones produced by inhibitory bacteria on the roots are possible causes of reduced shoot growth of direct-drilled seedlings. The dominant role of biological factors in determining plant response to soil management indicates the need for further studies to identify the organisms responsible, to determine the mechanism by which they influence shoot growth, and the effect of management on their populations and activity. [References: 26].

868 Kolar, J.S.; Grewal, H.S.; Singh, B. (1993) **NITROGEN SUBSTITUTION AND HIGHER PRODUCTIVITY OF A RICE-WHEAT CROPPING SYSTEM THROUGH GREEN MANURING.** *Tropical*

Agriculture. 70(4):301-304. English. [PUNJAB AGR UNIV LUDHIANA 141004 PUNJAB INDIA].

Field investigations were carried out on a sandy loam soil (Typic Ustochrept) to study the yield response of rice to green manuring with *Sesbania aculeata*, *Vigna sinensis* (common cowpea), and *Crotalaria juncea* (Sann hemp) grown for 40, 50, and 60 days between harvesting of wheat and transplanting of paddy with a view to improving the N economy for rice and increasing the productivity of a rice-wheat cropping system. Nitrogen accumulation in tops of *Crotalaria* at 40, 50, and 60 days after planting (DAP) was 84, 98, and 101 kg ha⁻¹, respectively, which were higher than the corresponding values in cowpea and *Sesbania*. Mean rice yield response with green manuring at 60 kg N ha⁻¹ was 2.6 t ha⁻¹. Rice yields obtained at 60 kg N ha⁻¹ with green manuring of either *Crotalaria* or cowpea or *Sesbania* incorporated at 40 or 50 or 60 DAP were higher than yields obtained at 120 kg N ha⁻¹ without green manuring, indicating a substitution of 60 kg N ha⁻¹ for rice. Highest agronomic efficiency of green manure N (rice grain response kg(-1) N added through green manure) was recorded in the green manure crop 40 DAP and lowest at 60 DAP. The residual effects of green manuring can under some conditions significantly increase the yield of wheat grown after rice due to an increase in organic content of the soil. Studies thus reveal that incorporation of a green manure crop (*Crotalaria* or cowpea or *Sesbania*) even at 40 DAP, one day before transplanting of paddy, results in a saving of 60 kg N ha⁻¹ for paddy and higher productivity of a rice-wheat cropping system. [References: 14].

869 Kramberger, B. (College of Agriculture, Maribor (Slovenia)); Klemencic, S. (Kmetijski zavod, Maribor (Slovenia)); Jeraj, A.; Smodis, S. (1993) [Effects of companion crops on spring seeded clovers and grasses]. *Uporabnost varovalnih posevkov pri spomladanski setvi detel in trav. Znanost in praksa v govedoreji (Slovenia) (no.17) p. 149-156. 4 tables; 5 ref. Slovenian. (AGRIS 95-012441).*

Influences of different companion crops on spring seeded alfalfa (*Medicago sativa* L., cv 'OS 66'), red clover (*Trifolium pratense* L., cv 'Marino') and complex grassclover mixture were studied in field trials. Oat (*Avena sativa* L., cv 'Leanda') and spring barley (*Hordeum vulgare* L., cv 'Japan') (seeding rate 70 kg/ha) reduced weeds and increased the dry matter yield of nutrients in the first cut. Because of shading, yields of grasses and clovers in the second cut were reduced. Oat in lower seeding rate (30 kg/ha) still increased the first cut dry matter yields. There were a little more weeds, but depressive effects on grasses and clovers were less shown. Italian ryegrass (*Lolium multiflorum* Lam.) as companion crop increased yields, but after its dying the sward density was low.

870 Martin, R.J.; Felton, W.L. (1994) **EFFECT OF CROP ROTATION, TILLAGE PRACTICE, AND HERBICIDES ON THE POPULATION DYNAMICS OF WILD OATS IN WHEAT - REPLY.** *Australian Journal of Experimental Agriculture*. 34(5):639. English. [NSW AGR HEAD OFF LOCKED BAG 21 ORANGE NSW 2800 AUSTRALIA].

871 Medd, R.W. (1994) **EFFECT OF CROP ROTATION, TILLAGE PRACTICE, AND HERBICIDES ON THE POPULATION DYNAMICS OF WILD OATS IN WHEAT - COMMENT.** *Australian Journal of Experimental Agriculture*. 34(5):637-639. English. [NSW AGR AGR RES & VET CTR FOREST RD ORANGE NSW 2800 AUSTRALIA].

872 Molnar, I.; Milosev, D. (Poljoprivredni fakultet, Novi Sad (Yugoslavia). Institut za ratarstvo i povrtarstvo) (1994) [System of field crops (winter wheat, maize, soybean and sugar beet) production under conditions of drought]. *Izbor sistema ratarenja u uslovima suse (ozima pšenica, kukuruz, soja i secerna repa)*. 28. seminar agronoma; Zlatibor (Yugoslavia); Jan 1994. *Zbornik radova - Poljoprivredni fakultet u Novom Sadu, Institut za ratarstvo i povrtarstvo (Yugoslavia) (no. 22) p. 21-33. 4 graphs; 1 table; 18 ref. Serbian. (AGRIS 95-002281).*

The best output was achieved with maize sown as a monoculture, followed by a 2-plot rotation, 12-plot rotation, 3-plot rotation while the worst output was achieved with wheat grown as a monoculture. Winter wheat included in the rotation diminished the low output of row crops in unfavourable years. The highest yield of winter wheat was achieved in the 3-plot rotation in favourable years, while in unfavourable years, the 12-plot rotation proved to be best. Due to cumulative effect of a crop rotation in unfavourable years, multi-plot rotations are more favourable

for wheat. In humid years, soybean gave highest yields in the 12-plot rotation where sugar beet was previous crop. In favourable and average years, sugar beet gave high yields after wheat in the 12-plot rotation. In dry years, lower yields were achieved.

873 Panse, A.; Maidl, F.X.; Dennert, J.; Brunner, H.; Fischbeck, G. (1994) YIELD FORMATION IN CEREAL-RICH CROP ROTATIONS AND MONOCULTURES IN AN EXTENSIVE AND INTENSIVE CROP-MANAGEMENT SYSTEM. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(3-4):160-171. German. [TECH UNIV MUNICH LEHRSTUHL PFLANZENBAU & PFLANZENZUCHTUNG D-85350 FREISING GERMANY].

In a long duration trial, conducted from 1979/80 to 1992 at TU-Munich's research station in Roggenstein, the performance of monocultures of winter wheat, winter barley and winter rye, as well as numerous cereal-crop rotations were compared in an extensive and intensive crop-management system. The results obtained can be summarized as follows. Over the course of 13 years, the influence of the immediately preceding crop on the yield of the main crops was of much greater significance than the rotation as a whole. With winter wheat, no yield differences could be observed between monoculture and cereal crop rotation (if the rotation did not include oats). Oats, rape, field bean, pea, potato and maize as preceding crops, however, in crop management systems, led to, on average, an increase in yield of 13 dt/ha from the following wheat. Winter barley yields were not significantly different in monoculture, cereal crop rotations and crop rotations containing 66% cereals. Furthermore, winter rye yields were the same in monocultures and cereal crop rotations. With all cereals, intensification of fertilizing and chemical plant protection led to a considerable increase in yield, but did not diminish the effects of the preceding crop. Hence, even with the use of modern agronomical techniques it is impossible to compensate for yield losses due to crop rotation. [References: 16].

874 Sarkar, A.; Faroda, A.S. (1993) MODIFIED FORM OF UREA FOR PEARL MILLET - WHEAT SEQUENCE UNDER SUBTROPICAL CONDITIONS. *Tropical Agriculture*. 70(3):279-281. English. [PROJECT DIRECTORATE CROPPING SYST RES A-1 PALLAVPURAM 250110 INDIA].

Pearl millet and wheat were grown in sequence during 1986-1987 and 1987-1988. Nitrogen was applied to pearl millet in the form of urea, bitumen-coated urea (BCU), urea supergranules (USG), and bitumen-coated urea supergranules (BCUSG) at 0, 40, 80, and 120 kg N ha⁻¹. Grain, dry matter (DM) yield, and plant height of pearl millet were highest at 120 kg N ha⁻¹ with BCUSG. The next highest were USG and BCU. These rates and forms of N showed-residual effects of soil NH₄+N after millet harvest which increased grain, DM yield, and plant height of unfertilized wheat grown subsequently. Modified forms of urea are recommended as better sources of urea N at 120 kg N ha⁻¹ in such a sequence. [References: 11].

875 Sasaki, M.; Yamamoto, Y.; Matsumoto, H. (1994) PUTATIVE CA²⁺ CHANNELS OF PLASMA MEMBRANE VESICLES ARE NOT INVOLVED IN THE TOLERANCE MECHANISM OF ALUMINUM IN ALUMINUM TOLERANT WHEAT (TRITICUM AESTIVUM L.) CULTIVAR. *Soil Science & Plant Nutrition*. 40(4):709-714. English. [OKAYAMA UNIV BIORESOURCES RES INST KURASHIKI OKAYAMA 710 JAPAN].

We compared the effect of aluminum on the calcium (Ca-45(2+)) influx through putative calcium channels of plasma membrane vesicles isolated from two wheat (*Triticum aestivum* L.) cultivars differing in Al sensitivity, Bepridil, a calcium channel blocker, and aluminum suppressed the influx in both cultivars. However, no differences were observed in the effects of these treatments between the two cultivars. [References: 22].

876 Sharma, K.; Sharma, I.M. (1994) PERFORMANCE OF WHEAT (TRITICUM-AESTIVUM) UNDER SHADE OF BOUNDARY-PLANTED GREY GUM (EUCALYPTUS-TERETICORNIS). *Indian Journal of Agricultural Sciences*. 64(8):574-575. English. [DR YASHWANT SINGH PARMAR UNIV HORT & FORESTRY REG HORT RES STN JACHH 1176201 HIMACHAL PRADES INDIA].

877 Sun Xianrong; Xiong Xinzhou; Mao Zijun (Huazhong Agricultural Univ., Wuhan (China). Dept. of Agronomy) (1994) Technological treatment of non-tillage with mulching stalk of three croppings in a year for rape (barley) with soybean and corn. *Hubei Agricultural Sciences (China)* (no. 1) p. 15-18. 5 tables, 7 ref. Chinese. (AGRIC 95-002332).

878 Sun Yanhao; Tao Shouxiang; Wang Caibin (Shandong Provincial Inst. of Groundnut, Jinan (China)) (1993) Characteristics of growth and development of peanut interplanted in wide bed wheat field and the techniques for double high yields of both wheat and peanut. *Oil Crops of China (China)* (no. 4) p. 21-24. 4 ill., 3 ref. Chinese. (AGRIC 95-002320).

879 Tekalign Mamo (Alemaya University of Agriculture, Debre Zeit (Ethiopia)); Abate Tedla; Teklu Erkosa (1994) The Effect of Undersowing Wheat with Clovers on Wheat Yield, Total Crop Residue Yield and Nutritive Value of Straw and Fodder Grown on Vertisols in Ethiopia. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 201-207. CIMMYT. 2 table; 3 fig.; 6 ref. English. (AGRIC 95-002298).

Field studies were conducted at various Vertisol sites from 1987 to 1989 to assess the effects of undersowing clover on wheat grain and straw yield, total crop residue and biomass production, and the nutritive value of straw and fodder. Clover mixtures in association with several wheat varieties did not cause significant reductions in Wheat grain yield, but the system significantly increased total fodder yield compared with the straw produced by wheat grown in a pure stand. Furthermore, the growth of clover in combination with wheat significantly (P less than .001) increased CP and IVOMD contents of total fodder (wheat straw plus clover), suggesting that higher quality crop residue can be achieved by growing clover with wheat. In addition, NDF content was reduced in the wheat straw/clover combination, confirming that the quality of straw from wheat varieties grown in pure stand is inferior to that of the total fodder from wheat/clover intercropping. On-farm studies are now being conducted to verify the improvement in total crop residue production and in the quality of the crop residue, and to demonstrate to peasant farmers that the undersowing system could improve livestock performance.

880 Teshome Yizengaw; Verheyde, W. (Gent Univ. (Belgium)) (1993) Crop growth requirements and approach to yield prediction for barley and tef in the central highlands of Ethiopia. *Pedologie (Belgium); Societe Belge de Pedologie* v. 43(3) p. 357-372. 2 ll.; 6 tables; 22 ref. English. (AGRIC 95-002303).

Two important aspects of crop growth and production requirements are discussed. The first refers to growth and adaptability requirements; the second deals with an approach to simulate the climatic yield potential of *Hordeum vulgare* and *Eragrostis tef* on the basis of climatic parameters, and predict expected potential production in function of soils and management limitations. In the Central Highlands of Ethiopia there is a high potential for rainfed crops. The current production levels, however, are much below the yield potential of the region. Adjustment of farming systems and better management may contribute to bring yield at the level of the expected potential production. Such management inputs include the use of improved varieties and fertilizers, as well as adapted agricultural practices to alleviate drainage problems.

881 Venturi, G.; Mambelli, S.; Amaducci, M.T. (Bologna Univ. (Italy). Dip. di Agronomia); Barbanti, L.; Candolo, G.; Rosso, F. (1994) [Economic and energy balance in integrated cropping systems including sugar beet, cereals and other arable crops (in Italy)]. Bilans économiques et energetiques de systemes de production integree comprenant des betteraves, des cereales et d'autres cultures industrielles. International Institute for Beet Research 57th winter congress; Bruxelles (Belgium); 16-17 Feb 1994. IIRB 57th winter congress. Brussels (Belgium). 16-17 Feb 1994. IIRB 57e congres d'hiver. Institut International de Recherches Betteravieres, Bruxelles (Belgium) p. 63-80. 6 ill.; 12 tables; 3 ref. French. (AGRIC 95-002337).

882 Vonboberfeld, W.O.; Jasper, J. (1994) EFFECTS OF ROTATIONAL FALLOWS (SET-ASIDE LAND) ON SUBSEQUENT WINTER WHEAT. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(2):125-134. German. [UNIV GIESSEN INST PFLANZENBAU &

The aim of the present study was to investigate the effects of different fallow treatment on subsequent winter wheat. The field trials included rotational fallows planted with *Trifolium repens*, *Festuca rubra* and *Lolium perenne* sown under winter barley compared to complete fallow and natural fallow without seed application and fallows planted with *Trifolium pratense*, *Festuca rubra* and *Dactylis glomerata* sown under winter wheat. After ploughing up the fallow vegetation, winter wheat was planted for 2 succeeding years at two levels of N-fertilization. Herbicides and fungicides were not applied. The following criteria were investigated: biomass-production, N-uptake, yield, weed infestation, nitrate and water content of the soil. In autumn, after ploughing up the fallow vegetation, the nitrate content of the soil (0-150 cm) increased by up to 210 kg NO₃-N/ha after complete fallow, by up to 60 kg NO₃-N/ha after natural fallow and by up to 75 and 130 kg NO₃-N/ha after fallows cropped with *Trifolium repens* and *Trifolium pratense*, respectively. Low nitrate levels of 20-27 kg NO₃-N/ha were observed after fallows planted with grass. N-immobilization caused by ploughing up grass fallows continued until the first harvest of the subsequent winter wheat. In the second year of winter-wheat, no differences of N-mineralization dependent on the previous fallow crop occurred, except in the case complete fallow which showed lower N-mineralization. It can be concluded that fallows cropped with grass lead to a higher nitrogen fertilizer requirement in the succeeding crops. *Festuca rubra* was able to form dense swards in strong competition with weeds and to decrease the abundance of *Alopecurus myosuroides* and *Apera spica-venti* in subsequent winter wheat, while natural fallow and fallow planted with *Trifolium repens* and *Lolium perenne* caused epidemical increases in grass-weed density. Preceding crop effects on grain yield of the winter wheat showed a close relation to N-supply and were compensated by mineral N-fertilization. After natural fallow and fallow covered with *Trifolium repens*, yield reductions due to grass-weed competition occurred. Undersown *Festuca rubra* seems to possess a special suitability for cultivation in rotational fallows. It establishes itself strongly under different cover crops and is able to form dense swards in strong competition with weeds. Grass-weed density in the succeeding crops will be reduced and nitrate leaching will still be prevented after ploughing up the fallow vegetation. N-fertilization of the subsequent crops must be carried out under considerations of higher N-requirements which is probably not entirely due to a stronger N-immobilization. [References: 28].

883 Voznyakovskaya, Y.M.; Kurdyukov, Y.F.; Popova, Z.P.; Loshchinina, L.P. (1994) ASSESSMENT OF SPRING WHEAT PREDECESSORS AS REGULATORS OF SOIL FERTILITY IN ARID ZONE OF THE VOLGA REGION. *Eurasian Soil Science*. 26(5):117-125. English. [RUSSIAN ACAD SCI INST AGR MICROBIOL ST PETERSBURG 196140 RUSSIA].

In wheat-dominated rotations, soil microbiological conditions are unfavorable because wheat plant residues are poorly degraded. Incorporation into rotation crops with plant residues which stimulate biological processes increases soil productivity. [References: 7].

884 Wall, P.C. (CIMMYT, Asuncion (Paraguay)); Causarano, H. (1994) The Reversal of Soil Degradation in the Wheat-Soybean Cropping System of the Southern Cone of South America. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 208-220. CIMMYT. 1 table; 7 fig.; 17 ref. English. (AGRS 95-002334).

Evidence of soil degradation and erosion in the River Plate catchment area is widespread. Much of the degradation is associated with soil structural breakdown due to excessive tillage, especially with heavy disc implements. Although less documented, the same processes are evident on small farms where animal traction is used. However, modified cropping practices based on zero or reduced tillage and crop rotations, including the use of green manures, are successful in reversing this degradation, largely through the successful management of crop residues on the soil surface. The area of commercial production using these practices is increasing. Examples of their effects on soil physical, chemical

and biological fertility are presented, and the major limitations and difficulties discussed.

885 Yeshanew Ashagrie; Tilahun Geleto; Ramanagowda, P. (IAR, Addis Abeba (Ethiopia)) (1994) A Double Cropping System for Bread Wheat and Chickpea on Drained Vertisols in Northwestern Ethiopia. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 301-304. CIMMYT. 3 tables; 5 ref. English. (AGRS 95-002319).

In northwestern Ethiopia, 27 percent of the arable crop area consists of Vertisols. Crop failures as a result of waterlogging are common in many areas of the season. Therefore, crops are generally grown after the main rainy season ends, using residual moisture. To test the feasibility of double cropping with an improved drainage system, a field experiment was conducted on a Vertisol at the Adet R.C. from 1988 to 1990. There was no difference between the grain yield of wheat and barley as a main season crop. The grain yield of chickpea, grown as the second crop, was highest after wheat (+24 percent), but was reduced after barley (-25 percent), relative to a single crop of chickpea. On average, 0.55 t/ha of wheat and 0.83 t/ha of chickpea grain were obtained in the double cropping system, compared to 0.67 t/ha of chickpea under single cropping.

830 PLANT GENETICS AND BREEDING

886 Acevedo, E. (CIMMYT, Mexico, D.F. (Mexico)) (1994) Improving the Yield Potential and Abiotic Stress Resistance of Cultivated Wheat. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 281-288. CIMMYT. 3 tables; 25 ref. English. (AGRS 95-002444).

World food production is limited primarily by abiotic environmental factors, accounting for ca. 71 percent of yield reductions. Resistance to abiotic stresses is part of the environmental fitness of crops and cultivars. As such, it is linked to the maximum or potential yield in a stress free environment. A sustained annual increase of 3 percent in the cereal production of developing countries is required to maintain current levels of nutrition to the year 2000 and beyond. Improving the stress resistance and yield stability of the major cereal crops and cropping systems, accounting for over 80 percent of the world's food production, is one approach to solving this crucial problem. Substantial efforts in plant breeding are aimed at increasing the yield potential of the major crops. For instance, the yield potential of wheat is being increased at a rate of 0.7 percent per year on global basis, which should have spillover effects on yield under stress. Since wide adaptability may be associated with relative insensitivity to environmental signals, it follows that additional scope for improvement exists in more fully exploiting specific environments.

887 Aksel, R. (1994) QUANTITATIVE-GENETIC ANALYSIS OF RECIPROCAL CROSSES BETWEEN A WINTER AND A SPRING CULTIVAR OF COMMON WHEAT (TRITICUM AESTIVUM L). *Theoretical & Applied Genetics*. 89(7-8):1032-1038. English. [UNIV ALBERTA DEPT GENET EDMONTON AB T6G 2E9 CANADA].

The winter wheat cultivar Sakhalin (parent A) and the spring wheat cultivar Khush-hal (parent B), assumed to be both nuclear-genetically and plasmotypically different, were reciprocally crossed and the F-1 generation of the reciprocals backcrossed to either parent. The populations (AxB)F-1, (AxB)F-2, [(AxB)F(1)xA]F-1 and [(AxB)F(1)xB]F-1, and their reciprocals (BxA)F-1, (BxA)F-2, [(BxA)F(1)xA]F-1 and [(BxA)F(1)xB]F-1, assumed to have the plasmotypes of the parents A and B respectively, were spring sown in the same field from unvernallized (experiment #1) and vernallized (experiment #2) seeds. The results of the analyses of variance of the data recorded in the two experiments are fairly similar. In both the experiments the plasmotypically A populations have produced more heads and higher grain yields per plant than their plasmotypically B reciprocals. The components of the family means and of half the differences between the reciprocals within the families show

that vernalization has not affected the efficiency of the nuclear genes of parent A but has reduced the efficiency of the nuclear genes of parent B in both the homozygous and the heterozygous states. This in turn has affected the components of family mean squares and those of the family x reciprocals interaction mean squares in the analysis of variance tables. [References: 13].

888 Al Hakimi, A. (Sana'a University (Yemen)); Monneveux, P.; Nachit, M. (1994) [The use of alien tetraploid wheat species to improve drought tolerance in durum wheat]. [Utilisation d'espece autre de ble tetraploide pour ameliorer la tolerance a la secheresse du ble dur]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France).* [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes p. 171-185. EUCARPIA. 47 ref., 5 graph. English. (AGRIS 95-012751).

889 Al Khatib, M. (Aleppo Univ. (Syria)); McNeilly, T. (Liverpool Univ. (United Kingdom). Dept. of Environmental and Evolutionary Biology) (1994) [The genetic basis of salt tolerance in lucerne (*Medicago sativa* L.)]. La base genetica della tolleranza del sale nell'erba medica (*Medicago sativa* L.). *Journal of Genetics and Breeding (Italy)* v. 48(2) p. 169-174. 5 tables; 28 ref. English. (AGRIS 95-012991).

The genetic basis of salt tolerance was examined in selected tolerant material from the two lucerne (*Medicago sativa* L.) cultivars, CUF 101 and Local Syria. The North Carolina Model 2 crossing design and analysis was followed, tolerance being assessed in two week-old seedlings grown in salinised solution culture at 175 mM NaCl. Salinity tolerance was heritable, with broad and narrow sense heritabilities estimated at 0.76 and 0.61, and 0.74 and 0.23 for CUF 101 and Local Syria respectively. Reciprocal differences were absent. Differences in narrow sense heritability estimates could be related to the history of development of the two cultivars.

890 Aleshchenko, P.I.; Mel'nikova, E.A. (1992) [New variety of brewery barley Medikum 135]. Novyj sort pivovarennogo yachmenya Medikum 135. [Breeding and seed production of field crops under conditions of irrigation] p. 69-71. Russian. (AGRIS 95-002478).

891 Ali, A.M.; Nakata, N.; Tomita, M.; Yasumuro, Y. (1994) IDENTIFICATION AND BREEDING SIGNIFICANCE OF TRANSLOCATED CHROMOSOMES IN A JAPANESE COMMON WHEAT VARIETY ESHIMASHINRIKI. *Breeding Science*. 44(4):391-396. English. [TOTTORI UNIV FAC AGR TOTTORI 680 JAPAN].

Translocated chromosomes in the common wheat variety Eshimashinriki were identified, and their transmission to Japanese varieties were investigated to evaluate their breeding significance. Pairing configurations were examined at the first metaphase in monotelodisomic hybrids of Eshimashinriki with Chinese Spring ditelosomics. Eshimashinriki was confirmed to contain two independent reciprocal translocations relative to Chinese Spring, one between chromosomes 4B and 6B and another of small segments between 3B and probably 7B. According to C-banding and pairing frequencies, the breakpoints in the translocation between 4B and 6B were identified to be within the centromeric regions, giving rise to T4BS.GBL and T4BL.GBS. The translocation between 4B and 6B originated in the local variety Shinriki and transmitted to Eshimashinriki in the course of its breeding. Furthermore, this translocation was transmitted from Eshimashinriki to 81 % of the tested 16 varieties. Among these varieties, Saikai 102 and 12 of Norin varieties had inherited this translocation through nine different breeding cross combinations. These results indicate that the translocation between 4B and 6B of Eshimashinriki has important breeding potential resulting in its preferential transmission and maintenance in different breeding crosses. Based on the information on these varieties, yellow rust resistance, and probably adaptability and yield-improvement genes are the most possible reasons for the wide spread of this translocation. Location of these genes at the proximal region of one or both arms of the translocated chromosomes, where recombination is very rare, would

insure their segregation and selection as a block with the translocated chromosomes.

892 Alizadeh, A.; Benetti, V.; Sarrafi, A.; Barrault, G.; Albertini, L. (1994) GENETIC ANALYSIS FOR PARTIAL RESISTANCE TO AN IRANIAN STRAIN OF BACTERIAL LEAF STREAK (*X-CAMPESTRIS* PV HORDED) IN BARLEY. *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 113(4):323-326. English. [INST NATL POLYTECH TOULOUSE ECOLE NATL SUPER AGRON 145 AVE MURET F-31076 TOULOUSE FRANCE].

Seven barley genotypes with high genetic variability for resistance to bacterial leaf streak (*Xanthomonas campestris* pv. *hordei*) were crossed in diallel fashion to determine the inheritance of resistance to this disease. Two experiments were undertaken in a controlled growth chamber using a complete-block design with four replicates. Each replicate consisted of a row of 20 seedlings per parent or F-1 hybrid. An Iranian strain of bacterial leaf streak was used for inoculation of 12-day-old seedlings. Results showed that the cultivars 'Express' and 'Morex' and the Iranian pure line Iran-3a had a high partial resistance in both experiments. Diallel analysis showed highly significant general and specific combining abilities. 'Morex' and Iran-3a were the best combiners for partial resistance to bacterial leaf streak in barley and could be successfully used for breeding purposes. [References: 19].

893 Anikeeva, L.A.; Khajdarova, Zh.S.; Novokhatin, V.V.; Fursov, O.V. (1993) [Alfa-amylase as a test for wheat resistance to "sprouting in ear"]. Al'fa-amilaza kak test na ustojchivost' k prorstaniyu v kolose form pshenitsy. *Prikladnaya biokhimiya i mikrobiologiya (Russian Federation)* v. 29(5) p. 776-781. 11 ref. Russian. (AGRIS 95-012605).

A test is proposed for rapid and accurate diagnosis of preharvesting sprouting of wheat grain, which has been developed using the results of studies on properties and regulation of amylases in cereal grains. The test is based on comparison of electrophoretic properties of alfa-amylase and enables quick selection of wheat genotypes with high resistance to "sprouting in ear". The outcome of the present study was the development of the variety Lyutetsens 70, which is characterized by high resistance to "sprouting in ear" and has other valuable properties.

894 Annicchiarico, P.; Perenzin, M. (1994) ADAPTATION PATTERNS AND DEFINITION OF MACRO-ENVIRONMENTS FOR SELECTION AND RECOMMENDATION OF COMMON-WHEAT GENOTYPES IN ITALY. *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 113(3):197-205. English. [IST SPERIMENTALE CULTURE FORAGGERE 29 VIALE PIACENZA I-20075 LODI ITALY].

Eighteen common-wheat varieties grown for three seasons at 31 locations in Italy were used to study the relationships between cultivar adaptation patterns, climatic factors and morphophysiological traits of genotypes, as well as defining macro-environments for the selection and recommendation of genotypes in the region. The variances of both the genotype-location and genotype-season interactions were significant, the former being almost 80 % greater than the latter. Some 10.4 % of genotype-location interaction was accounted for by heterogeneity of genotype regressions on site mean, 38.0 % by the first two axes of a principal components analysis and 32.0 % by definition of four macro-environments. Occurrence of genotype-location interaction was related to the level of late frosts, winter cold, and late drought and heat stress at each location, and to heading date and tolerance of frost, Septoria blotch and lodging in each genotype. Following estimates of broad-sense heritability, breeding for specific adaptation may be envisaged for northern and central Italy on the one hand, and southern Italy on the other. Morphophysiological traits contributing to better performance in each of these macro-environments were indicated. [References: 33].

895 Antonacci, M.; Bianco, A. (Bari Univ. (Italy). Istituto di Miglioramento Genetico delle Pianta Agrarie); Arrigoni, O.; Gara, L. de (Bari Univ. (Italy). Istituto Botanico) (1994) [Identification and chromosomal location of ascorbate peroxidase genes in wheat]. Identificazione e collocazione cromosomica di geni perossidasi ascorbato del grano. *Journal of Genetics and Breeding (Italy)* v. 48(2) p. 135-140. 32 ref. English. (AGRIS 95-012762).

Two cytosolic ascorbate-specific peroxidase isozymes, designed APX-1 and APX-2, were identified in cultivated wheats, in their diploid ancestors and some related species of Triticeae, by polyacrylamide gel

electrophoresis. Two genes controlling the production of APX-1 in tetraploid and hexaploid wheats were located on the short arm of chromosomes 2A and 2B by aneuploid analysis. The loci have been designed Apx-A1 and Apx-B1, respectively; the Apx-D1 locus is not expressed in common wheat. Apx-1 is ubiquitous and shows a high degree of conservation between genomes and varieties.

896 Antonacci, M.; Urbano, M.; Blanco, A. (Bari Univ. (Italy). Istituto di Miglioramento Genetico delle Pianta Agrarie) (1993) [Isolation and characterization of a *Triticum turgidum* L. - *Dasypyrum villosum* (L.) Candargy monosomic addition line]. Isolamento e caratterizzazione di una linea di addizione monosomica *Triticum turgidum* L. - *Dasypyrum villosum* (L.) Candargy. *Annali della Facoltà di Agraria, Bari (Italy)* v. 34 p. 95-99. 1 table; 19 ref. Italian. (AGRIS 95-002840).

Developing interspecific chromosome addition lines is a preliminary step in the interspecific gene transfer programs in the Triticeae. The direct isolation of the *Triticum turgidum* L. - *Dasypyrum villosum* (L.) Candargy monosomic addition for the D. villosum IV chromosome is reported in the present paper. Poly-acrylamide gel of the seed storage proteins (gliadins and glutenins) was used to identify and characterize the IV chromosome. The phenotype of addition line is similar to that of durum wheat cv. Creso parental line, but as fertility is reduced. The transmissibility of the complete extrachromosome is 9.5% by selfing.

897 Bahadu, P.; Singh, D.V.; Srivastava, K.D.; Aggarwal, R.; Nagarajan, S. (Indian Agricultural Research Institute, New Delhi (India). Division of Mycology and Plant Pathology) (1993) Seedling and adult plant resistance in wheat to *Puccinia recondita* tritici. *Indian Phytopathology (India)* v. 46(1) p. 76-77. 6 ref. English. (AGRIS 95-002602).

898 Baum, BR.; Johnson, DA. (1994) THE MOLECULAR DIVERSITY OF THE 5S rRNA GENE IN BARLEY (*HORDEUM VULGARE*). *Genome*. 37(6):992-998. English. [AGR CANADA CTR LAND & BIOL RESOURCES RES OTTAWA ON K1A 0C6 CANADA].

The 5S rDNA genes from several accessions of cultivated barley, *Hordeum vulgare* L., were amplified by the polymerase chain reaction, cloned, and sequenced. Analysis of the aligned sequences, followed by principal coordinate analysis, support the recognition of at least two distinct classes of 5S rDNA genes. The short repeat class corresponds to the 300-bp tandem repeat defined by E.V. Ananiev as containing several TAG repeating units. The long repeat class contains long tandem repeats and lacks the TAG repeating unit. Sequences in each class can be further subdivided, with the long repeat class containing two groups and the short repeat class containing two and possibly three groups. These results suggest that in cultivated barley the sequence diversity found within the 5S rDNA nontranscribed spacer region may be encoded by three or more loci and may be useful for phylogenetic analyses provided that orthology can be established. [References: 31].

899 Belkhodja, R. (1993) [Chlorophyll fluorescence in barley (*Hordeum vulgare* L.): Its possible application in the screening of cultivars for salinity and drought tolerance]. La fluorescence de la chlorophylle sur l'orge (*Hordeum vulgare* L.): Une possible voie pour le criblage de variétés tolérantes à la salinité et à la sécheresse. [La fluorescencia de la clorofila en la cebada (*Hordeum vulgare* L.): una vía posible para el cribado de variedades tolerantes a la salinidad y la sequía]. Centre International de Hautes Etudes Agronomiques Méditerranéennes. Zaragoza (Spain). Institut Agronomique Méditerranéen. 27 ill. 7 graphs. 8 tables. bibliography p. 113-122. 122 p. French. (AGRIS 95-002464).

900 Bernard, M. (Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amélioration des Plantes); Gay, G.; Bernard, S.; Bonhomme, H. (1994) [Development and use of interspecific hybrids and amphiploids in triticale and wheat breeding]. [Développement et utilisation d'hybrides interspécifiques et d'amphiploïdes dans la sélection du triticale et du blé]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France)*. [Evaluation et exploitation des ressources génétiques, la préselection. Comptes rendus de la section ressources génétiques, réunion Eucarpia 15-18 mars 1994,

Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amélioration des Plantes p. 285-286. EUCARPIA. 6 ref. English. (AGRIS 95-012489).

901 Bhagwat, MD.; Varghese, P.; Patil, VP. (1994) EFFECT OF A AND B GENOME CHROMOSOMES ON SEEDLING CHARACTERS IN TETRASOMICS OF CHINESE SPRING WHEAT (TRITICUM AESTIVUM). *Indian Journal of Agricultural Sciences*. 64(12):867-869. English. [AGHARKAR RES INST DIV PLANT SCI POONA 441004 MAHARASHTRA INDIA].

902 Borghi, B.; Perenzin, M. (1994) DIALLEL ANALYSIS TO PREDICT HETEROISIS AND COMBINING ABILITY FOR GRAIN YIELD, YIELD COMPONENTS AND BREAD-MAKING QUALITY IN BREAD WHEAT (T-AESTIVUM). *Theoretical & Applied Genetics*. 89(7-8):975-981. English. [IST SPERIMENTALE CEREALICOLTURA VIA MULINO 3 I-20079 SAN ANGELO LODIGIANO ITALY].

Combining ability for grain yield, yield components, and several agronomic and qualitative traits, was studied in a seven-parent diallel cross. The 21 F-1 hybrids and the seven parental cultivars were grown in replicated plot trials sown at normal seed density in three locations in the years 1992 and 1993. The effects of general combining ability (gca) were highly significant for all the traits measured with the exception of seeds per spikelet, while the specific combining ability (sca) effects were statistically significant for grain yield, plant height, heading time, for all the yield components, and for the Chopin alveographic parameters P and P/L ratio. For the majority of the traits measured gca was greater than sca. Standard heterosis (ah) for grain yield, i.e., the superiority of the hybrids over the best pure line cultivar (cv Eridano), was only 3.3%, confirming previous finding which indicate sh effects in the range of 10%. The most interesting hybrid derived from the cross MaestrazGolia revealed a yield level approaching that of the highest yielding cv Eridano but appeared more interesting because of its reduced plant height and superior bread-making quality, signifying a selling price 30% higher. It was concluded, therefore, that the first generation of hybrids, likely to appear on the market in the next few years, will be characterized by a yield potential only slightly superior to that of the best standard cvs but associated with other desirable traits, such as bread-making quality. [References: 22].

903 Boskovic, J.; Boskovic, M. (Faculty of Agriculture, Novi Sad (Yugoslavia)) (1993) Application of the gene-for-gene models in wheat hybrids resistant to *Puccinia recondita* tritici. *Zastita bilja (Yugoslavia)* v. 44(205) p. 197-202. 2 tables; 7 ref. English. (AGRIS 95-002451).

Boolean modeling in gene-for-gene relationship was applied in genetic differentiation of the hybrid wheat lines with two pairs resistance genes and conventional ratios 9:7. The methods of analysis included the infection type data, agricornus phenotypes which indicate aegricornus, parasite and host genotypes in parasite: host: environment specificity. From the results obtained, it was clear that inclusion of different environment in the Model would alter the phenotypes ratios, but not genotype ratios.

904 Bouguennec, A. (Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amélioration des Plantes); Koenig, J. (1994) [Evaluation of a French wheat collection]. [Evaluation d'une collection française de blé]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France)*. [Evaluation et exploitation des ressources génétiques, la préselection. Comptes rendus de la section ressources génétiques, réunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amélioration des Plantes p. 229-230. EUCARPIA. English. (AGRIS 95-012968).

905 Boyadjeva, D. (Institute of Introduction and Plant Genetic Resources, Sadovo (Bulgaria)) (1994) [The results of using different germplasm in the wheat breeding program for Bulgarian dry conditions]. [Résultats d'utilisation de différents matériels génétiques dans le programme de sélection de blé pour les conditions sèches bulgares]. Evaluation and

exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France)*. [Evaluation et exploitation des ressources génétiques, la préselection. Comptes rendus de la section ressources génétiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amélioration des Plantes p. 187-191. EUCARPIA. English. (AGRI 95-012752).

906 Chen Guangdou; An Chengli; Li Biyun (Shaanxi Provincial Inst. of Grain Crops, Yangling (China)) (1993) An experiment on processing quality and bread baking characters of the good quality wheat variety "Shaanyou 225". *Shaanxi Journal of Agricultural Sciences (China)* (no. 3) p. 39, 43. 4 tables. Chinese. (AGRI 95-002598).

907 Chen Wenhua; Zheng Qicheng; Fang Xuanming (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. for Application of Atomic Energy) (1993) Cytochemistry study on salt tolerant mutant of wheat. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(6) p. 270-272. 1 ill., 3 ref. Chinese. (AGRI 95-002596).

908 Cheng Junyuan (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. for Application of Atomic Energy) (1993) Effect of fast neutron radiation on Taigu nuclear male sterile wheat. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(6) p. 251-260. 2 tables, 3 ref. Chinese. (AGRI 95-002595).

909 Cho, C.H.; Han, O.K.; Song, I.K. (Dankook University, Cheonan (Korea Republic). College of Agriculture); Park, M.W. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station) (1994) Inheritance and pleiotropic effects of smooth awn on some characters related to feed adaptability of whole crop barley. *Korean Journal of Breeding (Korea Republic)* v.25(4) p.266-277. 13 tables; 9 ref. Korean. (AGRI 95-012628).

910 Cosic, T.; Poljak, M.; Custic, M.; Rengel, Z. (1994) ALUMINIUM TOLERANCE OF DURUM WHEAT GERMPLASM. *Euphytica*. 78(3):239-243. English. [FAC AGR ZAGREB INST AGROECOL SVETOSIMUNSKA 25 ZAGREB 41000 CROATIA].

Aluminium tolerance of Macedonian durum wheat (*Triticum turgidum* L. conv. durum (Desf.) MacKey) germplasm was evaluated in nutrient solutions containing 0, 74 or 148 μ M of total Al. Relative root length (148 μ M Al / 0 Al) of various genotypes ranged from 41 to 72% (from moderately sensitive to moderately tolerant to Al). No genotype with Al tolerance close to that of very tolerant T. aestivum cultivar Atlas-66 was found. Seed Ca concentration was positively ($r = 0.64$, P less than or equal to 0.05) and seed Fe concentration negatively ($r = -0.71$, P less than or equal to 0.05) related to the relative root growth. Such a significant correlation was not obtained for seed concentrations of other nutrients or seed protein content. [References: 30].

911 D'Ovidio, R.; Tanzarella, O.A.; Cenci, A.; Iacono, E.; Porceddu, E. (Università della Tuscia, Viterbo (Italy). Dipartimento di Agrobiologia e Agrochimica) (1994) [RFLP (restriction fragment length polymorphism) analysis in wheat. Isolation and chromosomal assignment of digoxigenin-labelled clones]. *Analisi RFLP (restriction fragment length polymorphism) del grano. Isolamento e assegnazione cromosomica di cloni con geni marcati digossigena. Journal of Genetics and Breeding (Italy)* v. 48(1) p. 73-80. 3 tables; 5 graphs; 36 ref. English. (AGRI 95-012622).

Partial genomic libraries of T. urartu and Ae. squarrosa and a leaf cDNA library from T. durum cv. Langdon were constructed. Randomly chosen clones were assayed, using non radioactive labelling procedures, for their ability to detect genetic polymorphism in wild species and cultivars of wheat. 15% of the analyzed clones were able to detect polymorphism between wheat species and 10% between cultivars. Polymorphic clones were assigned to specific chromosomes and chromosome arms using nulli-tetrasomic and ditelosomic lines of Chinese Spring, respectively. The same clones were used as markers to evaluate the genetic variation in wild wheat species. The resulting RFLP data were exploited to construct a dendrogram showing the genetic relationships between wild accessions of diploid wheat species and cultivated wheat.

912 Damberg, E. (Latvian Scientific Research Institute of Agriculture, Skriveri (Latvia)) (1994) [New varieties developed by Latvian plant breeders in 1989-1993]. *Lauku kulturu selekcionaru devums. Latvijas Lauksaimnieks (Latvia)* (no.3) p. 10-12. Latvian. (AGRI 95-012688).

The author describes the new varieties developed by the plant breeders of the Latvia State Research Institute of Agriculture and the affiliated Plant Breeding Stations during the period of 1989-1992. The varieties include those of winter wheat, malting barley, fodder barley, oats, peas, potatoes, clover. The varieties have been tested according to the present regulations and have been grown on private farms. Their high yielding capacity, good resistance to pests and diseases, their suitability to local conditions and high quality parameters are stressed.

913 Danial, D.L.; Kirigwi, F.M. (N.P.B.R.C., Njoro (Kenya)) (1994) Breeding for Complete Resistance in Bread Wheat to Puccinia Striformis in Kenya: A Case Study. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 144-152. CIMMYT. 7 tables; 8 ref. English. (AGRI 95-002579).

In Kenya, multi-location testing was carried out from 1984 to 1987 to evaluate over 11,000 wheat genotypes for resistance to yellow, stem and leaf rust. Across seven locations, a total of 35 genotypes were identified as carrying high levels of resistance to the three rust species at the adult plant stage. In a controlled environment, the yellow rust reaction of the 35 genotypes was studied in the seedling stage with six yellow rust races differing in their virulence to 20 differential cultivars. Fifteen genotypes showed a complete to intermediate resistance to all six races, indicating the presence of at least one unidentified seedling resistance gene. The remaining genotypes appeared to differentiate the test races, and varied in reaction from susceptible to resistant. In 1987, crosses were made between six Kenyan wheat cultivars and the 15 genotypes identified as having seedling and possibly adult resistance. F2 selections were advanced to the F7 generation using conventional breeding procedure, selecting the most resistant plants having good agronomic characteristics. In 1992, F7 progenies and their parents were evaluated for agronomic performance and resistance to yellow rust in 53 percent of the parents and in a considerable number of the F7 lines, indicating that a build up of more complex yellow rust races is inevitable for the wheat-yellow rust pathosystem when resistant parents are selected and tested carefully.

914 Dohmen, G.; Hessberg, H.; Geiger, H.H.; Tudzynski, P. (1994) CMS IN RYE - COMPARATIVE RFLP AND TRANSCRIPT ANALYSES OF MITOCHONDRIA FROM FERTILE AND MALE STERILE PLANTS. *Theoretical & Applied Genetics*. 89(7-8):1014-1018. English. [UNIV MUNSTER INST BOT SCHLOSSGARTEN 3 D-48149 MUNSTER GERMANY].

The mitochondrial (mt) genomes of rye (*Secale cereale* L.) lines with "normal" and cytoplasmic male sterility (CMS) inducing "Pampa" cytoplasm were compared by detailed restriction fragment length polymorphism (RFLP) and Northern analyses. RFLP analyses using several heterologous mt genes as probes revealed considerable differences in the overall structure of the two mt genomes. With *cob* and *atpA*, the data indicate intragenic recombination and/or different copy numbers of these genes in the two cytoplasms. In spite of this heterogeneity at DNA level, the transcriptional patterns of nine out of ten mitochondrial genes analysed are unaffected. The exception is in the "Pampa" cytoplasm which contains an additional *cob*-homologous transcript. Since this transcript is strongly reduced in the presence of restorer genes, it might causally be correlated to the CMS phenotype. [References: 23].

915 Doussinault, G. (Institut National de la Recherche Agronomique, Le Rheu (France). Centre de Rennes, Groupe d'Etudes et de Contrôle des Variétés et des Semences, Secteur d'Etude des Variétés) (1994) [Variability of the resistance of wheat to powdery mildew [*Erysiphe graminis* var. *tritici*]]. [Variabilité de la résistance à l'oidium [*Erysiphe graminis* var. *tritici*]]. *Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand*

(France). [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand Theix, Amelioration des Plantes p. 197-205. EUCARPIA. 3 ref. English. (AGRS 95-012753).

916 Duan Shuangke; Liu Changhong (Shaanxi Provincial Inst. of Plant Protection, Yangling (China)) (1993) Evaluation on mildew resistance of wheat varieties (lines) and determination on virulence of the pathogen in Shaanxi [China]. *Shaanxi Journal of Agricultural Sciences (China)* (no. 4) p. 6-7. 2 tables. Chinese. (AGRS 95-002599).

917 Dweikat, I.; Ohm, H.; Mackenzie, S.; Patterson, F.; Cambron, S.; Ratcliffe, R. (1994) ASSOCIATION OF A DNA MARKER WITH HESSIAN FLY RESISTANCE GENE H9 IN WHEAT. *Theoretical & Applied Genetics*. 89(7-8):964-968. English. [PURDUE UNIV DEPT AGRON W LAFAYETTE, IN 47907 USA].

The Hessian fly [*Mayetiola destructor* (Say)] is a major pest of wheat (*Triticum aestivum* L.) and genetic resistance has been used effectively over the past 30 years to protect wheat against serious damage by the fly. To-date, 25 Hessian fly resistance genes, designated H1 to H25, have been identified in wheat. With near-isogenic wheat lines differing for the presence of an individual Hessian fly resistance gene, in conjunction with random amplified polymorphic DNA (RAPD) analysis and denaturing gradient-gel electrophoresis (DGGE), we have identified a DNA marker associated with the H9 resistance gene. The H9 gene confers resistance against biotype L of the Hessian fly, the most virulent biotype. The RAPD marker cosegregates with resistance in a segregating F-2 population, remains associated with H9 resistance in a number of different T. *aestivum* and T. *durum* L. genetic backgrounds, and is readily detected by either DGGE or DNA gel-blot hybridization. [References: 28].

918 Ender, M.; Federizzi, L.C.; Decarvalho, F.F. (1994) INHERITANCE OF HARVEST INDEX IN SPRING WHEAT (*TRITICUM AESTIVUM* L.) CROSSES WITH DIFFERENT PLANT HEIGHT. *Pesquisa Agropecuaria Brasileira*. 29(9):1445-1452. Portuguese. [EMBRAPA EPAGRI CIAT IFAD DESENVOLVIMENTO GERMOPLASMA MANDIOCA SUBTROP CADX POSTAL 277 BR-88301970 ITAJAI SC BRAZIL].

The inheritance of harvest index trait in spring wheat has been studied in the analysis of parents and F1, F2, RC1F1 and RC2F1 generations, of nine crosses between the genotypes: Maringa a tall cultivar; IPF55243, semi-dwarf (medium height) and IPF55245, D8006 and D8017, all of them dwarf(short). There was genetic variability of harvest index among the studied genotypes. The broad sense heritabilities were low or intermediary because of the great environment effect on the character expression. Additive variance has showed important participation in genetic variance, which indicates less influence of dominance and/or epistasis. Additive gene effects were important in most of the crosses, although dominance effects showed importance in specific crosses involving D8006. Besides the importance of additive gene action, selection for harvest index in early segregating generations may be difficult because the high value of environmental variances, and it should be done in more advanced generations.

919 Feldman, M. (Weizmann Institute of Science, Rehovot (Israel). Plant Genetics); Millet, E.; Abbo, S. (1994) [Exploitation of wild emmer wheat [*Triticum turgidum* var. *dicoccoides*] to increase yield and protein content in durum and common wheat]. [Exploitation de l'amidonier sauvage [*Triticum turgidum* var. *dicoccoides*] pour augmenter le rendement et la teneur en proteines du ble dur et du ble tendre]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France)*. [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes p. 151-161. EUCARPIA. 12 ref. English. (AGRS 95-012750).

920 Felix, I. (Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes); Branlard, G. (1994) [Effect of HMW (high molecular weight) and LMW (low molecular weight) glutenin subunits and w gliadins diversity on the quality parameters of French bread wheat cultivars]. [Effet de la diversite des sous-unites de glutenines a haut poids moleculaire et a bas poids moleculaire et des gliadines w sur les parametres de qualite des varietes francaises de ble tendre]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France)*. [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes p. 225-227. EUCARPIA. 5 ref. English. (AGRS 95-012754).

921 Fodor, A. (Pannon Agrartud. Egyet, Keszthely (Hungary). Georgicon Mezogazdasagtud. Kar); Langne Molnar, M.; Sutka, J. (Magyar Tud. Akad., Martonvasar (Hungary). Mezogazd. Kut. Int.) (1994) [Utilization of the wild wheat variety *Triticum timopheevi* Zhuk. for improving the resistance of the cultivated wheat T. *aestivum* L.]. *Triticum timopheevii zhuk. vad buzafaj felhasználása a termesztett buza (Triticum aestivum L.) rezisztenciájának javítására*. 40. Novenyvedelmi Tudományos Napok; Budapest (Hungary); 22-23 Feb 1994. *Novenyvedelmi Tudományos Napok (Hungary)* (no.40) p. 108. Hungarian. (AGRS 95-012765).

The objective was to produce a hybrid material which would enable to introduce the powdery mildew resistance of T. *timopheevi* into cultivated wheat. As a first step, T. *timopheevi* was crossed with the Mv9 kr 1 line, and then back-crossed with them. A colchicine treatment of the F1 generation gave amphipolids which are already sufficiently fertile, and capable of being used for producing disomatic additional lines and translocations, i. e. for introducing the genes responsible for the resistance to powdery mildew into the gene set of the cultivated wheat.

922 Franchi, A.S. de; Gherbin, P.; Graziano, S.F.; Monteleone, M. (Basilicata Univ., Potenza (Italy). Dipartimento di Produzione Vegetale) (1994) [Bio-agronomic evaluation of barley varieties (*Hordeum* spp.) in a hilly area of Basilicata region]. *Valutazione bio-agronomica di varietà di orzo (Hordeum spp.) in ambiente collinare della Basilicata. Rivista di Agronomia (Italy)* v. 28(2) p. 109-115. 4 tables; 6 graphs; 13 ref. Italian. (AGRS 95-012627).

Results on two-year trial carried out in a hilly area of Basilicata region (Guardia Perticara - PZ - 700 m above s.l.), characterized by clay-sandy soil, with the aim of investigating on biological and agronomical characters of 24 barley varieties, 18 two-rowed and 6 six-rowed, are reported. The different meteorological patterns significantly influenced many characters, pointing out peculiarities of compared genotypes mainly in the better year. The two-rowed varieties, as compared with six-rowed, showed more favourable morphological and productive characters. With regard to some aspects concerning malting, it is necessary to investigate deeply the genotypes and the agricultural techniques in the tested environment to reach a higher quality production.

923 Francki, M.G.; Langridge, P. (1994) THE MOLECULAR IDENTIFICATION OF THE MIDGET CHROMOSOME FROM THE RYE GENOME. *Genome*. 37(6):1056-1061. English. [UNIV ADELAIDE WAITE AGR RES INST CTR CEREAL BIOTECHNOL DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

The diminutive "midget" chromosome is found in plants containing a wheat nuclear genome with a substituted rye cytoplasm. This cytoplasmic substituted line arose during successive backcrossing of a wheat/rye amphiploid to wheat as the recurrent male parent. Southern and in situ hybridization with a dispersed repeat sequence specific for rye, R173, indicates that the midget chromosome originates from within the rye genome. Various DNA markers previously mapped to group 1 chromosomes of wheat and barley were used to trace the origin of the midget chromosome from within the rye genome. Ten short arm and 36 long arm probes were used and one marker was identified, which hybridizes to the midget chromosome and maps to the proximal region of the long arm of chromosome 1R. An additional marker was generated

from a genomic library of the line containing the midget chromosome. This also maps to the long arm of 1R. The results indicate that the midget chromosome contains a small segment of the long arm of chromosome 1R. [References: 15].

924 Friebe, B.; Jiang, J.; Tuleen, N.; Gill, B.S. (1995) STANDARD KARYOTYPE OF TRITICUM UMBELLULATUM AND THE CHARACTERIZATION OF DERIVED CHROMOSOME ADDITION AND TRANSLOCATION LINES IN COMMON WHEAT. *Theoretical & Applied Genetics*. 90(1):150-156. English. [KANSAS STATE UNIV AGR & APPL SCI CTR WHEAT GENET RESOURCE DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

A standard karyotype and a generalized idiogram of *Triticum umbellulatum* (syn. *Aegilops umbellulata*, $2n = 2x = 14$) was established based on C-banding analysis of ten accessions of different geographic origin and individual *T. umbellulatum* chromosomes in *T. aestivum*-*T. umbellulatum* chromosome addition lines. Monosomic (MA) and disomic (DA) *T. aestivum*-*T. umbellulatum* chromosome addition lines (DA1U = B, DA2U = D, MA4U = F, DA5U = C, DA6U = A, DA7U = E = G) and telosomic addition lines (DA1US, DA1UL, DA2US, DA2UL, DA4UL, MA5US, (+ iso 5US), DA5UL, DA7US, DA7UL) were analyzed. Line H was established as a disomic addition line for the translocated wheat-*T. umbellulatum* chromosome T2DS.4US. Radiation-induced wheat-*T. umbellulatum* translocation lines resistant to leaf rust (Lr9) were identified as T40 = T6BL.6BS-6UL, T41 = T4BL.4BS-6UL, T44 = T2DS.2DL-6UL, T47 = 'Transfer' = T6BS.6BL-6UL and T52 = T7BL.7BS-6UL. Breakpoints and sizes of the transferred *T. umbellulatum* segments in these translocations were determined by in situ hybridization analysis using total genomic *T. umbellulatum* DNA as a probe [References: 44].

925 Froidmont, F. (Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium). Station d'Amelioration des Plantes); Maroquin, C.; Steyer, S. (1993) [The selection of barley varieties resistant to the Barley Yellow Mosaic Virus]. La selection d'orges resistantes a la mosaïque. *Parasitica (Belgium)* v. 49(3-4) p. 107-114. 4 tables; 2 ref. French. (AGRIS 95-012629).

The different BaYMV strains give typical symptoms on winter barley. By visual assessment of the symptoms on a 1-10 scale, we score the varietal resistance of a range of cultivars within the framework of the ONDAH experiments. A single allele *ym1* seems to control cultivars resistance to the strains BaYMV and BaMMV. The "new" strain, BaYMV-Y2, doesn't produce severe damage in the field and the resistance to this strain is controlled by the gene *ym2*. Crosses were carried out between resistant and sensitive varieties. From field result, it is concluded to a multiple allelism between the different characters. The choice of the selection method used at the Station d'Amelioration des Plantes is explained.

926 Fukushima, Y.; Konishi, T. (1994) GENETIC STUDIES ON HYBRID STERILITY IN BARLEY. *Japanese Journal of Genetics*. 69(6):719-726. English. [KYUSHU UNIV FAC AGR FUKUOKA 812 JAPAN].

Partially sterile F-1 barley plants were found when some Ethiopian varieties were crossed with Tayeh 1 (Chinese landrace), even though the parents were completely fertile. This hybrid sterility is shown to be controlled by two duplicate genes (*sfg1* and *sfg2*). Because this gene interaction affects the female gamete only, the female gametes carrying the both *sfg1* and *sfg2* genes became sterile, the end result being that seed fertility of the F-1 plants is decreased to around 75%. Seed fertility was not significantly influenced by cytoplasm and genetic backgrounds of the F-1 plants, and years grown the F-1 plants. [References: 11].

927 Gajdalenok, R.F.; Litkovskaya, N.P.; Khurabrova, M.A. (1993) [Obtaining of substitution lines of common wheat cultivar Saratovskaya 29 with two pairs of definite chromosomes of cultivar Janetskis Probat]. Poluchenie zameshchennykh linij myagkoj pshenitsy Saratovskaya 29 s dvumya parami opredelennykh khromosom sorta Yanetskis Probat. [Specific features in the reconstruction of genome and high plants populations] p. 74-82. 7 ref. Russian. (AGRIS 95-002610).

Results of development of common wheat substitution lines of cultivar Saratovskaya 29 with two pairs of chromosomes for homologous of the donor cultivar Janetskis Probat are reported for the first time. These lines were developed by crossing each line with the rest 20 lines with

substitution in each of them of a definite chromosome pair for a donor one. From a great number of lines with 2-chromosome substitutions 20 lines arrest great interest, in which the 3B chromosome can pair with the rest chromosomes of Janetskis Probat. The results of testcrossing indicate that such important characters as short and thick culm are controlled by genes on 3B chromosome. Genes on 2A, 4A, 5D, 7D chromosomes of Janetskis Probat also influence the phenotypic expression of these characters by reinforcing them, whereas the 1A and 4B chromosomes inhibit them. Initial plants with 2-chromosome substitutions were chosen from the F2 population on condition that the presence of both pairs of the donor chromosomes was phenotypically evident in homozygotes. However, identification of these plants is still made with a definite degree of uncertainty.

928 Gil, Z. (Akademia Rolnicza, Wroclaw (Poland). Katedra Technologii Zboz) (1993) [Effect of soil and climatic conditions on a technological value of grain of strains and varieties of triticale]. *Wartosc technologiczna rodow i odmian pszenzyta w zaleznosci od warunkow glebowo-klimatycznych. Biuletyn Instytutu Hodowli i Aklimatyzacji Roslin (Poland)* (no.186) p. 35-43. 4 tables; 17 ref. Polish. (AGRIS 95-012748).

It has been found that the technological value of triticale was influenced, first of all, by the location, year of harvest, interactions of locations with weather conditions in specific years and then by genetically conditioned traits of the studied varieties. The bread volume and an overbake of bread were correlated with a total protein content and sedimentation tests.

929 Gil, Z. (Akademia Rolnicza, Wroclaw (Poland). Katedra Technologii Zboz); Obuchowski, W. (Akademia Rolnicza, Poznan (Poland). Inst. Technologii Zywnosci Pochodzenia Roslinnego) (1993) [Possibilities of utilization of hardness determinants in qualitative characterization of triticale grain]. *Mozliwosci wykorzystania oznaczen twardosci w charakterystyce jakosciowej ziarna pszenzyta. Biuletyn Instytutu Hodowli i Aklimatyzacji Roslin (Poland)* (no.186) p. 29-33. 3 tables; 8 ref. Polish. (AGRIS 95-012747).

The study was aimed to estimate the effect of grain hardness on selected milling and baking characteristics of triticale. Statistical analysis of data showed a relationship between grain hardness and its calorimetric value, flour water absorption and baking quality. The grain hardness expressed by a torque as measured with Brabender hardness tester, was found to be the best way to determine the technological value of triticale grain.

930 Grossi, M.; Cattivelli, L.; Lacerenza, N.G.; Stanca, A.M.; Terzi, V. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1993) [Biochemical responses to cold stress and drought in barley (*Hordeum vulgare* L.)]. *Risposte biochimiche dell'orzo (Hordeum vulgare L.) a basse temperature e a carenza idrica. Societa Italiana di Agronomia*. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 290-296. 33 ref. Italian. (AGRIS 95-002473).

Several environmental stresses can affect the performance of many crops reducing their potential yield. In barley, for many aspects a model plant for all cereals, there are two main stress conditions; cold and drought. This paper reviews the most recent progress in stress physiology and in stress molecular biology. The identification and the isolation of many stress regulated genes can open new perspectives from an applied point of view. The identification of molecular markers for stress resistance can help for selecting of superior genotypes.

931 Gu Defeng; Xu Yaokui; Liu Bo (Jilin Agricultural Univ., Changchun (China). Dept. of Agronomy) (1993) The effects of Pingyanmycin on callus induction and plantlet regeneration of immature wheat embryo. *Journal of Jilin Agricultural University (China)* v. 15(3) p. 1-5. 6 ill., 4 tables, 7 ref. Chinese. (AGRIS 95-002583).

932 Gustafson, J.P.; Sears, E.R. (1993) An effective wheat gene manipulation system: problems and uses. *Plant breeding reviews (USA)* v. 11 p. 225-234. references. English. (AGRIS 95-012606).

933 Hadjichristodoulou, A. (Agricultural Res. Inst., Nicosia (Cyprus)) (1994) Breeding barley for forage and grain production in dry lands.

Technical Bulletin (Cyprus); no. 158 8 p. 2 tables; 1 illus. 26 ref. English. (AGRIS 95-012630).

Selection was exercised simultaneously for grain and hay yield in segregating populations of over 500 crosses. The hooded gene was associated with low hay and grain yields. However, a hooded line was selected combining high grain and hay yield.

934 Hadjichristodoulou, A. (Agricultural Res. Inst., Nicosia (Cyprus)) (1994) Exploitation of genetic heterogeneity present in breeding lines of barley. *Technical Bulletin (Cyprus)*; no. 159 5 p. 3 tables; 10 ref. English. (AGRIS 95-012631).

Pure line selection increased grain yield of material bulked in the F5 generation, without loss of stability, and retaining distinctness, uniformity and stability.

935 Hadjichristodoulou, A. (1994) THE PERFORMANCE OF THE HOODED GENE OF BARLEY (*HORDEUM VULGARE*) IN RAINFED MEDITERRANEAN CLIMATES. *Journal of Agricultural Science*. 123(Part 3):313-317. English. [AGR RES INST NICOSIA CYPRUS].

The progenies of six crosses, made in 1987, between the best available hooded barley line and six selected awned barley lines were used to study the effect of the hooded gene on the performance of barley under rainfed conditions in Cyprus. A single dominant gene was found to control the hooded character. Awned genotypes on average outyielded hooded genotypes by 17%, but the difference between the two genotypes was smaller in the central plain than in the coastal area. The effect of the hooded gene on yield varied also with the combination of parents, as the superiority of the awned genotypes varied with cross from 13 to 30%. Hooded lines giving a higher grain yield than their hooded parent were identified. On average the awned genotypes had higher 1000-grain weight (5.0 g), were slightly later in heading date (1.1 days), had slightly higher volume weight (1.3 kg/hl) than hooded genotypes, but had similar plant height. The 1000-grain weight of most hooded lines was significantly higher than that of their hooded parent. In spite of the negative effects of the hooded gene on grain yield, it was concluded that it is possible to increase the yield of hooded barley for hay production by continued crossing and selection (with special emphasis on 1000-grain weight), by selecting special combinations of parents through the Bulk-Pedigree method and by growing hooded barley in suitable areas, making use of the location-dependent performance of the hooded gene. [References: 20].

936 Hakro, A.A.; Aslam, M.; Khanzada, A.K. (1994) LEAF RUST DEVELOPMENT IN VARIOUS CULTIVARS OF WHEAT CARRYING DIFFERENT KNOWN GENES FOR RESISTANCE. *Pakistan Journal of Botany*. 26(1):173-176. English. [PAKISTAN AGR RES COUNCIL CROP DIS RES INST KARACHI 75270 PAKISTAN].

Wheat cultivars Punjab 76 (Lr1), Chenab 70 (Lr13), Khyber 79 (Lr13), ZA-77 (Lr1+13), Faisalabad 83 (Lr+13), Lyallpur 73 (Lr1+13), Pari-73 (Lr1+13), Sandal (Lr1+13), Sindh 81 (Lr1+13), Yecora (Lr1+13), Zamindar (Lr1+13), Zarghoon (Lr1), An (Lr3+13), Barani 83 (Lr3+13), Punjab 81 (Lr13+) and Morocco (without gene) for leaf rust resistance were included in the test. The plants 45 days after planting were inoculated through spraying with aqueous suspension of uredospores of *Puccinia recondita*. Leaf rust epidemic was first observed early in February on Morocco which does not carry any known gene for resistance. The start of the disease on the cultivars carrying one or other gene (s) for resistance were delayed by one to three weeks. Similarly the rate of development of the disease per unit time was also slower on cultivars carrying a gene for resistance than on the one without any known gene for resistance.

937 Handley, L.L.; Nevo, E.; Raven, J.A.; Martinezcarrasco, R.; Scrimgeour, C.M.; Pakniyat, H.; Forster, B.P. (1994) CHROMOSOME 4 CONTROLS POTENTIAL WATER USE EFFICIENCY (DELTA-C-13) IN BARLEY. *Journal of Experimental Botany*. 45(280):1661-1663. English. [SCOTTISH CROP RES INST DUNDEE DD2 5DA SCOTLAND].

By combining the approaches of whole-shoot carbon discrimination and genetic analysis, we found that chromosome 4 controls potential water use efficiency (delta(13)C) in barley. In a simultaneous experiment, delta(13)C of 19 wild barley populations from Israel were grown under well-watered conditions in Scotland. Populations originating at the most arid sites had the most negative delta(13)C, hence the lowest potential water use efficiency. [References: 10].

938 He Dexian; Wang Futing; Liang Jincheng (Henan Agricultural Univ., Zhengzhou (China). Dept. of Agronomy) (1994) Studies on the correlations between characters of roots and those of aerial parts of winter wheat in Northern China I. Correlations between characters of the roots and aerial parts from seeding time to heading stage. *Acta Agriculturae Universitatis Henanensis (China)* v. 28(1) p. 19-24. 3 tables, 8 ref. Chinese. (AGRIS 95-002440).

939 He Shixian; Yao Wenguo; Shi Xiangyu (Shandong Provincial Academy of Agricultural Sciences, Jinan (China). Inst. of Application of Atomic Energy) (1993) Study on mutagenesis of immature embryo callus treated with gamma rays in wheat. *Acta Agriculturae Nucleatae Sinica (China)* v. 7(2) p. 65-72. 4 ill., 3 tables, 9 ref. Chinese. (AGRIS 95-002588).

940 Horsley, R.D.; Schwarz, P.B.; Hammond, J.J. (1995) GENETIC DIVERSITY IN MALT QUALITY OF NORTH AMERICAN SIX-ROWED SPRING BARLEY. *Crop Science*. 35(1):113-118. English. [N DAKOTA STATE UNIV DEPT CROP & WEED SCI FARGO, ND 58105 USA].

Malting barley (*Hordeum vulgare* L.) breeders often are accused of using germplasm with a narrow genetic base for development of new cultivars. Yet, gains are being made in improving agronomic and malt quality traits. This suggests that more variability exists than otherwise can be expected by examining pedigrees. The objective of this study was to compare results from the cluster analysis based on the coefficients of parentage between 21 North American six-rowed barley cultivars with the cluster analysis based on 10 malt quality traits of the same cultivars. This information may aid us in determining if further gains can be expected by intercrossing closely related genotypes, and to identify those malt quality traits in which improvement can be expected. Malt quality traits evaluated were kernel plumpness, grain protein, hue-grind extract, coarse-grind extract, fine-coarse extract difference, soluble protein, soluble protein to total barley protein ratio, diastatic power, alpha-amylase activity, alkaline viscosity, and total malt beta-glucan content. Data on these traits for each of the 21 cultivars were collected on malt produced from samples of grain grown at Fargo, ND, over 3 yr. Composition of the clusters based on the coefficients of parentage was different from that of the clusters based on the analysis of malt quality traits. Clusters based on the analysis of the coefficients of parentage were related to the location of development of the cultivars. Results suggest that gains in malting quality still may be expected from intercrossing germplasm from different breeding programs and even within a program. Traits that may be improved further are kernel plumpness, diastatic power, alpha-amylase activity, soluble to total protein ratio, alkaline viscosity, and total malt beta-glucan. [References: 18].

941 Hu Tianci; Gao Mingwei; Liang Zhuqing (Zhejiang Agricultural Univ., Hangzhou (China). Inst. of Nuclear Agricultural Science) (1993) Influence of callus irradiation with 60Co gamma-rays on the cell ultrastructure of wheat. *Acta Agriculturae Nucleatae Sinica (China)* v. 7(1) p. 16-20. 14 ill., 12 ref. Chinese. (AGRIS 95-002587).

942 Huang Jidong (Xinjiang Division No.2 of Land Reclamation Troop, Korla County (China). Inst. of Agricultural Sciences) (1993) Spring wheat variety series and its cultivation structure in Yanqi Reclamation Area, Xinjiang (China). *Xinjiang Agricultural Sciences (China)* (no. 2) p. 57-58, 60. Chinese. (AGRIS 95-002581).

943 Hussain, A.; Lukow, O.M. (Agriculture Canada Research Station, Winnipeg) (1994) [Response of genetically diverse wheat cultivars to proteolytic digestion of glutenin]. *Risposta di cultivar di grano geneticamente diverse alla digestione proteolitica della glutenina. Journal of Genetics and Breeding (Italy)* v. 48(1) p. 67-71. 2 tables; 3 graphs; 17 ref. English. (AGRIS 95-012769).

Proteolytic digestion of the glutenin preparation of six wheat cultivars by pancreatic, bacterial, fungal or plant protease was studied using sodium dodecyl sulfate polycrylamide gel electrophoresis (SDS-PAGE). Freeze dried glutenin, suspended in 6M urea at 30 deg C was subjected to proteolysis and the extent of reaction was studied by observing the electrophoretic patterns of the proteolytic digests at different time intervals. Addition of protease facilitated extractability of 25-45 kDa

protein components. Cultivar response to proteolytic digestion was variable. High molecular weight glutenin subunit 2* was more resistant to proteolysis than subunit 9 in cv. Katepwa. For glutenin of cv. Katepwa, papain generated fewer fragments than the other proteases investigated. Susceptibility of similar subunits to proteolysis varied among cultivars. The differential susceptibility of glutenin to various proteases from genetically diverse wheat cultivars does not appear to be related to breadmaking quality.

944 Inagaki, M.; Mujeekazi, A. (1994) **STORAGE OF MAIZE POLLEN FOR USE IN HAPLOID PRODUCTION OF HEXAPLOID WHEAT.** *Breeding Science*. 44(4):387-390. English. [CIMMYT APARTADO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Viability of maize pollen after the drying and freezing process was estimated by its germination on maize silks. Secondly, frequencies of embryo formation were determined in crosses of hexaploid wheat with freeze-stored pollen of maize. Maize pollen germinated at frequencies ranging from 54.2 to 66.6% when pollen water content was reduced from 59.0% (fresh) to 9.5%. Pollen with a water content of 9.5% maintained viability and germinated at a frequency of 22.1% after four weeks of storage at -80 degrees C. Embryos were successfully obtained in crosses of wheat with the maize pollen dried to 12.7 and 10.3% water content and stored for 13 weeks at -80 degrees C. These embryo formation frequencies were 9.6 and 8.6% respectively. It was 22.2% in crosses with fresh pollen. All regenerated plants were wheat polyploids. These results suggest that stored maize pollen can be used for hexaploid wheat haploid production when and where fresh maize pollen is not available.

945 Jestin, L. (Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes); Le Blanc, A.; Ducher, M.L. (1994) [Management of the barley germplasm collections in Clermont-Ferrand]. [Gestion des collections de materiel genetique d'orge a Clermont-Ferrand]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France).* [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes p. 265-267. EUCARPIA. English. (AGRIS 95-012625).

946 Jiang, J.; Friebe, B.; Gill, B.S. (1994) **CHROMOSOME PAINTING OF AMIGO WHEAT.** *Theoretical & Applied Genetics*. 89(7-8):811-813. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT PLANT PATHOL MANHATTAN, KS 66506 USA].

Chromosome painting using multicolor fluorescence in situ hybridization showed that, in addition to the T1AL.1RS translocation derived from rye, a segment from chromosome 3Ae#1 of Agropyron elongatum ($2n=10x=70$), is present in Ami, oo wheat. The Agropyron chromosome segment is located on the satellite of chromosome 1B and the translocation chromosome is designated as T1BL.1BS-3Ae#1L. T1BL.1BS-3Ae#1L was inherited from Teewon wheat and carries resistance genes to stem rust (Sr24) and leaf rust (Lr24). The Agropyron chromosome segments in different Sr24/Lr24 carrier wheat lines, including Agent, TAP 48, TAP 67, Teewon, and Amigo, showed a diagnostic C-band, and were derived from the same chromosome, 3Ae#1. [References: 15].

947 Jing, Z. (1994) **PLANT TYPES AND GIBBERELLIN RESPONSES OF CHINESE DWARF-BARLEY GENETIC RESOURCES.** *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 113(3):258-261. English. [CHINESE ACAD AGR SCI INST CROP GERMPLASM RESOURCES BEIJING PEOPLES REPUBLIC OF CHINA].

Plant types and gibberellin responses were investigated in 20 Chinese dwarf and two tail check-barley varieties. Wide genetic variation was observed in plant height, ranging from 23.1 to 69.2 cm. Compared with the controls, no relationship was found between plant height and internode number, but a relationship was established between plant height and internode length. The ratio of the length to the diameter of each internode decreased greatly in most of the dwarfs. Three dwarf groups, three internode patterns and four leaf forms were differentiated in

Chinese dwarf barleys based on the main culm height, successive internode lengths, and top three leaf widths and lengths. Most showed sensitivity to GA(3). [References: 9].

948 Joensson, R.; Bertholdsson, N.O.; Engqvist, G.; Aahman, I. (1994) [Plant characters of importance in ecological farming]. *Vaextegenskaper av betydelse vid alternativ odling. Sveriges Utsaedsfoerennings Tidskrift (Sweden) v. 104(3) p. 137-148.* 9 ref. English. (AGRIS 95-002483).

949 Johnson, J.W.; Buntin, G.D.; Cunfer, B.M.; Roberts, J.J.; Bland, D. (1995) **REGISTRATION OF GA-HFR BARLEY GERMPLASM RESISTANT TO HESSIAN FLY.** *Crop Science*. 35(1):294-295. English. [UNIV GEORGIA DEPT AGRON GRIFFIN, GA 30223 USA].

950 Johnson, Roy (John Innes Center, Colney (United Kingdom). IPSR Cambridge Laboratory) (1994) **Developments in Prospects of Breeding for Durable Resistance to the Three Rust Diseases of Wheat.** 8. Regional wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa.* Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 123-140. CIMMYT. 5 tables; 3 fig.; 49 ref. English. (AGRIS 95-002443).

Breeding for durable resistance to the rusts of wheat is a worthwhile objective because it is an attainable goal, although a challenging one, and because these diseases remain as significant threats to wheat production. There is a history of failures of resistance due to the evolution of the respective pathogens for each of the three rusts. However, there is increasing evidence and knowledge about durable forms of resistance to each of the diseases and how they can be exploited. The examples of durable resistance to stem rust discussed include the use of the genes Sr36, Sr26 and Sr31. For leaf rust, the relationships of the genes Lr34, Lr13 and potential of resistances due to Yr18 linked to Lr34, and of durable resistance in European and North American wheats are considered.

951 Khan, M.A.; Begum, I.; Ahmad, S.; Jalil, S.A. (Arid Zone Research Inst., Quetta (Pakistan)); Thomson, E.F. (Arid Zone Research Inst., Quetta (Pakistan)). ICARDA, MART/AZR Project Office) (1992) **Germplasm evaluation in the arid highlands of Balochistan: annual report of the AZRI Germplasm Evaluation Group 1991/92.** MART/AZR project: high elevation research in Pakistan: research report no. 79. International Center for Agricultural Research in the Dry Areas, Aleppo (Syria); USAID, Washington (USA); Arid Zone Research Institute, Quetta (Pakistan). AZRI. 49 Tables; 12 ref. 56 p. English. (AGRIS 95-012908).

952 Khrabrova, M.A.; Gajdalenok, R.F.; Kovaleva, N.M. (1993) [Role of chromosomes in control of grain protein content in wheat substitution lines of Saratovskaya 29/Janetskis Probat]. *Rol' khromosom v kontrolirovani soderzhaniya belka v zerne zameshchennykh linij phenitisy Saratovskaya 29/Janetskis Probat. [Specific features in the reconstruction of genome and high plants populations]* p. 83-93. Bibliography p. 90-92. Russian. (AGRIS 95-002611).

A new series of substitution lines was established on the basis of aneuploid common wheat cultivar Saratovskaya 29 and highly productive and protein-rich cultivar Janetskis Probat as the donor. Total protein content in grain of 16 substitution lines and parental cultivars (relative content, %, absolute content, mg/cariopsis) was investigated. Lines 1A, 2D, 4D, 5B, 7A still remain to be explored. The effect of substitution of chromosomes of cultivar Saratovskaya 29 for homologous of cultivar Janetskis Probat was noted by an increase in total protein (%) in meat of substitution lines studied, compared with the recipient cultivar (15%). Lines 1D, 3D, 6D had highest protein content (17%). Chromosomes 1B, 1D, 2B, 2D, 3D, 4A, 4B, 5D, 6A, 6B, 7D carry genes which are responsible (in different degree) for increase in absolute protein content in cariopsis. It seems reasonable to suppose of a very complex nature of genetic control over the protein content in the grain of Janetskis Probat due to a contribution of several chromosomes which belong to three wheat genomes. It is also supposed that 6B chromosome carries genes which exert the highest positive effect. Chromosomes 1B, 1D, 2B, 2D, 3D, 4B, 6A and 7D carry genes responsible for the same characters but exhibiting fairly lower effect.

953 Kidd, G.; Dvorak, J. (1995) A PERSISTENT MONSANTO TAMES HYBRID WHEAT. *Bio-Technology*. 13(1):15-18. English. [KIDD & CO SHOREWOOD, WI 53211 USA].

954 Kinyua, M.G. (N.P.B.R.C., Njoro (Kenya)); Ayiecho, P.O.; Wanga, H.; Akunda bweni, L. (1994) Screening for Drought Tolerance in Kenyan Commercial Wheat Varieties and Introduced Lines. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 309. CIMMYT. English. (AGRI 95-002446).

Twenty-five commercial wheat varieties and four introduced lines were tested for tolerance to drought in Kenya from 1989 to 1992 at Kajado, Katumani and Naivasha. Performance varied significantly amongst these cultivars as well as across locations. K. Mbweha, K. Chiriku and Mbuni performed best amongst the commercial varieties. Mbuni, for example, had a mean yield of 3.9 t/ha. R672 and R674 performed best amongst the introductions with average yields of 3.7 and 3.5 t/ha, respectively. Further comparative testing of these lines is needed to ascertain the stability of their agronomic performance in these marginal environments.

955 Kinyua, M.G.; Kirigwi, F.M. (N.P.B.R.C., Njoro (Kenya)) (1994) Use of Yield Components as Selection Criteria for Wheat Varieties for the Marginal Areas of Kenya. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 114-122. CIMMYT. 2 tables; 3 fig.; 18 ref. English. (AGRI 95-002442).

Wheat yield trials were carried out during the growing seasons of 1989, 1990 and 1992 in three marginal (dryland) wheat growing areas of Kenya to determine the stability of yield components over time and locations. The components studied for seven cultivars were tillers per plant, seeds per spike, spikelets per spike, spike length and hundred kernel weight. The components of yield were found to be unstable over years and locations. Spikelets per spike was found to be among the most unstable of the yield components (eg. $b = 0.57$ for Mbuni and 0.80 for CM 64593) although it was one of the components highly correlated with yield. The differing environmental conditions in these areas and seasons are also discussed.

956 Kishor, N.; Chaubey, C.N.; Ahmad, Z. (Chander Shekhar Azad University of Agriculture and Technology, Kanpur (India). Department of Genetics and Plant Breeding) (1992) Stability analysis for yield and some quality traits in wheat (*Triticum aestivum* L.). *Indian Journal of Genetics and Plant Breeding (India)* v. 52(4) p. 356-360. 2 tables; 4 ref. English. (AGRI 95-002604).

957 Koebner, R.M.D.; Martin, P.K. (1994) [RAPDs (random amplified polymorphic DNA) as molecular markers for the detection of the presence of rye chromosomes in wheat]. RAPD (random amplified polymorphic DNA) come marcatori molecolari per l'individuazione della presenza di cromosomi di segale nel frumento. *Journal of Genetics and Breeding (Italy)* v. 48(1) p. 85-88. 1 table; 1 graph; 18 ref. English. (AGRI 95-012770).

The RAPD-PCR technique was explored as a source of convenient markers for the presence of rye chromosomes/chromosome segments present in a wheat background. Although a large number of primers gave differential rye PCR products in the wheat x rye hybrids tested, many of these patterns were not reproducible; of those that were reliable, the majority did not amplify the rye product from template carrying only one pair of rye chromosomes. Where the assay was successful in distinguishing addition lines from euploid template, in all but one case, more than one rye chromosome carried the appropriate primer annealing sites.

958 Koenig, J. (Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes); Le Blanc, A. (1994) A network for evaluation of wheat genetic

resources in France). [Reseau d'evaluation des ressources genetiques de ble en France]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia*, 15-18 March 1994, Clermont-Ferrand (France). [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes p. 193-196. EUCARPIA. 7 ref. English. (AGRI 95-012617).

959 Kohli, M.M. (CIMMYT, Asuncion (paraguay)); Camargo, C.E.O.; Franco, F. (1994) An Analysis of the Progress Made in Brazil in Breeding Wheat for Acid Soils. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 78-98. CIMMYT. 16 tables; 4 fig.; 29 ref. English. (AGRI 95-012602).

The acid soils covering large areas of Africa, Asia and Latin America represent a major part of the world's marginal and under-utilized arable land. While soil corrective methods such as liming have helped to promote agriculture in these regions, most wheat germplasm is highly susceptible to the toxicities present in acid soils. Genetic variability for resistance to aluminum, the major toxicity factor, has been used in wheat to develop high yielding varieties. Collaborative research, involving the Brazilian wheat breeding programs and CIMMYT growing two generations per year, has led to the identification of semidwarf varieties. While the genetic advance in yield potential shown by the new varieties is reasonably high in the temperate regions of Brazil, the progress in the newer non-traditional warm areas has been less. Limited germplasm variability for resistance to high temperature, drought, and the diseases prevalent in the warmer areas seems to be the most critical factor limiting progress. In addition, soil and organic matter degradation and nutrient uptake efficiency, especially for phosphorus, need to be taken into consideration in order to improve breeding efficiency on such soils.

960 Kosar, K. (Vyzkumny Ustav Pivovarsky a Sladarsky, Brno (Czech Republic). Sladarsky Ustav) (1994) [New varieties of spring barley]. *Nove odrudy jarniho jecmene. Krasny Prumysl (Czech Republic)* v. 40(7) p. 210-211. 4 tables. Czech. (AGRI 95-012633).

961 Lang, L. (Hungarian Academy of Sciences, Martonvasar (Hongrie). Agricultural Research Institute); Bedo, Z. (1994) [Genetic background of the Martonvasar (Hungary) wheat breeding programme]. [Contexte genetique du programme de selection du ble a Martonvasar (Hongrie)]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia*, 15-18 March 1994, Clermont-Ferrand (France). [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes p. 117-122. EUCARPIA. 6 tableaux. English. (AGRI 95-012749).

962 Lee, J.H.; Graybosch, R.A.; Peterson, C.J. (1995) QUALITY AND BIOCHEMICAL EFFECTS OF A 1BL/1RS WHEAT-RYE TRANSLOCATION IN WHEAT. *Theoretical & Applied Genetics*. 90(1):105-112. English. [UNIV NEBRASKA USDA ARS LINCOLN, NE 68583 USA].

Wheat (*Triticum aestivum* L.) breeders worldwide have used rye (*Secale cereale* L.) as a source of genes for agronomic improvement. The 1BL/1RS wheat-rye chromosomal translocation derived from the Russian cultivars 'Kavkaz' and 'Aurora' has been among the most common means of accessing useful rye genes. Unfortunately, deleterious wheat quality effects are often associated with the presence of 1RS. The identification of genetic backgrounds capable of alleviating the deleterious effects of 1RS is crucial for its continued exploitation. End-use quality parameters and flour protein composition, as measured by size-exclusion highperformance liquid chromatography (SE-HPLC) of 373 wheat lines, derived from seven 1BL/1RS breeding populations, were analyzed. In all populations, significant quality defects were detected in 1BL/1RS lines

compared to non-1RS sister lines. The detrimental quality effects resulted from alteration of the ratio of flour protein composition, especially, decreased glutenin concentrations, and increased salt-water soluble protein concentrations. The end-use quality of 1BL/1RS lines, however, was highly dependent on genetic backgrounds. The potential exists for improvement in quality through crosses between 1RS lines with high glutenin, or low salt-water soluble protein concentrations, and non-1RS lines with strong dough properties. [References: 24].

963 Leroy, P. (Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes); Boeuf, C.; Merlino, M.; Volatier, C.; Negre, S.; Giroux, M.; Bernard, M. (1994) [Characterization of two sets of bread wheat genotypes by two sets of RFLP probes]. [Caractérisation de 2 ensembles de genotypes de blé tendre par 2 ensembles de sondes a RFLP]. Evaluation and exploitation of genetic resources pre-breeding; Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France).* [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix, Amelioration des Plantes p. 231-233. EUCARPIA. 9 ref. English. (AGRIS 95-012755).

964 Li Guoquan; Yu Shaohua; Li Meng (Jilin Agricultural Univ., Changchun (China)) (1994) Damaging effect of combined treatment of acriflavin and gamma ray of Co 60 on wheat. *Journal of Jilin Agricultural University (China)* v. 16(2) p. 58-62. 4 ill., 2 tables, 6 ref. Chinese. (AGRIS 95-002585).

965 Li Wenxiong; Zeng Hanbing (Northeast Agricultural Univ., Harbin (China). Dept. of Agronomy) (1994) The way of regulating grain number per spike in spring wheat. *Journal of Northeast Agricultural University (China)* v. 25(1) p. 1-9. 4 ill., 6 tables, 21 ref. Chinese. (AGRIS 95-002438).

966 Limpert, E. (Swiss Federal Inst. of Technology, Zurich (Switzerland)); Lutz, J.; Remlein, E.I.; Zeller, F.J. (Munich Univ. (Germany, F.R.). Inst. of Agronomy and Plant Breeding); Sutka, J. (Hungarian Academy of Science, Martonvasar. Agricultural Research Inst.) (1994) [Identification of powdery mildew resistance genes in common wheat (*Triticum aestivum* L.). 3: Hungarian and Croatian cultivars]. Identificazione dei geni resistenti all'oidio in grano comune (*Triticum aestivum* L.). 3: Cultivar ungheresi e croate. *Journal of Genetics and Breeding (Italy)* v. 48(2) p. 107-112. 4 tables; 29 ref. English. (AGRIS 95-012771).

967 Lind, V.; Zuchner, S.; Spanakakis, A.; Thiele, A. (1994) ANALYSES OF INTERACTIONS OF WHEAT CULTIVARS IN TESTS FOR RESISTANCE TO PSEUDOCERCOPORELLA HERPOTRICHOIDES. *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 113(4):272-280. English. [BUNDESANSTALT ZUCHTUNGSFORSCH KULTURPFLANZEN INST RESISTENZGENET GRAF SEINSHEIM STR 23 D-85461 GRUNBACH GERMANY].

A total of 20 cultivars of winter wheat were tested by ELISA for resistance to *Pseudocercospora herpotrichoides* in six environments and three growth stages. In a three-factor statistical analysis, the contribution of the different factors to their respective interactions was studied. The genotype x environment interactions exerted a considerable influence which could be reduced by increasing the number of test locations. Environments with a high disease level were less suited to measuring resistance than those environments with a medium level. Estimates of heritability from 0.54 to 0.78 show that successful selection may be possible using ELISA. Significant correlations of quantitative resistance at different environments were only obtained under similar environmental conditions (the same location, the same year) and with *P. herpotrichoides* populations of similar composition (the same inoculum). The contributions of the individual cultivars to the genotype x environment interactions were not significantly different, except for 'Roazon' and 'Rendezvous'. Due to high environmental effects in growth stage 85, the determination of quantitative resistance was more reliable in younger stages (65, 75). Nevertheless, the use of the values from that late

stage did not reduce the genetic parameters ($\sigma^2(c)$, h^2) if they were combined with the earlier measurements. [References: 19].

968 Little, R.; Wagoire, W. (Wheat and Barley Development Project, Jinja (Uganda)) (1994) Developing Wheat Varieties for the Lowland Areas of Uganda. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 99-113. CIMMYT. 9 tables; 1 ref. English. (AGRIS 95-002441).

Wheat has been grown on a small scale in Uganda at altitudes between 1800 and 2500 m a.s.l. for over 90 years. Currently, Uganda has a policy of encouraging wheat production to reduce imports and ultimately reach self-sufficiency. The land available in the traditional wheat growing area is limited by high population pressure and unsuitable topography. If the area under wheat production is to substantially increase, new areas at lower altitudes (1000-1500 m), where large tracts of flat land suitable for mechanized production are available, will have to be brought into production. Over the past two seasons a large number of lines have been screened in nurseries and yield trials in the lowland areas of Uganda, and data are presented on their adaptability, especially in relation to yield potential and resistance to *Helminthosporium sativum* (spot blotch) and *Puccinia graminis* (stem rust). Those lines showing most promise are indicated.

969 Littlejohn, G.M.; Devonpienaar, R. (1995) THINOPYRUM DISTICHUM ADDITION LINES - PRODUCTION, MORPHOLOGICAL AND CYTOLOGICAL CHARACTERISATION OF 11 DISOMIC ADDITION LINES AND STABLE ADDITION-SUBSTITUTION LINE. *Theoretical & Applied Genetics*. 90(1):33-42. English. [ARC VOPI FYNBOS RES UNIT ELSBURG 7607 SOUTH AFRICA].

Plants of the partial amphiploid *Inia* 66/*Thinopyrum distichum* ($2n = 70$) // *Inia* 66 ($2n = 56$) were used as male parents in crosses with the monosomic series in the common wheat cultivar *Inia* 66. The genome and homoeologous group of the monosomic used in the cross affected the distribution of chromosome number of the progeny plants in the F-2 and F-4. Meiosis in the pollen mother cells of the B1F7 partial amphiploids was not stable, and not different from that of the B1F1 in which univalents and multivalents were observed. Disomic addition lines were selected on the basis of morphology and meiotic stability in the F-2, F-4 and F-5. Eleven of the fourteen possible wheat-Th. *distichum* disomic addition lines were identified using chromosome C-band pattern, as well as size and arm ratio, as genetic markers. Addition of T. *distichum* chromosome J(dll) produced a phenotype indicating homoeology with wheat group-2 chromosomes. Clear indications of homoeology based on morphological characteristics were not obtained in any of the other addition lines, probably due to the mixed homoeology of the Th. *distichum* chromosomes relative to wheat. The addition lines were all susceptible to leaf rust, unlike the germplasm-line *Indis* which carries a leaf rust resistance gene on a translocation segment derived from Th. *distichum*. Instability of meiotic pairing was observed in all addition lines. The stability, or not, of progeny chromosome counts did not reflect the level of chromosome pairing instability in the parental plants. SDS-PAGE for gliadin-type seed proteins revealed two addition lines which expressed seed storage proteins uncommon to *Inia* 66 but typical of Th. *distichum*. [References: 37].

970 Liu, CY.; Shepherd, KW.; Gras, PW. (1994) GRAIN YIELD AND QUALITY CHARACTERISTICS OF CHROMOSOME 1D AND 1B SUBSTITUTION LINES IN DURUM WHEAT AND THEIR F-2-DERIVED PROGENY LINES 2. PRELIMINARY COMPARISONS WITH NORMAL DURUM AND BREAD WHEATS. *Journal of Cereal Science*. 20(3):227-234. English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

The grain yield and quality characteristics of three types of wheat, bread wheat, durum wheat and chromosome 1D substituted durum wheats, were studied. The yields of the durum wheats were less than half those of the bread wheats, but higher than the durum substitution lines carrying chromosome 1D. Grain protein content was correlated negatively with grain yield among the hexaploid wheats, but not among the tetraploids. The proportion of glutenin in flour measured by SE-HPLC

was correlated consistently with all Mixograph quality parameters. Durum wheat lines carrying the gamma-45 prolamin (gliadin) band gave values for the proportion of total and highly-aggregated glutenin that were similar to those of medium strength bread wheats, whereas the Langdon 1D(1A) tetraploid lines were similar to medium dough strength hexaploid wheats as measured by SDS-sedimentation values. [References: 34].

971 Lu Debin; Huo Qingtao; Xia Baigen (Henan Agricultural Univ., Zhengzhou (China)) (1993) Genetic analysis on the contents of grain protein and protein components in wheat II. Genetic model and correlation. *Acta Agriculturae Universitatis Henanensis (China)* v. 27(4) p. 305-311. 5 ill., 4 tables, 6 ref. Chinese. (AGRI 95-002586).

972 Lukaszewski, A.J. (1994) GENETIC MAPPING IN THE 1R.1D WHEAT-RYE TRANSLOCATED CHROMOSOMES. *Genome*. 37(6):945-949. English. [UNIV CALIF RIVERSIDE DEPT BOT & PLANT SCI RIVERSIDE, CA 92521 USA].

Translocation chromosomes 1R.1D(5+10)-1 and 1R.1D(5+10)-2 were produced to improve bread-making quality in triticale and to manipulate the dosage of the Glu-D1 gene in wheat. They involve transfers of segments of the long arm of chromosome 1D of bread wheat to the long arm of rye chromosome 1R. The translocated long arms of the chromosomes were mapped genetically in wheat and triticale using polymorphism for C-banding patterns, allelic variation of the Glu-D1 gene, and a telocentric chromosome 1RL. The total frequency and the general distribution of recombination in the translocated arms was similar to that in normal long arms of group-1 chromosomes in wheat, rye, and triticale, except that the distal rye segments of the translocations showed a 15- to 20-fold increase in recombination frequency compared with normal 1R. Despite major differences in the physical structure of the translocated arms, both appeared very similar genetically, suggesting that genetic mapping is a poor indicator of the physical structure of translocations. Genetic length of the 1DL segment in chromosome 1R.1D(5+10)-1 was 31 cM, making the chromosome unsuitable for Glu-D1 dosage manipulation in wheat. The potential of chromosome 1R.1D(5+10)-2 for wheat breeding needs further testing. However, both chromosomes behave normally in hexaploid triticale. [References: 15].

973 Mannonen, L.; Kauppinen, V.; Enari, T.M. (1994) RECENT DEVELOPMENTS IN THE GENETIC ENGINEERING OF BARLEY [Review]. *Critical Reviews in Biotechnology*. 14(4):287-310. English. [VTI BIOTECHNOL & FOOD RES POB 1500 SF-02044 ESPOO FINLAND].

Cereals are the most important group of plants for human nutrition and animal feed. Partially due to the commercial value of crop plants, there has been an ever-increasing interest in using modern biotechnological methods for the improvement of the characteristics of cereals during the past decade. The rapid progress in molecular biology, plant cell culture techniques, and gene transfer technology has resulted in successful transformations of all the major cereals - maize, rice, wheat, and barley. This brings the biotechnological methods closer to the routine also in barley breeding. In this article, the current status of barley genetic engineering, including the patent situation, is reviewed. The needs, aims, and possible applications of genetic engineering in barley breeding are discussed. [References: 179].

974 Marais, G.F.; Horn, M.; Dutoit, F. (1994) INTERGENERIC TRANSFER (RYE TO WHEAT) OF A GENES FOR RUSSIAN WHEAT APHID RESISTANCE. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 113(4):265-271. English. [UNIV STELLENBOSCH DEPT GENET STELLENBOSCH 7600 SOUTH AFRICA].

An octoploid triticale was derived from the F-1 of a Russian wheat aphid-resistant rye, 'Turkey 77', and 'Chinese Spring' wheat. The allopolyploid was crossed to common wheat, and to 'Imperial' rye/'Chinese Spring' disomic addition lines. F-2 progeny from these crosses were tested for Russian wheat aphid resistance and C-banded. A resistance gene(s) was found to be associated with chromosome arm 1RS of the 'Turkey 77' rye genome. A monotelosomic 1RS ('Turkey 77') addition plant was then crossed with the wheat cultivar 'Gamtoos', which has the 1BL.1RS 'Veery' translocation. Unlike the 1RS segment in 'Gamtoos', the 'Turkey 77'-derived 1RS telosome did not express the rust resistance genes Sr31 and Lr26, which could then be used as markers. From the F-1 a monotelosomic

1RS addition plant that was also heterozygous for the 1BL.1RS translocation was selected and testcrossed with an aphid-susceptible common wheat, 'Inia 66'. Meiotic pairing between the rye arms resulted in the recovery of five euploid Russian-wheat-aphid-resistant plants. One recombinant also retained Sr31 and Lr26 and was selfed to produce translocation homozygotes. [References: 25].

975 Marais, G.F.; Marais, A.S. (1994) THE DERIVATION OF COMPENSATING TRANSLOCATIONS INVOLVING HOMOELOGOUS GROUP 3 CHROMOSOMES OF WHEAT AND RYE. *Euphytica*. 79(1-2):75-80. English. [UNIV STELLENBOSCH DEPT GENET STELLENBOSCH 7600 SOUTH AFRICA].

The Sr27 translocation in WRT238 was found to consist of chromosome arms 3RS of rye and 3AS of common wheat. An attempt was made to purposely produce compensating translocations having 3RS and a wheat homoeologous group 3L arm. To achieve this, plants, double monosomic for 3R and a wheat homoeologous group 3 chromosome, were irradiated (7.5 Gy gamma rays) or left untreated before being used to pollinate stem rust susceptible testers. Segregation for stem rust resistance was studied to identify F-2 families with Sr27-carrying translocated chromosomes, these were confirmed by means of C-banding. Compensating translocations 3RS3AL and 3RS3BL were obtained readily and at similar frequencies from untreated and irradiated plants (respectively 7.2% and 9.3%). Both translocation types have impaired transmission and segregate approximately 3 : 2 (present : absent) in the F-2. [References: 12].

976 Margiotta, B.; Colaprico, G.; Urbano, M.; Lafiandra, D. (1994) RECOMBINATION WITHIN THE GLI-B1 LOCUS IN DURUM WHEAT. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 113(3):250-253. English. [CNR INST GERMLASM VIA AMENDOLA 165-A I-70126 BARI ITALY].

Recombination within the closely linked genes encoding for omega and gamma gliadins at the complex Gli-B1 locus present on the short arm of chromosome 1B was detected in a durum-wheat line (*Triticum durum*) from Iran. This recombinant differs from a previous one the authors detected in the durum-wheat cultivar 'Berillo' since it shows the gamma gliadin component 45 associated with a triplet of omega components usually found linked with the allelic gamma gliadin 42. Analysis of low-molecular-weight glutenin subunits, encoded by genes at the complex Glu-B3 locus associated with the Gli-B1 locus, showed the presence of the protein type designated LMW-1 which is peculiar to durum-wheat cultivars possessing the gamma gliadin 42. [References: 14].

977 Martin, J.M.; Talbert, L.E.; Lanning, S.P.; Blake, N.K. (1995) HYBRID PERFORMANCE IN WHEAT AS RELATED TO PARENTAL DIVERSITY. *Crop Science*. 35(1):104-108. English. [MONTANA STATE UNIV DEPT PLANT SOIL & ENVIRONM SCI BOZEMAN, MT 59717 USA].

The probability of recovering a superior individual from the cross of two inbred parents is greater if both parents are similar in performance as opposed to one parent being inferior. Heterosis, coefficients of parentage, and molecular markers have been advocated to assess genetic diversity directly between parents. This study was done to determine the extent of DNA polymorphisms among a set of seven hard red spring wheats and the relationship between genetic diversity based on these molecular markers and coefficients of parentage, and to examine the relationship between diversity and hybrid performance in a diallel cross of these parents. Parents plus the F-1 hybrids were grown in three environments. Grain yield, kernel weight, and protein concentration were measured. Coefficients of parentage, r , were computed for all pairwise combinations of parents. Parents were assayed with 63 sequence tagged site (STS) polymerase chain reaction (PCR) primer sets. Genetic similarities, GS, were computed using 27 STS PCR primer sets that showed polymorphisms. Rank correlations were computed between the $1 - r$ and $1 - GS$ measures of genetic diversity and F-1 performance, mid-parent heterosis, and SCA effects. The only significant associations between diversity and hybrid performance were those between $1 - r$ and kernel weight SCA effects and heterosis, and protein concentration heterosis. Genetic diversity was inversely related to heterosis and SCA effects for protein concentration. Correlations between the $1 - r$ and $1 - GS$ measures of diversity and hybrid performance traits were of the same sign and about equal in magnitude. Coefficient of parentage and GS were

significantly correlated, and cluster analysis based on the 1 - r and 1 - GS measures of diversity grouped the genotypes similarly. Neither diversity measure showed promise for predicting F-1 performance, but both measures provided similar information for grouping and differentiating genotypes. [References: 28].

978 Martin, T.J.; Harvey, T.L. (1995) REGISTRATION OF TWO WHEAT GERMPLASMS RESISTANT TO RUSSIAN WHEAT APHID - KS92WGRC24 AND KS92WGRC25. *Crop Science*. 35(1):292. English. [KANSAS AGR EXP STN FT HAYS BRANCH HAYS, KS 67601 USA].

979 Martin, T.J.; Harvey, T.L.; Seifers, D.L.; Cox, T.S.; Sears, R.G.; Bequette, R.K.; Curran, S.P.; Hatchett, J.H.; Chung, O.K.; Witt, M.D. (1995) REGISTRATION OF IKE WHEAT. *Crop Science*. 35(1):285. English. [KANSAS AGR EXP STN FT HAYS BRANCH HAYS, KS 67601 USA].

980 Martinez, I.; Bernard, M.; Nicolas, P.; Bernard, S. (1994) STUDY OF ANDROGENETIC PERFORMANCE AND MOLECULAR CHARACTERISATION OF A SET OF WHEAT RYE ADDITION LINES. *Theoretical & Applied Genetics*. 89(7-8):982-990. English. [INRA AMELIORAT PLANTES STN DOMAINE CROUELLE F-63039 CLERMONT FERRAND FRANCE].

Rye chromosomes of wheat-rye addition lines were successfully identified by means of an RFLP analysis with 30 probes. Our results are in agreement with previous cytological data concerning the identity of lines F (+1R), D (+2R), C (+3R), A (+4R), E (+5R) and B (+7R). Two categories of chromosomal rearrangements have been distinguished, namely: (1) deletions: the current line D possesses a chromosome 2R deleted on its short arm and the line G a chromosome 3R deleted on its long arm; we have also noticed a deletion on the long arm of wheat chromosome 1A in line F61; and (2) evolutionary reciprocal translocations in rye relative to wheat which have been previously mentioned in the literature. The anther culture response of the different lines was studied. A significant difference between 'FEC 28' and the addition lines was observed for embryo production and plant regeneration. It appears that genes located on 'S 10' chromosome arm 3RL and on 'FEC 28' chromosome arm 1AL increase embryo frequency whereas gene(s) located on 'S 10' chromosome 5R reduce(s) it. Plant regeneration results suggest that genes increasing regeneration ability and green-plant frequency are located on 'S 10' chromosome 4R. The long arm of chromosome 1A seems to be involved positively in green-plant regeneration whereas chromosomes 1R and 3R limit plant regeneration. [References: 48].

981 Mckendry, A.L.; Henke, G.E. (1994) TOLERANCE TO SEPTORIA-TRITICI BLOTCH IN SOFT RED WINTER WHEAT. *Cereal Research Communications*. 22(4):353-359. English. [UNIV MISSOURI DEPT AGRON COLUMBIA, MO 65211 USA].

Resistance to Septoria tritici blotch (STB) has not proven effective in stabilizing yield in epidemic years. Tolerance may provide an interim means of broad-based genetic control unit effective resistance genes can be identified. Differential loss in traits, compared to fungicide protected plots, served as the basis for evaluation of STB tolerance in soft red winter wheats. Significant variation was identified in loss-severity ratios for grain yield components, test weight and milling quality traits, in cultivars differing in resistance. It was concluded that selection under high disease pressure based on an index of low disease rating, kernel weight and test weight would be feasible in early generation nurseries and should enhance STB tolerance in derived lines.

982 Merkle, O.G.; Hatchett, J.H.; Porter, D.R.; Webster, J.A. (1995) REGISTRATION OF WHEAT GERMPLASM (PI 510693) RESISTANT TO HESSIAN FLY. *Crop Science*. 35(1):294. English. [USDA ARS 1301 N WESTERN ST STILLWATER, OK 74075 USA].

983 Metakovsky, E.V.; Pogna, N.E.; Biancardi, A.M.; Redaelli, R. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) [Gliadin allele composition of common wheat cultivars grown in Italy]. *Composizione degli alleli di gliadina di cultivar di grano tenero coltivate in Italia. Journal of Genetics and Breeding (Italy)* v. 48(1) p. 55-66. 5 tables; 3 graphs; 30 ref. English. (AGRIS 95-012768).

984 Michalik, I.; Holecikova, J.; Urmanska, D. (Vysoka Skola Polnohospodarska, Nitra (Slovak Republic). Katedra Biochemie a Radiobiologie); Bojnanska, T. (1994) [The interaction between protein fractionation and the quality of winter wheat crop]. *Interakcne vzťahy medzi skladbou bielkovín a kvalitou úrody ozimnej pšenice. Polnohospodárstvo (Slovak Republic)* v. 40(1) p. 16-33. 8 graphs, 3 tables; 24 ref. Slovak. (AGRIS 95-012778).

The analysis of 27 varieties of the world assortment of winter wheat cultivated under identical conditions revealed following information: The biggest varietal differences were in baking (coefficient of variability $v=23\%$). The average grain crop was 8.42 t/ha* (-1) (variety variability 8%). The average values of the fraction analysis of grain proteins revealed that the fraction of cytoplasmatic proteins (albumins and globulins) represented 21-29%, prolamines 31-37%, 24-30% was the gluteline fraction. The biggest part of prolamines and glutelins contained the variety Kosava, the least part contained Turda. It corresponds with the values of the sedimentation test. The calculated correlations between important agronomical values and the content of organic substances confirmed generally valid relations. Following statistically important correlations were found: negative correlation between the content of starch and the content of proteins, positive correlation between baking quality and the content of gluten proteins, positive correlation between amylolytic activity or trypsin-inhibitor activity and the content of cytoplasmatic proteins, negative correlation between trypsin-inhibitor activity and exoproteinase activity.

985 Misić, T.; Borojević, S.; Mikić, D.; Dencić, S.; Mihaljević, I.; Jerković, Z.; Panković, L.; Jevtić, R. (Poljoprivredni fakultet, Novi Sad (Yugoslavia). Institut za ratarstvo i povrtarstvo) (1994) [Some important characteristics of the Novi Sad (Yugoslav) winter wheat varieties released in 1993]. *Vaznlje karakteristike novosadskih (jugoslovenskih) sorti ozime pšenice priznatih 1993. godine. 28. seminar agronoma; Zlatibor (Yugoslavia); Jan 1994. Zbornik radova - Poljoprivredni fakultet u Novom Sadu, Institut za ratarstvo i povrtarstvo (Yugoslavia) (no. 22) p. 639-652. 5 tables; 14 ref. Serbian. (AGRIS 95-002456).*

The paper presents important characteristics of nine winter wheat varieties developed at the Institute of Field and Vegetable Crops in Novi Sad (Yugoslavia) and released by the Yugoslav Federal Commission for Varietal Approval in 1993. Applying single, three-way, successive, multiple crossing of genetically divergent, high-yielding parents, we successfully combined the genes for significant characteristics and produced bread varieties Cenejka, Stepa, Rusija, Eva and Slava and base varieties Fortuna, Atina, Jarebica and Sloga. The varieties Fortuna, Atina, Jarebica and Sloga had the highest yield of grain.

986 Morgun, V.V.; Logvinenko, V.F.; Tyutyun, A.I. (1993) [Genetic aftereffects of the accident at the Chernobyl NPP on the example of the winter soft wheat]. *Geneticheskie posledstviya avarii na Chernobyl'skoj AEHS na primere ozimoy myagkoj pshenitsy. Fiziologiya i biokhimiya kul'turnykh rastenij (Russian Federation)* v. 25(no. 4) p. 315-323. 7 ref. Russian. (AGRIS 95-002450).

The seed samples of nine varieties of the winter wheat (gathered in 1986 in five regions of Ukraine) which from tillering till ripening were constantly affected by the radioactive emissions from the accident unit of ChNPP have been studied. Among the gathered materials 18.4% of the samples had true 2.7-32.3-fold increase of the frequency of chromosome rearrangements as compared to spontaneous level and 29.4% had true 2.7-8.7-fold increase of the frequency of visible mutations. The level of radionuclide contaminations proved sufficient for the increase of the mutation variability of the winter wheat even in comparatively remote Vinnitsa region. Visible mutations of 27 types as to the signs of stem, leaf and ear structure, physiological characteristics have been registered. Comparatively frequent mutation by the dwarfness genes as well as mutations "plucked ear", "branched ear" which rarely occur in nature were typical ones. The mutations of polymeric genes by the elements of the crop structure have lead to the changes in productivity of mutants of different origin and as a result - to the loss of varieties typization that should be taken into account in seed raising. As a whole, data obtained evidence for that the Chernobyl accident proves a serious genetic threat for the plants within the vast geographic zone.

987 Mori, N.; Liu, Y.G.; Tsunewaki, K. (1995) WHEAT PHYLOGENY DETERMINED BY RFLP ANALYSIS OF NUCLEAR DNA 2. WILD TETRAPLOID WHEATS. *Theoretical & Applied Genetics*. 90(1):129-134. English. [FUKUI PREFECTURAL UNIV FAC BIOTECHNOL 4-1-1 KENJOYOMA MATSUOKA FUKUI 91011 JAPAN].

Intra- and inter-specific variations in the nuclear DNA of *Triticum dicoccoides* Korn. (2n=28, genome constitution AABB) and *T. araraticum* Jakubz. (2n = 28, AAGG), wild species, respectively, of the Emmer and Timopheevi group, were studied by restriction fragment length polymorphism (RFLP) analysis. Total DNAs of 32 *T. dicoccoides* and 24 *T. araraticum* accessions, collected from throughout the distribution areas of these species, were treated with two 6-bp cutters and hybridized with 30 nuclear DNA clones as probes to detect RFLPs. A total of 167 hybrid bands were observed per accession. All the enzyme-probe combinations showed RFLPs between accessions. The average genetic distance between the *T. dicoccoides* accessions was 0.0135 +/- 0.0031 and that between the *T. araraticum* accessions 0.0036 +/- 0.0015, indicative of about a four-fold intraspecific variation in *T. dicoccoides* as compared to *T. araraticum* in terms of genetic distance. No significant genetic differentiation was found for the geographical populations of these species, the genetic distance between the two species being 0.0482 +/- 0.0022. The interspecific divergence corrected for intraspecific divergence was 0.0395, about three times that for *T. dicoccoides* and 11 times that for *T. araraticum*. The results show that in the wild state the Emmer and Timopheevi groups are clearly differentiated and that *T. dicoccoides* has much greater variation than *T. araraticum*, suggesting a relatively recent origin for the latter and therefore a diphyletic origin for these species. [References: 18].

988 Murray, TD.; Delapena, RC.; Yildirim, A.; Jones, SS. (1994) A NEW SOURCE OF RESISTANCE TO PSEUDOCERCOSPORELLA HERPOTRICHOIDES, CAUSE OF EYESPOT DISEASE OF WHEAT, LOCATED ON CHROMOSOME 4V OF DASYPYRUM VILLOSUM. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 113(4):281-286. English. [WASHINGTON STATE UNIV USDA ARS DEPT PLANT PATHOL PULLMAN, WA 99164 USA].

Resistance to *Pseudocercospora herpotrichoides* in live wheat cultivars, accession W6 7283 of *Dasypyrum villosum*, and 'Chinese Spring' disomic addition lines of the *D. villosum* chromosomes 1V, 2V, 4V, 5V, 6V and 7V, was evaluated in seedlings by measuring disease progress 6 weeks after inoculation with a beta-glucuronidase-transformed strain of the pathogen and by visual estimates of disease severity. *D. villosum* and the disomic addition line of chromosome 4V were as resistant as wheat cultivars 'VPM-1' and 'Cappelle Desprez', but less resistant than 'Rendezvous'. Resistance of the chromosome 4V disomic addition line was equivalent to that of *D. villosum*. 'Chinese Spring' and disomic addition lines of 1V, 2V, 5V, 6V and 7V were all susceptible. These results confirm SPRAGUE's (1936) report of resistance in *D. villosum* to *P. herpotrichoides* and establish the chromosomal location for the genes controlling resistance. The presence of chromosome 4V in the addition line and its homoeology to chromosome 4 in wheat were confirmed by Southern analysis of genomic DNA using chromosome group 4-specific clones. This genetic locus is not homoeologous with other known genes for resistance to *P. herpotrichoides* located on chromosome group 7, and thus represents a new source of resistance to this pathogen. [References: 36].

989 Nakamura, C.; Ohtani, K.; Mori, N.; Panayotov, I.; Kaneda, C. (1994) PHYSICAL MAPPING OF CHLOROPLAST DNAs OF AGROPYRON GLAUCUM, AG-TRICHOPHORUM AND HAYNALDIA VILLOSA USING ALLOPLASMIC COMMON WHEAT WITH CYTOPLASMS OF RESPECTIVE SPECIES. *Japanese Journal of Genetics*. 69(6):645-655. English. [KOBE UNIV FAC AGR GENET LAB NADA KU 1 ROKKODAI CHO KOBE 657 JAPAN].

Chloroplast DNAs (cpDNAs) of *Agropyron glaucum*, *Ag. trichophorum* and *Haynaldia villosa* were studied using alloplasmic hybrids of common wheat (*Triticum aestivum*; nuclear donor) with cytoplasm of the respective species. Chloroplast genome sizes of the two *Agropyron* species and *Hy. villosa* were very close to 135 kb of common wheat. Restriction maps were constructed using seven restriction enzymes. Eight fragment length mutations (deletions/insertions) and five recognition site mutations were detected among 167 sites studied. CpDNAs of *Agropyron*, *Hy. villosa* and common wheat were very closely

related: Base substitution rate per 100 base pairs (d) was 0.10 between *Hy. villosa* and common wheat, 0.19 between common wheat and *Agropyron*, and 0.29 between *Agropyron* and *Hy. villosa*. There was only one site difference (HindIII site) between the two *Agropyron* species (d=0.05). [References: 34].

990 Namuth, DM.; Lapitan, NLV.; Gill, KS.; Gill, BS. (1994) COMPARATIVE RFLP MAPPING OF HORDEUM VULGARE AND TRITICUM TAUSCHII. *Theoretical & Applied Genetics*. 89(7-8):865-872. English. [COLORADO STATE UNIV DEPT CROP & SOIL SCI FT COLLINS, CO 80523 USA].

Hordeum vulgare (barley) and *Triticum tauschii* are related, but sexually incompatible, species. This study was conducted to determine the extent of homology between the genomes of barley and *T. tauschii* using a common set of restriction fragment length polymorphism (RFLP) markers. Results showed that >95% of low-copy sequences are shared, but 42% of the conserved sequences showed copy-number differences. Sixty-three loci were mapped in *T. tauschii* using RFLP markers previously mapped in barley. A comparison of RFLP marker order showed that, in general, barley and *T. tauschii* have conserved linkage groups, with markers in the same linear orders. However, six of the seven linkage groups of *T. tauschii* contained markers which mapped to unrelated (i.e., non-homoeologous) barley chromosomes. Additionally, four of the *T. tauschii* linkage groups contained markers that were switched in order with respect to barley. All the chromosome segments differing between *T. tauschii* and barley contained markers that were detected by multi-copy probes. The results suggest that the observed differences between the *T. tauschii* and barley genomes were brought about by duplications or deletions of segments in one or both species. The implications of these findings for genetic mapping, breeding, and plant genome evolution are discussed. [References: 37].

991 Naumenko, T.L. (1993) [Polymorphism for tolerance to manganese toxicity in wheats (*Triticum*)]. Polimorfizm pshenits po ustojchivosti k margantsvevoj toksichnosti. [Specific features in the reconstruction of genome and high plants populations] p. 141-149. Bibliography p. 147-148. Russian. (AGRI 95-002449).

15 wheat species (A, D, AB, AG, ABD genomes) have been tested for tolerance to manganese toxicity in solution. All cultivars of *Triticum aestivum* L. had intermediate tolerance to Mn-toxicity. The samples of hexaploid species of *T. spelta*, *T. antiquorum*, *T. compactum* were tolerant. Among the tetraploid species there was a tolerant sample of *T. polonicum*. The highest tolerance was noted in samples of *T. timopheevii*. All species with A-genome were found to be Mn-sensitive, except for *T. sinkajae* A. Filat et Kurk. These results present interest for selection of potential tolerant donors within Genus *Triticum* and for studying the genetic control of tolerance to Mn-toxicity.

992 Nessa, D.; Islam, H.; Mirza, SH.; Azimuddin, M. (1994) GENETIC VARIABILITY, CORRELATION AND PATH ANALYSIS OF BARLEY (HORDEUM-VULGARE L). *Bangladesh Journal of Botany*. 23(2):181-185. English. [BANGLADESH AGR RES INST DIV PLANT BREEDING GAZIPUR 1701 BANGLADESH].

In a population of 14 six-rowed barley genotypes of different origin, the estimates of heritability, coefficient of variability, genetic advance, correlation coefficients and path coefficient analysis for seven agronomic traits showed significant differences for all the characters studied. The phenotypic coefficient of variation was higher than the genotypic and environmental coefficient of variations for all the traits. Heritability was also very high for all the traits. Grain yield showed significant positive association with the number of fertile tillers, plant height and the length of spike. The number of fertile tillers was found to have significant positive direct effect on grain yield. In the light of the present findings it is suggested that maximum emphasis be given on the number of fertile tillers in selecting genotypes for higher grain yield excluding from selection late flowering types, late maturing plants with high 1000-grain weight.

993 Nettevich, Eh.D.; Chistyakova, V.N.; Smolin, V.P.; Molchanova, L.M.; Kosmacheva, I.A. (1993) [Haplody usage for evaluation of recombination capacity and breeding value of barley base forms]. Ispol'zovanie gaploidii dlya otsenki rekombinatsionnoj sposobnosti i

selektionnoj tsennosti iskhodnykh form yachmenya. *Doklady Rossijskoj akademii sel'skokhozyajstvennykh nauk (Russian Federation) (no.3) p. 3-8. 5 ref. Russian. (AGRI 95-002477).*

Results of breeding-genetical studies on spring barley doubled haploid lines, produced with 'bulbosum' technique on the base of intraspecific F1 hybrids, have been adduced.

994 Numerova, O.M.; Pershina, L.A.; Belova, L.I.; Devyatkina, E.H.P. (1993) [Possibility of restoration of fertility in barley-wheat hybrids, *Hordeum vulgare* L. x *Triticum aestivum* L.]. *Vozmozhnosti vosstanovleniya fertil'nosti u yachmenno-pshenichnykh gibridov. [Specific features in the reconstruction of genome and high plants populations]* p. 49-62. Bibliography p. 59-61. Russian. (AGRI 95-002608).

Various genotypes of barley and common wheat were crossed to produce new barley-wheat hybrids. Regenerated plants were induced from callus culture of young hybrid spikes. The initial hybrids and regenerates were backcrossed to various common wheat cultivars. Each hybrid combination was examined for possibility of setting seeds. Viable gametes in hybrids and regenerates were cytogenetically studied. Three types of chromosomes in meiosis were noted which could provide for development of fertile and sterile gametes. Investigations have shown that common wheat cultivar Pyrotix 8 had a positive influence on development of viable gametes in barley-wheat polyhaploids. Among the regenerates there were plants with increased ability to produce viable gametes, compared with the initial hybrids. One such regenerated plant set seeds both by backcrossing and self-fertilization. Thus, the role of wheat genotype in the restoration of fertility in barley-wheat hybrids has been shown. In vitro methods for increasing viability of gametes in barley-wheat polyhaploids have been developed.

995 Ostapenko, E.K.; Vilenskij, E.R.; Naumenko, V.D.; Bubyak, I.I.; Grodzinskij, D.M. (1993) [Genetic disturbances in waxy barley pollen under conditions of radioactive pollution after Chernobyl' disaster]. *Geneticheskie narusheniya v pyl'tsevykh kletkakh yachmenya waxy v usloviyakh radioaktivnykh zagryaznenij posle Chernobyl'skoj avarii. Ontogenez (Russian Federation) v. 24(no. 5) p. 11-19. Bibliography p. 18. Russian. (AGRI 95-002479).*

Genotoxic effects during microsporogenesis and gametogenesis were studied in barley of the waxy strain grown on 3 experimental plots situated in the region of the Chernobyl disaster (plot 1 in the town of Chernobyl, plots 2 and 3 in the town of Yanov, 3 km away from the damaged power plant). It was determined that an increased level of radionuclide pollution and chronic irradiation during ontogenesis results in higher incidence of meiotic disturbances and abnormalities during formation of the male gametophyte. Incidence of waxy reversions in pollen grains depends of the activity of radionuclide pollutants as well. We suggest that selection affecting both diplontic and haplontic forms will provide for the absence of significant aberrations in subsequent plant generations.

996 Otani, M.; Shimada, T. (Agricultural Coll., Ishikawa (Japan). Research Inst. of Agricultural Resources) (1994) [Pollen embryo formation and plant regeneration from cultured anthers of tetraploid wheat]. *Formazione dell'embrione dal polline e rigenerazione della pianta da antere coltivate di grano tetraploide. Journal of Genetics and Breeding (Italy) v. 48(1) p. 103-106. 2 tables; 6 ref. English. (AGRI 95-012604).*

Anthers of 31 genotypes of tetraploid wheat (*Triticum durum*, *T. dicoccum*, *T. turgidum*, *T. polanicum*, *T. persicum*, *T. abyssinicum*, *T. paleocolchicum*) were cultured on three different media. Varietal differences were observed for pollen embryo formation on each medium. Modified Csub(17) medium containing 0.26 M maltose as a carbohydrate source was most effective for pollen embryo formation. Green haploid plants were obtained in *T. durum* var. *agricumum*.

997 Pan, A.; Hayes, P.M.; Chen, F.; Chen, T.H.; Blake, T.; Wright, S.; Karsai, I.; Bedo, Z. (1994) GENETIC ANALYSIS OF THE COMPONENTS OF WINTERHARDINESS IN BARLEY (*Hordeum vulgare* L.). *Theoretical & Applied Genetics. 89(7-8):900-910. English. [OREGON STATE UNIV DEPT CROP & SOIL SCI CORVALLIS, OR 97331 USA].*

Winterhardiness in cereals is the consequence of a number of complex and interacting component characters: cold tolerance, vernalization

requirement, and photoperiod sensitivity. An understanding of the genetic basis of these component traits should allow for more-effective selection. Genome map-based analyses hold considerable promise for dissecting complex phenotypes. A 74-point linkage map was developed from 100 doubled haploid lines derived from a winter x spring barley cross and used as the basis for quantitative trait locus (QTL) analyses to determine the chromosome location of genes controlling components of winterhardiness. Despite the greater genome coverage provided by the current map, a previously-reported interval on chromosome 7 remains the only region where significant QTL effects for winter survival were detected in this population. QTLs for growth habit and heading date, under 16 h and 24 h light, map to the same region. A QTL for heading date under these photoperiod regimes also maps to chromosome 2. Contrasting alleles at these loci interact in an epistatic fashion. A distinct set of QTLs mapping to chromosomes 1, 2, 3, and 5 determined heading date under 8 h of light. Under field conditions, all QTLs identified under controlled environment conditions were determinants of heading date. Patterns of differential QTL expression, coupled with additive and additive x additive QTL effects, underscore the complexity of winterhardiness. The presence of unique phenotype combinations in the mapping population suggests that coincident QTLs for heading date and winter survival represent the effects of linkage rather than pleiotropy. [References: 48].

998 Papa, R. (Ancona Univ. (Italy). Dipartimento di Biotecnologie Agrarie ed Ambientali) (1994) [Response to salinity of barley (*Hordeum vulgare* L.) genotypes extracted from a local population (Sardinia)]. *Risposta alla salinità di genotipi di orzo (Hordeum vulgare L.) estratti da una popolazione locale (Sardegna). Journal of Genetics and Breeding (Italy) v. 48(1) p. 99-102. 1 table; 1 graph; 10 ref. English. (AGRI 95-012637).*

The aim of this study was to characterize the responses to salinity stress of ten genotypes of six-row barley (*Hordeum vulgare* L.) extracted from the local population Sinis O collected in a salt stressed area in Sardinia, Italy. Among these genotypes different responses to salinity were found, the different behaviours being partially related to salt exclusion. According to these results, the use of adapted germplasm seems to be worthwhile for studying the processes related to salt tolerance as well as for practical breeding purposes for salty soils. The present investigation highlights the importance of landraces not only as a source of genetic variability but also as valuable materials to study the environmental adaptation of barley populations.

999 Papa, R.; Attene, G. (Sassari Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee); Veronesi, F. (Ancona Univ. (Italy). Dipartimento di Biotecnologie Agrarie ed Ambientali) (1993) [Tolerance to salinity stresses in Sardinian barley (*Hordeum vulgare* L.) germplasm]. *Tolleranza a stress salini in germoplasma sardo di orzo (Hordeum vulgare L.). Società Italiana di Agronomia. 26. Annual meeting on Crop physiology; Udine (Italy); 22-25 Sep 1992. Rivista di Agronomia (Italy) v. 27(4) p. 497-503. 5 graphs; 20 ref. Italian. (AGRI 95-002474).*

Sardinia is one of the Italian regions where the salty soil is most frequently found. Soil borne salinity often occurs together with air borne salinity due to the effects of the salty wind. In Sinis, a peninsula located in Central Western Sardinia, both types of salinity stress are present. In this area barley is widely cultivated and many farmers generally prefer to grow local populations which are well adapted to local environmental conditions. The aim of the research was to characterize the responses to both types of salinity stress (via root and via leaf) of two genotypes (Sinis 0/27 and Sinis 0/28) extracted from a local Sinis population of six-row barley, and compare them with two varieties, California Mariout 67 and Sunbar 400, well known to be salt tolerant to soil borne salinity. The results showed that in barley differences in the effects of salt absorbed via the root vs foliar uptake exist, together with genetic diversity for air borne salinity tolerance which is usually found only in coastal and cliff species. In particular the Sinis genotypes appeared to be tolerant to salty spray due to their specific adaptation. According to these results, the use of adapted germplasm seems to be worthwhile in breeding programs which are aimed at the synthesis of varieties suitable for areas where salinity stresses frequently occur.

1000 Paull, J.G.; Pallotta, M.A.; Langridge, P.; The, T.T. (1994) RFLP MARKERS ASSOCIATED WITH SR22 AND RECOMBINATION

BETWEEN CHROMOSOME 7A OF BREAD WHEAT AND THE DIPLOID SPECIES TRITICUM BOEOTICUM. *Theoretical & Applied Genetics*. 89(7-8):1039-1045. English. [UNIV ADELAIDE DEPT PLANT SCI WAITE CAMPUS GLEN OSMOND SA 5064 AUSTRALIA].

Analysis of the bread wheat variety Schomburgk, and related lines in its pedigree, identified RFLP markers associated with the segment of chromosome 7A carrying the Sr22 gene derived from the diploid species *T. boeoticum*. The distribution of the RFLP markers indicated that at least 50% of 7AS and 80% of 7AL in Schomburgk is of *T. boeoticum* origin. Evaluation of five sets of near-isogenic lines, backcross lines in 20 different genetic backgrounds and an F-2 population segregating for Sr22 demonstrated a very low level of recombination between the 7A chromosomes of *T. boeoticum* and *T. aestivum*. Several recombinants carrying Sr22 but with a much reduced segment of *T. boeoticum* were identified and these may prove useful in the breeding of further varieties with Sr22. [References: 16].

1001 Peltonensainio, P.; Peltonen, J. (1994) **PROGRESS SINCE THE 1930S IN BREEDING FOR YIELD, ITS COMPONENTS, AND QUALITY TRAITS OF SPRING WHEAT IN FINLAND.** *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 113(3):177-186. English. [UNIV HELSINKI DEPT PLANT PROD CROP HUSBANDRY SECT BOX 27 VIKKI SF-00014 HELSINKI FINLAND].

The contribution of improvements in morphophysiological traits to increased grain yield in spring wheat (*Triticum aestivum* L.) and the achievements of breeding for high bread-making quality in Finland since the 1930s were assessed. Ten wheat cultivars released in Finland between 1939 and 1990 were evaluated in field experiments at the Viikki Experimental Farm, University of Helsinki, Finland (60 degrees 13'N) in 1991 and 1992. Twenty-two traits representing maturity, plant architecture, plant stand structure and N accumulation, and nine quality traits, including protein concentration and protein quality, were assessed. A 20 % increase in grain yield arising from cultivar improvement was associated with a 7 % reduction in height, an 80 % improvement in lodging resistance, and a 15 % higher harvest index (HI). Ear weight was 30 % higher in the modern cultivars. The higher ear weight of the modern cultivars was a result of more grains per ear and a higher spikelet weight. No decrease in vegetative phytomass in modern cultivars was recorded in this study. Grain yield and total N accumulation increased simultaneously and a positive correlation between year of cultivar release and nitrogen index was established. Although use of high N fertilizer application rates resulted in significantly improved baking quality of the flour, no trend between baking quality and year of cultivar release was recorded. The relatively low HI recorded in this study suggests that further yield increases are likely to be achieved by selecting for higher HI. [References: 28].

1002 Pershina, L.A.; Numerova, O.M.; Belova, L.I.; Devyatkina, E.P.; Shumnyj, V.K. (1993) [The peculiarities of androgenesis of common wheat, interspecific and intergeneric hybrids]. *Osobennosti androgeneza u myagkoj pshenitsy, mezhvidovykh i mezhrodovykh gibridov. Sibirskij biologicheskij zhurnal (Russian Federation) (no.3) p. 3-8. 9 ref. Russian.* (AGRI 95-012773).

Anthers from four *T. aestivum* varieties and three lines (1-3) produced after crossing *T. aestivum* X *T. timopheevii* with common wheat Saratovskaya 29 and Norin 29, three lines (4-6) produced after crossing barley X wheat hybrid *H. geniculatum* X *T. aestivum* with Pirotrix 28 and Novosibirskaya 67 were cultured on the Chinese potato medium P-II. Significant variation was observed among the genotypes for green plants was produced for line 1: 173, 3 green plants per 100 anthers and 25% albino plants only.

1003 Piao Tefu; Xu Yaokui; Bao Heping (Jilin Agricultural Univ., Changcun (China). Dept. of Agronomy) (1993) Genetic effects of 60 Co gamma ray combined with EMS in barley. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(6) p. 263-266. 5 tables, 7 ref. Chinese. (AGRI 95-002467).

1004 Piao Tiefu; Ren Yaoying; Yuan Yaping (Jilin Agricultural Univ., Changchun (China)) (1994) Mutant effects of Gengshengmycin on barley. *Journal of Jilin Agricultural University (China)* v. 16(1) p. 17-19. 4 tables, 7 ref. Chinese. (AGRI 95-002466).

1005 Pignone, D.; Galasso, I.; Hammer, K.; Perrino, P. (1994) **CYTOGENETIC AND GENETIC RELATIONSHIPS BETWEEN POPULATIONS OF AEGILOPS VENTRICOSA TAUSCH.** *Euphytica*. 79(1-2):81-85. English. [CNR IST GERMOPLASMA I-70126 BARI ITALY].

Five samples of *Aegilops ventricosa* ($2n = 4x = 28$, genome formula DDNN) from different geographical origins, were crossed in a diallelic scheme. Metaphase I chromosome pairing of the hybrids, accounting for all the possible genetic combinations, was analysed. Only bivalents were formed in some hybrids, while multivalents were scored in other ones. Seed storage proteins, gliadins and albumins, were also analysed by means of polyacrylamide gel electrophoresis. Based on the presence of multivalents in hybrids, and on the differences in seed protein profiles, the samples could be grouped into two clusters. Meiosis was regular in hybrids obtained within samples of the same group, while multivalents were present in hybrids involving a sample of one group and one of the other. The evolutionary trends in *Ae. ventricosa* are discussed. [References: 17].

1006 Pinto, J.M. (N.P.B.R.C., Njoro (Kenya)) (1994) Screening for Kenyan Wheat (*Triticum aestivum* L.) Varieties with Two Races of Stripe Rust (*Puccinia striiformis*). 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 308. CIMMYT. English. (AGRI 95-002445).

Eighteen Kenyan wheat varieties (*Triticum aestivum* L.) were screened in growth chambers (at 16/8 degree centigrade day and night cycle, respectively) with two races of *Puccinia striiformis* (SRC4-84 and SRC-89). The objective was to identify Kenyan wheat varieties with resistance to these races. Eight varieties (Kenya Chiriku, K. Mlembe, K. Popo, K. Kulungu, K. Nyumbu, Kwale, Pasa and Paa) were resistant to both races. Based on previous observations in the literature and the findings of this study, it can be postulated that the effective resistance in K. Kulungu against race SRC 4-84 is conferred by Yr3b or a previously unidentified gene. Low levels of residual resistance were detected in seven older varieties (K. Tembo, K. Swara, K. Leopard, K. Page, Bounty, Romany and Africa Mayo).

1007 Prasanna, B.M.; Raut, R.N.; Raghavaiah, P. (1994) **MEIOTIC STABILITY AND FERTILITY IN PRIMARY TRITICALES AND THEIR WHEAT AND RYE PARENTS.** *Cereal Research Communications*. 22(4):293-300. English. [INDIAN AGR RES INST DIV GENET NEW DELHI 110012 INDIA].

Nine octoploid and two hexaploid triticales were evaluated for meiotic behaviour, pollen fertility and floret fertility, along with their wheat and rye parents. Considerable extent of variability in meiotic stability was observed in the octoploid primary triticales. The most common abnormality observed was the occurrence of univalents. Meiotic stability was appreciable in two hexaploid triticales, PMT-10 [(HD-4545 x JNK-184)FI-1 x Russian rye] and PMT-11 [(HD-4545 x JNK-184)FI-2 x Russian rye], and also an octoploid, PMT-5 (UP-262 x Russian rye). The wheat parents showed remarkably superior meiotic stability over the triticales and Russian rye. Octoploid triticales revealed better floret fertility (grain set per floret) than the hexaploids. Correlation analysis showed absence of significant associations among the three parameters, namely meiotic stability, pollen fertility and floret fertility in the primary triticales.

1008 Qi Jiahua; Wang Zixia; Hao Zhengrong (Xinjiang Academy of Agricultural Urumqi (China). Inst. of Nucleus and Biological Technology) (1993) Study on increasing settling percentage of anther culture plant of winter wheat. *Xinjiang Agricultural Sciences (China)* (no. 6) p. 234-236. 2 tables, 6 ref. Chinese. (AGRI 95-002619).

1009 Qiu Quansheng; Jing Lanhua; Yang Chengde (Lanzhou Univ., Gansu (China). Dept. of Biology) (1993) Effect of irradiation with 14 MeV fast neutron on contents of nucleic acids and soluble protein in wheat seedling. *Acta Agriculturae Nucleatae Sinica (China)* v. 7(3) p. 145-148. 4 ill., 12 ref. Chinese. (AGRI 95-002590).

The contents DNA decreased strongly with increasing dose of fast neutron irradiation. The change of content of RNA was complicated. RNA content increased with the treatment of low dose and decreased with the

treatment of high dose. RNase activity increased at the low dose of irradiation and decreased at the high dose of irradiation, indicating that the variation of RNA was related to the change in RNase activity. Soluble protein contents dropped quickly with the treatment of fast neutron. SDS-PAGE showed that the composition of soluble protein had a great change.

1010 Rajput, S.C.; Ahmad, Z. (Chander Shekhar Azad University of Agriculture and Technology, Kanpur (India). Department of Genetics and Plant Breeding) (1992) Stability parameters in macaroni wheat. *Indian Journal of Genetics and Plant Breeding (India)* v. 52(4) p. 350-355. 2 tables; 7 ref. English. (AGRI 95-002614).

1011 Ren Changzhong; Deng Luguang; Sha Li (Baicheng Municipal Inst. of Agricultural Sciences, Jilin (China)) (1994) Correlative and path analysis on quantitative characters of spring wheat. *Jilin Agricultural Sciences (China)* (no. 2) p. 18-21. 3 tables, 2 ref. Chinese. (AGRI 95-002439).

1012 Riede, CR.; Fairbanks, DJ.; Andersen, WR.; Kehrer, RL.; Robison, L.R. (1994) ENHANCEMENT OF RAPD ANALYSIS BY RESTRICTION-ENDONUCLEASE DIGESTION OF TEMPLATE DNA IN WHEAT. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 113(3):254-257. English. [BRIGHAM YOUNG UNIV DEPT BOT & RANGE SCI PROVO, UT 84602 USA].

Random amplified polymorphic DNA (RAPD) analysis has proven to be an effective procedure for molecular marker applications in plant breeding, although non-specific amplification may limit its utility in some species. The objective of this study was to determine the effectiveness of restriction-endonuclease digestion of template DNA for elimination of non-specific amplification and generation of heritable RAPD markers. Restriction endonucleases digested wheat DNA to completion in an amplification buffer, suggesting that the restriction endonuclease can be added directly to the reaction mixture prior to amplification. A 1-h 37 degrees C step was programmed into the thermal cycler for restriction-endonuclease digestion which was followed immediately by amplification. Non-specific amplification was reduced and DNA marker patterns were altered in digested samples when compared to undigested samples. Genetic segregation of two polymorphic markers tested in F-5 inbred progeny fit expected 1:1 ratios. These results suggest that heritable DNA markers may be generated with reduction in non-specific amplification when restriction-endonuclease digestion of template DNA is conducted as part of the RAPD procedure. [References: 7].

1013 Ritala, Anneli; Aspegren, Kristian; Teeri, Teemu; Kauppinen, Veli (1994) [Gene transfer to barley]. *Geeninsiirto ohraan. Kemia (Finland)* v. 21(3) p. 194-197. 21 ref. Finnish. (AGRI 95-012635).

1014 Roy, I.; Sarkar, AKD. (1994) INHERITANCE OF SEEDLING AND ADULT-PLANT REACTION TO LEAF RUST IN INTERVARIETAL CROSSES OF WHEAT. *Bangladesh Journal of Botany*. 23(2):205-210. English. [BANGLADESH AGR RES COUNCIL DHAKA 1205 BANGLADESH].

The nature of inheritance of seedling and adult-plant reaction to leaf rust was studied in F2 from crosses of seven resistant spring-habit and three susceptible winter-habit wheat cultivars. Seedling reaction to races/biotypes 58, 21, 77/1, 77/103 and 77/31 of leaf rust produced monogenic or digenic ratios suggesting that effects such as epistasis, complementary or duplicate gene action may be involved. The number of genes controlling resistance and the nature of their interaction were defined by the virulence of race/biotype tested and the response of the susceptible parents in the crosses. Segregation for rust reaction in adult plants indicated that resistance was controlled by a single or two pairs of genes. The genes for resistance were present both in dominant and recessive form with complementary or duplicate effect.

1015 Sal'nikova, T.V.; Degtyareva, S.S.; Ketova, T.A.; Pyl'nev, V.V. (1993) [Amylase activity and germinating power in morphological mutants of soft winter wheat]. *Amilaznaya aktivnost' prorasayushchego zerna u morfologicheskikh mutantov ozimoi myagkoj pshenitay. Izvestiya Timiryazevskoy sel'skokhozyajstvennoy akademii (Russian Federation)* (no.3) p. 79-84. 21 ref. Russian. (AGRI 95-012775).

Comparative investigation of amylase activity and germinating power was conducted in speltoids, dense-eared, square-headed, spherococcoids and compactums produced by means of chemical mutagens in soft winter wheat variety Belotserkovskaja 198. It has been found that on the average mutant lines differ from initial variety in lower germinating power of seed and amylase activity of germinating grain. However, the range of variation in total amount of alpha- and beta-amylases in each mutant group was extremely wide - from 3 times or more lower to significant excess. Forms with sharp reduction of amylase activity were mostly found among speltoids. Direct connection between germinating power of seed and amylase activity has been revealed.

1016 Sandukhadze, B.N. (1992) [Efficiency of using interrupted backcrosses in breeding winter wheat of intensive type in the Central area of Non-Black Earth zone]. *Effektivnost' ispol'zovaniya preryvayushchikh bekkrossov v selektsii ozimoi pshenitsy intensivnogo tipa v Tsentral'nom rajone Nechernozemnoj zony. Vestnik sel'skokhozyajstvennoj nauki (Russian Federation)* (no.7-12) p. 92-96. Russian. (AGRI 95-002448).

1017 Sebesta, EE.; Smith, EL.; Young, HC.; Porter, R.; Webster, JA. (1995) REGISTRATION OF TEEWON WHEAT GERMPLASM. *Crop Science*. 35(1):294. English. [USDA ARS 1301 N WESTERN ST STILLWATER, OK 74075 USA].

1018 Sebesta, EE.; Wood, EA.; Porter, DR.; Webster, JA.; Smith, EL. (1995) REGISTRATION OF AMIGO WHEAT GERMPLASM RESISTANT TO GREENBUG. *Crop Science*. 35(1):293. English. [USDA ARS 1301 N WESTERN ST STILLWATER, OK 74075 USA].

1019 Sehrawat, KD.; Rana, RK. (1994) COMPARISON OF MEAN AND VARIABILITY IN SINGLE, DOUBLE AND MULTIPLE CROSS BRED POPULATIONS OF BREAD WHEAT FOR VARIOUS TRAITS. *Cereal Research Communications*. 22(4):315-319. English. [CCS HARYANA AGR UNIV DEPT PLANT BREEDING HISAR 125004 INDIA].

The present study was conducted to compare the extent of variability and mean performance in populations involving different number of parents. The mean of seven populations of single crosses exhibited significant differences for days to heading and maturity while means of seven double cross populations were significantly different for heading days and plant height. On individual cross basis, significant differences were observed for heading days in double crosses while multiple crosses exhibited significant differences for 1000-grain weight and grain yield. The mean performance of multiple crosses was improved for grain weight/ten spikes, tillers/meter and grain yield/meter, maximum being for tillers/meter as compared to parents and other populations. The coefficient of variation was higher in case of multiple crosses as compared with parents, single and double crosses for plant height, tillers/meter, 1000-grain weight and grain weight/ten spikes. Range increased in cross populations as compared with parents for all traits under study.

1020 Shang Junhua; Han Xincheng (Altay Prefectural Inst. of Agricultural Sciences, Xinjiang (China)) (1993) Variation and selection of plant height and spike characters of spring wheat seed production in South China. *Xinjiang Agricultural Sciences (China)* (no. 5) p. 195-197. 2 tables. Chinese. (AGRI 95-002582).

1021 Sharma, S.K.; Dhaliwal, H.S.; Randhawa, A.S.; Multani, D.S. (Punjab Agricultural University, Gurdaspur (India). Regional Research Station) (1992) Isoproturon tolerant derivatives of durum wheat variety pbw 34. *Indian Journal of Genetics and Plant Breeding (India)* v. 52(4) p. 422-424. 1 table; 1 ill., 2 ref. English. (AGRI 95-002615).

1022 Shchapova, A.I.; Potapova, T.A.; Kravtsova, L.A. (1993) [Genome reconstruction in hexaploid wheat using intergeneric chromosome substitution]. *Rekonstruktsiya genoma geksaploidnoj pshenitsy s pomoshch'yu metoda mezhrodovogo zameshcheniya khromosom. [Specific features in the reconstruction of genome and high plants populations]* p. 37-48. 10 ref. Russian. (AGRI 95-002609).

The results of cytological study are presented of wheat-rye hybrids F1 ABDR (4x=28), F2 and F2 (BC1) derived from crosses involving common wheat cultivar Saratovskaya 29 and three different populations of

commercial rye cultivar Onokhoiskaya. Existence of genetic control mechanisms of postgametic incompatibility in wheat-rye polyploids was experimentally proved. It was studied that all hybrid combinations studied differ in type of division (equational or reductional) and segregation of univalent chromosomes. Experimental data suggest that there exist genetic mechanisms of development of viable gametes with nonreduced sets of chromosomes and low levels of aneuploidy. Though univalent chromosomes have different types of division at meiosis, the level of aneuploidy in viable gametes is the same and constitutes about 0 to 6 chromosomes. It is necessary to search for rye genotypes such that could provide a definite type of meiotic division resulting in development of the restitution nuclei in wheat-rye hybrids. It was shown that single selection of rye male parents with high levels of pollen fertility significantly increases the frequency of viable gametes in wheat-rye F1 hybrids.

1023 Shevlyakova, N.F. (1993) [Genetic control of competitive ability in spring wheat varieties]. *Geneticheskaya obuslovlennost' konkurentosposobnosti u sortov yarovoj pshenitsy. Izvestiya Timiryazevskoj sel'skokhozyajstvennoj akademii (Russian Federation) (no.3) p. 71-79. 5 ref. Russian. (AGRIS 95-012774).*

Ruso and Leningradka varieties and F1, F2, F3 hybrids have been studied in pure and mixed planting with three areas of plant nutrition. Competitive ability was estimated by variability in plant grain content in which the varieties are not in contrast. It has been found that in the mixture of varieties Ruso is a high-competitive variety, Leningradka - a low-competitive one irrespective of planting density. In mixture of parental forms P1, P2 and F1 hybrids (1:1:2), F1 undergo beneficial effect, while P1, P2 - undesirable one. In studying the genetic analysis of quantitative characters developed by K.Mazer, J.Jinx was applied. The nature of mutual influence of homozygous and heterozygous genotypes in model population P1+P2+2F1, theoretical one - backcrosses B1, B2, and experimental one - F2 hybrids has been studied.

1024 Singh, P.P. (Raja Balwant Singh College, Agra (India). Department of Agriculture Botany) (1992) Genetic variability for lanther length, pollen production and anther extrusion in four exotic lines of wheat (*Triticum aestivum* L.). *Indian Journal of Genetics and Plant Breeding (India) v. 52(4) p. 347-349. 1 table; 3 ref. English. (AGRIS 95-002603).*

1025 Srivastava, A.N.; Singh, C.B.; Rao, S.K. (R.A.K.College of Agriculture, Sehore (India). Department of Plant Breeding and Genetics) (1992) Combining ability analysis of physiological and economic traits in breadwheat (*Triticum aestivum* L.) over environments. *Indian Journal of Genetics and Plant Breeding (India) v. 52(4) p. 390-395. 4 tables; 11 ref. English. (AGRIS 95-002606).*

1026 Sun Guangzu; Chen Yichun; Zhang Yuxue (Heilongjiang Provincial Academy of Agricultural Sciences, Harbin (China). Inst. of Crop Breeding) (1993) A study on screening scab resistant wheat mutants by irradiation and in vitro culture. *Journal of Nuclear-Agricultural Sciences (China) v. 14(5) p. 205-209. 5 tables, 7 ref. Chinese. (AGRIS 95-002593).*

1027 Svitashv, S.; Bryngelsson, T.; Vershinin, A.; Pedersen, C.; Sall T.; Vonbothner, R. (1994) PHYLOGENETIC ANALYSIS OF THE GENUS HORDEUM USING REPETITIVE DNA SEQUENCES. *Theoretical & Applied Genetics. 89(7-8):801-810. English. [SWEDISH UNIV AGR SCI DEPT PLANT BREEDING RES S-26831 SVALOV SWEDEN].*

A set of six cloned barley (*Hordeum vulgare*) repetitive DNA sequences was used for the analysis of phylogenetic relationships among 31 species (46 taxa) of the genus *Hordeum*, using molecular hybridization techniques. In situ hybridization experiments showed dispersed organization of the sequences over all chromosomes of *H. vulgare* and the wild barley species *H. bulbosum*, *H. marinum* and *H. murinum*. Southern blot hybridization revealed different levels of polymorphism among barley species and the RFLP data were used to generate a phylogenetic tree for the genus *Hordeum*. Our data are in a good agreement with the classification system which suggests the division of the genus into four major groups, containing the genomes I, X, Y, and H. However, our investigation also supports previous molecular studies of barley species where the unique position of *H. bulbosum* has been pointed out. In our experiments, *H. bulbosum* generally had hybridization patterns different

from those of *H. vulgare*, although both carry the I genome. Based on our results we present a hypothesis concerning the possible origin and phylogeny of the polyploid barley species *H. secalinum*, *H. depressum* and the *H. brachyantherum* complex. [References: 56].

1028 Takumi, S.; Otani, M.; Shimada, T. (1994) EFFECT OF SIX PROMOTER-INTRON COMBINATIONS ON TRANSIENT REPORTER GENE EXPRESSION IN EINKORN, EMMER AND COMMON WHEAT CELLS BY PARTICLE BOMBARDMENT. *Plant Science. 103(2):161-166. English. [ISHIKAWA AGR COLL AGR RESOURCES RES INST GENET RESOURCES LAB NONOICHI ISHIKAWA 921 JAPAN].*

The effect of six promoter-intron combinations on transient expression of beta-glucuronidase (GUS) as the reporter gene was estimated in cultured einkorn (*Triticum monococcum*), emmer (*Triticum durum*) and common (*Triticum aestivum*) wheat cell lines. Four promoters; cauliflower mosaic virus (CaMV) 35S, tandem CaMV35S, maize alcohol dehydrogenase gene (*Adh1*) and rice actin gene (*Act1*) promoters, and two introns; *Adh1* intron 1 and castor bean catalase intron, were tested. Six vectors having different promoter-intron combinations were introduced into wheat cells by using particle bombardment. Different levels of GUS gene activity in three wheat calli were detected by an in situ enzyme assay. The CaMV35S promoter gave the lowest level of transient expression in wheat cells. On the other hand, the rice *Act1* promoter showed the highest level of transient expression in all three wheat cells and was also the most efficient promoter of all, suggesting that the rice *Act1* promoter is efficient for use in wheat transformation. [References: 20].

1029 Talbert, L.E. (1993) Molecular biology and wheat improvement. *Plant breeding reviews (USA) v. 11 p. 235-274. references. English. (AGRIS 95-012607).*

1030 Tao Dan (PLA Univ. of Agriculture and Animal Sciences, Changchun (China)); Tong Mingyao; Shen Sile (1994) Studies on the expression and genetic basis of heterosis of male sterile hybrid wheat with *Triticum timopheevi* cytoplasm. *Journal of Jilin Agricultural University (China) v. 16(1) p. 9-13, 16. 3 tables, 9 ref. Chinese. (AGRIS 95-002584).*

1031 Tian Xiaoming (Xinjiang Academy of Land Reclamation Science, Shihezi (China). Inst. of Agricultural Sciences) (1993) Correlation analysis of characters among F2 to F5 generations from diallel crossing of winter wheat. *Xinjiang Agricultural Sciences (China) (no. 4) p. 145-147. 3 tables, 2 ref. Chinese. (AGRIS 95-002617).*

1032 Uzic, M. (Research Institute of Plant Production, Piastany (RFTS)); Zofajova, A. (1994) [Specific and non specific stability parameters]. [Parametres de la stabilite specifique et non specifique]. Evaluation and exploitation of genetic resources pre-breeding: Clermont Ferrand (France); 15-18 Mar 1994. *Evaluation and exploitation of genetic resources - prebreeding. Proceedings of the genetic resources section, meeting of Eucarpia, 15-18 March 1994, Clermont-Ferrand (France). [Evaluation et exploitation des ressources genetiques, la preselection. Comptes rendus de la section ressources genetiques, reunion Eucarpia 15-18 mars 1994, Clermont-Ferrand (France)]. Institut National de la Recherche Agronomique, Clermont Ferrand (France). Centre de Clermont Ferrand Theix. Amelioration des Plantes p. 141-147. EUCARPIA. 11 ref., 6 tableaux. English. (AGRIS 95-012624).*

1033 Vanhantun, T.J.L. (1994) COMPARISON OF MARKER SYSTEMS AND CONSTRUCTION OF A CORE COLLECTION IN A PEDIGREE OF EUROPEAN SPRING BARLEY. *Theoretical & Applied Genetics. 89(7-8):991-997. English. [CTR PLANT BREEDING & REPROD RES CTR GENET RESOURCES POB 16 6700 AA WAGENINGEN NETHERLANDS].*

Based on data in four publications describing European barley cultivars, similarities between pairs of cultivars were calculated using individual markers and combinations of markers. These markers included 19 isoenzyme patterns, Giemsa C-banding variants of each of the seven chromosomes, hordein polypeptide patterns, DDT susceptibility type, and three morphological descriptors. The rank correlation between the coefficients of parentage and marker-based similarities is low; the highest

single marker correlation is with Est-1, 0.41, and the highest correlation with a combination of markers is 0.58. Giemsa C-banding patterns score rather high, as opposed to the three morphological characters that score very low. Selection of core collections using the effective-number-of-origin-lines theory is successful. The average number of types found in a core collection of cultivars of given size is always considerably larger than a random set of the same size. The core collection approaches the maximum possible number of types. [References: 21].

1034 Vetelainen, M. (1994) EXOTIC BARLEY GERMPLASM - VARIATION AND EFFECTS ON AGRONOMIC TRAITS IN COMPLEX CROSSES. *Euphytica*. 79(1-2):127-136. English. [SWEDISH UNIV AGR SCI DEPT PLANT BREEDING RES S-26831 SVALOV SWEDEN].

Utilization of exotic germplasm offers an approach to broaden genetic variability in breeding populations. This study was conducted in order to 1) compare germplasm of exotic origin with adapted Swedish barleys with respect to genetic differences and 2) to evaluate how exotic material affected agronomic performance in complex crosses. Allozyme studies showed the following Nei's gene diversities among parents: 0.13 (adapted parents), 0.16 (landraces) and 0.25 (H. spontaneum). Cluster analysis indicated that parental groups were genetically divergent. Earliness, straw length, number of ears per plant and thousand kernel weight (TKW) were studied. Variation in agronomic traits showed the following pattern: landraces > H. spontaneum > adapted lines. The best sources for earliness were adapted parents and landraces. Mean straw length was greatest in H. spontaneum lines. Number of ears per plant was quite similar in all groups. The highest TKW was among landraces and adapted parents. Hybrids from the complex crossing programme exceeded parents in earliness and TKW. An index composed from the four traits showed the most favorable frequency distributions for adapted parents and hybrids. Both genetic and agronomic studies indicate that new valuable variation from exotic germplasm may be introduced into barley breeding material. [References: 32].

1035 Villareal, R.L.; Mujeeb Kazi, A.; Rajaram, S.; Toro, E. del (International Maize and Wheat Improvement Center (CIMMYT), Mexico City) (1994) [Morphological variability in some synthetic hexaploid wheats derived from *Triticum turgidum* x *T. tauschii*]. Variabilita' morfologica in grano esaploide sintetico derivato da *Triticum turgidum* x *T. tauschii*. *Journal of Genetics and Breeding (Italy)* v. 48(1) p. 7-15. 2 tables; 1 graph; 32 ref. English. (AGRIS 95-012603).

A morphological study of 50 synthetic hexaploid (SH) wheats ($2n=6x=42$) derived from *Triticum turgidum* ($2n=4x=28$) x *T. tauschii* ($2n=2x=14$) crosses was undertaken to establish descriptors for subsequent use in wheat breeding. Thirty five qualitative and quantitative traits of seedlings, leaves, culms, glumes, inflorescences, spikes and grains for each entry were recorded and compared. Data on quantitative traits subjected to complete linkage cluster analysis resulted in classifying the SH materials into three distinct phenotypic groups. Substantial variation existed within the materials tested. Our observations demonstrate that from relatively simple taxonomic descriptors, classifications can be developed for utilizing the synthetic hexaploid wheat germplasm.

1036 Villareal, R.L.; Mujeebkazi, A.; Deltoro, E.; Crossa, J.; Rajaram, S. (1994) AGRONOMIC VARIABILITY IN SELECTED TRITICUM-TURGIDUM X T-TAUSCHII SYNTHETIC HEXAPLOID WHEATS. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(5):307-317. English. [INT MAIZE & WHEAT IMPROVEMENT CTR LISBOA 27 APARTADO POSTAL 6-641 DELEG CUAUHEMOC MEXICO CITY 06600 DF MEXICO].

Two trials were conducted at the Mexican National Institute of Agricultural Research Experiment Station at Yaqui Valley, Sonora, Mexico to investigate the nature and extent of agronomic variation in 50 synthetic hexaploid (SH) wheats ($2n = 6x = 42$, AABBDD) derived from *Triticum turgidum* ($2n = 4x = 28$, AABB) x *T. tauschii* ($2n = 2x = 14$, DD) crosses for subsequent use in wheat improvement. Plant height, spike length, days to flowering, physiological maturity, grain yield, above-ground biomass at maturity, harvest index, yield components and test weight were determined. Significant agronomic variation was observed among the germplasm evaluated. Outstanding SH genotypes were identified with higher grain yield, above-ground biomass at maturity, 1000-grain weight,

and spikes m⁻² than the bread wheat (*Triticum aestivum* L.) check cultivar Seri 82. Genotypic correlations of grain yield with other character traits show that grain m² was the most important determinant of grain yield ($r = 0.993$). Data on agronomic traits subjected to complete linkage cluster analysis resulted in classifying the genotypes into two distinct phenotypic groups excluding Seri 82. Groups generally corresponded to durum progenitors of the SH with significant group differences for all characters. This demonstrates use of practical numerical analysis procedures to describe agronomic variation in representative SH genotypes. Clustering by quantitative traits may be valuable for identification of genotypes with divergent sources for breeding and agronomic purposes. [References: 24].

1037 Wang Zhigang; Huang Liye (Xinjiang Division No.7 of Land Reclamation Troop, Kuitun (China). Inst. of Agricultural Sciences) (1993) Application of fuzzy probability value to comprehensive evaluation of winter wheat variety. *Xinjiang Agricultural Sciences (China)* (no. 6) p. 236-238. 3 tables, 4 ref. Chinese. (AGRIS 95-002620).

1038 Wang Zixia; Qi Jiahua; Hao Zhengrong (Xinjiang Academy of Agricultural Sciences, Urumqi (China). Inst. of Nucleus and Biological Technology) (1993) Effect of hormone PAA on anther culture of wheat. *Xinjiang Agricultural Sciences (China)* (no. 6) p. 239-240. 3 tables, 5 ref. Chinese. (AGRIS 95-002597).

1039 Wettstein, D. von (1992) Genes and barley. Carlsberg Research Center, Copenhagen (Denmark). Dept. of Physiology. CRC. 8 ill. 16 p. English. (AGRIS 95-002471).

1040 White, A.J.; Dunn, M.A.; Brown, K.; Hughes, M.A. (1994) COMPARATIVE ANALYSIS OF GENOMIC SEQUENCE AND EXPRESSION OF A LIPID TRANSFER PROTEIN GENE FAMILY IN WINTER BARLEY. *Journal of Experimental Botany*. 45(281):1885-1892. English. [UNIV NEWCASTLE UPON TYNE DEPT BIOCHEM & GENET NEWCASTLE UPON TYNE NE2 4HH TYNE & WEAR ENGLAND].

Three genomic clones (gblt4.2, gblt4.6, gblt4.9) have been isolated from a barley (*Hordeum vulgare* L.) cv. Igri genomic library using a cDNA clone of the low temperature responsive gene blt4.1 as the probe. The genomic clones are closely related and from sequence homology are believed to be three further members of a barley gene family encoding lipid transfer proteins. One clone, gblt4.9, corresponds to a second cDNA clone (blt4.9). Northern blot analysis revealed that the three genes reported here are induced by low temperature and drought; however, the relative level of response to these stimuli was shown to differ between the genes. Further, the developmental response of gblt4.2 is different from that found for other members of the gene family. The degree of low temperature induction of the blt4 gene family appears to be cultivar-dependent. Comparative analysis of the putative promoter regions of the genomic clones indicates three regions that show over 80% sequence conservation between gblt4.9 and gblt4.6. Also identified are putative cis acting elements previously identified in ABA responsive genes and low temperature inducible genes. The possible functional significance of the conserved regions and elements is discussed in relation to the expression of the blt4 gene family. [References: 38].

1041 William, M.D.H.M.; Mujeeb Kazi, A. (International Maize and Wheat Improvement Center (CIMMYT), Mexico City); Gray, L. (Illinois State Univ., Urbana (USA)); Rayburn, A.L. (Illinois State Univ., Urbana (USA). Dept. of Agronomy) (1994) [Development of DNA markers based on randomly amplified polymorphic sequences in a *Triticum aestivum* L. x *Thinopyrum bessarabicum* amphiploid]. Sviluppo dei marcatori DNA in base alle sequenze polimorfiche amplificate randomizzate in un anfiploide *Triticum aestivum* L. x *Thinopyrum bessarabicum*. *Journal of Genetics and Breeding (Italy)* v. 48(1) p. 1-6. 12 ref. English. (AGRIS 95-012767).

Randomly amplified polymorphic DNA (RAPD) markers were developed using the polymerase chain reaction (PCR) for the amphiploid of *Triticum aestivum* L. cv. Chinese Spring and *Thinopyrum bessarabicum* (Savul. and Rayss) Love. Polymorphisms observed with seven arbitrary oligonucleotide decamer primers are reported. There was no polymorphism among different DNA extracts from different individual seedlings of Chinese Spring. The amplification patterns

generated with primers for the two plant species were repeatable. The marker bands specific to *Th. bessarabicum* may be helpful in tracking its chromatin in the wheat background when chromosome additions, substitutions, translocations or subtle chromosomal interchanges are produced.

1042 Williams, KJ.; Fisher, JM.; Langridge, P. (1994) IDENTIFICATION OF RFLP MARKERS LINKED TO THE CEREAL CYST NEMATODE RESISTANCE GENE (CRE) IN WHEAT. *Theoretical & Applied Genetics*. 89(7-8):927-930. English. [UNIV ADELAIDE DEPT PLANT SCI WAITE CAMPUS URRBRAE SA 5064 AUSTRALIA].

The cereal cyst nematode (CCN) (*Heterodera avenae* Woll.) is an economically damaging pest of wheat in many of the world's cereal growing areas. The development of CCN-resistant cultivars may be accelerated by the use of molecular markers. The Cre gene of the wheat line "AUS 10894" confers resistance to CCN. Using a pair of near-isogenic lines (NILs) that should differ only in a small chromosome segment containing the Cre locus, we screened 58 group-2 probes and found two (Tag605 and CDO588) that detect polymorphism between the NILs. Nulli-tetrasomic and ditelosomic lines confirmed that the restriction fragment length polymorphism (RFLP) markers identified were derived from the long arm of wheat chromosome 2. Crosses between "AUS10894" and "Spear" and the NIL "AP" and its recurrent parent "Prins" were used to produce F-2 populations that gave the expected 3:1 segregation ratio for the resistance gene. Linkage analysis identified two RFLP markers flanking the resistance gene. Xglk605 and Xcdo588 mapped 7.3 cM (LOD=6.0) and 8.4 cM (LOD=6.7), respectively, from the Cre locus. [References: 31].

1043 Worland, AJ.; Sayers, EJ.; Börner, A. (1994) THE GENETICS AND BREEDING POTENTIAL OF RBT12, A DOMINANT DWARFING GENE IN WHEAT. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 113(3):187-196. English. [CAMBRIDGE LAB JI CTR COLNEY LANE NORWICH NR4 7UJ NORFOLK ENGLAND].

Rht12, a dominant dwarfing gene of wheat, was shown to be located distally on the long arm of chromosome 5A. Lack of recombination with the awn inhibitor B1 suggested that Rht12 is either tightly linked to this gene or is, in this material, a pleiotropic expression of the gene. Linkage to beta-Amy-A1 was also very tight, indicating that Rht12 is present on the of chromosome 5AL ancestrally translocated from 4AL. The close linkage to beta-Amy-A1 also suggests that Rht12 is not a homeoallele of the commercially important GA-insensitive dwarfing genes. Analysis of near-isogenic lines in a number of genetic backgrounds showed that Rht12 reduces height without altering ear size and significantly increases spikelet fertility. However its successful utilization in breeding programmes will require careful selection since in some backgrounds the gene reduces grain numbers and grain size. In all backgrounds, Rht12 delayed ear emergence time by around 6 days. A delay of this magnitude could, in many environments, adversely affect yield if it is not neutralized by altering the balance of other genes determining ear emergence time. [References: 33].

1044 Wu Xinyuan; Huang Tianrong (Xinjiang Academy of Agricultural Sciences, Urumqi (China). Inst. of Grain Crops) (1993) Selection of winter wheat cultivars in South Xinjiang [China]. *Xinjiang Agricultural Sciences (China)* (no. 5) p. 201-203. 3 ref. Chinese. (AGRI 95-002618).

1045 Xin Wenli; Xiao Zhimin; Qi Shiyu (Heilongjiang Provincial Academy of Agricultural Science, Harbin (China). Inst. Crop Breeding) (1994) Yield stability analysis of spring wheat varieties with different reactive characteristics to photoperiod and temperature. *Heilongjiang Agricultural Sciences (China)* (no. 1) p. 8-12. 2 ill., 3 tables, 5 ref. Chinese. (AGRI 95-002437).

1046 Yan Jianmin; Zhu Xiandai; Cai Shibin (Jiangsu Academy of Agricultural Sciences, Nanjing (China). Inst. for Application of Atomic Energy) (1993) Identification of waterlogging tolerance of wheat varieties by tracer technique. *Acta Agriculturae Nucleatae Sinica (China)* v. 7(4) p. 193-197. 2 ill., 3 tables. Chinese. (AGRI 95-002591).

1047 Yau, S.K.; Ortiz Ferrara, G. (International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo (Syria)) (1994) [Regression

and cluster analysis of elite wheat lines grown in rain-fed environments]. *Regression e analisi cluster di linee di elite di grano cresciute in ambienti molto piovosi. Journal of Genetics and Breeding (Italy)* v. 48(2) p. 183-189. 6 tables; 37 ref. English. (AGRI 95-012772).

The objective of this study was to evaluate the efficacy of cluster analysis and joint regression analysis for describing differential yield responses of elite breeding lines of common wheat (*Triticum aestivum* L.) to diverse environments. There were 22 or 23 different wheat entries grown at 14 to 25 mainly rainfed sites in each of the four seasons analyzed. Entry, site, entry X site, and deviations from regression were highly significant in each season, but heterogeneity among regressions, which accounted for less than 3.6% of the interaction variances, was non-significant. Cluster analysis suggested seven to nine groups of entries in each of the seasons, with the cluster X site interaction accounting for more than 49% of the entry X site sum of squares. Clusters of entries reflected different selection history to some extent. It was concluded that cluster analysis is a useful technique for describing differential yield responses of elite breeding lines grown in diverse environments even when the joint regression analysis shows non significant heterogeneity of regression.

1048 Yi Huiying; Peng Furong; Yu Hongbing (Academia Sinica, Yangling, Shaanxi (China). Northwestern Inst. of Soil Water Conservation) (1993) Cytogenetic effect of combined treatment of microwave and 60 Co gamma rays on root tip cell of wheat. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(1) p. 18-21. 3 tables, 9 ref. Chinese. (AGRI 95-002592).

1049 Yi Huiying; Peng Furong; Yu Hongbing (Academia Sinica, Yangling, Shaanxi (China). Northwestern Inst. of Soil and Water Conservation) (1993) Increase of mutagenic efficiency of gamma irradiation in wheat by microwave treatment. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(5) p. 213-216. 2 tables, 3 ref. Chinese. (AGRI 95-002594).

1050 Zhang Chaomei; Mao Yanlin (Beijing Agricultural Univ. (China)) (1993) Radiation-induced changes in enzymes of wheat during seed germination and seedling growth. *Acta Agriculturae Nucleatae Sinica (China)* v. 7(2) p. 93-97. 5 ill., 24 ref. Chinese. (AGRI 95-002589).

1051 Zhang Maoyin; Qi Jiahua (Xinjiang Academy of Agricultural Sciences, Urumqi (China). Inst. of Nucleus and Biological Technology) (1993) Effects of treating F1 hybrid seeds with colchicine and 60 Co gamma rays on agronomic characters of spring wheat. *Xinjiang Agricultural Sciences (China)* (no. 2) p. 51-54. 4 tables, 4 ref. Chinese. (AGRI 95-002580).

F40 PLANT ECOLOGY

1052 Biederbeck, VO.; Janzen, HH.; Campbell, CA.; Zentner, RP. (1994) LABILE SOIL ORGANIC MATTER AS INFLUENCED BY CROPPING PRACTICES IN AN ARID ENVIRONMENT. *Soil Biology & Biochemistry*. 26(12):1647-1656. English. [AGR CANADA BOX 1030 SWIFT CURRENT S9H 3X2 SK CANADA].

The dynamics of organic matter (OM) in prairie soils play an important role in long-term soil productivity and in the global carbon cycle. Temporal fluctuations in OM occur primarily in the readily-decomposable, labile fractions. We analyzed soils from a long-term study on a Brown Chernozem (Aridic Haploboroll) in southwestern Saskatchewan to determine the effect of cropping practices on OM content and composition under arid conditions. Soils (0-7.5 and 7.5-15 cm layers) from various rotations of spring wheat (*Triticum aestivum* L.), winter wheat, flax (*Linum usitatissimum* L.), lentil (*Lens culinaris* Medikus) and fallow were analyzed for organic C, total N and selected indicators of labile OM [light fraction (LF)-C, LF-N, mineralizable-C, mineralizable-N, microbial biomass (MB)-C and MB-N]. The indicators of labile OM were all more sensitive than total OM to agronomic variables. Treatment effects on air characteristics were usually similar in the 0-7.5 and 7.5-15 cm layers, but effects in the surface layer were often more highly significant. Frequency of fallow in the rotation was the dominant factor influencing labile OM. For example, LF-C in the 0-7.5 cm layer of well-fertilized continuously-cropped spring wheat, bare fallow-wheat-wheat and bare fallow-wheat was 3.15, 1.55 and 1.17 mg C kg⁻¹ soil, respectively. The

corresponding values for CO₂-C mineralized at 21 degrees C in 30 days were 371, 184 and 158 mg C kg⁻¹ soil and those for cumulative net N mineralized in 16 weeks at 35 degrees C were 126, 96 and 80 mg N kg⁻¹ soil. MB-C and MB-N exhibited similar trends (e.g. MB-C was 368, 256 and 257 mg C kg⁻¹ soil for the three treatments, respectively). Application of N fertilizer and substitution of winter wheat (with chemical fallow) for spring wheat (with tilled bare fallow) tended to increase labile OM, while substitution of flax or lentil for spring wheat had little effect or reduced labile OM. Differences in labile OM appeared to be related, not only to residue inputs, but also to moisture and temperature conditions. Our findings suggest that it may be possible to manipulate the timing of residue inputs and moisture through cropping practices and thereby maintain adequate labile OM concentrations and improve the synchrony of mineralization with crop requirements. Our results also imply that LF and mineralizable fractions may be useful as early indicators of OM change. [References: 44].

1053 Bomke, A.A.; Yu, S.; Temple, W.D. (1994) WINTER WHEAT GROWTH AND NITROGEN DEMAND IN SOUTH COASTAL BRITISH COLUMBIA. *Canadian Journal of Soil Science*. 74(4):443-451. English. [UNIV BRITISH COLUMBIA DEPT SOIL SCI 139 2357 MAIN MALL VANCOUVER BC V6T 1Z4 CANADA].

Winter wheat, *Triticum aestivum*, is a new crop in south coastal British Columbia. The purposes of this study were to characterize plant development, dry matter accumulation and N uptake under low input and intensively managed systems as well as to assess the capability of some of the region's soils to supply N to the crop. Grain yields, crop development and dry matter and N accumulation were similar to those reported from southern England. High amounts of winter rainfall (November-April precipitation ranged from 523 to 1111 mm) leach virtually all residual NO₃ from south coastal B.C. soils and, without N fertilization, result in uniformly N deficient winter wheat. The low input N regime, 75 kg N ha⁻¹ at Zadoks growth stage 31, plus soil N mineralized subsequent to the winter leaching period were sufficient in this study to maximize grain and total aboveground crop dry matter yields, but not to achieve adequate grain protein contents. The soils in the study were capable of supplying N in amounts sufficient to support only 30-53 % of the maximum N uptake between growth stages 31 and 78. Appropriate quantities and timing of N are critical to successful production of high-yielding, good-quality wheat in south coastal British Columbia. Nitrogen management is likely to be most efficient when guided by the stage of crop development and demand and not by spring soil sampling and mineral N analysis. [References: 21].

1054 Breland, T.A. (1994) MEASURED AND PREDICTED MINERALIZATION OF CLOVER GREEN MANURE AT LOW TEMPERATURES AT DIFFERENT DEPTHS IN TWO SOILS. *Plant & Soil*. 166(1):13-20. English. [AGR UNIV NORWAY DEPT BIOTECHNOL SCI POB 5040 N-1432 AS NORWAY].

Predictive models of the temporal mineralization pattern of organic residues may help in development of strategies to synchronize N mineralization with the crop demand and minimize off-season losses. In the present investigation, two double first-order models with temperature as a driving variable were tested against data on decomposition and N mineralization, respectively, in two field experiments with green manure. On 15 November 1984, mesh bags with red clover (*Trifolium pratense* L.) shoot material were placed at five depths (0-30 cm) on a sandy-loam and a loam site in south-eastern Norway. 167 days after burial, 73% of the initial clover nitrogen remained on the surface, 62% at 5-cm depth, and 56% at 30-cm depth. The differences among buried samples largely persisted throughout the experimental period (1.5 years). The decomposition rate slowed down appreciably after day 270, when the amount of N in buried bags averaged 33% of the initial N. The effect of site was small and varied during the experiment. The decay model, which was derived from laboratory incubations, predicted the initial observations of remaining clover material fairly well. Later, predicted and measured values diverged because recalcitrant residues decomposed more extensively in the field than in the laboratory. The N mineralization model was tested against net N mineralization from white-clover (*T. repens* L.) green manure ploughed down in late October. The course of the net N mineralization was well described when disregarding an over-prediction (6-12% of applied clover N), which may be due to N losses not

accounted for in the model. The predictions were sensitive to the kind of function applied for correction of decay rates at temperatures below 0 degrees C. The results showed that decomposition of clover green manure is rapid, even at temperatures below 5 degrees C. N-rich plant material, therefore, should be worked into the soil as late as possible in the autumn or, preferably, remain on the soil surface until spring in order to reduce the probability of N losses. [References: 30].

1055 Christensen, H.; Ronn, R.; Ekelund, F.; Christensen, S. (1995) BACTERIAL PRODUCTION DETERMINED BY [H-3] THYMIDINE INCORPORATION IN FIELD RHIZOSPHERES AS EVALUATED BY COMPARISON TO RHIZODEPOSITION. *Soil Biology & Biochemistry*. 27(1):93-99. English. [BIOTECHNOL INST DTH 227 LUNDTOFTEVEJ 100 DK-2800 LYNGBY DENMARK].

In a sandy loam soil cropped to barley bacterial production in the rhizosphere was compared to the results of a parallel investigation on rhizodeposition. Bacterial production was stimulated in the rhizosphere as revealed by an increased biomass of bacteria (643-883 mug C g⁻¹ soil) and protozoa (7.2-15 x 10⁴ cells g⁻¹ soil) as well as elevated thymidine incorporation (9.7-12 pmol g⁻¹ soil) in rhizosphere soil compared to bulk soil. Rhizodeposition, as determined by several pulse labellings with CO₂(14), was estimated to be 412 mug C g⁻¹ dry wt soil in the 0-15 cm layer. Bacterial production, as determined by incorporation of H-3-labelled thymidine converted to bacterial C, revealed a plant-induced formation of 1348 mug bacterial C g⁻¹ soil in the 0-15 cm layer. This is probably the first estimate for bacterial production based on thymidine incorporation which has been compared to an estimate of C availability in a terrestrial ecosystem. The discrepancy between the rhizodeposition data and the estimate of bacterial production suggests that conversion factors between [H-3]thymidine incorporation and bacterial production obtained in laboratory incubations are not generally applicable to the field situation. It is proposed that estimates of bacterial production should be based on measurements of actual conversion factors to improve the accuracy of the method. [References: 23].

1056 Cleugh, H.A.; Dunin, F.X. (1995) MODELLING SENSIBLE HEAT FLUXES FROM A WHEAT CANOPY - AN EVALUATION OF THE RESISTANCE ENERGY BALANCE MODEL. *Journal of Hydrology*. 164(1-4):127-152. English. [CSIRO CTR ENVIRONM MECH POB 821 CANBERRA ACT 2601 AUSTRALIA].

Sensible heat fluxes measured over a growing wheat crop are used to evaluate the performance of the resistance energy balance model for both sparse and full canopy covers. Aerodynamic temperatures (for heat and momentum) are derived from measured sensible heat fluxes and then compared to canopy radiometric temperatures which were measured using infra-red radiometers and a pyrgeometer. Agreement between measured radiometric and aerodynamic temperatures is excellent for the more dense, fully-closed wheat crop, and the resistance energy balance model also performed adequately for this canopy. However, very large differences between radiometric and aerodynamic temperatures were observed for the sparse wheat crop, especially at intermediate leaf area indexes (LAIs) (less than 2). Large differences were even found between the infra-red radiometer-based and pyrgeometer-based canopy temperatures. Under such conditions of sparse canopy cover the model performs poorly. At these times greater agreement between aerodynamic and canopy temperatures was found when the latter was determined as a 'composite temperature', combining both infra-red radiometer and pyrgeometer measurements. Modelling of sensible heat flux using the resistance energy balance model is improved with the use of this composite canopy temperature. Measured values for kB⁻¹ were extremely variable and so a unique value for the ratio of roughness lengths for heat and momentum could not be determined. [References: 21].

1057 Duijff, B.J.; Dekogel, W.J.; Bakker, P.A.H.M.; Schippers, B. (1994) INFLUENCE OF PSEUDOBACTIN 358 ON THE IRON NUTRITION OF BARLEY. *Soil Biology & Biochemistry*. 26(12):1681-1688. English. [UNIV UTRECHT DEPT PLANT ECOL & EVOLUT BIOL PLANT PATHOL SECT POB 80084 3508 TB UTRECHT NETHERLANDS].

The influence of pseudobactin 358 (PSB358) on the iron uptake and chlorophyll synthesis of hydroponically-grown barley seedlings (*Hordeum vulgare* L. cv. Femina) was studied. PSB358 is the siderophore

produced by the plant-growth promoting *Pseudomonas putida* strain WCS358. Iron uptake by iron-deficient barley plants was significantly higher with (59)FePSB358 than with (59)FeEDDHA as an iron source. However, iron uptake from the ferrated barley phytosiderophores ((FePS)-Fe-59) was the most efficient. Chlorophyll synthesis in barley was stimulated by 4 μ M FePSB358 compared with that in barley supplied with 4 μ M FeCl₃. The unferrated PSB358 (4 μ M) positively influenced chlorophyll synthesis in barley if the plants were grown with Fe(OH)(3) as an iron source, whereas 4 μ M EDDHA had a negative effect. Under axenic conditions, chlorophyll synthesis was high and did not differ between plants that were grown with either FePSB358 or FeCl₃ as iron source. Inoculation of the axenic plants with barley-rhizosphere microorganisms reduced their chlorophyll synthesis and the phytosiderophore accumulation in their nutrient solution. Under these conditions, FePSB358 stimulated chlorophyll synthesis in barley compared with that in barley supplied with FeCl₃. It is concluded that both FePSB358 and PSB358 can affect the iron nutrition of barley positively, if, due to microbial degradation of the phytosiderophores, phytosiderophore-mediated iron nutrition was not sufficient for the plant's iron requirement. [References: 40].

1058 Gantar, M.; Rowell, P.; Kerby, NW.; Sutherland, IW. (1995) **ROLE OF EXTRACELLULAR POLYSACCHARIDE IN THE COLONIZATION OF WHEAT (TRITICUM VULGARE L) ROOTS BY N-2-FIXING CYANOBACTERIA.** *Biology & Fertility of Soils*. 19(1):41-48. English. [UNIV DUNDEE DEPT BIOL SCI DUNDEE DD1 4HN SCOTLAND].

The characteristics of the mucilaginous sheaths of the cyanobacteria *Nostoc* 259B and *Anabaena* C5 and their role in the formation of associations with the roots of wheat plants grown in liquid culture have been assessed. Light and scanning electron microscopy revealed that the filaments of *Nostoc* 259B that formed a tight association with the root surface were contained in a firm mucilaginous shell. In contrast, filaments of *Anabaena* C5 formed a loose association and were easily detached from the mucilage that had a sheet-like appearance and tended to disintegrate as the culture aged. Similarly, there was a tight attachment of the isolated polysaccharide from *Nostoc* 259B to the root surface and a loose attachment of the *Anabaena* C5 polysaccharide. When the crude polysaccharide from *Nostoc* 259B was freed from proteins by phenol or pronase treatment, its ability to adhere to the root surface was lost or considerably reduced, suggesting that a protein component contributes to the tight attachment of *Nostoc* 259B. The crude polysaccharide preparation from *Nostoc* 259B contained 2.8% (w/w) protein while that from *Anabaena* C5 was only 0.6% (w/w) protein. The purified exopolysaccharide from *Nostoc* 259B contained three neutral sugars and glucuronic acid, whereas fucose and a uronic acid were the main components of that from *Anabaena* C5. Washing the roots or treating them with different sugars did not alter the ability of *Nostoc* 259B to colonize the root surface, indicating that cyanobacterial attachment may not be specific. [References: 32].

1059 Heathcote, DG.; Brown, AH.; Chapman, DK. (1995) **THE PHOTOTROPIC RESPONSE OF TRITICUM AESTIVUM COLEOPTILES UNDER CONDITIONS OF LOW GRAVITY.** *Plant Cell & Environment*. 18(1):53-60. English. [MARTIN MARIETTA SERV INC AMES RES CTR BIOL FLIGHT RES PROJECTS POB 138 MOFFETT FIELD, CA 94035 USA].

Wheat (*Triticum aestivum* L, cv Broom) coleoptiles were stimulated by unilateral blue light pulses, the duration of which varied between 3 s and 30 min, under microgravity conditions on the DML-1 Spacelab mission and in ground controls. The stimuli covered first positive, indifferent and second positive response regions. When phototropic responses were observed under low-gravity conditions, slightly fewer seedlings responded compared with 1 g conditions. The latent period was similar in flight and 1 g treatments (10-20 min), except for the response to 300 μ mol m⁻² in the indifferent response region, where a positive response in flight plants followed a 130 min latent period, while no response was observed in 1 g plants. First positive responses at 0g were slightly enhanced, both in magnitude and in duration, compared to the 1 g controls, but not to the extent predicted by clinostat studies. The response kinetics in the second positive region at 1 g showed a plateau at 120 min, in contrast to the single maximum at 9 g. The fluence-response relationship was similar in both flight and ground controls. Only the

responses to 4 and 6 μ mol m⁻² showed significantly greater curvatures at 9 g. This contrasts with previous clinostat studies, which reported substantial response enhancement at all fluence levels. [References: 23].

1060 Higuchi, K.; Kanazawa, K.; Nishizawa, NK.; Chino, M.; Mori, S. (1994) **PURIFICATION AND CHARACTERIZATION OF NICOTIANAMINE SYNTHASE FROM FE-DEFICIENT BARLEY ROOTS.** *Plant & Soil*. 165(2):173-179. English. [UNIV TOKYO DEPT AGR CHEM PLANT NUTR & FERTILIZERS LAB BUNKYO KU YAYOIE 1-1 TOKYO 113 JAPAN].

Nicotianamine (NA), the key precursor of the mugineic acid family phytosiderophores (MAs), is synthesized from S-adenosylmethionine (SAM). The NA synthase was strongly induced by Fe-deficiency treatment, and the activity increased to the maximum level faster than the time of maximum level of MAs secretion and also before the appearance of severest chlorosis. The enzyme was mainly localized in the roots of barley. NA synthase had the optimum pH at 9.0, a molecular weight of about 40,000-50,000 estimated by gel filtration or about 30,000 by SDS-PAGE. Using hydrophobic chromatography, hydroxylapatite chromatography, and preparative SDS-PAGE, NA synthase was purified as one band on SDS-PAGE. [References: 36].

1061 Levininzi, R.; Saviozzi, A.; Riffaldi, R. (1994) **ORGANIC ACIDS AS SEED GERMINATION INHIBITORS.** *Journal of Environmental Science & Health Part A-Environmental Science & Engineering*. 29(10):2203-2217. English. [UNIV PISA INST AGR CHEM VIA S MICHELE SCALZI 2 I-56124 PISA ITALY].

Phytotoxicity of aromatic and aliphatic acids was tested by a wheat seed bioassay. Wheat seed germination was found to be influenced by the number of hydroxy and methoxy groups, the molecular position of single and double hydroxy groups, the length of the aliphatic chain, as well as by the pK(a) of the acid solutions. Orto and meta coumaric, ferulic and orto hydroxybenzoic among phenolic acids, and butyric acid among aliphatic acids showed the most inhibitory activity; toxicity was found to increase exponentially with the increasing acid concentrations. Levels of 0.25 and 1.8mM resulted in a 10 and 50% toxicity, respectively. [References: 32].

1062 Ma Yuanxi; Wang Chenyang (Henan Agricultural Univ., Zhengzhou (China). Dept. of Agronomy); Zhon Jize (1994) **Study on the main ecological effects of wheat root systems.** *Acta Agricultural Universitatis Henanensis (China)* v. 28(1) p. 12-18, 49. 3 ill., 7 tables, 8 ref. Chinese. (AGRI 95-003028).

1063 Martens, DA.; Frankenberger, WT. (1994) **ASSIMILATION OF EXOGENOUS 2'-C-14-INDOLE-3-ACETIC ACID AND 3'-C-14-TRYPTOPHAN EXPOSED TO THE ROOTS OF THREE WHEAT VARIETIES.** *Plant & Soil*. 166(2):281-290. English. [UNIV CALIF RIVERSIDE DEPT SOIL & ENVIRONM SCI RIVERSIDE, CA 92521 USA].

This study was conducted to determine if plants can assimilate indole-3-acetic acid (IAA) from rooting media and if exogenous L-tryptophan (L-TRP) can be assimilated and converted by plants into auxins. The addition of 2'-C-14-IAA (3.7 kBq plant⁻¹) to wheat (*Triticum aestivum* L.) seedlings of three varieties grown in nutrient solution resulted in the uptake (avg. = 7.6%) of labelled IAA. Most of the label IAA was recovered in the shoot (avg. = 7.2%) with little accumulation in the root (avg. = 0.43%). A portion of the assimilated IAA-label in the plant was identified by co-chromatography and UV spectral confirmation as IAA-glycine and IAA-aspartic acid conjugates. Little of the assimilated IAA label was found as free IAA in the wheat plants. These same assimilation patterns were observed when 2'-C-14-IAA was added to wheat plants grown in sterile and nonsterile soil. In contrast, the wheat varieties assimilated considerably less (avg. = 1.3%) of the added microbial IAA precursor, 3'-C-14-L-TRP (3.7 kBq plant⁻¹) and thus much lower amounts of IAA conjugates were detected. Glasshouse soil experiments revealed that 2 out of 3 wheat varieties had increased growth rates and increased yields when L-TRP (10(-5) and 10(-7) M) was added to the root zone. It is surmised that this positive response is a result of microbial auxin production within the rhizosphere upon the addition of the precursor, L-TRP. The amino acid composition of the root exudates plays a critical role in microbial production of auxins in the rhizosphere. This study showed that wheat roots can assimilate IAA from their rooting media, which will

supplement the endogenous IAA levels in the shoot tissue and may positively influence plant growth and subsequent yield. [References: 38].

1064 Rouchaud, J.; Gustin, F.; Callens, D.; Vanhimme, M.; Bulcke, R. (1994) EFFECTS OF RECENT ORGANIC FERTILIZER TREATMENT ON HERBICIDE DIFLUFENICAN SOIL METABOLISM IN WINTER WHEAT CROPS. *Toxicological & Environmental Chemistry*. 42(3-4):191-198. English. [CATHOLIC UNIV LEUVEN PHYTOPHARM LAB B-1348 LOUVAIN BELGIUM].

The soil dissipation and metabolism of the herbicide diflufenican was studied in a field trial in Belgium in winter wheat which, before sowing, had been treated with green manure, cow manure, or pig slurry. Wheat was sown and the soil was treated with 250 g diflufenican ha⁻¹ in October. Diflufenican dissipated with first-order kinetics over the first six months with half-lives of 101, 116, 215 and 176 days in control plots, green manure, pig slurry and cow manure treated plots, respectively. The organic fertilizers soil treatments thus increased the diflufenican soil persistence, and probably also its herbicide efficiency. The organic amendments also decreased the soil concentrations of the sum of the diflufenican herbicide 2 (2-[3-(trifluoromethyl)phenoxy]-3-pyridinecarboxylic acid) and 3 (N-(2, 4-difluorophenyl)-2-hydroxy-3-pyridinecarboxamide) and non herbicide 4 (2-hydroxy-3-carboxypyridine) metabolites. As the organic fertilizers were applied just before sowing, their effects onto the diflufenican soil metabolism corresponded to the ones of the young soil organic matter. After 6 months, the organic fertilizers effect was less pronounced leading to diflufenican (1) and its metabolites soil concentrations in all treatments becoming similarly low. The diflufenican (1) and its herbicide metabolites soil residues remaining after harvest in all the organic fertilizers treated or untreated plots would be too low to be harmful to a rotational crop. [References: 8].

1065 Rouchaud, J.; Gustin, F.; Callens, D.; Vanhimme, M.; Bulcke, R.; Roisin, C.; Grevy, L.; Raimond, Y. (1994) PAST ORGANIC FERTILIZER TREATMENTS - INFLUENCE ON THE HERBICIDE DIFLUFENICAN SOIL METABOLISM IN WHEAT CROPS. *Toxicological & Environmental Chemistry*. 42(3-4):199-208. English. [CATHOLIC UNIV LEUVEN PHYTOPHARM LAB B-1348 LOUVAIN BELGIUM].

The influence of several organic fertilizer treatment regimens, applied at the beginning of crop rotation cycles, were compared as to their slowing down effect on the herbicide diflufenican soil metabolism in wheat crops. In a first trial made at the site "Longs Tours", the organic fertilizers treatment schemes had been repeatedly applied in the past since 30 years, according to a 3 years rotation cycle. The following organic fertilizers treatment regimens were compared: treatment (1) no organic fertilizer at all; treatment (2) cow manure; treatment (3) pig slurry + green manure + crop wastes; treatment (4) green manure + crop wastes; treatment (5) straw cereal wastes alone. A spring wheat crop was sown and diflufenican was applied, i.e. 1.6 years after the latest external organic fertilizers application. During the 4 first crop months, the diflufenican soil half-lives were 59, 91, 117, 81 and 70 days in the treatments 1, 2, 3, 4 and 5 treated plots, respectively. During the end period of the crop, the effect of the organic fertilizers treatments disappeared, the diflufenican and its metabolites soil concentrations becoming very low and similar in the organic fertilizers treated and untreated control plots. A second trial was made with winter wheat at the site "Les Pompes". The organic fertilizers regimens however had been applied only one time 1.2 years before sowing and diflufenican application. In this trial, the organic fertilizers treatments had no significant influence on diflufenican soil half-life. [References: 7].

1066 Stadt, K.J.; Taylor, G.J.; Dale, M.T. (1994) MEASURING THE EFFECT OF AN ABIOTIC STRESS ON COMPETITION. *Oecologia*. 100(3):221-228. English. [UNIV ALBERTA DEPT BIOL SCI EDMONTON AB T6G 2E9 CANADA].

Using recently developed solution culture techniques, the effect of a non-resource abiotic stress, nickel toxicity, was tested on intraspecific nutrient competition among wheat. The choice of an appropriate statistical model was of paramount importance in interpreting these effects. We argue that a multiplicative model is more appropriate for experiments on interactions of competition and abiotic stress. By such an analysis, nickel had no relative effect on the ability of competition to reduce plant size in two experiments, and caused a small reduction in

competition in another. These results are contrary to other reports of the effect of a non-resource abiotic stress on competition and appear to be due to an increased demand for nutrients in the presence of toxic levels of nickel. The effects of an abiotic stress on competition may thus be specific to the stress and not generalized across all abiotic stresses. [References: 36].

1067 Stieger, P.A.; Feller, U. (1994) SENESCENCE AND PROTEIN REMOBILISATION IN LEAVES OF MATURING WHEAT PLANTS GROWN ON WATERLOGGED SOIL. *Plant & Soil*. 166(2):173-179. English. [UNIV BERN INST PLANT PHYSIOL ALTENBERGRIN 21 CH-3013 BERN SWITZERLAND].

The influence of waterlogging on leaf senescence and protein remobilisation was investigated in winter wheat (*Triticum aestivum* L., cv. Arina), which was grown in large pots embedded in the field in spring. The soil of intact pots was flooded permanently from anthesis to maturity, while in perforated control pots the soil was well aerated throughout the maturation period. No major effects of waterlogging were observed in the third leaf from the top, which was already senescing when the treatment was started. The degradation of proteins and chlorophyll was accelerated slightly in the second leaf from the top and considerably in the flag leaf. The contents of free amino acids in the uppermost leaf blades were lower on waterlogged soil than on control pots. Furthermore, amino acids in the blades did not accumulate during the earlier protein remobilisation observed on flooded soil, indicating that the export of amino acids via the phloem was fully functional. The loss of leaf proteins and the changes in the pattern of peptide hydrolases during senescence were similar in treated and control plants. Endopeptidase activities increased in an early phase of senescence at pH 5 and later also at pH 9, while aminopeptidase activities decreased. Therefore, nitrogen remobilisation was accelerated on flooded soil, but the senescence-related changes were very similar to those observed in control plants. [References: 33].

1068 Swinnen, J. (1994) EVALUATION OF THE USE OF A MODEL RHIZODEPOSITION TECHNIQUE TO SEPARATE ROOT AND MICROBIAL RESPIRATION IN SOIL. *Plant & Soil*. 165(1):89-101. English. [DLO AB AGROBIOL & SOIL FERTIL RES INST POB 14 6700 AA WAGENINGEN NETHERLANDS].

A model rhizodeposition technique to estimate the root and microbial components of C-14 soil/root respiration in pulse-labelling experiments is described. The method involves the injection of model rhizodeposits, consisting of C-14-labelled glucose, root extract or root cell wall material, into the rooted soil of an unlabelled plant, simultaneously with the pulse-labelling of a separate but similar plant with (CO₂)-C-14. In a growth chamber experiment with 30 day old wheat and barley the contribution of direct root respiration to C-14 soil/root respiration over a 26 day period after labelling was estimated 89-95%. Estimates of direct root respiration in field-grown wheat and barley at different development stages in most cases accounted for at least 75% of C-14 soil/root respiration over a 21 day period after labelling. The mineralization rate of injected C-14-glucose was positively correlated with the concentration of glucose-C established in soil. The use of the method in rhizosphere carbon budget estimations is evaluated. [References: 45].

1069 Swinnen, J.; Vanveen, J.A.; Merckx, R. (1994) LOSSES OF C-14 FROM ROOTS OF PULSE-LABELLED WHEAT AND BARLEY DURING WASHING FROM SOIL. *Plant & Soil*. 166(1):93-99. English. [DLO AGROBIOL & SOIL FERTIL RES INST POB 14 6700 AA WAGENINGEN NETHERLANDS].

In crop carbon budget studies losses of root material during storage and washing of samples may cause considerable errors. To correct data from field experiments where rhizosphere C fluxes in wheat and barley were determined by C-14 pulse-labelling at different development stages, experiments were performed to quantify losses of C-14 from roots during washing. Losses of C-14 from wheat roots grown on nutrient solution and stored in different ways, decreased from on average 45% of total C-14 content 8 days after labelling to 27% after 21 days. This decrease was probably related to the incorporation of C-14 into structural compounds. During washing of oven-dried soil cores of field-grown wheat and barley 3 weeks after labelling, different size classes of losses of C-14 from the roots increased substantially with the development stage of the crop at labelling. The 0.3-0.6 mm size class increased from 5% of the C-14 in roots

> 0.3 mm in young plants to 25% at ripening, and the < 0.3 mm size class increased from 8 to 41% of total C-14 content. The latter size class was, however, determined by washing handpicked roots and may therefore partly consist of adhering exudates, mucilages and microorganisms. The effect of development stage on root washing losses was attributed to root senescence which increases the fragility of roots. Thus, especially at the late development stages root washing losses caused a severe underestimation of the root C-14 content. However, with these results the C-14 distribution patterns of the field experiments could be adequately corrected. [References: 14].

F50 PLANT STRUCTURE

1070 Cai Xiwen (Huazhong Agricultural Univ., Wuhan (China)) (1993) Karyotypic evolution of common wheat and hexaploid triticale. *Journal of Huazhong Agricultural University (China)* v. 12(6) p. 535-543. 3 tables, 23 ref. Chinese. (AGRI 95-003087).

1071 Feng Chaozhang; Yu Zegao (Hubei Agricultural Coll., Jiangling (China). Dept. of Agronomy) (1994) Effects of canopy leaves and awns on yield components in wheat. *Journal of Hubei Agricultural College (China)* v. 14(1) p. 1-7. 3 tables, 12 ref. Chinese. (AGRI 95-003088).

1072 Wang Zhifen; Chen Xueliu (Shandong Provincial Academy of Agricultural Sciences, Jinan (China). Inst. for Application of Atomic Energy) (1993) Studies on the change of root vigour for absorption in spring wheat by ³²P tracing. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(4) p. 177-179. 2 ill., 4 ref. Chinese. (AGRI 95-003071).

1073 Wang Zhong; Gu Yunjie; Gao Yuzhu (Jiangsu Agricultural Coll., Yangzhou (China). Dept. of Agronomy) (1993) Structure and photosynthetic characteristics of awns of wheat and barley. *Acta Botanica Sinica (China)* v. 35(12) p. 921-928. 19 ill., 20 ref. Chinese. (AGRI 95-003089).

1074 Xiang Qijun; Wu Lanpei (Beijing Agricultural Univ. (China). Dept. of Agronomy) (1993) Meiotic analysis of the regenerated plants derived from a young spike of octoploid Triticale X *Secale cereale* F1 hybrid. *Acta Botanica Sinica (China)* v. 35(2) p. 99-104. 6 ill., 2 tables, 24 ref. Chinese. (AGRI 95-003086).

F60 PLANT PHYSIOLOGY AND BIOCHEMISTRY

1075 Awasthi, U.D.; Bhan, S. (Chander Shekhar Azad University of Agriculture and Technology, Kanpur (India). Department of Soil Conservation and Water Management) (1994) Physiological response of barley genotypes to nitrogen levels under moisture scarce conditions on light textured soils of central Uttar Pradesh. *Indian Journal of Plant Physiology (India)* v. 37(1) p. 32-34. 2 tables; 7 ref. English. (AGRI 95-013383).

1076 Barclay, K.D.; McKersie, B.D. (1994) PEROXIDATION REACTIONS IN PLANT MEMBRANES - EFFECTS OF FREE FATTY ACIDS. *Lipids*. 29(12):877-882. English. [DALHOUSIE UNIV DEPT PHYSIOL & BIOPHYS HALIFAX NS B3H 4H7 CANADA].

Free fatty acids accumulate in plant membranes after exposure of plants to environmental stress, such as freezing and desiccation. Fatty acid accumulation has been linked to various biophysical changes and to the occurrence of lipid peroxidation, but the relationships appear complex and inconsistent. The interactions between oxygen free radicals, free fatty acids and lipid peroxidation in plant membranes were examined further by studying peroxidation reactions in a model membrane system composed of a complex mixture of plant phospholipids, including various free fatty acids. Multilamellar liposomes were treated with oxygen free radicals generated from iron ascorbate. Increased concentrations of free palmitic acid up to 10 mol% (fatty acid/phospholipid) reduced the production of aldehydes detected by the thio barbituric acid assay, but enhanced the production of fluorescent products. By contrast, increased concentrations of free linolenic acid increased aldehyde production and reduced the formation of fluorescent products. The two free fatty acids

both enhanced the susceptibility of phospholipids to degradation as shown by the reduced recovery of esterified polyunsaturated fatty acids (linoleic and linolenic). The free radical reactions with or without free fatty acid additions catalyzed the selective degradation of phospholipids in the order phosphatidylethanolamine > phosphatidylcholine > phosphatidylinositol > phosphatidylglycerol. Selective degradation of phospholipids is often observed after periods of environmental stress or during senescence of plants, and has been cited as evidence for the involvement of phospholipases in these degenerative processes. The results indicate that selectivity is not a criterion for eliminating the involvement of oxygen free radicals in these degenerative processes. Furthermore, the results suggest that modifications of lipid composition during a plant's acclimation to adverse environments may determine the types of free radical reactions that occur due to stress. [References: 25].

1077 Becker, M.; Vincent, C.; Reid, J.S.G. (1995) BIOSYNTHESIS OF (1, 3)-(1, 4)-BETA-GLUCAN AND (1, 3)-BETA-GLUCAN IN BARLEY (*HORDEUM VULGARE* L.) - PROPERTIES OF THE MEMBRANE-BOUND GLUCAN SYNTHASES. *Planta*. 195(3):331-338. English. [UNIV STIRLING DEPT BIOL & MOLEC SCI STIRLING FK9 4LA SCOTLAND].

Mixed membrane preparations from the coleoptiles and first leaves of young barley (*Hordeum vulgare* L. cv. Triumph) plants catalysed the synthesis of 55% methanol-insoluble labelled material from UDP-[U-C-14]glucose, the main components of which were identified as (1, 3)-(1, 4)-beta- and (1, 3)-beta-D-glucans. The membrane preparations also catalysed the transformation of UDP-glucose into labelled low-molecular-weight products, mainly glucose (by phosphatase action), glucose-1-phosphate (by phosphodiesterase action) and glyco(phospho)lipids (by glycosyltransferase action). The formation of (1, 3)-(1, 4)-beta-glucans, (1, 3)-beta-glucans, and the other reactions competing for UDP-glucose, were monitored simultaneously and quantitatively by a novel procedure based on enzymatic analysis, thin-layer chromatography and digital autoradiography. Thus it was possible (i) to optimise conditions to obtain (1, 3)-(1, 4)-beta-glucan synthesis or (1, 3)-beta-glucan synthesis in isolation, and (ii) to study the influence of temperature, pH, cofactors, substrate concentration etc. on the (1, 3)-(1, 4)- and (1, 3)-beta-glucan synthesis reactions even when both occurred together. The synthesis of both beta-glucans was optimal at 20 degrees C. In Tris-HCl buffer, the pH optima for (1, 3)-(1, 4)-beta-glucan synthesis and (1, 3)-beta-glucan synthesis were pH 8.5 and pH 7.0, respectively. Both glucan-synthesis reactions required Mg²⁺: (1, 3)-beta-glucan synthesis was optimal at 2 mM, whereas (1, 3)-(1, 4)-beta-glucan synthesis continued to increase up to 200 mM Mg²⁺, when the ion was supplied as the sulphate. (1, 3)-beta-Glucan synthesis was Ca²⁺ dependent and this dependence could be abolished by proteinase treatment. The K_m with respect to UDP-glucose was 1.5 mM for (1, 3)-beta-glucan synthesis and approximately 1 mM for (1, 3)-(1, 4)-beta-glucan synthesis. The (1, 3)-(1, 4)-beta-glucan formed in vitro had the same ratio of trisaccharide to tetrasaccharide structural blocks irrespective of the experimental conditions used during the synthesis: its enzymatic fragmentation pattern was indistinguishable from that of barley endosperm (1, 3)-(1, 4)-beta-glucan. This indicates either a single synthase enzyme, which is responsible for the formation of both linkage types, or two enzymes which are very tightly coupled functionally. [References: 27].

1078 Bernardvaille, M.A.; Besle, J.M.; Dore, J. (1995) TRANSFORMATION OF C-14-LIGNIN-LABELED CELL WALLS OF WHEAT BY SYNTROPHOCOCCUS SUCROMUTANS, EUBACTERIUM OXIDOREDUCTENS, AND NEOCALLIMASTIX FRONTALIS. *Applied & Environmental Microbiology*. 61(1):379-381. English. [INRA CLERMONT FERRAND THEIX UNITE DIGEST MICROBIENNE F-63122 ST GENES CHAMPANE FRANCE].

Wheat cell walls, saponified or not, labeled with [U-C-14]phenylalanine or [O-methyl-C-14]sinapate were fermented by *Neocallimastix frontalis* or *Syntrophococcus sucromutans* plus *Eubacterium oxidoreductens* or a mixed culture. Phenolics were less solubilized but more transformed by bacteria than by the fungus, and mineralization was slight. *S. sucromutans* O-demethylated [O-methyl-C-14]syringyl lignins, yielding labeled acetate. [References: 21].

1079 Bogdanov, V.P.; Nurminskaya, L.O.; Morozkin, A.D.; Gorpinchenko, T.V.; Rakitin, L.Yu. (1993) [Wheat glutenin complex: fractionation and

sedimentation analysis]. Glyuteninovyj kompleks psheinity:fraksionirovanie i sedimentatsionnye issledovaniya. *Prikladnaya biokhimiya i mikrobiologiya (Russian Federation)* v. 29(5) p. 765-775. 20 ref. Russian. (AGRI 95-013371).

The isolation conditions and molecular weight distribution of the wheat glutenin complex prepared from delipidated wheat flour were studied. The specific volumes and molecular weights of protein particles from some areas of a glutenin chromatogram of Sepharose CL-24B were estimated by ultracentrifugation methods. The results obtained indicate that most of glutenin particles are composed of only a few protein subunits. The protein particles corresponding to the maximum of the molecular weight distribution curve have molecular weights from 100 to 300 kD. Superhigh-molecular weight particles and one-subunit molecules are minor components of the glutenin complex, their content is less than 20%.

1080 Brazdovicova, B.; Vizarova, G.; Zatklikova, T. (1994) THE EFFECT OF ALUMINIUM ON MITOTIC ACTIVITY AND LEVEL OF FREE CYTOKININS IN BARLEY (*HORDEUM VULGARE* L.) ROOTS. *Biologia* 49(6):899-904. English. [SLOVAK ACAD SCI INST ECOBIOL MLYNSKE NIVY 59 BRATISLAVA 81434 SLOVAKIA].

Mitotic activity in root apical meristem was negatively influenced by aluminium sulphate at low concentration (0.025 μ mol.l⁻¹) and acid pH. The low concentration of aluminium sulphate in nutrition medium at pH 4.5 decreased the level of free endogenous cytokinins in young barley plants (*Hordeum vulgare* L.) as compared with the effect of pH 4.5 and 5.5. Different concentrations of Al(OH)₃ (3, 6, and 12 μ mol.l⁻¹), respectively) and pH (5.5 control; 4.5 and 6.7) inhibited the mitotic activity mainly at pH 6.7. Also the level of free cytokinins was decreased. The mitotic activity in root apical meristem correlated with the level of free endogenous cytokinins.

1081 Chang, H.G.; Park, G.G. (Kyungwon University, Sungnam (Korea Republic). Department of Food Science and Technology) (1993) Changes in physicochemical characteristics of barley during kernel maturation. *Korean Journal of Food Science and Technology (Korea Republic)* v.25(6) p.602-607. 3 illus.; 9 tables; 13 ref. Korean. (AGRI 95-003217).

1082 Christerson, P. (1994) [Beta-glucans in barley and oats]. Beta-glukan i korn och havre. *Publikation - Sveriges Lantbruksuniversitet, Institutionen for Livsmedelsvetenskap (Sweden)*; no. 18 37 p. ref. p. 31-37. Swedish. (AGRI 95-003219).

1083 Cyrus, P. (Vysoka Skola Pedagogicka, Hradec Kralove (Czech Republic)) (1994) [Coefficient of smoothing friction of wheat caryopses at smoothing along the material of stainless steel, perspex, novodur, polypropylene]. Soucinitel smykoveho treni obilek psenice pri smyku po materialech nerez plech, plexi, novodur, polypropylen. *Zemedelska Technika - UZPI (Czech Republic)* v. 40(3) p. 161-176. 5 graphs, 1 ill., 5 schemes, 2 tables; 10 ref. Czech. (AGRI 95-013369).

1084 Delahoz, P.S.; Castagnaro, A.; Carbonero, P. (1994) SHARP DIVERGENCE BETWEEN WHEAT AND BARLEY AT LOCI ENCODING NOVEL MEMBERS OF THE TRYPSIN ALPHA-AMYLASE INHIBITORS FAMILY. *Plant Molecular Biology* 26(4):1231-1236. English. [UNIV POLITECN MADRID ETS INGN AGRON DEPT BIOTECNOL BIOQUIM & BIOL MOLEC LAB E-28040 MADRID SPAIN].

Amino acid sequences for three members (CMx1, CMx2, and CMx3) of a new subfamily of trypsin/alpha-amylase inhibitors in wheat have been deduced from the nucleotide sequences of the corresponding cDNAs. A cDNA clone encoding CMx1 was selected from a wheat developing endosperm library using a probe that encoded barley trypsin inhibitor BTI-CMe at low stringency. Sequences corresponding to CMx2 and CMx3 were obtained from cDNA amplified by the polymerase chain reaction. The three CMx sequences contain a premature stop codon after 363 nt, as well as a second stop codon at the same position as in BTI-CMe (nt 439-441). Southern analysis of DNAs from diploid, tetraploid, and hexaploid wheats, as well as from aneuploid lines, indicate that there is a single CMx locus in each of the three genomes of hexaploid wheat, respectively associated with chromosomal arms 4AS, 4BS, and 4DL. These genes are expressed early during endosperm development and not expressed at

detectable levels in other tissues. Evolutionary implications are discussed. [References: 19].

1085 Dietz, K.J.; Klughammer, B.; Lang, B.; Thume, M. (1994) Solute transport across the tonoplast of barley mesophyll vacuoles: Mg²⁺ determines the specificity, and ATP and lipophilic amino acids the activity of the amino acid carrier. *The Journal of membrane biology (USA)* v. 137(2) p. 151-158. references. English. (AGRI 95-003221).

1086 Hailu Beyene (IAR, Addis Abeba (Ethiopia)) (1994) Herbicide Use for Sustainable Bread Wheat Production in the Central Highlands of Ethiopia. 8. Regional Wheat workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 186-191. CIMMYT. 4 tables; 13 ref. English. (AGRI 95-003263).

Bread wheat is one of the most important cereals in the central highlands of Ethiopia, and is grown mainly under rainfed conditions by subsistence farmers. The national mean wheat grain yield for subsistence farmers is less than 1.5 t/ha. Weed competition is one of the factors causing significant yield losses. In addition, labor shortages due to overlapping operations often result in late weeding or no weeding for the wheat crop. Consequently, wheat yields remain low in some regions, making wheat production unsustainable. During the 1991 and 1992 crop seasons, post-emergence grass herbicides were found to be both economical for wheat production and effective in releasing labor for timely hand weeding of other crops. Wheat yields were increased by 26 percent while 111 work-days of labor per ha of wheat were released for weeding faba bean. However, the use of herbicides for sustainable wheat production will depend on government policy which in the past has discouraged this practice by peasant farmers.

1087 Harthill, J.E.; Thomsen, K.K. (1995) ANALYSIS OF GLYCAN STRUCTURES OF BARLEY (1-3, 1-4)-BETA-D-GLUCAN 4-GLUCANOHYDROLASE ISOENZYME EII. *Plant Physiology & Biochemistry* 33(1):9-18. English. [CARLSBERG LAB DEPT PHYSIOL GAMLE CARLSBERG VEJ 10 DK-2500 COPENHAGEN DENMARK].

Barley (1-3, 1-4)-beta-glucanase (EC 3.2.1.73) isoenzyme EII has only one site for potential N-glycosylation. The carbohydrate moieties were released as oligosaccharides by hydrazinolysis followed by N-acetylation and reductive labelling with tritiated sodium borohydride. The tritium labelled oligosaccharide mixture was fractionated by Bio-Gel P-4 chromatography and high voltage electrophoresis of borate complexes. Partial exoglycosidase sequencing and co-electrophoresis with plant N-glycans of known structure made it possible to assign tentative structures to the five major oligosaccharide fractions obtained, representing about 85% of the labelled glycans. More than 50% of the N-glycan structures present are substituted with alpha-fucose, presumably in 3-linkage to the reducing terminal N-acetylglucosamine which is characteristic of plant modified-type N-glycans. Substitution of fucose in this position confers on the glycoprotein resistance to the enzyme most often used for deglycosylation, glycopeptidase F. [References: 28].

1088 Hong, B.H.; Yoo, S.D. (Korea University, Seoul (Korea Republic). College of Natural Resources) (1994) Studies on selection of dietary fiber resources (1). Varietal variation of beta-glucan in barley grain. *Korean Journal of Breeding (Korea Republic)* v.25(4) p.307-314. 1 illus.; 8 tables; 15 ref. Korean. (AGRI 95-013378).

1089 Hong, B.H.; Yoo, S.D. (Korea University, Seoul (Korea Republic). College of Natural Resources) (1994) Studies on selection of dietary fiber resources (2). Quantity of fractional beta-glucan in barley. *Korean Journal of Breeding (Korea Republic)* v.25(4) p.315-321. 2 illus.; 5 tables; 10 ref. Korean. (AGRI 95-013379).

1090 Ivanov, I.I.; Trapeznikov, V.K.; Kudoyarova, G.R. (1993) [Cytokinins and abscisic acid in the wheat roots at local increased levels of nutrient elements in the medium]. Tsitokininy i abstsizovaya kislota v kornyakh psheinity pri lokal'nom povyshenii kontsentratsii ehlementov pitaniya v srede. *Fiziologiya i biokhimiya kul'turnykh rastenij (Russian Federation)* v. 25(no.4) p. 356-362. 19 ref. Russian. (AGRI 95-003270).

As shown by ELISA, a primary hormonal response to local enrichment of nutrient medium is formed during no more than 6 hours in the spring wheat seedling roots. The whole root system is involved in the reaction to heterogeneous nutrition, including low-salt roots, not affected by the concentrated nutrient solution. Seven days after the local effect of nutrient salts, hormonal differentiation of the root system is established: concentrations of ABA and zeatin-like substances in high-salt roots exceed significantly the same indexes for low-salt ones but do not differ from the hormone concentrations in the plant roots exposed to total salt treatment. Hormonal differentiation of the root system is discussed as one of the mechanisms underlying the physiological action of local fertilization.

1091 Kanazawa, K.; Higuchi, K.; Nishizawa, N.K.; Fushiyu, S.; Chino, M.; Mori, S. (1994) NICOTIANAMINE AMINOTRANSFERASE ACTIVITIES ARE CORRELATED TO THE PHYTOSIDEROPHORE SECRETIONS UNDER FE-DEFICIENT CONDITIONS IN GRAMINEAE. *Journal of Experimental Botany*. 45(281):1903-1906. English. [UNIV TOKYO DEPT AGR CHEM BUNKYO KU YAYOI 1-1-1 TOKYO 113 JAPAN].

The activities of nicotianamine aminotransferase, one of the enzymes for the biosynthesis of mugineic acid-family phytosiderophores, were examined in six graminaceous species. The enzyme activities were induced by Fe-deficiency treatments in all species tested and had a considerable correlation to the amounts of secreted mugineic acids. [References: 15].

1092 Karsai, I.; Bedo, Z.; Hayes, P.M. (1994) EFFECT OF INDUCTION MEDIUM PH AND MALTOSE CONCENTRATION ON IN VITRO ANDROGENESIS OF HEXAPLOID WINTER TRITICALE AND WHEAT. *Plant Cell Tissue & Organ Culture*. 39(1):49-53. English. [HUNGARIAN ACAD SCI AGR RES INST H-2462 MARTONVASAR HUNGARY].

Low levels of in vitro androgenesis limit the utility of anther culture as a routine tool for the improvement of triticales. The objectives of this research were to determine the effect of induction medium modifications on the embryoid induction (EI) and green plant regeneration (GPR) of three hexaploid winter triticales and a hexaploid winter wheat. Medium modifications were factorial combinations of gelling agents, pH and maltose concentration. There was a significant difference in the response of wheat and triticales. An induction medium pH of 4.8 vs. 5.8 led to higher EI percentages in all cases and in Ficoll containing medium to a significantly higher GPR in the wheat, but it had no effect on the response of the triticales. Maltose at 0.26 M vs. 0.21 M increased the EI of both the triticales and the wheat but led to higher GPR only in the case of wheat. Averaged over genotypes, induction media with agar and Ficoll 400 were superior to the liquid form. In terms of GPR the wheat gave the highest response: 9.1%. The GPR percentages for the triticales ranged from 1.4 to 7.1. Genotype specificity must be overcome if anther culture is to be routinely used in diverse arrays of triticales germplasm. [References: 20].

1093 Khanna, V.K.; Dhaubhadel, S.; Kodali, S.; Garg, G.K. (1994) EFFECT OF HORMONES ON WHEAT BARLEY CROSSES, EMBRYO RESCUE AND MITOTIC AND ISOZYMIC STUDIES IN HYBRIDS. *Current Science*. 67(12):1003-1012. English. [GOVIND BALLABH PANT UNIV AGR & TECHNOL DEPT PLANT BREEDING PANTNAGAR 263145 UTTAR PRADESH INDIA].

The objective of this study was to investigate the effect of application of gibberellic acid and kinetin on pollen germination, pollen tube growth and seed set in wheat-barley crosses and to find out the best timing of their application on flowers in order to get maximum seed set. Embryo rescue was also tried to obtain the hybrid plants, and mitosis and isozymic analysis was done to confirm their hybridity. Seed set was more in barley-wheat cross than in its reciprocal cross. The different hormonal treatments had a drastic effect on pollen tube growth and abnormal pollen tubes. The correlation between pollen tube growth and seed set was also found to be highly significant. Maximum seed was obtained in the crosses where gibberellic acid was applied 5 min after pollination, followed by another application after 24 h. The best age of the hybrid embryos to be rescued from in vivo condition was 17-19 days after pollination, which produced healthy-looking plantlets. Out of the five different modified Murashige-Skoog (MS) media with growth regulators, modified MS media with 2, 4-dichlorophenoxyacetic acid (1 mg/l) and

kinetin (0.5 mg/l) gave the best results. Mitotic abnormalities of chromosomes in the hybrid root tips were in the form of bridges at anaphase, and somatic chromosome numbers in these were 21 and 28 in most of the cases but in one cell 35 chromosomes could be counted. In both the isoenzymes studied, i.e. peroxidase and esterase, the hybrids showed a combination of both the parental bands, but some new bands also appeared at different positions with different intensities. Some parental bands were missing in all the hybrids. [References: 40].

1094 Kolupaev, Yu.E.; Borisenko, L.R.; Ryabchun, N.I. (1993) [Manifestation peculiarities of invertase activity under hyperthermia in connection with frost hardiness of winter cereals (Triticum, Secale cereale)]. *Osobennosti proyavleniya aktivnosti invertazy v usloviyakh glipotermii v svyazi s morozostojkost'yu ozimnykh zlakov. Fiziologiya i biokhimiya kul'turnykh rastenij (Russian Federation)* v. 25(no.4) p. 387-393. 17 ref. Russian. (AGRIC 95-003254).

The nature of expression of invertase activity in the winter wheat and rye varieties, digging in frost hardness under the effect of low temperature has been studied. In field trials during overwintering we have not registered any significant differences in invertase activity in tillering nodes of the wheat varieties, differing in frost hardness; rye varieties were remarkable for higher activity in comparison with wheat. In response to cryoloading, applied to the plants selected in the field in the middle of overwintering, there were some differences in invertase activity; it increased in frost resistant rye and wheat varieties, but decreased in low frost resistant ones. The investigation of invertase activity using model objects - wheat seedling and coleoptiles - showed different nature of variation in invertase activity: in the process of hardening in frost resistant varieties its activity was lower, than that in low frost resistant ones while under the effect of low temperatures there was the reverse correlation: enzyme activity was considerably higher in frost resistant varieties, then in low frost resistant ones.

1095 Li Keyou (Shaanxi Provincial Inst. of Forestry, Yangling (China)) (1993) Lamina-isoelectrofocusing techniques used in isolating esterase-isozyme of common wheat. *Shaanxi Journal of Agricultural Sciences (China)* (no. 6) p. 39. Chinese. (AGRIC 95-003265).

1096 Massantini, F.; Masoni, A. (Pisa Univ. (Italy). Dipartimento di Agronomia e Gestione dell'Agroecosistema) (1993) [Relationship between nitrogen content and spectral properties in corn (Zea mays L.) and wheat (Triticum aestivum L.) leaves (Tuscany)]. *Le modificazioni della radiazione luminosa indotte dalle foglie come indice del loro contenuto di azoto (Toscana)*. *Societa Italiana di Agronomia*. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 398-403. 1 table; 4 graphs; 13 ref. Italian. (AGRIC 95-003236).

The relations between corn and wheat leaf nitrogen concentration and reflectance, absorbance and transmittance have been studied. Leaf nitrogen content was modified increasing crop nitrogen fertilizer rate. For corn, data derived from measurements carried out at 2 different stages (3 and 5) on 2 leaves growing at different stem height and for wheat, measurements were taken on flag leaf at inflorescence emergence stage. Spectral reflectance and transmittance were determined, in vivo, using a hand-held spectroradiometer connected to an external integrating sphere in a spectral band ranging from 400 to 1,100 nm. Absorbance was computed. The relations between corn and wheat leaf nitrogen concentration and reflectance, absorbance and transmittance were curvilinear with progressive decrease in reflectance and transmittance and progressive increase in absorbance. At the same leaf N concentration, corn leaf absorbance was higher than wheat and reflectance and transmittance was lower. Within the PAR region TM2 region TM2 was always the most sensitive to the variations of leaf nitrogen content.

1097 Menkovska, M. ("Zyto Skopje", Skopje, Macedonia, Former Yugoslav Republic) (1994) Characterization of gluten proteins and wheat technological quality. Faculty of Agriculture, Belgrade (Yugoslavia). *Review of research work at the Faculty of Agriculture (Yugoslavia)* v. 39(1) p. 29-40. 4 ill.; 7 tables; 28 ref. English. (AGRIC 95-003268).

Ten wheat varieties, *Triticum aestivum* of domestic origin, the Skopje region (Macedonia, Former Yugoslav Republic), were analyzed for their gross composition and functional properties (milling and bread-making).

Varieties were milled into flour on an experimental Buhler mill according to the standardized method. Significant relationship between the presence of particular gliadin blocks and high molecular weight glutenin subunits and functional properties of the wheat varieties (milling and bread-making) was established.

1098 Pande, P.C.; Datta, P.S.; Bhattacharya, S.K. (Indian Agricultural Research Institute, New Delhi (India). Nuclear Research Laboratory) (1994) Biphasic enrichment of H₂ 18O in developing wheat grain water. *Indian Journal of Plant Physiology (India)* v. 37(1) p. 30-31. 1 ill., 8 ref. English. (AGRIS 95-013370).

1099 Perras, M.R.; Abrams, S.R.; Balsevich, J.J. (1994) CHARACTERIZATION OF AN ABSCISIC ACID CARRIER IN SUSPENSION-CULTURED BARLEY CELLS. *Journal of Experimental Botany*. 45(280):1565-1573. English. [UNIV WINNIPEG DEPT PLANT SCI WINNIPEG R3T 2N2 MB CANADA].

The uptake of [³H]-abscisic acid in barley (*Hordeum vulgare* L. cv. Heartland) cell cultures was found to be mediated through both non-saturable and saturable components. The kinetic parameters of the saturable component, determined at pH 4.5 and 21 degrees C, showed a K_m for natural or (+)-ABA of 1.3+/-0.7 μM and an apparent V_{max} of 7.0+/-2.8 nmol g⁻¹ cells h⁻¹. The carrier showed a strong preference for the natural enantiomer of ABA as compared to the unnatural one. Other substances tested, e.g. amino acids, organic acids, and other growth regulators, did not appear to interfere with the carrier-mediated uptake of ABA. At low external concentrations of ABA (below 2.0 μM), the saturable component was greater than the diffusion component. Similarly, between pH 4.0 and 6.0, the saturable uptake was responsible for more than 50% of the total uptake. The carrier may be important in vivo for mediating uptake when endogenous levels of ABA are low (c. 1 μM). The carrier specificity was evident in inhibition experiments done with ABA analogues. Our data showed that the carrier could accommodate small modifications in the ABA structure. Four analogues were able to compete efficiently with (+)-ABA for the binding site of the carrier. Three of these competitors were of the (+)-series. Only one (-)-analogue, (-)-ABA, was able to inhibit markedly the saturable uptake of (+)-ABA. The induction of the ABA-responsive gene WCS120 (Houde et al., 1992) presented stricter requirements for the ABA molecule than the carrier, although with a similar preference for the (+)-analogues. Besides (+)-ABA itself, only two of the analogues tested, both (+)-series, were able to induce the WCS120 gene after a 24 h incubation period. The absence of correlation between the activity of the analogues as ABA inhibitors in the carrier system, and their capacity to induce the WCS120 gene tend to suggest that the carrier is not directly involved in the signal transduction pathway leading to the induction of this specific gene. [References: 32].

1100 Rascio, A.; Platani, C.; Tonti, A.; Ronga, G.; Di Fonzo, N. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) [Soil moisture determination to obtain a non destructive determination of plant water status in durum wheat (*Triticum durum* Desf.). Misure dell'umidità del terreno per una stima non distruttiva dello stato idrico delle piante di frumento (*Triticum durum* Desf.). *Rivista di Agronomia (Italy)* v. 28(1) p. 31-35. 1 table; 4 graphs; 14 ref. Italian. (AGRIS 95-003269).

To verify if gravimetric non destructive determination of soil moisture may be predictive of leaf water status two experiments have been conducted in a growth chamber. Plants of durum wheat ("Capeiti 8" cv.) have been used, that have been subjected to different drought stress conditions, during plant growth cycle. Soil moisture has been estimated by weighing the pot, while leaf water status has been determined by water potential and relative water content measurements. Leaf water potential has been affected by soil moisture content, plant growth stage, mode of drought stress inducement and drought intensity. With a good approximation, it is possible to estimate the leaf water potential (but not the RWC) by weighing the pot for soil moisture humidity greater than 20%; however it is necessary to construct the relationship: leaf water potential-pot humidity for the examined growth stage and stress type.

1101 Sekhon, N.K.; Singh, G. (Punjab Agricultural University, Ludhiana (India)) (1994) Effect of growth regulators and date of sowing on grain development in wheat. *Indian Journal of Plant Physiology (India)* v. 37(1) p. 1-4. 1 table; 3 ill., 11 ref. English. (AGRIS 95-013413).

1102 Tomos, D.; Pritchard, J. (1994) BIOPHYSICAL AND BIOCHEMICAL CONTROL OF CELL EXPANSION IN ROOTS AND LEAVES. *Journal of Experimental Botany*. 45(280 Special Issue S1):1721-1731. English. [COLEG PRIFYSGOL GOGLEDD CYMRU YSGOL GWYDDORAU BIOLEG BANGOR LL57 2UW GWYNEDD WALES].

The endogenous regulation of the extension of cells and tissues appears to be dominated by cell wall mechanics. By simultaneously measuring growth rate at near-single cell resolution and single cell turgor pressure we have begun to chart the behaviour of an expanding cell as it passes from the meristem to the mature region of the roots of maize, wheat, barley, tomato, and *Pinus pinaster*. A key feature is that turgor pressure is unchanged throughout the development of the cell. Two phases can be distinguished within the expanding zone. (i) An acceleration phase in which the cell walls loosen. The cells of this phase can rapidly alter their wall mechanics following water stress and have the most powerful capacity for osmotic adjustment. This phase is associated with a peak in the activity of the potential cell-wall-loosening enzyme XET. (ii) A decelerating phase in which the walls stiffen. This phase can be initiated prematurely by a number of external factors such as NaCl, high osmotic pressure, galactose and, possibly, soil impedance. The corresponding behaviour of examples of leaf (*Lolium*, wheat and barley) and stem (*Sinapis*) growth are discussed. Finally the presence of, and roles for, high concentrations of solutes in the walls of expanding cells are discussed. In this context motor cells that are responsible for reversible movement (e.g. those of *Phaseolus pulvini*) are compared and contrasted with those undergoing irreversible growth. In the pulvini, movement is due to changes in turgor pressure brought about by changes in the apoplast osmotic pressure. [References: 59].

E61 PLANT PHYSIOLOGY-NUTRITION

1103 Chirkova, T.V.; Zhukova, T.M.; Belyaeva, A.I. (1993) [On the problem of Ca²⁺ role in cell permeability of wheat and rice seedling roots under different aeration conditions]. *K voprosu o roli Ca²⁺ v kletochnoj pronitsaemosti kornej proroskov pshenitsy i risa v razlichnykh usloviyakh aehratsii. Fiziologiya i biokhimiya kul'turnykh rastenij (Russian Federation)* v. 25(no.4) p. 340-346. 11 ref. Russian. (AGRIS 95-003600).

The changes in Ca²⁺-ion content in the roots and solutions, surrounding roots in the wheat and rice seedlings has been studied under anaerobiosis. The anaerobiosis was shown to increase Ca²⁺-efflux from the wheat roots more than from rice ones. The preliminary processing of seedlings by exogenous 5x10⁻⁴ M CaCl₂ inhibited the Ca²⁺-efflux from the rice roots, while such stabilizing effect of calcium was not observed in the wheat. Calcium effect on membrane permeability was blocked in the case of EDTA (10⁻³ M) fixation of bivalent cations. It was shown when using calcium channel blockers: nifedipin (10⁻⁴ M) and verapamil (10⁻⁴ M) that under anaerobic conditions Ca²⁺ transport is to the great extent connected with the activity of calcium channels.

1104 Devienne, F. (1993) [The effect of external nitrate concentration on uptake and fluxes of nitrogen and on growth of wheat [compartmental analysis]]. *Influence de la concentration en nitrate du milieu sur les flux d'absorption d'azote et la croissance du ble [analyse compartimentale]*. Institut National Agronomique Paris Grignon (France); Institut National de la Recherche Agronomique, Versailles (France). Centre de Versailles, Metabolisme et Nutrition des Plantes. ref., tableaux, graph. 170 p. French. (AGRIS 95-003608).

1105 Kondrat'ev, M.N.; Lebedinskaya, S.O. (1993) [Dynamics of nitrate reductase activity in spring wheat plants under different moisture level during generative period]. *Dinamika nitratvosstanovitel'noj sposobnosti rastenij yarovoj pshenitsy pri razlichnoj vlagobespechennosti v generativnyj period. Izvestiya Timiryazevskoj sel'skokhozyajstvennoj akademii (Russian Federation) (no.3)* p. 143-153. 16 ref. Russian. (AGRIS 95-013708).

Series of experiments conducted in controlled conditions (sand culture, 1.5 normal Knopp mixture in optimum and insufficient sand humidity) explained the dynamics of nitrate reductase activity (NRA) and nitrogen

redistribution in two spring wheat varieties, belonging to different ecology types. It has been found that the change of plant NRA during ontogenesis was identical in both studied varieties. Contribution of every plant organ to NRA of a whole plant was estimated at different stages of plant development. There are enough experimental facts proving the absence of a strong genetic control over plant NRA.

1106 Loue, A. (1993) [20. Tropical food crops]. 20. Les cultures vivrières tropicales. [Trace elements in agriculture]. Oligoelements en agriculture. Société Commerciale des Potasses et de l'Azote, Aspach le Bas (France) p. 465-484. Nathan. 117 ref., 8 tableaux. French. (AGRIS 95-003568).

1107 Merbach, W. (Zentrum fuer Agrarlandschafts und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion); Augustin, J.; Jacob, H.J. (1993) [(14)C utilization from spring wheat during ontogenesis]. (14)C-Verwertung von Sommerweizen im Verlauf der Ontogenese. Oekophysiologie des Wurzelraumes; Borkheide (Germany); 30 Aug - 1 Sep 1993. (Proceedings of the 4th scientific workshop). Merbach, W. Deutsche Landakademie "Thomas Muentzer", Borkheide (Germany); Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion no. 4, p. 64-67. Selbstverlag. 3 tables; 6 ref. German. (AGRIS 95-003567).

1108 Meyer, D. (Goettingen Univ. (Germany). Inst. fuer Agrikulturchemie); Jungk, A. (1993) [Kinetics of potassium uptake of cultivated plants influenced by temperature and supply state with potassium]. Kinetik der Kaliumaufnahme von Kulturpflanzen unter dem Einfluss der Temperatur und des Kaliumversorgungszustandes. Oekophysiologie des Wurzelraumes; Borkheide (Germany); 30 Aug - 1 Sep 1993. (Proceedings of the 4th scientific workshop). Merbach, W. Deutsche Landakademie "Thomas Muentzer", Borkheide (Germany); Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion no. 4, p. 45-48. Selbstverlag. 3 ill., 1 table; 3 ref. German. (AGRIS 95-003693).

1109 Rizza, F.; Crosatti, C.; Cattivelli, L.; Delogu, G.; Stanca, A.M. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1993) [Effects of agronomic factors on photosynthetic efficiency of flag leaf in old and new barley (*Hordeum vulgare* L.) varieties (Emilia-Romagna)]. Effetti di fattori agronomici sull'efficienza fotosintetica della foglia bandiera in vecchie e nuove varietà di orzo (*Hordeum vulgare* L.) (Emilia Romagna). Società Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 578-582. 4 tables; 12 ref. Italian. (AGRIS 95-003583).

Due to breeding improvement barley showed an increasing yield during the last century. Several physiological parameters have been modified over this period and particularly the harvest index that increased up to 0.50 in the modern varieties. In this work we have investigated if also other parameters, such those related to photosynthetic activity, have been modified by selection. A new high yielding cultivar (Tebbia) has been compared with two old varieties (Orazio and Agello) and a local population from South Italy. Tebbia as aspect showed in 2 year trials both under low and high input conditions, higher yielding and lower LAI+SAI compared with the other genotypes. The photosynthetic activity of flag leaf at anthesis and 15 days after flowering was higher in Tebbia than in the other genotypes when measured at all the agronomic conditions. This fact indicates that this character has had a particular role on the high yield stability.

1110 Shevchenko, O.V.; Kochubej, S.M. (1993) [Variations of structural organization of leaf pigmentary apparatus at different vegetation phases of winter wheat]. Izmeneniya strukturnoj organizatsii pigmentnogo apparata list'ev ozimoy pshenitsy v razlichnye fazy vegetatsii. *Fiziologiya rastenij (Russian Federation)* v. 40(5) p. 749-753. 15 ref. Russian. (AGRIS 95-013718).

1111 Sun Lianfa; Qi Shiyu; Xiao Zhimin (Heilongjiang Provincial Academy of Agricultural Science, Harbin (China). Inst. of Crop Breeding) (1994) Effect of light length and its pattern on growth of different photosensitive spring wheats. *Heilongjiang Agricultural Sciences (China)* (no. 1) p. 13-15. 4 tables, 2 ref. Chinese. (AGRIS 95-003566).

F62 PLANT PHYSIOLOGY-GROWTH AND DEVELOPMENT

1112 Abdin, M.Z.; Kaim, M.S.; Bansal, K.C.; Abrol, Y.P. (1994) NITRATE ASSIMILATION AND NITROGEN HARVEST IN UNICULM GIGAS WHEAT (*TRITICUM AESTIVUM* L.). *Journal of Agronomy & Crop Science-Zeitschrift fuer Acker und Pflanzenbau*. 173(3-4):225-229. English. [HAMDARD UNIV FAC SCI DEPT BOT NEW DELHI 110062 INDIA].

Contribution of the upper laminae designated as 7, 8 and 9 (flag), to the total reduced nitrogen was determined by two different methods; integration of nitrate reductase activity over the entire growing season of individual laminae, and laminae removal at ear emergence. The values obtained by these methods were: 20, 14, and 12%, and 23, 15, 12%, respectively. The in vivo nitrate reductase activity was relatively higher in the lamina 9, which contributed an extra 8% towards total reduced nitrogen when the other laminae were removed from the shoot. No such compensatory response was observed when either lamina 7 or 8 was retained. [References: 22].

1113 Acharya, C.L.; Sharma, P.D. (1994) TILLAGE AND MULCH EFFECTS ON SOIL PHYSICAL ENVIRONMENT, ROOT GROWTH, NUTRIENT UPTAKE AND YIELD OF MAIZE AND WHEAT ON AN ALFISOL IN NORTH-WEST INDIA. *Soil & Tillage Research*. 32(4):291-302. English. [HIMACHAL PRADESH AGR UNIV DEPT SOIL SCI PALAMPUR 176062 HIMACHAL PRADESH INDIA].

Field experiments were conducted for 6 years on a silty clay loam to study the effect of soil management on soil physical properties, root growth, nutrient uptake and yield of rainfed maize (*Zea mays* L.) and wheat (*Triticum aestivum* L.) grown in a sequence. Treatments were: no-tillage (NT), NT+pine needle mulch at a rate of 10 t ha⁻¹ (NT+M), conventional tillage (CT), CT+pine needle mulch at a rate of 10 t ha⁻¹ (CT+M) and deep tillage (DT). The soil is classified as a Typic Hapludalf and has compact sub-surface layers. The NT treatment increased the bulk density of the surface layer but this problem was not observed in the no-tilled treatment having mulch at the surface (NT+M). The CT+M and NT+M treatments favourably moderated the hydro-thermal regime resulting in greater root growth, nutrient uptake and grain yields of maize and wheat. The DT treatment, imposed only once, at the beginning of the study, also enhanced root growth and grain yields. The yields were similar to the mulched treatments for maize and somewhat less than the mulched treatments for wheat. Mulched treatments generally showed significantly greater total uptake of N, P and K than corresponding unmulched ones. Since NT+M was comparable to CT for maize and superior for wheat, the latter is preferable since it does not require elaborate tillage. [References: 19].

1114 Akhtar, J.; Gorham, J.; Qureshi, R.H. (1994) COMBINED EFFECT OF SALINITY AND HYPOXIA IN WHEAT (*TRITICUM AESTIVUM* L.) AND WHEAT *THINOPYRUM* AMPHIPLOIDS. *Plant & Soil*. 166(1):47-54. English. [UNIV COLL N WALES SCH BIOL SCI BANGOR LL57 2UW GWYNEDD WALES].

The effects of sodium chloride salinity and hypoxia were studied in eight wheat lines and three wheat-*Thinopyrum* amphiploids in vermiculite-gravel culture. The lines were treated with either 100 or 150 mol m⁻³ NaCl with and without hypoxia. Saline hypoxic conditions significantly reduced the vegetative growth, water use, grain and straw yields for all wheat varieties except the amphiploids, whereas NaCl or hypoxia alone had less pronounced effects. In addition, saline hypoxic stress reduced K⁺ concentration and increased significantly the Na⁺ and Cl⁻ concentrations in cell sap expressed from leaves. There was more Na⁺ and Cl⁻ accumulation in wheats than the amphiploids in hypoxic conditions at 150 mol m⁻³ NaCl. Of the wheats, Pato was the most sensitive at all stress levels while a *Triticum aestivum* cv. Chinese Spring x *Thinopyrum elongatum* amphiploid was the most tolerant of the three amphiploids. [References: 27].

1115 Ali, Z.I.; Mahalakshmi, V.; Singh, M.; Ortizferrara, G.; Peacock, J.M. (1994) VARIATION IN CARDINAL TEMPERATURES FOR GERMINATION AMONG WHEAT (*TRITICUM-AESTIVUM*)

GENOTYPES. *Annals of Applied Biology*. 125(2):367-375. English. [AGRES CORP WAD MADANI SUDAN].

In most tropical regions where wheat is grown under irrigation, high temperatures at sowing adversely affect crop establishment and subsequent seedling survival. The objective of this study was to compare wheat (*Triticum aestivum*) genotypes for their ability to germinate and grow at high temperatures during the seedling stage. Twenty-five seeds each of 14 spring wheat cultivars were placed on moist filter paper at different temperatures (5-degrees-C to 40-degrees-C) in a one-way thermogradient plate to determine the cardinal temperatures for germination. Rate of germination at each temperature for each genotype was computed as the inverse of time taken for 50% of the seeds to germinate. Rate of germination for each genotype at different temperatures was modelled with temperature to determine the base ($t(b)$), and optimum ($t(opt)$) temperatures. Response of germination to temperature for each genotype was calculated as the slope of a linear regression of the rate of germination on temperature below $t(opt)$. Genotypes differed in their optimum temperatures and Mexipak (= Kalyansona) had the lowest. Range in base temperature among the genotypes was between 0-degree-C and 2-degrees-C differences but were not statistically significant though they might be biologically significant. Genotypes differed in their response to temperature with Gomam having the lowest rate, implying that it was slow to respond to increasing temperatures. Debeira and Cham 6 showed a similar response. Three lines which had performed well in spring wheat evaluation trials for moderate rainfall areas under heat stress had the highest response rate. It is concluded that combining higher optimum temperatures with faster response rates would result in better-adapted germplasm for regions where high temperatures persist at sowing. [References: 19].

1116 Andrzejczukhybel, J.; Bartoszewicz, K.; Bielawski, W.; Kaczowski, J. (1994) CHANGES OF ACTIVITY OF SOME HYDROLASES DURING TRITICALE GRAIN DEVELOPMENT DIFFERENTIATED IN PRE-HARVEST SPROUTING RESISTANCE. *Acta Physiologiae Plantarum*. 16(4):279-284. English. [AGR UNIV WARSAW DEPT BIOCHEM RAKOWIECKA 26-30 PL-02528 WARSAW POLAND].

Changes of some hydrolytic enzyme activities were investigated in the developing grains of 5 winter Triticale cultivars of different pre-harvest sprouting resistance. Samples were harvested weekly beginning on ninth day after pollination (dap) until full maturity (7 times) and the following enzymes were analyzed: alpha-amylase and total amylolytic activity, beta-endoglucanase, acid phosphatase and total proteinase. The endogenous alpha-amylase inhibitor level was analysed as well. The intervarietal differences which could be connected with the pre-harvest sprouting resistance were observed only in case of alpha-amylase, beta-endoglucanase and acid phosphatase. The activity of alpha-amylase showed such dependence in the earlier period of development (up to 30 dap) being lower in the resistant varieties and higher in the susceptible ones. beta-endoglucanase showed similar relation but only in the final maturation period. Also the acid phosphatase activity in some harvests was higher in the susceptible varieties than in the resistant ones. However, there are obtained too few data to formulate any final conclusions.

1117 Aslam, M.; Travis, RL.; Huffaker, RC. (1994) STIMULATION OF NITRATE AND NITRITE EFFLUX BY AMMONIUM IN BARLEY (*HORDEUM VULGARE* L.) SEEDLINGS. *Plant Physiology*. 106(4):1293-1301. English. [UNIV CALIF DAVIS DEPT AGRON & RANGE SCI DAVIS, CA 95616 USA].

The inhibitory effect of NH_4^+ on net NO_3^- uptake has been attributed to an enhancement of efflux and, recently, to an inhibition of influx. To study this controversy, we devised treatments to distinguish the effects of NH_4^+ on these two processes. Roots of intact barley (*Hordeum vulgare* L.) seedlings, uninduced or induced with NO_3^- or NO_2^- , were used. Net uptake and efflux, respectively, were determined by following the depletion and accumulation in the external solutions. In roots of both uninduced and NO_2^- -induced seedlings, NO_3^- efflux was negligible; hence, the initial uptake rates were equivalent to influx. Under these conditions, NH_4^+ had little effect on NO_3^- uptake (influx) rates by either the low- or high-K-m uptake systems. In contrast, in plants preloaded with NO_3^- , NH_4^+ and its analog $CH_3NH_3^+$ decreased net uptake, presumably by enhancing NO_3^- efflux. The stimulatory effect of NH_4^+ on

NO_3^- efflux was a function of external NH_4^+ and internal NO_3^- concentration. These results were corroborated by the absence of any effect of NH_4^+ on NO_2^- uptake unless the roots were preloaded with NO_2^- . In this case NH_4^+ increased efflux and decreased net uptake. Hence, the main effect of NH_4^+ on net NO_3^- and NO_2^- uptake appears to be due to enhancement of efflux and not to inhibition of influx. [References: 42].

1118 Awad, F.; Romheld, V.; Marschner, H. (1994) EFFECT OF ROOT EXUDATES ON MOBILIZATION IN THE RHIZOSPHERE AND UPTAKE OF IRON BY WHEAT PLANTS. *Plant & Soil*. 165(2):213-218. English. [NATL RES CTR DEPT SOILS & WATER USE CAIRO EGYPT].

To examine the effect of root exudates (e.g. phytosiderophores) on iron (Fe) mobilization in the rhizosphere and Fe uptake, wheat seedlings (*Triticum aestivum* L. cv. Ares) were precultured for 17 d in nylon bags filled with fine sand and provided with nutrient solution without or with Fe (0.1 mM FeEDTA). After the preculture the nylon bags with the roots of the seedlings (central root compartment, RC) were brought in contact for 4 d with nylon bags filled with calcareous soil (SC). In different distance from the RC (0, 2, 4 mm) the calcareous soil on each side of the RC had been amended with Fe rich sewage sludge resulting in an increase in DTPA-extractable Fe from 1.45 to 4.22 mg Fe kg⁻¹ dry soil. Through the influence of roots in the RC extractable Fe increased in the SC between 2 and 133%. For the untreated soil this relative increase declined with the distance of 0, 2, and 4 mm from the RC from 86, 50, and 41% with Fe adequate plants and from 133, 86, and 35% with Fe deficient plants, respectively. The corresponding values for the sewage sludge treated soil was 13, 2, and 3% with Fe adequate plants and 24, 20, and 1% with Fe deficient plants, respectively. In accordance with the increased Fe solubility in the various SC Fe uptake and growth of wheat were also enhanced during the 4 d treatment. It can be concluded that the higher solubilization and uptake of Fe by the root of the Fe deficient (chlorotic) compared with the Fe sufficient (green) plants is mainly caused by enhanced release of phytosiderophores under Fe deficiency. The increased mobilization of Fe over a distance of up to 4 mm from the RC demonstrates the high capacity of root exudates (e.g. phytosiderophores) for Fe mobilization in the rhizosphere even under non-axenic conditions. [References: 28].

1119 Barkan, A.; Voelker, R.; Mendelhartwig, J.; Johnson, D.; Walker, M. (1995) GENETIC ANALYSIS OF CHLOROPLAST BIOGENESIS IN HIGHER PLANTS. *Physiologia Plantarum*. 93(1):163-170. English. [UNIV OREGON INST MOLEC BIOL EUGENE, OR 97403 USA].

The biogenesis of chloroplasts is genetically complex, involving hundreds of genes distributed between the nucleus and organelle. In higher plants, developmental parameters confer an added layer of complexity upon the genetic control of chloroplast biogenesis: the properties of plastids differ dramatically between different cell types. While the biochemistry and structure of different plastid types have been described in detail, factors that determine the timing and localization of chloroplast development and that mediate chloroplast assembly have remained elusive. To identify nuclear genes that play novel roles in chloroplast biogenesis, we are exploiting nuclear mutations that block the accumulation of subsets of chloroplast proteins. Detailed study of the mutant phenotypes provides clues concerning the primary defect in each mutant. Mutants with defects in chloroplast translation and mRNA metabolism have been identified. Other mutants defective in the accumulation of multiple thylakoid complexes show no apparent defect in the synthesis of the missing proteins. These may identify factors involved in the integration of proteins into the thylakoid membrane acid their assembly into functional complexes. [References: 33].

1120 Bason, ML.; Zounis, S.; Ronalds, JA.; Wrigley, CW. (1995) SEGREGATING RED AND WHITE WHEAT VISUALLY AND WITH A TRISTIMULUS COLOUR METER. *Australian Journal of Agricultural Research*. 46(1):89-98. English. [NEWPORT SCI UNIT 1 2 APOLLO ST WARRIEWOOD NSW 2102 AUSTRALIA].

With red-grained wheat now being grown in Australia in some places, there is a need to segregate it from white grain at the silo to avoid loss of milling and end-use quality. The Minolta tristimulus colour meter and visual inspection have been assessed as possible means to facilitate this segregation. Using only reflected light for sample illumination, 86% of a

restricted sample set were correctly classified visually, and 95% of all samples using the Minolta meter. These values were increased to up to 99% in both cases by additionally using transmitted light to illuminate the samples. Thus both the Minolta and visual methods that included alternate use of both illuminant sources provided good segregation of red and white wheat samples. Sample transillumination was particularly helpful for classifying vitreous white grain, and also red grain that had been bleached by rain. [References: 15].

1121 Basu, U.; Godbold, D.; Taylor, GJ. (1994) ALUMINUM RESISTANCE IN TRITICUM AESTIVUM ASSOCIATED WITH ENHANCED EXUDATION OF MALATE. *Journal of Plant Physiology*. 144(6):747-753. English. [UNIV ALBERTA DEPT BOT EDMONTON T6G 2E9 AB CANADA].

Two aluminum (Al)-resistant (Atlas 66, Maringa) and two Al-sensitive (Roblin, Katepwa) cultivars of *Triticum aestivum* (wheat) were grown under aseptic conditions in the presence and absence of Al to evaluate the potential role of organic anion exudates in conferring resistance to Al. Five organic anions, or-ketoglutarate, citrate, malate, succinate and fumarate, were commonly detected in the root exudates, but only malate and succinate were consistently exuded in all cultivars under all treatments. Under control conditions, malate was exuded in higher quantities from roots of Al-resistant cultivars (Atlas 66 and Maringa), compared with the Al-sensitive cultivars. Exposure to 100 μ M Al increased exudation of malate from roots of Al-resistant cultivars by 100-120%, while in the Al-sensitive cultivars, exudation of malate was reduced. A decrease in exudation of succinate was observed in Atlas 66 and Maringa with 100 μ M Al, while no effect was observed in Roblin and Katepwa. Differences between cultivars in the effect of Al on malate accumulation were detected as early as 24 h after exposure. Addition of exogenous malate (250 μ M to 500 μ M) to nutrient media containing 100 μ M Al restored root elongation in Al-sensitive cultivars, Roblin and Katepwa, to control levels. To determine whether exudation of malate from roots reflected de novo synthesis arising from activity of the TCA cycle, plants were labeled with C-14-acetate. With the exception of acetate itself, malate was the only organic anion in which C-14 was detected. In Al-resistant cultivars, treatment with Al increased exudation of C-14 into malate by 48 to 54% when expressed as a percent of total label in root exudates. In Al-sensitive cultivars, incorporation of C-14 into malate declined by 22 to 29% with exposure to Al. The unique pattern of C-14 labeling and enhanced exudation of malate in the Al-resistant cultivars, Atlas 66 and Maringa, provides strong although indirect evidence for a role of malate in Al-resistance. [References: 25].

1122 Bielawski, W. (1994) EFFECT OF SOME COMPOUNDS ON GLUTAMINE SYNTHETASE ISOFORMS ACTIVITY FROM TRITICALE SEEDLING LEAVES. *Acta Physiologiae Plantarum*. 16(4):303-308. English. [AGR UNIV WARSAW DEPT BIOCHEM PL-02528 WARSAW POLAND].

The Mg^{2+} -dependent activity of the chloroplastic form of glutamine synthetase was activated by hydrosulphide compounds while the activity of the cytoplasmic form of the enzyme did not change under the same conditions. Moreover, the chloroplastic enzyme activity was much stronger inhibited by the inhibitors binding the enzyme SH groups than it happened in case of cytosolic one. Besides the compounds binding the enzyme SH groups, some bivalent metal ions (Mn^{2+} , Co^{2+} , Ca^{2+}) also affected the activity of both forms of glutamine synthetase (GS). Total substitution of the Mg^{2+} with Mn^{2+} or Co^{2+} not only decreases the activity of both GS isoforms but also decreases their substrate specificity to L-glutamate and ATP. Both activities were also inhibited by the reduced forms of glutamate dehydrogenase coenzymes (NADH, NADPH) and such nucleotides as AMP, CTP and GTP.

1123 Blum, A.; Sinmena, B. (1995) ISOLATION AND CHARACTERIZATION OF VARIANT WHEAT CULTIVARS FOR ABA SENSITIVITY. *Plant Cell & Environment*. 18(1):77-83. English. [VOLCANI CTR INST FIELD CROPS POB 6 BET DAGAN ISRAEL].

Genetic variants for abscisic acid (ABA) sensitivity are important for investigating the role of ABA sensitivity in conditioning plant response to environmental stress, and especially to those soil conditions that may elicit a root-mediated hormonal signal. This study was performed in order to isolate variation in ABA sensitivity among wheat (*Triticum aestivum*

and *T. durum*) cultivars, as characterized by two plant responses: (i) shoot growth reduction in response to 5×10^{-2} mol m^{-3} ABA (racemic) in the root medium of hydroponically grown plants, and (ii) changes in transpiration and gas exchange in a bioassay of detached leaves (leaf laminae) infused with 10^{-4} mol m^{-3} ABA. Very significant (P less than or equal to 0.01) and repeatable differences were found among 36 wheat cultivars and 19 landraces in the growth rate in ABA-containing nutrient solutions, expressed as a percentage of the growth rate in control nutrient solutions (ABA/control ratio). In duplicate experiments, the ABA/control ratio ranged between 60 and 83% for the least sensitive cultivars (V2151-3, Bethlehem, K1056 and Sunstar) and between 9 and 19% for the most sensitive cultivars (Sunder, Comet, Barkae and V5). In the transpiration bioassay, performed with seven selected cultivars, it was found that the reductions in transpiration of ABA-infused leaves corresponded very well with the reductions in growth in response to ABA in the root media. Measurement of gas exchange in the detached leaves of two cultivars differing in ABA sensitivity (Bethlehem and Sundor) showed that variable ABA sensitivity was expressed very well in the stomatal conductance, carbon exchange rate (CER) and photosynthetic capacity (CER/C-i ratio) of the leaf. These results therefore allowed us to isolate wheat variants for ABA sensitivity and to conclude that, while ABA sensitivity is expressed in the growth of plants challenged by ABA in the root medium, the control of sensitivity resides, at least partly, in the leaf. [References: 19].

1124 Braun, HP.; Emmermann, M.; Kruf, V.; Bodicker, M.; Schmitz, UK. (1995) THE GENERAL MITOCHONDRIAL PROCESSING PEPTIDASE FROM WHEAT IS INTEGRATED INTO THE CYTOCHROME BC1 COMPLEX OF THE RESPIRATORY CHAIN. *Planta*. 195(3):396-402. English. [INST GENBIOL FORSCH BERLIN GMBH IHNESTR 63 D-14195 BERLIN GERMANY].

The bc(1)-complex (EC 1.10.2.2.) from *Triticum aestivum* L. was purified by cytochrome-c affinity chromatography and gel filtration using either etiolated seedlings or wheat-germ extract as starting material. Sodium dodecyl sulfate-polyacrylamide gel electrophoresis of the isolated enzyme revealed ten bands, which were analysed by immunoblotting and direct amino-acid sequencing. The enzyme from wheat is the first bc(1)-complex that is reported to contain four core proteins (55.5, 55.0, 51.5 and 51.0 kDa). In addition, the wheat bc(1)-complex comprises cytochrome b (35 kDa), cytochrome c(1) (33 kDa) the "Rieske" iron-sulphur protein (25 kDa) and three small subunits < 15 kDa. This composition differs from the one reported in fungi, mammals and potato. Partial sequence determination of the large subunits suggests that the 55.5- and 55.0-kDa-proteins represent the beta-subunit of the general mitochondrial processing peptidase, and the 51.5- and 51.0-kDa proteins the alpha-subunit of this enzyme. The bc(1)-complex from wheat efficiently processes mitochondrial precursor proteins as shown in an in-vitro processing assay. In control experiments the isolated bc(1)-complexes from potato, yeast, *Neurospora* and beef, all purified by the same isolation procedure, were also tested for processing activity. Only the protein complexes from plants contain the general mitochondrial processing peptidase. The composition of the wheat bc(1)-complex sheds new light on the co-evolution of the processing peptidase and the middle segment of the respiratory chain. [References: 50].

1125 Cervato, A. (Universita Cattolica del Sacro Cuore, Piacenza (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee) (1993) The effect of environmental factors on the growth of a wheat cultivar under field conditions [Emilia-Romagna]. *Influenza dei fattori ambientali sulla crescita del frumento tenero in condizioni di pieno campo* [Emilia Romagna]. *Annali della Facolta' di Agraria - Universita' Cattolica del Sacro Cuore, Milano (Italy)* v. 33(2) p. 91-109. 1 table; 12 graphs; 14 ref. Italian. (AGRI 95-003833).

The effects of photosynthetically active radiation (PAR), temperature and soil water content (swc) on the growth of "Mec" wheat were studied during five crop-years. D.m. accumulation depends on intercepted PAR and swc. Yield components develop at a rate depending on temperature but not on assimilation or swc. The phyllocron, the rate of leaf expansion and senescence were function of temperature only. The results are compared with those reported in the literature.

1126 Chen Xueliu; Wang Zhifeng; Yu Meiyang (Shandong Provincial Academy of Agricultural Sciences, Jinan (China). Inst. for Application of

Atomic Energy) (1993) Photosynthetic rate and assimilate distribution for wheat plant during different growing stages. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(5) p. 225-228. 8 tables, 3 ref. Chinese. (AGRIC 95-003827).

1127 Chen, FQ.; Hayes, PM. (1994) NUCLEOTIDE SEQUENCE AND DEVELOPMENTAL EXPRESSION OF DUPLICATED GENES ENCODING PROTEIN DISULFIDE ISOMERASE IN BARLEY (*HORDEUM VULGARE* L.). *Plant Physiology*. 106(4):1705-1706. English. [OREGON STATE UNIV DEPT CROP & SOIL SCI CORVALLIS, OR 97331 USA].

1128 Close, TJ.; Meyer, NC.; Radik, J. (1995) NUCLEOTIDE SEQUENCE OF A GENE ENCODING A 58.5-KILODALTON BARLEY DEHYDRIN THAT LACKS A SERINE TRACT. *Plant Physiology*. 107(1):289-290. English. [UNIV CALIF RIVERSIDE DEPT BOT & PLANT SCI RIVERSIDE, CA 92521 USA].

1129 Darroch, BA.; Baker, RJ. (1995) TWO MEASURES OF GRAIN FILLING IN SPRING WHEAT. *Crop Science*. 35(1):164-168. English. [UNIV SASKATCHEWAN DEPT CROP SCI & PLANT ECOL SASKATOON SK S7N 0W0 CANADA].

Grain weight is a component of grain yield and duration of grain filling is a component of maturity. Both are important traits in applied plant breeding and both depend upon the grain filling process. Grain filling has been described by multi-point and two-point curves. Multipoint curves, based on repeated measurements of grain weight during the grain filling period, are much more demanding of labor and laboratory resources than curves based on records of anthesis, maturity, and final grain weight. To evaluate these two methods of measuring grain filling characteristics, we grew 11 spring wheat cultivars in irrigated and dryland field trials at Saskatoon, SK, Canada in 1989 and 1990. Final grain weight, time to 50% filled, and relative grain growth rate were estimated from logistic curves fitted to grain weights measured twice weekly from anthesis to maturity. Duration of grain filling and average filling rate (harvest grain weight/duration) were estimated from records of anthesis and maturity. Relative grain growth rate was not related to average filling rate ($r = -0.01$), and was less closely related than average filling rate to harvest grain weight ($r = 0.08$ compared with $r = 0.93$, $P = 0.01$). Estimated time to 50% filled was moderately correlated with observed duration ($r = 0.66$, $P = 0.05$) and, compared with observed duration, differences among cultivars were more consistent and less sensitive to environmental influence. Compared with two-point curves, logistic curves provided better estimates of inherent differences in rate and duration of grain filling. However, this advantage does not justify routine use of multi-point curves in plant breeding except where late season stress masks inherent differences in maturity. [References: 13].

1130 Deppert, WR.; Wagner, E. (1995) PURIFICATION OF ADENYLATE KINASE FROM GREEN LEAVES OF BARLEY, MAIZE AND *CHENOPODIUM RUBRUM* L. *Journal of Plant Physiology*. 145(1-2):17-23. English. [UNIV FREIBURG INST BIOL 2 SCHANZLESTR 1 D-79104 FREIBURG GERMANY].

Adenylate kinase (ATP:AMP phosphotransferase, E.C. 2.7.4.3) plays an important role in the regulation of energy metabolism in all living systems. The enzyme has been purified and crystallized from a variety of animals and microorganisms, while purification from plant tissues was described only for leaves from the C-4-plant maize. Here, we present an efficient purification procedure for adenylate kinase derived from green leaves of the C-3-plant barley (*Hordeum vulgare* L.). The same purification procedure was applied to adenylate kinases from leaves of maize (*Zea mays* L.) and *Chenopodium rubrum*. In both these cases, isoforms of adenylate kinase could be purified using an additional affinity chromatography step. The main isoforms of adenylate kinase from all three plants exhibited apparent molecular masses between 25 and 31 kDa according to gel electrophoresis and gel filtration. [References: 15].

1131 Dib, TA.; Monneveux, P.; Acevedo, E.; Nachit, MM. (1994) EVALUATION OF PROLINE ANALYSIS AND CHLOROPHYLL FLUORESCENCE QUENCHING MEASUREMENTS AS DROUGHT TOLERANCE INDICATORS IN DURUM WHEAT (*TRITICUM*

TURGIDUM L VAR *DURUM*). *Euphytica*. 79(1-2):65-73. English. [TISHREEN UNIV FAC AGR LATAKIA SYRIA].

The possibility of using proline accumulation and fluorescence inhibition as predictive tests for drought tolerance in durum wheat has been investigated. The drought susceptibility of 25 genotypes was evaluated by comparing yields and yield components in irrigated and non irrigated conditions in the field. A drought susceptibility index (DSI) was calculated based on yields from irrigated and dry treatments and compared with the results obtained using the two physiological criteria. Proline accumulation and chlorophyll fluorescence inhibition were found to be significantly and negatively correlated with DSI of grain yield, biological yield, and thousand kernel weight, and tiller index. The use of both criteria for breeding durum wheat in Mediterranean dryland is discussed. [References: 28].

1132 Elsharif, M.; Grossmann, F. (1994) COMPARATIVE INVESTIGATIONS ON THE ANTAGONISTIC ACTIVITY OF FLUORESCENT PSEUDOMONADS AGAINST *GAEUMANNOMYCES-GRAMINIS* VAR *TRITICI* INVITRO AND INVIVO. *Microbiological Research*. 149(4):371-377. English. [UNIV HOHENHEIM INST PHYTOMED D-70593 STUTTGART GERMANY].

886 isolates, which were able to produce siderophores, were tested for their antagonistic activity against the test fungus *Gaeumannomyces graminis* var. *tritici* in vitro. 65% of the isolates proved to be effective antagonists. By addition of Fe³⁺ to the nutrient medium, it could be shown that besides siderophores other inhibitors are also involved in the growth-inhibiting effect. 73 isolates were tested in pot trials in the greenhouse. The application of fluorescent pseudomonads was carried out in form of a seed treatment of wheat. A total of 55% of the in vitro active antagonists and 73% of the isolates, which had no effect in vitro, were able to reduce the attack by *Gaeumannomyces graminis* var. *tritici* and to increase the fresh weight of wheat plants. Obviously, there is no relationship between the antagonistic activity of individual isolates in vitro and their efficacy in vivo. With regard to the search for promising candidates for biological control under practical conditions a pre-selection on artificial media, therefore, does not seem to be useful.

1133 Estiarte, M.; Penuelas, J.; Kimball, BA.; Idso, SB.; Lamorte, RL.; Pinter, PJ.; Wall, GW.; Garcia, RL. (1994) ELEVATED CO₂ EFFECTS ON STOMATAL DENSITY OF WHEAT AND SOUR ORANGE TREES. *Journal of Experimental Botany*. 45(280):1665-1668. English. [UNIV AUTONOMA BARCELONA FAC CIENCIAS CREA E-08193 BARCELONA SPAIN].

No significant differences were found in stomatal densities or stomatal indices of wheat or sour orange trees grown at high CO₂ concentrations in two different CO₂ enrichment systems (Free-Air CO₂ enrichment for wheat and Open-Top Chambers for orange trees). These results are in accordance with most of the previous results obtained in short-term experimental studies which suggest that plants do not acclimate to increasing CO₂ concentration by changing stomatal density within a single generation. [References: 22].

1134 Falk, S.; Bruce, D.; Huner, NPA. (1994) PHOTOSYNTHETIC PERFORMANCE AND FLUORESCENCE IN RELATION TO ANTENNA SIZE AND ABSORPTION CROSS-SECTIONS IN RYE AND BARLEY GROWN UNDER NORMAL AND INTERMITTENT LIGHT CONDITIONS. *Photosynthesis Research*. 42(2):145-155. English. [UNIV WESTERN ONTARIO DEPT PLANT SCI LONDON ON N6A 5B7 CANADA].

The size of the Photosystem II light harvesting antenna and the absorption cross-sections of PS I (sigma(PSI)) and PS II (sigma(PSII)) were examined in relation to photosynthetic performance fluorescence. Wild-type (WT) rye (*Secale cereale*) and barley (*Hordeum vulgare*) as well as the barley chlorophyll b-less chlorina F2 mutant were grown under control and intermittent light (IML) conditions. (sigma(PSII)) in control barley F2 was similar to IML grown WT rye and barley, which, in turn was 2.5 to 3.5 times smaller than for control WT plants. In contrast, sigma(PSI) was similar for all control plants. This was 2.5 to 4 times larger than for IML-grown WT plants. IML-grown barley mutant plants had the smallest absorption cross-sections. Photosynthetic light response curves revealed that the barley chlorina F2-mutant had rates of oxygen evolution on a per leaf area basis that were only slightly lower than control WT rye

and barley while IML-, grown plants had strongly reduced photosynthetic performance. Convexity (Theta) for control barley chlorina F2-mutants was equal to the WT controls (0.6-0.7), while all IML-grown plants had a Theta of 0. This indicates that, in contrast to control barley mutants, IML-plants were limited by PS II turn-over rates at all irradiances. However, on a per leaf Chl-basis the IML-grown plants exhibited the highest photosynthetic rates. Thus, the comparatively poor photosynthetic rates for IML-grown plants on a per leaf area basis were not due to less efficient photosynthetic reaction centers, but may rather be due to an increased limitation from PS II turn-over and a reduction in the number of reaction centers per leaf area. [References: 46].

1135 Frank, AB.; Bauer, A. (1995) PHYLLOCHRON DIFFERENCES IN WHEAT, BARLEY, AND FORAGE GRASSES. *Crop Science*. 35(1):19-23. English. [USDA ARS POB 459 MANDAN, ND 58554 USA].

The phyllochron is a measure of rate of development of plant leaves. Knowledge of the phyllochron for crop species is useful in formulating simulation models and for tracking plant development to determine when to apply management practices that depend on crop development stage. Our objectives were to determine the phyllochron and genetic effects among cultivars of hard red spring wheat (*Triticum aestivum* L.), durum wheat (*T. durum* Desf.), and spring barley (*Hordeum vulgare* L.) and among and within species of crested wheatgrass [*Agropyron desertorum* (Fischer ex Link) Schultes], western wheatgrass [*Elymus smithii* (Rydb.) Gould], intermediate wheatgrass [*Elytrigia intermedia* (Host) Nevski:Syn:A. *intermedium* (Host) Beauv.], and reed canarygrass (*Phalaris arundinacea* L.). Phyllochrons for all cultivars of hard red spring wheat, durum wheat, and spring barley averaged 76.9, 79.6, and 77.2 growing degree days (GDD) per leaf, respectively. The range in phyllochron among cultivars of hard red spring wheat, durum wheat, and spring barley was 11.2, 5.1, and 9.8 GDD, respectively. Among forage grasses, the phyllochron was 90, 99, 119, and 139 GDD for reed canarygrass, crested wheatgrass, intermediate wheatgrass, and western wheatgrass, respectively. Phyllochron differences among clones within crested wheatgrass cultivar Summit was 21 GDD and within cultivar Nordan was 17 GDD. Specific genetic factors influencing the phyllochron of the species studied were not identified. However, variation among cultivars within species and variation among clones within heterogeneous cultivars suggest that genetic expression should be considered in evaluating the phyllochron for each species. [References: 26].

1136 Friend, AD. (1995) PGEN - AN INTEGRATED MODEL OF LEAF PHOTOSYNTHESIS, TRANSPIRATION, AND CONDUCTANCE. *Ecological Modelling*. 77(2-3):233-255. English. [INST TERR ECOL EDINBURGH RES STN BUSH ESTATE PENICUIK EH26 0QB MIDLOTHIAN SCOTLAND].

A detailed model of leaf-scale photosynthesis, respiration, transpiration, stomatal conductance, and energy balance is described. The model, PGEN v2.0(1), is designed for use in larger-scale ecosystem, climate and hydrological models concerned with fluxes of CO₂, water, and heat. Given a set of environmental and biological (mostly leaf) parameters, PGEN calculates instantaneous rates of net photosynthesis and transpiration, and associated conductances to CO₂ and water. The model is intended to predict species-specific behaviour with minimal need for empirical parameterisation. The biochemical model of photosynthesis is derived from the models of Farquhar and co-workers. This biochemical model is embedded in a model of the leaf's energy balance, which is based on the work of Monteith and Jones. Stomatal conductance is calculated using an optimisation concept. In this concept there is an assumed tradeoff between CO₂ entering and water leaving the leaf, resulting in a single stomatal conductance for each set of environmental conditions, that maximises a function including the costs and benefits. Predicted responses of stomatal conductance, net photosynthesis, transpiration rate, and the ratio of CO₂ concentration in the leaf to that outside the leaf boundary layer, to key environmental factors, closely match observed responses. A sensitivity analysis of PGEN v2.0 shows that predicted net photosynthesis is most sensitive to the degree of co-limitation between carboxylation- and ribulose-1, 5-bisphosphate regeneration-limited photosynthesis, the Rubisco carboxylation kinetic parameters, the atmospheric concentration of CO₂, and leaf nitrogen content. Predicted stomatal conductance is most sensitive to relative humidity, the critical leaf water potential for plant

dry matter production, the hydraulic resistance between the root and the leaf, and the atmospheric concentration of CO₂. [References: 49].

1137 Gaonker, SBN.; Greenivasa, MN. (1994) EFFECTS OF INOCULATION WITH GLOMUS-FASCICULATUM IN CONJUNCTION WITH DIFFERENT ORGANIC AMENDMENTS ON GROWTH AND YIELD OF WHEAT (TRITICUM-AESTIVUM L.). *Microbiological Research*. 149(4):419-423. English. [UNIV AGR SCI DEPT AGR MICROBIOL DHARWAD 580005 INDIA].

The response of three genotypes of wheat (*Triticum aestivum* L.) viz. DWR-39, DWR-163 and DWR-187 to the inoculation with the vesicular-arbuscular mycorrhizal (VAM) fungus, *Glomus fasciculatum* in conjunction with locally available organic amendments was studied. The effects caused by *G. fasciculatum* inoculation were highest in DWR-39 and DWR-187 when amended with farm yard manure and these effects were more pronounced in DWR-163 when amended with biogas spent slurry. Proliferation of VAM fungi was highest in these treatments and a corresponding trend was observed in plant characteristics e.g. plant height, shoot biomass, seed yield, shoot phosphorus and seed protein concentrations. DWR-39 was found to be superior compared with DWR-163 and DWR-187 and organic amendments with narrow C:N ratio were found to have better influence on VA mycorrhizal proliferation compared to amendments with wider C:N ratio.

1138 Gawronska, H.; Grzelak, K. (Department of Plant Physiology, Warsaw Agricultural University, 02 528 Warsaw (Poland)) (1993) Seed germination and seedling vigour of triticale (*xTriticosecale* Wittmack) under drought stress. *Plant Varieties and Seeds (United Kingdom)* v. 6(1) p. 9-19. 18 ref. English. (AGRI 95-013785).

1139 Giardini, L.; Borin, M.; Giupponi, C. (Padua Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee); Berti, A. (Consiglio Nazionale delle Ricerche, Padua (Italy). Centro per lo Studio dei Diserbanti) (1993) [Eco-physiology of winter wheat (*Triticum aestivum* L.). Relationships between phenological phases and formulas of cumulative temperatures (Veneto)]. *Eco-fisiologia del frumento tenero* (*Triticum aestivum* L.). Relazioni fra fasi fenologiche e formule di correlazione climatica (Veneto). Società Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 472-478. 4 tables; 2 graphs; 18 ref. Italian. (AGRI 95-003832).

1140 Giorgio, D. de; Rizzo, V.; Rinaldi, M. (Istituto Sperimentale Agronomico, Bari (Italy)) (1993) [Growth analysis on continuous durum wheat (*Triticum durum* Desf.) submitted to different soil tillage methods and nitrogen doses (Apulia)]. *Dinamica dell'accrescimento del frumento duro* (*Triticum durum* Desf.) in monosuccessione - sottoposto a differenti modalità di lavorazioni del terreno e dosi di fertilizzante azotato (Puglia). Società Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 524-531. 2 tables; 5 graphs; 11 ref. Italian. (AGRI 95-003834).

1141 Giunta, F.; Motzo, R.; Deidda, M. (1995) EFFECTS OF DROUGHT ON LEAF AREA DEVELOPMENT, BIOMASS PRODUCTION AND NITROGEN UPTAKE OF DURUM WHEAT GROWN IN A MEDITERRANEAN ENVIRONMENT. *Australian Journal of Agricultural Research*. 46(1):99-111. English. [UNIV SASSARI FAC AGR SCI IST AGRON GEN & COLTIVAZ ERBACEE VIA E DE NICOLA I-07100 SASSARI ITALY].

A field experiment was carried out in Sardinia (Italy) on durum wheat to analyse the effects of different moisture treatments, irrigated (I), rainfed (R) and stressed (S), on leaf area index (LAI), radiation intercepted (Q) and water use (WU), efficiency of conversion of radiation and water into dry matter (RUE and WUE), nitrogen uptake and carbon and nitrogen partitioning in the above-ground part of the plant. In the period between beginning of stem elongation and heading, drought affected the maximum LAI in the most stressed treatment (4.7 in S v. about 6.9 in R and I), but not Q and WU. RUE was also lowered by drought in this period (0.68 in S v. about 0.95 g MJ⁻¹) in R and I as a reduced biomass was recorded in S at heading (528 g m⁻²) in S v. 777 g m⁻²) on average in R and I). In contrast with the previous period, the reduction in LAI between heading and maximum ear weight (MEW) determined a

significant reduction in Q and WU, WUE and RUE, resulting, ultimately, in notable differences in the total biomass produced until MEW (1203, 930 and 546 g m⁻²) in I, R and S respectively). The amount of stem reserves relocated to the grain decreased as the level of stress increased, going from 223 g m⁻² in I to 9 g m⁻² in S and was accumulated almost entirely (from 76% of the total in I to 100% in S), in the post-heading period. Nitrogen percentage was not affected by the treatments applied apart from the higher values in stem and flag leaf in S later in the growing season due to an inhibition of nitrogen translocation in S. The total nitrogen uptake was lower in S (12.3 g m⁻²) than in I (16.6 g m⁻²) only as a consequence of the different dry matter accumulation patterns. The importance of WUE in this type of Mediterranean environment is discussed, with particular concern to the key role of modulation of leaf area development through the growing season. [References: 42].

1142 Gniazdowskosczyk, H.; Bandurska, H. (1994) **PROLINE ACCUMULATION AND RIBONUCLEASE ACTIVITY IN 3 BARLEY GENOTYPES DURING WATER STRESS.** *Acta Physiologiae Plantarum*. 16(4):309-315. English. [ACAD AGR POZNAN DEPT PLANT PHYSIOL WOLYNSKA 35 PL-60637 POZNAN POLAND].

A response of seedlings of two parental spring barley (*Hordeum vulgare* L.) forms, cv. Aramir and line R567, and their F1 generation to water stress was investigated. These barley forms significantly differed in their leaf water content under the applied water stress conditions. The cv. Aramir lost water more slowly as compared to line R567. After 18 hours of stress the relative water content (RWC) in the F1 seedling leaves was maintained at the intermediate level as compared to that of the parents. At the same level of water stress significant differences between the parental forms were observed in the accumulation of proline and in the RNase activity increase. In the F1 generation the accumulation of free proline was significantly lower than in the both parents, whereas the RNase activity was similar to that of the maternal form - the cv. Aramir. The obtained results indicate genetic variability in response to water stress in the investigated forms of spring barley.

1143 Goos, R.J.; Johnson, B.E.; Stack, R.W. (1994) **PENICILLIUM-BILAJI AND PHOSPHORUS FERTILIZATION EFFECTS ON THE GROWTH, DEVELOPMENT, YIELD AND COMMON ROOT ROT SEVERITY OF SPRING WHEAT.** *Fertilizer Research*. 39(2):97-103. English. [N DAKOTA STATE UNIV DEPT SOIL SCI FARCO, ND 58105 USA].

A strain of *Penicillium bilaji* Chalabuda (PB) has recently been commercially released as a seed inoculant to increase phosphorus (P) uptake by wheat (*Triticum aestivum* L.). The purpose of this study was to compare the effects of drill applied P (15 kg P ha⁻¹) with PB seed inoculation on early growth, development, P uptake, and grain yield of 'Stoa' spring wheat at four sites in North Dakota. Fertilization with P consistently enhanced early season growth, main stem development, tillering and P uptake. Seed inoculation with PB had little or no effect on these traits. Phosphorus fertilization tended to increase common root rot severity (CRR, incited by *Cochliobolus sativus* (Ito & Kurib) Drechs.), while PB inoculation had no effect. Grain yields were significantly increased by P fertilization at one location. Inoculation with PB also increased grain yield at this location. The reason why PB inoculation increased yield at this location is not evident, as plant growth and P uptake were not enhanced earlier in the season. Averaged across all four sites, PB inoculation increased wheat yields 66 kg ha⁻¹, which is similar to averaged yield responses reported from the Prairie Provinces of Canada.

1144 Hansson, L.; Johansson, K.; Olin, A.; Siman, G. (1994) **METHOD FOR THE DETERMINATION OF SELENIUM IN LOW-SELENIUM GRAIN AND THE EFFECT OF LIMING ON THE UPTAKE OF SELENIUM BY BARLEY AND OATS.** *Acta Agriculturae Scandinavica Section B-Soil & Plant Science*. 44(4):193-200. English. [UNIV UPPSALA DEPT ANALYT CHEM POB 531 S-75121 UPPSALA SWEDEN].

Selenium was determined in grain of barley and oats grown at locations distributed all over Sweden with the objective of studying the influence of liming on the selenium uptake at natural levels in the soil. The samples were taken from on-going field experiments, limed to different levels. An analytical procedure, carried out in a single test tube, was developed to cope with the low selenium concentrations in the grain. It involves combined wet/dry ashing of the organic matter, reduction to selenite by hydrochloric acid, complexation to obtain a brominated

piazselenol, extraction of the complex into toluene, and finally determination by capillary gas chromatography with electron capture detection. The concentrations of selenium in the grains investigated were low, ranging from 1.5 to 16 ng g⁻¹ dry weight. The limit of detection for a 0.1 g sample is 0.4 ng g⁻¹, as estimated by three times the standard deviation of the blank determination (n = 34) and the absolute limit of detection for pure solutions is below 20 fg (0.5 ml injection on the column). The procedure was validated by determinations on reference materials, testing an alternate digestion procedure, and by determination using hydride generation atomic absorption spectrometry. Liming of the soil was found to have a small, but significant negative effect on plant uptake of selenium. [References: 21].

1145 He Suquan; Zhou Binxiang (Xinjiang Division No.9 of Land Reclamation Troop, Tacheng County (China). Inst. of Agricultural Sciences) (1993) **Formation of spring wheat grain and its relationship with environmental condition.** *Xinjiang Agricultural Sciences (China)* (no. 3) p. 97-100. 1 ill., 6 tables. Chinese. (AGRIS 95-003826).

1146 Hurry, V.; Tobiaeson, M.; Kromer, S.; Gardestrom, P.; Oquist, G. (1995) **MITOCHONDRIA CONTRIBUTE TO INCREASED PHOTOSYNTHETIC CAPACITY OF LEAVES OF WINTER RYE (SECALE CEREALE L.) FOLLOWING COLD-HARDENING.** *Plant Cell & Environment*. 18(1):69-76. English. [AUSTRALIAN NATL UNIV RES SCH BIOL SCI COOPERAT RES CTR PLANT SCI BOX 475 CANBERRA ACT 2601 AUSTRALIA].

Cold-hardening of winter rye (*Secale cereale* L. cv. Musketeer) increased dark respiration from -2.2 to -3.9 $\mu\text{mol O}_2 \text{ m}^{-2} \text{ s}^{-1}$ and doubled light- and CO₂-saturated photosynthesis at 20 degrees C from 18.1 to 37.0 $\mu\text{mol O}_2 \text{ m}^{-2} \text{ s}^{-1}$. We added oligomycin at a concentration that specifically inhibits oxidative phosphorylation to see whether the observed increase in dark respiration reflected an increase in respiration in the light, and whether this contributed to the enhanced photosynthesis of cold-hardened leaves. Oligomycin inhibited light- and CO₂-saturated rates of photosynthesis in non-hardened and cold-hardened leaves by 14 and 25%, respectively, and decreased photochemical quenching of chlorophyll a fluorescence to a greater degree in cold-hardened than in non-hardened leaves. These data indicate an increase both in the rate of respiration in the light, and in the importance of respiration to photosynthesis following cold-hardening. Analysis of metabolite pools indicated that oligomycin inhibited photosynthesis by limiting regeneration of ribulose-1, 5-bisphosphate. This limitation was particularly severe in cold-hardened leaves, and the resulting low 3-phosphoglycerate pools led to a feed-forward inhibition of sucrose-phosphate synthase activity. Thus, it does not appear that oxidative phosphorylation supports the increase in photosynthetic O₂ evolution following cold-hardening by increasing the availability of cytosolic ATP. The data instead support the hypothesis that the mitochondria function in the light by using the reducing equivalents generated by non-cyclic photosynthetic electron transport. [References: 37].

1147 Ibragimov, T.Z.; Chertova, T.S.; Sarin, S.S. (1994) **CHANGES OF SPECTRAL PROPERTIES OF PLANTS AND WHEAT CROPS AFFECTED BY RUST DISEASES.** *Mikologiya i Fitopatologiya*. 28(4):56-63. Russian. [ALL RUSSIAN PHYTOPATHOL RES INST MOSCOW RUSSIA].

1148 Jensen, B. (1994) **DISTRIBUTION OF C-14 IN PULSE-LABELLED SPRING BARLEY - EFFECT OF LIGHT INTENSITY AND LENGTH OF PHOTOPERIOD BEFORE LABELLING.** *Acta Agriculturae Scandinavica Section B-Soil & Plant Science*. 44(4):214-218. English. [RES CTR FOULUM DEPT PLANT NUTR & PHYSIOL POB 23 DK-8830 TJELE DENMARK].

The distribution of photoassimilated C in spring barley plants was determined at different times after the onset of light and at different light intensities during assimilation. The plants were grown in pots in a greenhouse, and at late tillering and late elongation, 14CO₂ pulse-labelings of 2 h duration were carried out 1.5, 4 or 8.5 h after the onset of light. At the labelling started after a 4 h photoperiod, two light intensities was included (80 and 170 W m⁻²). To analyse samples low in C-14, a 14CO₂-trapping system interfaced with a Leco high-temperature induction furnace was developed. The 14CO₂ was trapped directly in the

scintillation vial in 5 mL of liquid Carbosorb, enabling subsequent liquid C-14-scintillation counting to take place without subsampling. The proportion of photosynthate translocated below ground tended to be higher early in the morning than later in the day. Labelling 1.5 h after the onset of light, 19.8 and 7.6% was translocated below ground at late tillering and late elongation, respectively. Corresponding values found at later labellings were 15.4-16.0 and 6.0-6.4%. Higher proportions tended to be translocated below ground when plants were exposed to low light intensity. Exposing plants to low light intensity caused below ground translocation to be 15.4 and 6.0% of the C-14 recovered at late tillering and late elongation, respectively, compared with 12.1 and 5.2% after exposure to a higher light intensity. Further experiments are needed to substantiate the observations of this study. The results suggest that the distribution of photoassimilates varies during the daytime and light intensity during the labelling. [References: 14].

1149 Kichatinova, S.V.; Trufanov, V.A.; Permyakov, A.V. (1993) [Thiol oxidase and disulfide reductase activities of wheat cell organelles]. *Tioloksidaznaya i disulfidoreduktaznaya aktivnosti kletochnykh organell pshenitsy. Prikladnaya biokhimiya i mikrobiologiya (Russian Federation)* v. 29(3) p. 412-417. 15 ref. Russian. (AGRIS 95-013797).

The intracellular localization of the enzymes of thiol disulfide metabolism, thiol: protein-disulfide oxidoreductase (EC 1.8.4.2) and thiol: oxygen oxidoreductase (EC 1.8.3.2) has been studied at different stages of development of the spring soft wheat kernel. Two forms of the enzymes of thiol disulfide metabolism were found, i. e. free (cytoplasmic) and bound to different subcellular organelles (mitochondria, plastids, microsomes, and protein bodies). The enzyme forms bound to the membranes of endoplasmic reticulum (the place where storage proteins are synthesized) and to protein bodies (the place where proteins are stored) are suggested to be directly involved in the formation of the protein complexes of the developing endosperm.

1150 Kirby, EJM. (1995) FACTORS AFFECTING RATE OF LEAF EMERGENCE IN BARLEY AND WHEAT. *Crop Science*. 35(1):11-19. English. [THE STUDIO BLYTHBURGH RD SAXMUNDHAM IP17 3AS ENGLAND].

Rate of leaf emergence of wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.) changes with sowing date and temperature and appears to be set early in the plant's life cycle. Four models that advance different hypotheses to explain this variation are examined. None is completely satisfactory, partly because of a nonlinear response to thermal or photothermal time. Soil strength, N nutrition, and depth of sowing affect rate of leaf emergence, as may sub-zero temperature or ontogeny. An alternative hypothesis proposes that leaf emergence rate depends on daylength and acclimation to temperature. Potential rate of leaf emergence may be determined by factors acting on leaf primordia, which are initiated early in the life cycle. [References: 28].

1151 Kleemola, J.; Peltonen, J.; Peltonensainio, P. (1994) APICAL DEVELOPMENT AND GROWTH OF BARLEY UNDER DIFFERENT CO₂ AND NITROGEN REGIMES. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(2):79-92. English. [UNIV HELSINKI DEPT PLANT PROD POB 27 SF-00014 VILKKI FINLAND].

Increases in atmospheric carbon dioxide (CO₂) concentration have stimulated interest in the response of agricultural crops to elevated levels of CO₂. Several studies have addressed the response of C3 cereals to CO₂, but the interactive effect of nutrient supply and CO₂ on apical development and spikelet set and survival has not been investigated thoroughly. Hence, an experiment was conducted in the greenhouse to evaluate the effect of high (700 µmol CO₂mol⁻¹ air) and low (400 µmol mol⁻¹) levels of atmospheric CO₂ on apical development, spikelet set and abortion, and pre- and post-anthesis growth in spring barley (*Hordeum vulgare* L.) grown under high N (0.3 g N pot⁻¹ before sowing +0.11 g N pot⁻¹ week⁻¹) and low N (0.3 g N pot⁻¹) regimes. The plants were grown in 5 L pots. Development of spike was hastened due to CO₂ enrichment, and the C+ plants pollinated few days earlier than the C- plants. Carbon dioxide enrichment had no effect on date of ripening. Development of spike slowed following application of extra N, and plants pollinated 10 days later and matured 2 weeks later when compared with plants under low N. Carbon dioxide enrichment did not affect the number of spikelets at anthesis. Excess N decreased spikelet abortion and the

increased maximum number of spikelets under both [CO₂]. Barley plants did not tiller when grown in low [CO₂] and low N. Increased endogenous IAA concentration in those plants, recorded three days before tillers appeared in other treatments, may have contributed to this. Carbon dioxide enrichment increased the C concentration of plants, but decreased the N concentration under high N regime. Both the C and N concentration of plants were increased under high N regime. Carbon dioxide enrichment increased the total dry matter of mature plants by 9% under high N regime and by 21% under low N regime. Under high [CO₂] increased kernel number on tiller spikes, and increased kernel weight both on main stem and on tiller spikes resulted in a 23% increase in kernel yield under low N regime and 76% increase in kernel yield under high N regime. The rate of N application influenced growth and yield components to a greater extent than CO₂ enrichment. At maturity, plant dry matter, kernel weight, the number of kernels per spike, and the number of spikes per plant were higher under high N regime than under low N regime. Long days (16 h), low light intensity (280 µmol m⁻²s⁻¹), and at constant temperature of 20-degrees-C high [CO₂] increased kernel weight and the number of kernels on tiller spikes under high and low N application rate, but did not increase the number of kernels on main stem spike, or the number of tillers or tiller spikes per plant. [References: 29].

1152 Kodali, S.; Khanna, VK. (1994) STANDARDIZATION OF THE BEST TIMING OF GROWTH HORMONE APPLICATION IN WHEAT-BARLEY CROSSES TO INCREASE SEED SET. *Cereal Research Communications*. 22(4):309-313. English. [COLL AGR DEPT PLANT BREEDING PANTNAGAR 263145 INDIA].

The effect of gibberellic acid and kinetin on seed set was studied after applying these hormones on flowers before and after pollination in wheat-barley crosses. The maximum seed set obtained in UP 2121 x Jagrati was 2.5 per cent when gibberellic acid was applied 5 min after pollination followed by another application after 24 hr. In the reciprocal cross it was maximum (11.86 per cent) with the same treatment. Multiple pollinations and application of a mixture of hormones resulted in a higher percentage of seed set than control in both the crosses.

1153 Kogel, KH.; Beckhove, U.; Dreschers, J.; Munch, S.; Romme, Y. (1994) ACQUIRED RESISTANCE IN BARLEY - THE RESISTANCE MECHANISM INDUCED BY 2, 6-DICHLOROISONICOTINIC ACID IS A PHENOCOPY OF A GENETICALLY BASED MECHANISM GOVERNING RACE-SPECIFIC POWDERY MILDEW RESISTANCE. *Plant Physiology*. 106(4):1269-1277. English. [RHEIN WESTFAL TH AACHEN INST BIOL PFLANZENPHYSIOL 2 WÖRRINGER WEG D-52074 AACHEN GERMANY].

Treatment of susceptible barley (*Hordeum vulgare*) seedlings with 2, 6-dichloroisonicotinic acid (DCINA) induces disease resistance against the powdery mildew fungus (*Erysiphe graminis* f. sp. *hordae*). A cytological analysis of the interaction reveals the hypersensitive cell collapse in attacked, short epidermal cells, along with the accumulation of fluorescent material in papillae, that appear at the time of fungal arrest. The cell-type-specific hypersensitive reaction occurs prior to formation of haustoria, reminiscent of the mechanism identified in genetically resistant barley plants containing the functionally active Mlg gene (R. Gorg, K. Hollricher, P. Schulze-Lefert [1993] *Plant J* 3: 857-866). This observation indicates that the mechanism of DCINA-induced resistance is a phenocopy of the mechanism governed by the Mlg locus. The onset of acquired resistance correlates with high-level transcript accumulation of barley defense-related genes encoding pathogenesis-related protein-1, peroxidase, and chitinase but not beta-1, 3-glucanase. Subcellular localization of peroxidase activity shows an increase in enzyme activity in the epidermal cell layer and in the intercellular fluids of barley leaves. Four out of more than 10 identified extracellular isozymes are induced by DCINA. The epidermal cell layer contains a major constitutively formed isozyme, together with two isozymes specifically induced by DCINA. The data support the hypothesis that host cell death and high-level accumulation of defense-related gene transcripts are not only commonly controlled in certain types of race-specific resistance (A. Freialdenhoven, B. Scherag, K. Hollricher, D.B. Collinge, H. Thordal-Christensen, P. Schulze-Lefert [1994] *Plant cell* 6: 983-994) but also in acquired resistance, which confers protection to a broad spectrum of different pathogens. [References: 55].

1154 Lai, D.M.L.; Slade, A.M.; Fincher, G.B. (Department of Biochemistry, La Trobe University, Bundoora, Vic. 3083 (Australia)) (1993) Development and regulation of (13, 14)-beta-glucan endohydrolases in germinating wheat (*Triticum aestivum*). *Seed Science Research* (United Kingdom) v. 3(1) p. 65-73. 31 ref. English. (AGRI 95-013795).

1155 Lang, B.; Kaiser, W.M. (1994) SOLUTE CONTENT AND ENERGY STATUS OF ROOTS OF BARLEY PLANTS CULTIVATED AT DIFFERENT pH ON NITRATE- OR AMMONIUM-NITROGEN. *New Phytologist*. 128(3):451-459. English. [JULIUS VON SACHS INST BIOWISSENSCH LEHRSTUHL BOT 1 MITTLERER DALLENBERGWEG 64 D-97082 WURZBURG GERMANY].

Barley seedlings (*Hordeum vulgare* cv. 'Gaulois') were precultured hydroponically for 4d on nutrient solutions with nitrate (3 mM) as N-source at pH 4.7, and were then transferred to solutions with ammonium or nitrate as N-source (3 mM), buffered and adjusted to different pH (4.0, 5.5, 6.8). Variations in shoot and root growth and solute contents were examined and grouped into pH effects, ammonium effects and interactions. Shoot biomass was not affected under all conditions. Root fresh weight was insensitive to the external pH when nitrate was the N-source, but was drastically affected by a combination of ammonium and low pH. In contrast, root length was negatively affected by low pH per se. In nitrate-grown plants, ammonium levels in roots and shoots were low (0.5 to 1 mM). After transfer of plants to ammonium solution, roots accumulated ammonium within 24h about sixfold (18 mM) above the external concentration. At pH 5.5 or 6.8, but not at pH4, root ammonium contents decreased afterwards to a lower steady state value (10 mM). Leaves also accumulated ammonium, especially at the most acidic pH. Concentrations of major inorganic cations in roots were markedly but differentially affected by acidic pH and ammonium. The magnesium content of roots was drastically decreased (from 18 to 2 mM) by ammonium nutrition, and this was independent of the external pH. In contrast, calcium levels in roots were decreased by low external pH, independent of the N-source. Potassium levels in roots were rather insensitive to both low pH and ammonium. The pH of crude root homogenates was measured in order to obtain at least crude information about trends in possible cellular pH changes, at an external pH of 4.0 and 5.5, the pH of the homogenates was 5.8, and it increased to 6.3 when the external pH was 6.8. The pH of the homogenates was not affected by the N-source. In spite of the drastic effects of the N-source on the concentration of ammonium and magnesium in root tissues, ATP/ADP-ratios were not affected. Also, sugar levels were unchanged or even increased. Thus, growth impairment could not be traced back to impaired carbohydrate or ATP-supply, which might occur as a consequence of ammonium accumulation or Mg²⁺-deficiency. [References: 27].

1156 Lascano, R.J.; Baumhardt, R.L.; Hicks, S.K.; Heilman, J.L. (1994) SOIL AND PLANT WATER EVAPORATION FROM STRIP-TILLED COTTON - MEASUREMENT AND SIMULATION. *Agronomy Journal*. 86(6):987-994. English. [TEXAS AGR EXPTL STN RT 3 BOX 219 LUBBOCK, TX 79401 USA].

It is estimated that 20% of cotton producers in the Texas High Plains use the strip tillage practice of planting cotton (*Gossypium hirsutum* L.) in residues of chemically terminated winter wheat (*Triticum aestivum* L.). The effect of the residue on water use partitioning between soil (E(s)) and crop (E(c)) evaporation has not been reported. This study tested the hypothesis that the cumulative evapotranspiration (E(t)), of a crop in a strip tillage system and in conventional tillage are similar, and that the residue modifies the components of total E(t) by reducing E(s) and increasing E(c). Winter wheat was planted in the fall of 1990 and was chemically terminated in the spring of 1991 in an Olton soil (fine, mixed, thermic Aridic Paleustoll) at Lubbock, TX. The plot was divided into a wheat-stubble and a conventional treatment. Residue on half of the plot was left as stubble and residue on the other half was shredded and incorporated. Both plots were planted with cotton on 20 May 1991. Measurements included soil water and temperature profiles, soil evaporation, weather, and crop phenology and lint yield. Input values obtained from these data were used in the energy and water balance model (ENWATBAL) to calculate the daily and seasonal water lost to E(s) and E(c) for 100 d. Calculated daily E(s) varied <1 SD from measured values. Measured mean total E(t) were similar, i.e., 305 +/- 20 mm for conventional and 304 +/- 41 mm for cotton in the wheat stubble.

Simulated E(t) was within 10% of the measured value. The ratio of total E(c) to E(t) was 0.50 in the conventional and 0.69 in the wheat stubble cotton. The more efficient use of E(t) in the wheat stubble increased lint yield by 35%. The E(c) water use efficiency was not modified by the wheat stubble and was 3.8 g lint kg⁻¹ of transpired water. The modified version of EMWATBAL was adequate to calculate the daily and seasonal water use of a cotton crop in a terminated wheat stubble, and the results support our hypothesis. The E(t) water use efficiency was increased by the wheat residue without additional input of water. [References: 35].

1157 Lee, D.W.; Apel, K.; Binding, H. (1995) THE FORMATION OF LEAF THIONINS AND THEIR EFFECT ON THE VIABILITY OF ISOLATED PROTOPLASTS OF BARLEY (*HORDEUM VULGARE* L.). *Journal of Plant Physiology*. 145(1-2):131-136. English. [DONGGUK UNIV COLL NAT SCI DEPT BIOL KYONGJU 780350 SOUTH KOREA].

Thus far, reliable regeneration of plants from isolated protoplasts of cereals is restricted to embryogenic *in vitro* cultures as the starting material. In the present work we provide evidence that thionins released from the leaf material may contribute to the regeneration incompetence of barley leaf protoplasts. This conclusion is based on the following observations: Leaf thionins and their corresponding RNA are not found in young sexual embryos used for initiating embryogenic cultures or in embryogenic cells yielding regenerable protoplasts, but occur in significant amounts in non-regenerable callus and leaves; furthermore, wounding of leaves during the preparation of protoplasts induced a strong increase in leaf thionin mRNA. Improved stability and microcallus formation of leaf protoplasts were obtained when an antiserum against leaf thionins was added to the sample. [References: 25].

1158 Lees, A.K.; Nicholson, P.; Rezanoor, H.N.; Parry, D.W. (1995) ANALYSIS OF VARIATION WITHIN MICRODOCHMIUM NIVALE FROM WHEAT - EVIDENCE FOR A DISTINCT SUB-GROUP. *Mycological Research*. 99(Part 1):103-109. English. [HARPER ADAMS COLL CROP & ENVIRONM RES CTR NEWPORT TF10 8NB SHROPS ENGLAND].

Random amplified polymorphic DNA (RAPD) assay revealed polymorphisms among isolates of *Microdochium nivale* from wheat which indicated the presence of a distinct sub-group. Average conidial length and average number of septa were distributed continuously among the isolates and did not correlate with the groupings indicated by RAPDs. However, conidial width fell into two broad groups which correlated closely with the groups revealed by RAPD analysis. The sub-group identified by RAPDs showed a correlation with *M. nivale* var. *majus* as distinguished by conidial morphology, and the remaining isolates largely corresponded to *M. nivale* var. *nivale*. The perithecial state of *M. nivale* occurred *in vitro*, indicating that the majority of isolates were homothallic, but not all isolates produced perithecia. [References: 23].

1159 Lenton, J.R.; Appleford, N.E.; Croker, S.J. (1994) GIBBERELLINS AND ALPHA-AMYLASE GENE EXPRESSION IN GERMINATING WHEAT GRAINS. *Plant Growth Regulation*. 15(3):261-270. English. [UNIV BRISTOL INST ARABLE CROPS RES LONG ASHTON RES STN DEPT AGR SCI BRISTOL BS18 9AF AVON ENGLAND].

Gibberellins (GAs), GA(8), GA(17), GA(19), GA(20), GA(29), and GA(79) were identified by full-scan gas chromatography-mass spectrometry in a purified acidic fraction and GA(8), GA(20), GA(79), and GA(90) in a hydrolysed conjugate fraction from mature wheat grains. Gibberellin A(20)-13-O-glucoside was also quantified directly as the permethyl derivative in dry seed. The scutellum was identified as the major site of *de novo* GA biosynthesis by measuring ent-kaurene accumulation *in vivo* in grains treated with 2S, 3S-paclobutrazol. Several GAs of the early 13-hydroxylation GA pathway began to accumulate in the axis and scutellum between 24 and 48 hours in untreated grains germinated at 15 degrees C. Bioactive GA(1) and GA(3) also increased in the endosperm during this period, whereas abscisic acid contents of embryo and endosperm declined rapidly over 48 hours following imbibition. Treating grains with 2S, 3S-paclobutrazol reduced GA(1) plus GA(3) content of scutella by 70-80% over 4 days without affecting significantly the steady-state pool of alpha-amylase mRNA transcripts. In contrast, a 50-80% reduction in the content of bioactive GAs in the endosperm was associated with a 70-78% decrease in transcripts for both alpha-amylase gene families in aleurones of paclobutrazol-treated grains.

It was concluded that the initiation of alpha-amylase gene expression in wheat scutella was independent of de novo GA biosynthesis, whereas that in the aleurone was largely dependent on embryo-produced GAs. [References: 28].

1160 Lenton, JR.; Appleford, NE.; Templesmith, KE. (1994) GROWTH RETARDANT ACTIVITY OF PACLOBUTRAZOL ENANTIOMERS IN WHEAT SEEDLINGS. *Plant Growth Regulation*. 15(3):281-291. English. [UNIV BRISTOL INST ARABLE CROPS RES LONG ASHTON RES STN DEPT AGR SCI BRISTOL BS18 9AF AVON ENGLAND].

The resolved enantiomers of paclobutrazol appeared to have different primary modes of action as plant growth retardants in rht3 (tall) wheat seedlings. 2S, 3S-Paclobutrazol reduced shoot growth more effectively than root growth, whereas the opposite was the case with the 2R, 3R-enantiomer. Low concentrations (0.03-1.0 μ M) of 2S, 3S-paclobutrazol specifically inhibited gibberellin A(1) (GA(1)) production in Rht3 (dwarf) seedlings without affecting shoot growth, confirming that inhibition of GA biosynthesis is the primary mode of action of this enantiomer. Reductions in shoot growth of rht3 (tall) wheat treated with 2S, 3S-paclobutrazol were associated with reductions in GA(1) content, an effect that could be reversed by gibberellic acid (GA(3)) application, showing that GAs are important regulators of light-grown shoot growth in wheat. The inhibition of root growth of wheat seedlings following treatment with 2R, 3R-paclobutrazol was associated with a decline in de novo synthesis of major sterols, a decrease in stigmasterol: sitosterol ratio and an accumulation of the 14 alpha-methyl sterol, obtusifoliol. Concentrations >3 μ M 2S, 3S-paclobutrazol also affected de novo sterol production in wheat roots, suggesting that root growth is more responsive to interference with sterol than GA biosynthesis. There was a decline in abscisic acid (ABA) content in Rht3 (dwarf) shoots treated with relatively high concentrations of 2S, 3S-paclobutrazol but no effect with its optical isomer. [References: 41].

1161 Liker, E.; Garab, G. (1995) DIURNAL FLUCTUATION IN THE COMPOSITION OF CHLOROPHYLL A/B LIGHT HARVESTING ANTENNA OF PHOTOSYSTEM II IN YOUNG WHEAT LEAVES. *Physiologia Plantarum*. 93(1):187-190. English. [HUNGARIAN ACAD SCI BIOL RES CTR INST PLANT BIOL POB 521 H-6701 SZEGED HUNGARY].

We investigated the diurnal fluctuation in the composition of the light harvesting chlorophyll a/b antenna of photosystem II in young wheat (*Triticum aestivum*) leaves grown under periodic day/night irradiation. By means of gel electrophoresis of the polypeptides of thylakoid membranes, we determined the amount of 25 kDa and 27 kDa polypeptides, which are the main components of the peripheral and inner antenna subpopulations, respectively. Our data show a preferential fluctuation in the amount of the 25 kDa protein relative to the 27 kDa polypeptide, in parallel to the fluctuation in the amount of chlorophyll a/b antenna of photosystem II, which suggests that the peripheral antenna plays a role in the diurnal adjustment of the antenna size. [References: 19].

1162 Loboda, T. (1994) GAS EXCHANGE OF WINTER WHEAT AND RYE SEEDLINGS UNDER CHANGING CONDITIONS OF SOIL AND AIR HUMIDITY. *Cereal Research Communications*. 22(4):389-395. English. [AGR UNIV WARSAW DEPT PLANT PHYSIOL RAKOWIECKA ST 26-30 PL-02528 WARSAW POLAND].

During 6 days of water stress and after following rewatering photosynthetic and transpiration rates were measured in air containing 1 and 10 g H₂O m⁻³ for 3 wheat and 3 rye cultivars. From 4th to 6th day of stress both photosynthetic and transpiration rates substantially decreased in air containing both 1 and 10 g H₂O m⁻³. In the last day of the experiment all rye cultivars and cv. Grana had positive net photosynthetic rate independently of air humidity, while cvs. Liwilla and Mironowska 808 had higher respiration than photosynthetic rate. Generally photosynthetic rate in the air containing 10 g H₂O m⁻³ was the same from 1st to 3rd day of water stress and higher from 4th to 6th of water stress than in the air containing 1 g H₂O m⁻³. After rewatering partial recovery of photosynthetic rate was observed during several minutes. Transpiration rate was also decreasing from 4th to 6th day of water stress and its rapid increase was observed after rewatering.

1163 Lombardo, M.G.; Cassaniti, S.; Leonardi, S.; Di Vincenzo, G. (Catania Univ. (Italy). Istituto di Agronomia Generale e Colture Erbacee) (1993) [Study on roots growth in *Triticum durum* Desf. (Sicily)]. *Studio dell'accrescimento delle radici in *Triticum durum* Desf. (Sicilia)*. Società Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 546-552. 7 graphs; 36 ref. Italian. (AGRI 95-003836).

1164 Lombardo, M.G.; Leonardi, S. (Catania Univ. (Italy). Istituto di Agronomia Generale e Colture Erbacee); Litrico, P.G. (Reggio Calabria Univ. (Italy). Istituto di Agronomia e Colture Erbacee) (1993) [Evaluation of grain growth on durum wheat (*Triticum durum* Desf.) in relation to climatic parameters (Sicily)]. *Studio del processo di accumulo degli elaborati nelle cariossidi di frumento duro (*Triticum durum* Desf.) in relazione ai parametri meteorologici (Sicilia)*. Società Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 532-538. 3 tables; 7 graphs; 24 ref. Italian. (AGRI 95-003835).

The Authors refer about a four years research aimed to evaluate grain growth of five cultivars of durum wheat, Amedeo, Messapia, Karel, Capeiti and Cresco, different for morphological characters. Results have shown a direct influence of air temperature on lag, EFPD and GFR. Both EFPD and GFR have been significantly correlated to number of kernels per spike and grain yield. It was observed, finally, a highly significant correlation between GDD and kernels growth.

1165 Luo, Y.M.; Rimmer, DL. (1995) ZINC COPPER INTERACTION AFFECTING PLANT GROWTH ON A METAL-CONTAMINATED SOIL. *Environmental Pollution*. 88(1):79-83. English. [UNIV NEWCASTLE UPON TYNE DEPT AGR & ENVIRONM SCI NEWCASTLE UPON TYNE NE1 7RU TYNE & WEAR ENGLAND].

In order to assess the effects of metal interactions on plant growth, a greenhouse experiment was conducted, in which spring barley was grown for 48 days in a soil to which cadmium, copper, lead and zinc were added singly and in combination. Plant growth was measured as shoot and root dry matter production. At the end of the experiment the plant material was analysed for metal uptake and the soil was extracted with CaCl₂ solution, to measure the plant-available metal content. The most consistent effect on plant growth was an interaction between copper and zinc, which was also important in determining uptake of these metals and the amounts extractable with CaCl₂ solution. An analysis of the underlying mechanism led to the conclusion that the growth of barley was controlled principally by the amount of plant-available zinc, which depended on the amounts of both added zinc and added copper. The effect of the added copper was to increase the toxicity of the added zinc. [References: 16].

1166 McMaster, GS.; Wilhelm, WW. (1995) ACCURACY OF EQUATIONS PREDICTING THE PHYLLOCHRON OF WHEAT. *Crop Science*. 35(1):30-36. English. [USDA ARS GREAT PLAINS SYST RES UNIT POB E FT COLLINS, CO 80522 USA].

Predicting the rate of leaf appearance, or phyllochron, aids in understanding and modeling grass development and growth. Nine equations predicting the phyllochron of wheat (*Triticum aestivum* L.) were evaluated using field data from a variety of locations, cultivars, and management practices. Each equation is referred to by the last name of the first author; if there is more than one equation by the first author, additional descriptors were included. The BAKER and KIRBY equations predict the phyllochron based on changes in daylength following seedling emergence; CAO-TEMP and CAO-DAY use a curvilinear relationship with temperature and daylength, respectively; CAO-T&D uses the ratio of temperature to daylength; VOLK mathematically refines CAO-T&D; MIGLIETTA uses an ontogenetic decline in the rate of leaf appearance; and MIGLIETTA-DAY adds photoperiod effects to MIGLIETTA. No equation adequately predicted the phyllochron. The r² values between predicted and measured phyllochron for winter wheat and spring wheat cultivars, respectively, were BAKER (0.001, 0.486), KIRBY (0.002, 0.487), CAO-DAY (0.000, 0.174), MIGLIETTA-DAY (0.013, 0.008), MIGLIETTA (0.002, 0.405), CAO-TEMP (0.100, 0.190), CAO-FIELD (0.078, 0.036), CAO-T&D (0.066, 0.030), and VOLK (0.119, 0.043). All equations predicted the phyllochron for spring wheat cultivars better than winter wheat cultivars. BAKER and MIGLIETTA showed no bias towards either over or

underestimating the phyllochron; KIRBY tended to overestimate the phyllochron; and the remaining equations were biased towards underestimating the phyllochron. Equations developed from field data had the greatest range of predicted phyllochrons. Based on multiple criteria, the BAKER equation best predicted the phyllochron for the experimental data set. Other factors must be added to the equations to improve predictions. Much opportunity exists to improve our ability to predict the phyllochron. [References: 48].

1167 Meharg, AA. (1994) A CRITICAL REVIEW OF LABELLING TECHNIQUES USED TO QUANTIFY RHIZOSPHERE CARBON-FLOW. *Plant & Soil*. 166(1):55-62. English. [INST TERR ECOL MONKS WOOD EXPTL STN HUNTINGDON PE17 2LS ENGLAND].

The rhizosphere is a major sink for photo-assimilated carbon and quantifying inputs into this sink is one of the main goals of rhizosphere biology as organic carbon lost from plant roots supports a higher microbial population in the rhizosphere compared to bulk soil. Two fundamentally different (CO₂)-C-14 labelling strategies have been developed to estimate carbon fluxes through the rhizosphere-continuous feeding of shoots with labelled carbon dioxide and pulse-chase experiments. The biological interpretation that can be placed on the results of labelling experiments is greatly biased by the technique used. It is the purpose of this paper to assess the advantages, disadvantages and the biological interpretation of both continuous and pulse labelling and to consider how to partition carbon fluxes within the rhizosphere. [References: 56].

1168 Miglietta, F.; Castellani, M. (Consiglio Nazionale delle Ricerche, Florence (Italy). Istituto di Analisi Ambientale e Telerilevamento Applicati all'Agricoltura); Bindi, M.; Maracchi, G. (Florence Univ. (Italy). Dipartimento di Agronomia e Produzioni Erbacee) (1993) [Wheat (*Triticum* spp.) ontogenesis. 1: Effect of temperature - photoperiod and vernalization]. Sviluppo ontogenetico del frumento (*Triticum* spp.). 1: Influenza di temperatura - fotoperiodo e vernalizzazione. Società Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 565-569. 4 graphs; 10 ref. Italian. (AGRI 95-003805).

In this paper the effects of temperature, photoperiod and vernalization on wheat ontogenesis are examined. These effects are quantified by means of experimental data taken from the literature. The results show that: the vegetative primordium initiation rate is independent of photoperiod and increases with increasing temperature; vernalization contributes to synchronize the heading date, by keeping plants photoperiodic insensitive during autumn-winter period; photoperiodism determines the final leaf number of leaves on the main stem and contributes, together with the low temperatures, to the synchronization of heading among plants sown at different dates.

1169 Miglietta, F.; Castellani, M. (Consiglio Nazionale delle Ricerche, Florence (Italy). Istituto di Analisi Ambientale e Telerilevamento Applicati all'Agricoltura); Bindi, M.; Maracchi, G. (Florence Univ. (Italy). Dipartimento di Agronomia e Produzioni Erbacee) (1993) [Wheat (*Triticum* spp.) ontogenesis. Simulation model (Italy). Pt.2]. Sviluppo ontogenetico del frumento (*Triticum* spp.). Modello di simulazione (Italia). Pt.2. Società Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 484-489. 1 table; 4 graphs; 34 ref. Italian. (AGRI 95-003804).

1170 Mosaad, MG.; Ortizferrara, G.; Mahalakshmi, V.; Fischer, RA. (1995) PHYLLOCHRON RESPONSE TO VERNALIZATION AND PHOTOPERIOD IN SPRING WHEAT. *Crop Science*. 35(1):168-171. English. [ICARDA CEREAL PROGRAM POB 5466 ALEPPO SYRIA].

An understanding of how environment controls the initiation and development of the leaf is required to construct dynamic crop simulation models. The aim of this study was to determine the effect of vernalization and photoperiod on total number of leaves at anthesis, leaf emergence rate, and phyllochron in 20 spring wheat genotypes (*Triticum aestivum* L.). An experiment was conducted under greenhouse conditions during spring 1992 at ICARDA, Tel Hadya, Syria, with all combinations of three photoperiods (8-, 12-, and 16-h daylength) and two vernalization treatments (vernalized and nonvernalized). Total number of leaves on the main stem at anthesis decreased with increasing photoperiod.

Vernalization reduced the total number of leaves on main stem at anthesis in the eight vernalization-sensitive genotypes. Leaf number on the main stem was linearly ($r = 0.99$) related to accumulated growing degree days (degrees C d). Genotypes differed in leaf emergence rates. Leaf-emergence rate increased with increasing photoperiod. Phyllochron decreased with increased daylength from 124 degrees C d leaf⁻¹ at 8 h to 97 degrees C d leaf⁻¹ at 16-h photoperiod. These results suggests that, to model leaf appearance and canopy development in wheat, genotypic coefficients of phyllochron need to be determined in relation to photoperiod. Additionally, the effect of vernalization at inductive photoperiods on the phyllochron in genotypes adapted to heat-prone tropical environments needs further study. [References: 16].

1171 Myagmarsuren, Y. (1994) EFFECT OF DAYLENGTH SENSITIVITY ON SOME AGRONOMIC TRAITS OF SPRING WHEAT. *Cereal Research Communications*. 22(4):397-400. English. [RES INST AGR & PLANT BREEDING DARKHAN MONGOLIAN PEOPLES REPUBLIC].

1172 Nagy, Z.; Galiba, G. (1995) DROUGHT AND SALT TOLERANCE ARE NOT NECESSARILY LINKED - A STUDY ON WHEAT VARIETIES DIFFERING IN DROUGHT TOLERANCE UNDER CONSECUTIVE WATER AND SALINITY STRESSES. *Journal of Plant Physiology*. 145(1-2):168-174. English. [AGR UNIV GODOLLO DEPT BOT & PLANT PATHOL PLANT PHYSIOL SECT H-2103 GODOLLO HUNGARY].

Hydroponically-grown seedlings of two bread-wheat (*Triticum aestivum* L.) varieties (Kobomugi: drought tolerant, Regina: drought and salt sensitive) were evaluated for drought (PEG 4000) and salt (NaCl) tolerance under controlled environmental conditions. Changes in net photosynthesis (A), stomatal conductance (g(s)), specific leaf area (SLA), abscisic acid content (ABA), and water content of shoots (W-s) and roots (W-r) were measured. Osmotic pressures of the culture solutions were 0.25 [11% PEG(1)] and 1.0 MPa [21% PEG(2)]. After the 7 days of exposure, control and PEG treated plants were transferred to equi-osmolar. [i.e. with PEG(1) and PEG(2)] NaCl culture solutions. Throughout the PEG induced drought stress, the leaves of Kobomugi exhibited lower stomatal conductance (g(s)) and higher leaf ABA content than those of Regina. However, net photosynthesis (A) was similar for both varieties. Thus, Kobomugi possessed a higher water use efficiency (WUE) than Regina. Following the transfer of the plants from control to saline culture solution g(s), A, WUE, SLA, W-s, and W-r in Kobomugi were not significantly different from those in Regina. Based on these results Kobomugi can be considered as susceptible as Regina for high salinity. Transfer from PEG(2) to equi-osmolar NaCl(2) nutrient solution resulted in a steady increase in both A and g(s) in Regina, though in Kobomugi both A and g(s) declined dramatically after an initial increase. So, as a consequence of the consecutive occurrence of water and salt stresses the drought tolerant Kobomugi was more retarded than the drought sensitive Regina. The possible disadvantage of a genotype only possessing the traits that enable it to be a <<water saver>> without any obvious ability to cope with the toxic effect of ions, when water limitation is followed with salinity imposed stresses, is discussed. [References: 38].

1173 Nielsen, TH. (1994) PYROPHOSPHATE-FRUCTOSE-6-PHOSPHATE 1-PHOSPHOTRANSFERASE FROM BARLEY SEEDLINGS - ISOLATION, SUBUNIT COMPOSITION AND KINETIC CHARACTERIZATION (VOL 92, PG 311, 1994). *Physiologia Plantarum*. 92(4):718. English.

1174 Obenland, DM.; Brown, CS. (1994) THE INFLUENCE OF ALTERED GRAVITY ON CARBOHYDRATE METABOLISM IN EXCISED WHEAT LEAVES. *Journal of Plant Physiology*. 144(6):696-699. English. [USDA ARS HORT CROPS RES LAB 2021 S PEACH AVE FRESNO, CA 93727 USA].

We developed a system to study the influence of altered gravity on carbohydrate metabolism in excised wheat leaves by means of clinorotation. The use of excised leaves in our clinostat studies offered a number of advantages over the use of whole plants, most important of which were minimization of exogenous mechanical stress and a greater amount of carbohydrate accumulation during the time of treatment. We found that horizontal clinorotation of excised wheat leaves resulted in significant reductions in the accumulation of fructose, sucrose, starch and

fructan relative to control, vertically clinorotated leaves. Photosynthesis, dark respiration and the extractable activities of ADP glucose pyrophosphorylase (EC 2.7.7.27), sucrose phosphate synthase (EC 2.4.4.14), sucrose sucrose fructosyltransferase (EC 2.4.1.99), and fructan hydrolase (EC 3.2.1.80) were unchanged due to altered gravity treatment. [References: 17].

1175 Oyanagi, A. (1994) GRAVITROPIC RESPONSE GROWTH ANGLE AND VERTICAL DISTRIBUTION OF ROOTS OF WHEAT (*TRITICUM AESTIVUM* L.). *Plant & Soil*. 165(2):323-326. English. [NATL AGR RES CTR TSUKUBA IBARAKI 305 JAPAN].

Recent work on root distribution, growth angles and gravitropic responses in Japanese cultivars of winter wheat are reviewed. Vertical distribution of roots, which influences the environmental stress tolerance of plants, was observed in the 12 Japanese cultivars in the field. The root depth index (RDI: the depth at which 50% of the root length has been reached) differed among the cultivars at the stem elongation stage. Since the RDI was closely related to the growth angle of seminal roots obtained in a pot experiment, it was assumed that growth angle is useful for predicting vertical root distribution among wheat genotypes. Gravitropic responses of the primary seminal root of 133 Japanese wheat cultivars assessed by measuring the growth angle in agar medium, were larger in the northern Japanese cultivars and smaller in the southern ones. It was also found that the geographical variation resulted from the wheat breeding process, i.e. genotypes with limited gravitropic responses of roots had been selected in the southern part of Japan where excessive soil moisture is one of the most serious problems. [References: 14].

1176 Pandey, A.; Shende, ST. (1994) COMPARATIVE STUDIES ON MICROBIAL ACTIVITY IN AZOTOBACTER-CHROOCOCCUM INOCULATED WHEAT (*TRITICUM-AESTIVUM*) RHIZOSPHERE BY PLATE COUNT AND MANOMETRIC METHODS. *Microbiological Research*. 149(4):379-384. English. [GB PANT INST HIMALAYAN ENVIRONM & DEV ENVIRONM PHYSIOL & BIOTECHNOL ALMORA 263643 INDIA].

The serial dilution plate count method has been generally used to estimate the number of microorganisms in the rhizosphere soil. However, this method gives a partial view of the range of organisms and the microbial biomass in the soil. In view of finding an alternate method to estimate the microbial activity, in the present study the plate count method was compared with the respiratory activity of rhizosphere soil measured by a manometric technique. Two strains of *Azotobacter chroococcum* were used for seed inoculation of three varieties of wheat. Periodically, the titres of different groups of microorganisms, viz. bacteria, actinomycetes, fungi and *Azotobacter* were determined by the plate count method and the results obtained were correlated with the respiratory activity of rhizosphere soil.

1177 Pearson, JN.; Rengel, Z. (1994) DISTRIBUTION AND REMOBILIZATION OF ZN AND MN DURING GRAIN DEVELOPMENT IN WHEAT. *Journal of Experimental Botany*. 45(281):1829-1835. English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

Wheat (*Triticum aestivum* cv, Aroona) was grown in siliceous sand with essential nutrients for unlimited growth except for the following treatments: controls (sufficient Zn and Mn), low Mn (sufficient Zn) and low Zn (sufficient Mn) until anthesis. Replicate plants were harvested at anthesis; the remaining plants were transferred to a chelate-buffered nutrient solution containing all essential nutrients except Zn and Mn to allow monitoring of the remobilization of existing Zn and Mn reserves within the plant. These plants were harvested 14 d post-anthesis and at grain maturity. At each harvest plants were separated into individual components. There were no growth differences between any of the treatments at the three harvests. Large amounts of Zn and Mn found in the roots and stems at anthesis were rapidly depleted during grain development. The Zn content of the leaves increased from anthesis to 14 d post-anthesis, but then declined. The Mn content of the leaves increased throughout grain development in the controls whilst remaining constant in the plants pre-grown at low Mn. The Zn and Mn content of the glumes, palea and lemma rose in the controls from anthesis to 14 d post-anthesis; thereafter Zn content declined but Mn content continued to increase. The Zn and Mn content of the grain rose sharply toward grain maturity. We

conclude that Mn was not remobilized from the leaves of wheat during grain development, Zinc was remobilized from the leaves, especially the flag leaf and from the leaves of the low Zn plants. The post-anthesis accumulation of Zn and Mn within the glumes will be discussed in relation to the transport pathway that Zn and Mn use to enter the developing seed. [References: 25].

1178 Penson, SP.; Cairns, AJ. (1994) FRUCTAN BIOSYNTHESIS IN EXCISED LEAVES OF WHEAT (*TRITICUM AESTIVUM* L.) - A COMPARISON OF DE NOVO SYNTHESIS IN VIVO AND IN VITRO. *New Phytologist*. 128(3):395-402. English. [AFRC INST GRASSLAND & ENVIRONM RES DEPT CELL BIOL PLAS GOGERRDAN ABERYSTWYTH SY23 3EB DYFED WALES].

Carbohydrate accumulation by excised, continuously illuminated leaves of wheat (*Triticum aestivum* L.) was followed over a 24 h period. At 0 h, the tissue contained no detectable fructan. In the initial 6 h, only sucrose was accumulated. After 6 h the de novo synthesis of fructans was induced. Fructans accumulated in the sequence 1-kestose, bifurcose, nystose, oligofructans of apparent degree of polymerization (DP) up to 9 and finally, 6-kestose, which was first detected after 22 h. A cell-free protein extract from leaves illuminated for 24 h catalyzed the de novo synthesis of fructan from sucrose. The properties of this fructan synthetic activity (FSA) were characterized. The FSA was stable, exhibiting < 20 % loss of activity when stored at 5 degrees C or 25 degrees C for 6 h. The FSA exhibited an apparent K_m K_{sue} of 114 mM, and an apparent pH optimum at 5.5. The in vitro synthesis of fructan of DP > 3 was not inhibited by sucrose even at 1000 mM. Pyridoxal-hydrochloride at 20 mM did not enhance rates of enzymatic fructan synthesis or significantly inhibit the release of free fructose in the optimized enzymatic reaction. The rate of oligofructan synthesis in the optimized reaction approximated to rates of accumulation in the leaf (1.35 mg g h⁻¹) and 1.18 mg g h⁻¹), respectively). The sequence of oligofructan synthesis in vitro was the same as that observed in the leaf, with the exception that 6-kestose was synthesized early in the time course, in parallel with 1-kestose and bifurcose. Fructans of apparent DP less than or equal to 8 were detected after 10 h of incubation. When incubated with bifurcose as sole substrate, the cell-free preparation liberated free monosaccharides, without the accumulation of trisaccharide or sucrose as intermediates. The results are discussed with reference to current, conflicting models for the biosynthesis of fructan in cereals. [References: 20].

1179 Rickman, RW.; Klepper, BL. (1995) THE PHYLLOCHRON - WHERE DO WE GO IN THE FUTURE. *Crop Science*. 35(1):44-49. English. [USDA ARS COLUMBIA PLATEAU CONSERVAT RES CTR POB 370 PENDLETON, OR 97801 USA].

This paper integrates, expands, and applies information from seven articles written for a symposium on the use of phyllochron concepts for describing shoot development in grasses. Generally, no one environmental factor is a perfect predictor of plant development rate. Factors that influence development rate include genetics, nutrition, water supply, day length, light, and temperature. Average air temperature, when accumulated in the form of a degree-day sum, does at times correlate linearly with plant developmental descriptors such as the Haun stage. The interval between visual appearance of successive leaves (the phyllochron) may be approximated as a constant number of degree-days for such a situation. If not only the visual extension of plant organs but the initiation of both vegetative and reproductive organs at active growing points can be linearly correlated with average temperature sums, an elegantly simple line diagram illustrates the full season synchronous initiation and development of all plant vegetative and reproductive parts. Development of each organ at the cellular level may be represented. This simple but complete representation of synchronous development based on the phyllochron provides a foundation for describing and improving understanding of the genetic and environmental control of grass development rate. [References: 24].

1180 Riffkin, HL.; Duffus, CM.; Bridges, IC. (1995) SUCROSE METABOLISM DURING ENDOSPERM DEVELOPMENT IN WHEAT (*TRITICUM AESTIVUM*). *Physiologia Plantarum*. 93(1):123-131. English. [SCOTTISH AGR COLL DEPT CROP SCI & TECHNOL W MAINS RD EDINBURGH EH9 3JG MIDLOTHIAN SCOTLAND].

This work reports changes in sucrose synthase and invertase activities throughout endosperm development in wheat, together with the associated substrates and metabolites, sucrose, UDP, glucose fructose and UDP-glucose. Throughout endosperm development, sucrose synthase had consistently higher activity than invertase and indeed invertase activity did not change appreciably. The observed variation in pattern and amounts of glucose and fructose present during the mid- and late stages of endosperm development confirmed the suggestion that invertase was not the preferred pathway of sucrose catabolism. Kinetic parameters for sucrose synthase were determined in crude extracts. Estimates of UDP and sucrose concentrations suggest that sucrose synthase is unlikely to achieve its potential maximum velocity. This limitation may however be overcome in part by the apparent excess catalytic activity measured during endosperm development. [References: 19].

1181 Robertson, E.J.; Leech, R.M. (1995) SIGNIFICANT CHANGES IN CELL AND CHLOROPLAST DEVELOPMENT IN YOUNG WHEAT LEAVES (TRITICUM AESTIVUM CV HEReward) GROWN IN ELEVATED CO₂. *Plant Physiology*. 107(1):63-71. English. [UNIV YORK DEPT BIOL YORK YO1 5DD N YORKSHIRE ENGLAND].

Cell and chloroplast development were characterized in young *Triticum aestivum* cv Hereward leaves grown at ambient (350 μ mol L⁻¹) or at elevated (650 μ mol L⁻¹) CO₂. In elevated CO₂, cell and chloroplast expansion was accelerated by 10 and 25%, respectively, in the first leaf of 7-d-old wheat plants without disruption to the leaf developmental pattern. Elevated CO₂ did not affect the number of chloroplasts in relation to mesophyll cell size or the linear relationship between chloroplast number or size and mesophyll cell size. No major changes in leaf anatomy or in chloroplast ultrastructure were detected as a result of growth in elevated CO₂, but there was a marked reduction in starch accumulation. In leaf sections fluorescently tagged antisera were used to visualize and quantitate the amount of cytochrome f, the α - and β -subunits of the coupling factor 1 in ATP synthase, D1 protein of the photosystem II reaction center, the 33-kD protein of the extrinsic oxygen-evolving complex, subunit II of photosystem I, and ribulose-1, 5-bisphosphate carboxylase/oxygenase. A significant finding was that in 10 to 20% of the mesophyll cells grown in elevated CO₂ the 33-kD protein of the extrinsic oxygen-evolving complex of photosystem II and cytochrome f were deficient by 75%, but the other proteins accumulated normally. [References: 30].

1182 Rowland, C.Y.; Kurtboke, D.I.; Shankar, M.; Sivasithamparan, K. (1994) NUTRITIONAL AND BIOLOGICAL ACTIVITIES OF A STERILE RED FUNGUS WHICH PROMOTES PLANT GROWTH AND SUPPRESSES TAKE-ALL. *Mycological Research*. 98(Part 12):1453-1457. English. [UNIV WESTERN AUSTRALIA SCH AGR SOIL SCI & PLANT NUTR NEDLANDS WA 6009 AUSTRALIA].

The nutritional behaviour of a 'Sterile Red Fungus' (SRF) was studied with a view to the development of efficient field delivery systems for its use in plant growth promotion and disease protection. The vegetative cells of the fungus are binucleate with occasional presence of trinucleate terminal cells. Responses to 28 biochemical tests and 19 different carbon sources were determined to detect the enzymatic activities and preferred carbon source utilization for growth. Pectic enzyme patterns and manganese oxidation/reduction abilities of the SRF were also investigated. The SRF was found to have a wide range of enzymatic activity. It produced cellulase, esterase, ligninase, peroxidase, acid phosphatase, phenoloxidase and pectinase and required thiamine (0.6 μ g l⁻¹) for growth. With the exception of chitin, lactose, dulcitol and L-arabinose it utilized all the carbon sources tested. It oxidized and reduced manganese and its isoenzyme pattern is characterized by distinct bands of esterase and polygalacturonase. [References: 30].

1183 Sah, D.N. (1994) EFFECTS OF LEAF WETNESS DURATION AND INOCULUM LEVEL ON RESISTANCE OF WHEAT GENOTYPES TO PYRENOPHORA TRITICI-REPENTIS. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 142(3-4):324-330. English. [PARWANIPUR AGR RES STN POB 4 BIRGANJ NEPAL].

Percent leaf necrosis and lesion length on wheat genotypes increased markedly with increasing duration of leaf wetness (up to 24 h or 48 h) following inoculation with *Pyrenophora tritici-repentis*. A long wetting duration favoured less disease development on resistant (Fink's), and

moderately resistant (Bon/YR/3/F3570//KAL/BB) genotypes than on susceptible Glenlea. No significant difference in per cent necrosis was detected among the upper three leaf positions within a genotype. A long wetness duration had a varying effect on the resistance of wheat genotypes, depending upon the inoculum level. Increasing the inoculum level along with the leaf wetness period increased the per cent leaf necrosis on all three wheat genotypes tested. However, the ranking of the genotype for resistance did not alter even after prolonged duration of leaf wetness (up to 96 h) and/or high inoculum level (12000 conidia/ml water). Various post-inoculation wet-periods in combination with high conidia concentrations in inoculum should be used in identifying highly resistant germplasm in breeding populations at the seedling stage of the wheats. [References: 19].

1184 Sairam, R.K. (1994) EFFECT OF HOMOBRASSINOLIDE APPLICATION ON METABOLIC ACTIVITY AND GRAIN YIELD OF WHEAT UNDER NORMAL AND WATER-STRESS CONDITION. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(1):11-16. English. [INDIAN AGR RES INST DIV PLANT PHYSIOL NEW DELHI 110012 INDIA].

Activities of nitrate reductase, glutamine synthetase along with rate of photosynthesis, chlorophyll content, soluble protein, relative water content, transpiration and diffusion resistance were estimated in wheat cv. C306 at anthesis stage under irrigated and moisture-stress condition and two levels (0.1 and 1.0 ppm) of homobrassinolide application. Yield and yield attributing parameters were recorded at harvest. Moisture-stress adversely affected relative water content, transpiration, net photosynthesis, nitrate reductase and glutamine synthetase activity, chlorophyll and soluble protein content. Homobrassinolide application increased leaf relative water content and transpiration and decreased diffusion resistance in water-stressed and recovered plants. Homobrassinolide application also had positive effect on nitrate reductase and glutamine synthetase activities, photosynthesis, chlorophyll and total soluble protein content in stressed, irrigated and revived plants. The beneficial effect was also observed on grain yield and yield attributing parameters such as grain number per ear, 1000 grain weight, ear number per plant and harvest index. It was concluded that homobrassinolide induced promotion in metabolic activity was mediated through increased enzyme protein synthesis as well as uptake of water resulting in enhanced relative water content under moisture-stress. [References: 23].

1185 Schunmann, PHD.; Harrison, J.; Ougham, H.J. (1994) SLENDER BARLEY, AN EXTENSION GROWTH MUTANT. *Journal of Experimental Botany*. 45(280 Special Issue S1):1753-1760. English. [AFRC INST GRASSLAND & ENVIRONM RES WELSH PLANT BREEDING STN ABERYSTWYTH SY23 3EB DYFED WALES].

Slender barley arises from a mutation in a single nuclear-gene and has pleiotropic effects on growth and development. Plants homozygous for the mutant allele have a greatly increased leaf extension rate, resulting in long and attenuated leaves. The difference in growth rate is accentuated at low temperature. Individual epidermal cells are both longer and narrower in slender, so the whole-plant phenotype is mirrored at the cell level. Whilst the slender phenotype can be mimicked in normal plants by the application of gibberellin, endogenous levels are low. In addition, unlike the normal plants, embryo-less half-seeds of slender show GA-independent secretion of α -amylase. Unlike mature leaf tissue of normal and slender plants which have similar cell wall theology, young slender leaves are much more plastic than the corresponding normal. Differential screening of cDNA libraries has led to the identification of at least five genes with altered patterns of expression in slender. Described in detail are expression patterns for two of these; pCD1311 encoding a shoot peroxidase, and WPRP1 encoding a proline-rich protein thought to have a structural role in the cell wall. Gene expression at low temperatures suggests that slender is abnormally insensitive to temperature reduction at the molecular level. This is consistent with leaf extension continuing at lower than normal temperatures in slender compared with normal. [References: 35].

1186 Schunmann, PHD.; Ougham, H.J.; Turk, K.S. (1994) LEAF EXTENSION IN THE SLENDER BARLEY MUTANT - DELINEATION OF THE TONE OF CELL EXPANSION AND CHANGES IN

TRANSLATABLE MRNA DURING LEAF DEVELOPMENT. *Plant Cell & Environment*. 17(12):1315-1322. English. [INST GRASSLAND & ENVIRONM RES DEPT CELL BIOL PLAS GOGERRDAN ABERYSTWYTH SY23 3EB DYFED WALES].

The slender mutant of barley (*Hordeum vulgare* L.) results from an alteration to a single nuclear gene. Plants homozygous for the mutant allele have long, attenuated leaves as a result of a greatly increased extension rate. Although the growth rate at any one position in the extension zone appears not to differ between slender and normal (wildtype) barley, in slender the length of the zone over which cells extend is approximately 50% greater than that in normal barley. Epidermal cells are both longer and narrower in slender, so the whole-plant phenotype is mirrored at the cell level. Translation in vitro of RNA extracted from successive sections of the young primary leaf, followed by one-dimensional SDS-PAGE separation, facilitated the alignment of equivalent developmental stages in the two genotypes, but failed to demonstrate major differences between the two genotypes. Two-dimensional separation of translation products from total leaf tissue revealed a few small differences between normal and slender. Growth of plants at 8 degrees C compared with 20 degrees C caused changes in some translation products, with one (unknown) product decreasing in abundance in cold-treated normal tissue but not in slender tissue. [References: 30].

1187 Sharmanatu, P.; Ghildiyal, MC. (1994) PHOTOSYNTHESIS AND DRY MATTER PRODUCTION IN T-MONOCOCCUM AND T-AESTIVUM WHEAT IN RESPONSE TO EAR REMOVAL. *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau*. 173(3-4):218-224. English. [INDIAN AGR RES INST DIV PLANT PHYSIOL NEW DELHI 110012 INDIA].

The photosynthesis, shoot formation, leaf area development and dry matter production were examined in control and de-earied plants of T. monocooccum, var. G 1372 and T. aestivum var. Sonalika. The removal of ears decreased the diurnal maintenance of photosynthesis and consequently, the dry matter production in Sonalika but not in G 1372. There was a considerable growth of alternative sinks such as shoots and roots when ear sinks were removed. This alternative sink capacity of de-earied plants seemed to have compensated for limited sink demand of ears in G 1372 but could not entirely compensate for the more efficient grain sink in Sonalika. The diploid wheat produced more dry matter than the hexaploid wheat in the pre-ear emergence period and less in the post-ear emergence period. In the pre-ear emergence period, the difference in dry matter appeared to be mostly because of the difference in duration to ear emergence. During the post-ear emergence period, the lower dry matter in G 1372 seemed to be owing to a rapid decrease in photosynthesis rate after anthesis because of the lower sink capacity of its grains. [References: 14].

1188 Shimoni, Y.; Segal, G.; Zhu, XZ.; Galili, G. (1995) NUCLEOTIDE SEQUENCE OF A WHEAT CDNA ENCODING PROTEIN DISULFIDE ISOMERASE. *Plant Physiology*. 107(1):281. English. [WEIZMANN INST SCI DEPT PLANT GENET IL-76100 REHOVOT ISRAEL].

1189 Sieling, K.; Christen, O.; Richterharder, H.; Hanus, H. (1994) EFFECTS OF TEMPORARY WATER STRESS AFTER ANTHESIS ON GRAIN YIELD AND YIELD COMPONENTS IN DIFFERENT TILLER CATEGORIES OF 2 SPRING WHEAT VARIETIES. *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau*. 173(1):32-40. English. [CHRISTIAN ALBRECHTS UNIV KIEL INST CROP SCI & PLANT BREED OLSHAUSENSTR 40 D-24118 KIEL GERMANY].

Water stress might limit grain yields of cereals under humid conditions. The objective of this study was to investigate the effect of a temporary water shortage at three different stages after anthesis on the grain yield and yield components of different tiller categories in two spring wheat varieties. A pot experiment with controlled water supply and rain shelters was conducted in 1984 and 1985 in Kiel, N.W. Germany. The water stress (pF 2.9 to 3.4) was imposed either between anthesis to early milk development of the caryopsis (WS1) (EC 65 to EC 72 according to ZADOKS scale), early milk development to late milk development of the caryopsis (WS2) (EC 72 to EC 77) and late milk development to maturity (WS3) (EC 77 to EC 92). The control had a constant water supply throughout the growing season of between pF 2.2 to 2.5. The water stress

treatment WS1 significantly reduced the single plant yield by 10% (1984) and 15% (1985) in one variety (Selpak), whereas the other variety was unaffected. The response of both varieties to the two later treatments was smaller and insignificant. In the first year the yield decrease in the variety Selpak after the WS1 treatment was mainly caused by a lower number of ears per plant compared with the untreated control (WS0). In the second year (1985) additionally a lower grain weight of the second category shoots caused by a reduction of the number of kernels per ear contributed to the decrease of the single plant yield. The yield component thousand grain weight could not compensate for the reduction in the number of kernels per ear. [References: 26].

1190 Slaski, JJ. (1995) NAD(+) KINASE ACTIVITY IN ROOT TIPS OF NEARLY ISOGENIC LINES OF WHEAT (TRITICUM AESTIVUM L.) THAT DIFFER IN THEIR TOLERANCE TO ALUMINIUM. *Journal of Plant Physiology*. 145(1-2):143-147. English. [PLANT BREEDING & ACCLIMATIZAT INST RADZIKOW DEPT PLANT BIOCHEM & PHYSIOL MINERAL STRESS LAB PL-00950 WARSAW POLAND].

Aluminium tolerance and NAD(+) kinase activity were measured in apical segments of roots from wheat cultivars Chinese Spring (C.S.) and BH 1146, as well as in lines C.S.ditelo2Ds and C.S.allo2Ds. Plants were grown for 4 days in solutions containing aluminium, calcium or magnesium salts. In the presence of 30 mu M AlCl3 root growth was greatly reduced in the ditelosomic line; root growth of cultivar C.S. and its allosomic line was less affected, while root growth of the Al tolerant cultivar, BH 1146, was not affected at all. Transfer of the long arm of chromosome 2D from BH 1146 to C.S. markedly increased Al tolerance in the developed C.S.allo2Ds line compared with the C.S.ditelo2Ds line. In the presence of Al the total NAD(+) kinase activity increased 2-5 times in root tips of tested genotypes with a maximum activity observed after 6 h of exposure to aluminium. In the Al tolerant allosomic line changes in total and calmodulin-dependent activity of NAD(+) kinase under conditions of Al stress did not follow the same pattern as changes in activity in Al tolerant BH 1146, but resembled changes in activity found in the Al sensitive ditelosomic line. These unexpected observations could be explained if genes located on the 2D1 chromosome segment were not involved in the operation of an Al tolerance mechanism based on NAD(+) kinase activity, but were involved in another mechanism(s) of Al tolerance, for example exclusion of Al. Both calcium and magnesium ameliorated the toxic effects of aluminium on root growth and NAD(+) kinase activity. [References: 31].

1191 Smith, RCG.; Adams, J.; Stephens, DJ.; Hick, PT. (1995) FORECASTING WHEAT YIELD IN A MEDITERRANEAN-TYPE ENVIRONMENT FROM THE NOAA SATELLITE. *Australian Journal of Agricultural Research*. 46(1):113-125. English. [CSIRO DIV EXPLORAT & MIN WEMBLY WA 6014 AUSTRALIA].

This paper reports the relationship between the spatial variation in mean wheat yield/ha of 50 Local Government Areas in Western Australia and satellite measures of the Normalized Difference Vegetation Index (NDVI). Yield/ha was based on estimates of the area harvested and actual grain received by the Cooperative Bulk Handling Ltd. The study area covered 16.3 million ha, in which 2.9 million ha of wheat were sown and 4.66 million tonnes of grain harvested. This was 78% of the total Western Australian wheat crop. Spatial variations in NDVI in early July, at around stem elongation, accounted for 46% of the spatial variation in final yield. This increased to 56% of yield variance around the onset of anthesis at the end of August. It remained high until early November (48%) when crops were senescing or senescent. A combination of NDVI from late August and early November accounted for 70% of the yield variance. In comparison, total rainfall during the 1992 growing season from April to October, the main determinant of yield variations, accounted for 28% of the yield variation. The significant correlation of NDVI with final yield by the middle of the growing season 3 to 5 months before harvest indicates the feasibility of making useful yield forecasts from this time onwards. In addition, the NDVI could provide useful spatial information on the significance of the yield/canopy development/water use relationship which underlies this correlation. [References: 39].

1192 Sutton, F.; Kenefick, DG.; Chang, LY. (1995) A HIGH MOBILITY GROUP PROTEIN CDNA CLONE FROM BARLEY. *Plant Physiology*.

107(1):269-270. English. [S DAKOTA STATE UNIV DEPT PLANT SCI BROOKINGS, SD 57007 USA].

1193 Tatarintsev, N.P.; Lebedeva, A.I.; Pachepskaya, L.B.; Ruzieva, R.Kh.; Gerts, S.M.; Rudenko, T.I. (1993) [Correlation of various types of photophosphorylation and metabolites pools of indol and fenol nature in ontogeny of cereal cultures]. *Vzaimosvyaz' razlichnykh tipov fotofosforilirovaniya i pulov metabolitov indol'noj i fenol'noj prirody v ontogeneze zlakovykh kul'tur. Fiziologiya rastenij (Russian Federation) v. 40(5) p. 709-714. 17 ref. Russian. (AGRI 95-013798).*

1194 THOMAS.; Fukai, S. (1995) GROWTH AND YIELD RESPONSE OF BARLEY AND CHICKPEA TO WATER STRESS UNDER THREE ENVIRONMENTS IN SOUTHEAST QUEENSLAND .1. LIGHT INTERCEPTION, CROP GROWTH AND GRAIN YIELD. *Australian Journal of Agricultural Research. 46(1):17-33. English. [UNIV QUEENSLAND DEPT AGR ST LUCIA QLD 4072 AUSTRALIA].*

Two barley cultivars (early-maturing Corvette and late-maturing Triumph) and one cultivar of chickpea (Amethyst at Redland Bay and Borwen at Hermitage), were grown in well-watered and water stress trials in three experiments to determine how the effect of water stress on growth and yield of these crops was modified by other environmental conditions, particularly temperature. Two experiments (experiments 1 and 2) were conducted at one location (Redland Bay) with two times of sowing (April and July), while experiment 3 (June sowing) was conducted at Hermitage Research Station, which had much lower temperatures in winter. In water stress trials, rainout shelters were used to exclude rain from plots from crop establishment to approximately maturity. In both well-watered and water stress conditions, the barley crop produced a lower yield when sown in April than in mid-winter, as grain filling occurred in late winter/early spring, when radiation and temperature were low. Chickpea in the irrigated control, however, produced the lowest yield in the July sowing at Redland Bay, because of the rapid increase in temperature in spring which hastened maturity. In water stress trials chickpea produced the lowest yield at Hermitage, as water stress severely reduced crop growth after flowering. Early-maturing Corvette produced a higher grain yield than late-maturing Triumph in one water stress trial (experiment 1), when difference in maturity time was 40 days, but not in others when the difference in maturity was less than 15 days. In most crops, development of water stress was slow during early stages of growth, and severe stress developed after maximum light interception was achieved. In these cases, water stress had a small effect on light interception but a large effect on light use efficiency (total dry matter produced per unit of solar radiation intercepted). However, for the chickpea sown in April, water stress developed during leaf area expansion, and severely reduced light interception with little adverse effect on light use efficiency. The results thus suggest that whether water stress affects light interception or light use efficiency depends on the timing of water stress in relation to the canopy development. [References: 22].

1195 THOMAS.; Fukai, S. (1995) GROWTH AND YIELD RESPONSE OF BARLEY AND CHICKPEA TO WATER STRESS UNDER THREE ENVIRONMENTS IN SOUTHEAST QUEENSLAND 3. WATER USE EFFICIENCY, TRANSPIRATION EFFICIENCY AND SOIL EVAPORATION. *Australian Journal of Agricultural Research. 46(1):49-60. English. [UNIV QUEENSLAND DEPT AGR BRISBANE QLD 4072 AUSTRALIA].*

Two cultivars of barley and one cultivar of chickpea were grown in both well-watered and water stress conditions in three experiments. Water use efficiency (biomass produced per unit evapotranspiration) was lower in chickpea than in barley, and between two barley cultivars it was higher in early-maturing Corvette than in late-maturing Triumph. These differences in water use efficiency were mostly related to the differences in transpiration efficiency (biomass produced per unit transpiration). The latter appeared to reflect the differences in biomass production under well-watered conditions, as similar differences were found in light use efficiency (biomass produced per unit of photosynthetically active radiation intercepted) among the three crops. Transpiration efficiency was inversely related to vapour pressure deficit of the air. In three experiments soil evaporation accounted for about 55% and 10-30% of total water use for chickpea and barley respectively during observation

periods, when rainfall was excluded from the plots. Slow canopy development of chickpea was a reason for such a high proportion of soil evaporation, and this contributed to its lower water use efficiency compared to barley. The amount of radiation transmitted to the soil surface appeared to be an important factor determining soil evaporation, even when soil water was not fully available and limiting soil evaporation. [References: 18].

1196 THOMAS.; Fukai, S.; Hammer, G.L. (1995) GROWTH AND YIELD RESPONSE OF BARLEY AND CHICKPEA TO WATER STRESS UNDER THREE ENVIRONMENTS IN SOUTHEAST QUEENSLAND 2. ROOT GROWTH AND SOIL WATER EXTRACTION PATTERN. *Australian Journal of Agricultural Research. 46(1):35-48. English. [UNIV QUEENSLAND DEPT AGR BRISBANE QLD 4072 AUSTRALIA].*

Root growth and water extraction of two barley cultivars, Corvette (early maturing), Triumph (late maturing) and one cultivar of chickpea (Amethyst at Redland Bay and Borwen at Hermitage) were compared under three environments: April sowing and July sowing at Redland Bay and June sowing at Hermitage Research Station, south-east Queensland. This work was designed to explain differences in dry matter production in terms of root growth and water uptake during the crop growth, which relied only on stored soil moisture. In the April sowing where all crops grew well during the early stages of growth, decline in soil water with time for the whole profile was similar among all crops. In the winter sowings (June, July), total water use was less in chickpea than in barley, particularly during early stages when chickpea growth was poor. Water extraction patterns of two barley cultivars were similar in all experiments, though the late-maturing Triumph extracted slightly more water than early maturing Corvette towards maturity. Water extraction front velocities of the three crops were similar in each experiment. At Redland Bay, the water extraction front velocities varied from 1.4 to 1.6 cm day⁻¹ in the April sowing and 2.3 to 2.4 cm day⁻¹ in the July sowing, while they varied from 2.0 to 2.3 cm day⁻¹ at Hermitage. However, descent of the water extraction front commenced later in chickpea than in barley when sown in winter months, and this resulted in lower total water use in chickpea, particularly at Hermitage. In both sowings at Redland Bay total root length increased rapidly to about 60 days after sowing in barley, whereas the increase was slower in chickpea. Root length density was high in the upper soil layers, and this was associated with high extractable soil water. In deeper layers both root length density and extractable soil water decreased. For a given root length density chickpea extracted more water than barley. These results indicate that the differences in root growth and water extraction by the two barley crops were rather small and were unlikely to be the reason for the differences in total dry matter production. Chickpea on the other hand appeared to be susceptible to low temperatures during early stages of growth, and this caused poor growth of both shoots and roots. [References: 15].

1197 Trufanov, V.A.; Permyakov, A.V.; Kichatinova, S.V. (1993) [Relationship between reductase and thiol oxidase activities and the content of low molecular thiols in developing seeds of spring wheat]. *Disul'fidreduktaznaya i tioloksidaznaya aktivnosti v zavisimosti ot soderzhaniya nizkomolekulyarnykh tiolov v razvivayushcheysya zernovke yarovoj pshenitsy. Prikladnaya biokhimiya i mikrobiologiya (Russian Federation) v. 29(5) p. 728-733. 19 ref. Russian. (AGRI 95-013799).*

Four genotypically different forms of spring soft wheat were used to study changes in the content of low molecular SH-compounds with the activity of thiol:protein-disulfide oxidoreductase (EC 1.8.4.2) and thiol:oxygen oxidoreductase (EC 1.8.3.2) catalyzing the reactions of thiol-disulfide metabolism in developing wheat seeds. During intensive biosynthetic processes associated with maturation of seeds, the specific disulfide reductase activity correlated directly with the content of nonprotein SH-groups, which in turn may be determined by the activity of oxygen-dependent thiol oxidase, highly specific to low molecular SH-compounds. It is suggested that nonprotein SH-groups, in particular reduced glutathione, may be involved in regulation of the activity of the enzymes responsible for thiol-disulfide balance at different stages of wheat seed maturation.

1198 Tuba, Z.; Szente, K.; Koch, J. (1994) RESPONSE OF PHOTOSYNTHESIS, STOMATAL CONDUCTANCE, WATER USE

EFFICIENCY AND PRODUCTION TO LONG-TERM ELEVATED CO₂ IN WINTER WHEAT. *Journal of Plant Physiology.* 144(6):661-668. English. [AGR UNIV GODOLLO DEPT BOT & PLANT PHYSIOL PLANT PHYSIOL SECT H-2103 GODOLLO HUNGARY].

Responses of photosynthesis, stomatal conductance, water use efficiency (at the beginning of flowering) and production allocation (at full ear/grain ripening) to long-term elevated CO₂ were assessed in winter wheat (*Triticum aestivum* L. cv. MV16). Plants were grown in open top chambers under a temperate-continental climate from germination at ambient (350 $\mu\text{mol mol}^{-1}$) and elevated (700 $\mu\text{mol mol}^{-1}$) CO₂ concentrations. High CO₂ plants displayed a decreased initial slope of the A/C_i-response curve, with the assimilation rate (A) continuing to increase above 400 $\mu\text{mol mol}^{-1}$ internal CO₂ concentration (C_i). A in the ambient plants showed P regeneration limitation while RuBP regeneration appeared to be limiting A in the high CO₂ treatment. Variable fluorescence ratios (Rfd 690) were lower in the high CO₂ plants indicating a lower potential photochemical activity. The increase in the values for the chlorophyll fluorescence ratio F690/F735 in the high CO₂ plants was in agreement with the lower chlorophyll a+b concentrations. The high CO₂ plants had higher concentrations of starch in their leaves and roots than the ambient plants. Stomatal conductance (g_s) was lower in the high CO₂ plants at every CO₂ concentration (C-a) and C-i and the C-i-dependent g_s response had a large influence on the A/g_s function. The higher water use efficiency (WUE) values (at C-a's > 350 $\mu\text{mol mol}^{-1}$) in the high CO₂ wheat plants were the result of a larger decrease in transpiration rate (E) in the high CO₂ plants than in the ambient plants, and of a simultaneous larger increase in A in the range of C-a above 350 $\mu\text{mol mol}^{-1}$ COP. The integrated and combined effect of the photosynthetic and stomatal acclimation to elevated CO₂ produced a higher C-assimilation in high CO₂ plants at elevated CO₂ than in the ambient plants, however, this was not followed by an acclimation in C-allocation. These were reflected in a slightly increased (6.7%) overall dry matter production and lower reproductive allocation (RA). [References: 45].

1199 Tuttobene, R.; Cosentino, S. (Catania Univ. (Italy). Istituto di Agronomia Generale e Colture Erbacee); Cavallaro, V. (Consiglio Nazionale delle Ricerche, Catania (Italy). Centro di Studio sulle Colture Precoci Ortive in Sicilia) (1993) [A possible model of growth and production of durum wheat (*Triticum durum* Desf.) in relation to meteorological parameters in Mediterranean environment (Sicily)]. Su un possibile modello di accrescimento e produzione del frumento duro (*Triticum durum* Desf.) in relazione a parametri meteorologici in ambiente mediterraneo (Sicilia). Società Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. *Rivista di Agronomia (Italy)* v. 27(4) p. 608-620. 7 tables; 11 graphs; 43 ref. Italian. (AGRIS 95-003837).

This research aimed at studying a simulation model to describe the growth and yield of durum wheat in relation to meteorological parameters in Mediterranean environment, using data of trials carried out by the Institute of Agronomy and field crops of the University of Catania in two years and three localities of the Eastern Sicily. The model is divided into four modules which determine separately main phenological phases, leaf area index, total biomass and yield and soil water balance. The model uses air maximum and minimum temperature, photoperiod, solar radiation, rainfall and evaporation from a class A pan. Simulation carried out on the data of the trials showed a good interpretation of the variability of the actual data in relation to meteorological parameters. The model could simulate the variation due to plant density and sowing date. The model should be verified using independent data.

1200 Tynnela, J.; Stitt, M.; Lonneborg, A.; Smeekens, S.; Schulman, A.H. (1995) **METABOLISM OF STARCH SYNTHESIS IN DEVELOPING GRAINS OF THE SHX SHRUNKEN MUTANT OF BARLEY (*HORDEUM VULGARE*).** *Physiologia Plantarum.* 93(1):77-84. English. [UNIV HELSINKI INST BIOTECHNOL POB 45 SF-00014 HELSINKI FINLAND].

The shx mutant of barley (*Hordeum vulgare* L. cv. Bomi) produces grains greatly decreased in starch content and containing smaller A-starch granules together with normal B-granules. Soluble starch synthase (SSS) and ADP-glucose pyrophosphorylase (AGP) are reduced to about 20% normal activity. To help determine the position of the block to starch

synthesis in shx, we measured enzyme activities and metabolite levels in developing grains of normal and mutant genotypes in a cv. Bomi background. We demonstrate that sucrose, free hexose, hexose phosphates and, critically, ADP-Glc accumulate as a result of the mutation. In addition to AGP and SSS, several other enzyme activities are affected in the shx mutant, most of them showing activities 50-80% of normal. Northern blots showed that transcripts for the AGP small subunit are much less abundant, but of normal size, in shx. These and earlier results together indicate that the metabolic block is at the end of the starch synthetic pathway, with a primary effect on a type I, primer-independent soluble starch synthase. [References: 53].

1201 Uotila, M.; Aioub, A.A.; Gullner, G.; Komives, T.; Brunold, C. (1994) **INDUCTION OF GLUTATHIONE TRANSFERASE ACTIVITY IN WHEAT AND PEA SEEDLINGS BY CADMIUM.** *Acta Biologica Hungarica.* 45(1):11-16. English. [UNIV HELSINKI DEPT PLANT PHYSIOL POB 27 VIIKKI SF-00014 HELSINKI FINLAND].

The effect of the heavy metal cadmium on the glutathione transferase (GT) activity was studied in the shoots and roots of wheat and pea seedlings. The exposure to cadmium led to the reduction of plant growth rates and to a marked induction of GT activity in both plants. In wheat the induction was stronger in the roots than in the shoots at low cadmium concentrations (40-160 μM), but at 640 μM cadmium the effect was more pronounced in the shoots (4.0-fold increase of the activity as compared to control). In pea seedlings the induction rates were generally higher in the roots than in the shoots (at 640 μM cadmium the activity in the roots was 340% of the control). [References: 12].

1202 Voronina, S.S.; Kalinina, I.G.; Kuznetsov, Y.V.; Komissarov, G.G. (1994) **THE USE OF THERMOGRAVIMETRY METHOD FOR INVESTIGATION OF THE AMBIOL EFFECT ON SWELLING OF THE BARLEY SEEDS.** *Izvestiya Akademii Nauk SSSR. Seriya Biologicheskaya.* (3):476-478. Russian. [RUSSIAN ACAD SCI NN SEMENOV INST CHEM PHYS MOSCOW RUSSIA].

Changes in the desorption constants and energy of water desorption activation were studied in the swollen barley seeds using thermogravimetry. The constant and energy of desorption of free and bound water were determined in the seeds after their watering in a solution of growth regulator (ambiol) and in water (control). The desorption constant of free water increased 1.4-fold and the energy of activation of its desorption increased 1.6-fold as compared with the control. These results suggest that thermogravimetry can be used when studying the effects of plant growth regulators. [References: 8].

1203 Walkersimmons, M.K.; Rose, P.A.; Shaw, A.C.; Abrams, S.R. (1994) **THE 7'-METHYL GROUP OF ABSCISIC ACID IS CRITICAL FOR BIOLOGICAL ACTIVITY IN WHEAT EMBRYO GERMINATION.** *Plant Physiology.* 106(4):1279-1284. English. [WASHINGTON STATE UNIV USDA ARS 209 JOHNSON HALL PULLMAN, WA 99164 USA].

Wheat (*Triticum aestivum* L.) embryo germination is inhibited by natural (S)-(+)-abscisic acid (ABA). In this report we have determined critical structural features of the ABA molecule, particularly the methyl and ketone groups of the ABA ring, required for inhibitory activity. To examine the ring residues a series of new optically active ABA analogs have been synthesized in which the 4'-keto, 7-, 8-, or 8'- and 9'-carbons have been replaced with hydrogen atoms. Each of the analogs was tested over a range of concentrations as a germination inhibitor. Enantiomers of the analogs altered at the 4'-keto or 8'- and 9'-methyl groups were active, but less so than ABA. Both enantiomers of 7-demethylABA were inactive as germination inhibitors. The results show that the 7-methyl group is absolutely required for activity, but that the other residues are less critical for hormone recognition. [References: 29].

1204 Wei, Y.D.; Deneer, E.; Thordal-Christensen, H.; Collinge, D.B.; Smedegaard-Petersen, V. (1994) **ACCUMULATION OF A PUTATIVE GUANIDINE COMPOUND IN RELATION TO OTHER EARLY DEFENCE REACTIONS IN EPIDERMAL CELLS OF BARLEY AND WHEAT EXHIBITING RESISTANCE TO ERYTHROGRAMINIS F SP HORDEI.** *Physiological & Molecular Plant Pathology.* 45(6):469-484. English. [ROYAL VET & AGR UNIV DEPT PLANT BIOL PLANT PATHOL SECT THORVALDSENVEJ 40 DK-1871 COPENHAGEN C DENMARK].

The infection process was compared in interactions between *Erysiphe graminis* f.sp. *hordei* isolate A6 and two near-isogenic barley lines (the susceptible line P-01 and the resistant line P-02), and the non-host wheat. A low frequency of successful infections, measured as the percentage of germinated conidia forming primary haustoria, was detected in both susceptible (7.5 %), and resistant (7.3 %) barley isolines and wheat plants (22.3 %). In all three types of plants, papilla formation around the sites of attempted penetration seems to be a general resistance factor and thus not the determining step for distinguishing between race-specific and non-host resistance. In wheat plants, further resistance was manifested early after penetration and characterized by hypersensitively reacting (HR) single cells, no or limited growth of elongating secondary hyphae and no visible sign of infection. The race-specific resistance of barley isolate P-02 occurred later after penetration, and was characterized by plant tissue necrosis and no or weak fungal sporulation. In the susceptible barley isolate P-01, successful infections resulted in heavily sporulating powdery mildew colonies. Putative guanidine compounds, indicated by the Sakaguchi test, occurred in papillae 4-5 h after inoculation and subsequently in HR cells too, and are apparently associated with the very early resistance responses in barley and wheat. The highly basic guanidine compounds, not identified previously in plant defence responses, were found to be bound to the cell wall, and referred to as "basic staining material". Accumulation of polyphenolic substances and callose were demonstrated in papillae and HR cells of both barley and wheat. Lignification occurred in wheat, but did not occur or did so only minimally in barley. [References: 44].

1205 Weyhrich, RA.; Carver, BF.; Martin, BC. (1995) PHOTOSYNTHESIS AND WATER-USE EFFICIENCY OF AWNED AND AwnLETTED NEAR-ISOGENTIC LINES OF HARD RED WINTER WHEAT. *Crop Science*. 35(1):172-176. English. [OKLAHOMA STATE UNIV DEPT AGRON STILLWATER, OK 74078 USA].

Awned hard red winter wheat (HRWW, *Triticum aestivum* L.) cultivars have prevailed in the Great Plains since the introduction of 'Turkey' wheat in the 1870s, but the role of awns in wheat productivity is unclear. Awns may serve a photosynthetic function during periods of drought stress, and may actually compensate for flag leaf photosynthesis reduced by drought stress. Our objectives were to determine the effect of genetic awn suppression on photosynthesis and instantaneous or season-long measurements of water-use efficiency (WUE), and to monitor associated changes in kernel characteristics. Plants of awned and awnleted near-isogenic lines of three contemporary HRWW cultivars (TAM 107, Century, and Mustang) were grown in controlled-environment chambers under well-watered and water-deficit conditions. Photosynthetic rates of spikes and flag leaves were measured separately at two stages of kernel development. Whole-plant and grain WUE were measured based on actual water use. Under well-watered conditions, net photosynthetic rates of awnleted spikes were significantly lower than awned spikes for all cultivars at 14 d after anthesis (DAA) and for two cultivars at 24 DAA. Under water-deficit conditions, rates were significantly lower for awnleted spikes of Mustang and TAM 107 at 14 DAA, while no differences were found at 24 DAA. No differences were found between isolines for flag leaf photosynthesis at either stage. Generally, differences in kernel characteristics were nonsignificant between awned and awnleted lines. Although some instantaneous photosynthetic measurements suggested higher WUE of awned spikes, this difference did not result in higher WUE based on whole-plant biomass or grain weight for awned isolines. [References: 21].

1206 Wojcieszka, U. (1994) THE EFFECT OF NITROGEN NUTRITION OF WHEAT ON PLANT GROWTH AND CO₂ EXCHANGE PARAMETERS. *Acta Physiologiae Plantarum*. 16(4):269-272. English. [INST SOIL SCI & CULTIVAT PLANTS DEPT PLANT PHYSIOL PL-24100 PULAWY POLAND].

Nitrogen stress (deficiency and surplus) restricted growth of wheat plants, their dry matter production as well as chlorophyll and protein synthesis. The rate of photosynthesis and ribulose-1, 5-bisphosphate carboxylase (RuBPC) activity of wheat leaves increased with increasing of nitrogen concentration in the nutrient solution up to 180 mg N dm⁻³. Light and dark CO₂ evolution and CO₂ compensation concentration increased with nitrogen level and their increase was observed over the entire range of nitrogen levels tested (up to 360 mg N dm⁻³).

1207 Yadava, N.; Yadav, VK.; Kumar, A. (1994) EFFECT OF BENZYLADENINE ON TRANSPIRATION, WATER POTENTIAL AND ITS COMPONENTS IN GENOTYPES OF WHEAT CONTRASTING IN DROUGHT TOLERANCE. *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau*. 173(1):61-68. English. [RAJASTHAN AGR UNIV SKN COLL AGR DEPT PLANT PHYSIOL JOBNER 303329 INDIA].

Drought tolerant and susceptible cultivars of wheat, C-306 and Kalyan sona, growing under non-stressed and water-stressed conditions, were sprayed with benzyladenine (BA) at 70 days after sowing (DAS). Observations recorded at 5, 10, 15, 20 and 25 days after spraying revealed that BA increased the rate of transpiration (TR) in C-306 under non-stressed conditions. However, under water stress, the increase was significant only after 5 days of BA spraying. In Kalyan sona BA treatment either decreased TR or did not exhibit significant increase under non-stressed conditions, but caused significant increase in TR under water stress. The increase in TR was elicited through enhanced stomatal opening. Water potential, osmotic potential and pressure potential of both genotypes decreased on account of water stress. The effect of BA was not perceptible on restoration of leaf water potential (LWP) or its components. The effect of BA was possibly confined to stomatal behaviour and transpiration. [References: 31].

1208 Yamashita, K.; Kasai, M.; Yamamoto, Y.; Matsumoto, H. (1994) STIMULATION OF PLASMA MEMBRANE H⁺-TRANSPORT ACTIVITY IN BARLEY ROOTS BY SALT STRESS - POSSIBLE ROLE OF INCREASE IN CHLORIDE PERMEABILITY. *Soil Science & Plant Nutrition*. 40(4):555-563. English. [OKAYAMA UNIV BIORESOURCES RES INST KURASHIKI OKAYAMA 710 JAPAN].

Plasma membrane vesicles were prepared from barley roots (*Hordeum vulgare* cv. Kikaihadaka) using the phase partitioning method. H⁺-transport activity could be measured without membrane inversion treatment, since the plasma membrane vesicles showed a latency value of approximately 50% for the activity. Following the exposure to NaCl, alterations of the plasma membrane H⁺-ATPase and H⁺-transport activity were investigated. After barley roots were treated with 200 mol m⁻³ NaCl for 1 d, both plasma membrane H⁺-ATPase activity and H⁺-transport activity assayed in the presence of nitrate were reduced as compared with those of control roots. However, in the salinized roots, the H⁺-transport activity measured with chloride was higher than that of control roots, though the H⁺-ATPase activity was lower. These results suggest that the permeability of the plasma membrane to chloride may increase by salt stress. [References: 31].

F63 PLANT PHYSIOLOGY-REPRODUCTION

1209 Scott, MP.; Nielsen, VS.; Knoetzel, J.; Andersen, R.; Møller, BL. (1994) IMPORT OF THE BARLEY PSI-F SUBUNIT INTO THE THYLAKOID LUMEN OF ISOLATED CHLOROPLASTS. *Plant Molecular Biology*. 26(4):1223-1229. English. [ROYAL VET & AGR UNIV DEPT PLANT BIOL PLANT BIOCHEM LAB THORVALDSENSEJ 40 DK-1871 FREDERIKSBURG DENMARK].

A full-length cDNA clone encoding the PSI-F subunit of barley photosystem I has been isolated and sequenced. The open reading frame encodes a precursor polypeptide with a deduced molecular mass of 24 837 Da. The barley PSI-F precursor contains a bipartite presequence with characteristics similar to the presequences of proteins destined to the thylakoid lumen. In vitro import studies demonstrate that an in vitro synthesized precursor is transported across the chloroplast envelope and directed to the thylakoid membrane, where it accumulates in a protease-resistant form. Incubation of the precursor with a chloroplast stromal extract results in processing to a form intermediate in size between the precursor and mature forms. Hydrophobicity analysis of the barley PSI-F protein reveals a hydrophobic region predicted to be a membrane spanning alpha-helix. The hydrophobic nature of PSI-F combined with a bipartite presequence is unusual. We postulate that the second domain in the bipartite presequence of the PSI-F precursor proteins is required to ensure the proper orientation of PSI-F in the thylakoid membrane. The expression of the *PsaF* gene is light-induced similar to other barley photosystem I genes. [References: 28].

1210 Tian Guowei; Shen Jiaheng (Harbin Normal Univ., Heilongjiang (China). Dept. of Biology) (1993) The ultracytochemical localization of ATPase activity in the ovules of wheat during fertilization. *Acta Botanica Sinica (China)* v. 35(5) p. 329-336. 29 ill., 21 ref. Chinese. (AGRI 95-003970).

H01 PROTECTION OF PLANTS-GENERAL ASPECTS

1211 Douglas, LI.; Deacon, JW. (1994) STRAIN VARIATION IN TOLERANCE OF WATER STRESS BY IDRIELLA-(MICRODOCHIUM)-BOLLEYI, A BIOCONTROL AGENT OF CEREAL ROOT AND STEM BASE PATHOGENS. *Biocontrol Science & Technology*. 4(2):239-249. English. [UNIV EDINBURGH INST CELL & MOLEC BIOL DANIEL RUTHERFORD BLDG KINGSBLDG EDINBURGH EH9 3JH SCOTLAND].

Three randomly chosen isolates of *Idriella bolleyi* differed markedly in tolerance of water stress down to -5 MPa in vitro. The differences were seen with respect to osmotic potential of media adjusted with KCl or matric potential of media adjusted with polyethylene glycol 8000. They were consistent when assessed by linear extension of colonies, spore germination, biomass production in liquid culture and sporulation in liquid culture. In comparative tests, one strain of *I. bolleyi* showed similar stress tolerance to that of *Fusarium culmorum*, noted as a pathogen of cereals in dry conditions, whereas another strain of *I. bolleyi* showed low tolerance equivalent to that of the take-all fungus *Gaeumannomyces graminis* and a *Phialophora* sp. from maize. The extreme variation in water stress tolerance of *I. bolleyi* might be used to select strains for biocontrol of different cereal root- and foot-rot pathogens or strains might be combined in seed-applied inocula for consistency of biocontrol in different site or seasonal conditions. [References: 28].

1212 Wahmhoff, W. (Deutsche Bundesstiftung Umwelt, Osnabrueck (Germany)) (1994) [Examples of integrated plant production in arable farming - Pointed chemical plant protection with special consideration of economic damage thresholds]. *Gezielter chemischer Pflanzenschutz unter besonderer Beruecksichtigung von Schadensschwellen im Ackerbau. (Integrated plant production); (Systems of sustainable plant production, grounding, experience, developments -arable farming, vegetables, fruits, hops, grassland).* Dierks, R.; Heitefuss, R. 2. Auflage p. 294-315. BLV Verlagsgesellschaft. 2 graph, 17 tables; 19 ref. German. (AGRI 95-004113).

H10 PESTS OF PLANTS

1213 Bowling, R.; Wilde, G.; Harvey, T.; Sloderbeck, P.; Bell, KO.; Morrison, WP.; Brooks, HL. (1994) OCCURRENCE OF GREENBUG (HOMOPTERA, APHIDIDAE) BIOTYPES E AND I IN KANSAS, TEXAS, NEBRASKA, COLORADO, AND OKLAHOMA. *Journal of Economic Entomology*. 87(6):1696-1700. English. [KANSAS STATE UNIV DEPT ENTOMOL MANHATTAN, KS 66506 USA].

Greenbugs collected from Kansas, Texas, Nebraska, Colorado, and Oklahoma were tested to determine the occurrence of greenbug, *Schizaphis graminum* (Rondani), biotypes E and I in sorghum and wheat from 1991 through 1993. The occurrence of biotype I appears to be widespread in the Texas panhandle and in Kansas. Biotype I appears to occur more frequently in southwestern Kansas than other areas of Kansas. An intensive field survey was conducted in 1992 and 1993 to determine occurrence of the two greenbug biotypes within 10 randomly selected sorghum fields in southwestern Kansas. Biotype I occurred in all but one intensively sampled field. [References: 14].

1214 Caillaud, CM.; Dedryver, CA.; Simon, JC. (1994) DEVELOPMENT AND REPRODUCTIVE POTENTIAL OF THE CEREAL APHID SITOBION-AVENAE ON RESISTANT WHEAT LINES (TRITICUM-MONOCOCCUM). *Annals of Applied Biology*. 125(2):219-232. English. [INRA CHAIRE ZOOL ENSAR DOMAINE MOTTE VICOMTE F-35650 LE RHEU FRANCE].

The effect of wheat resistance in lines of *Triticum monococcum* L., on the reproductive performances of the cereal aphid (*Sitobion avenae* F.)

was investigated. Aphids were reared from birth to adult moult either on resistant or susceptible wheat lines, and transferred as apterae to both host genotypes. The influence of these transfers on the subsequent adult weight, gonad status and reproductive performances was evaluated. Aphids transferred from resistant to susceptible plants proved able to compensate for their poor nymphal growth, mainly through additional embryo growth and an increase in the number of matured embryos within the first 10 days of their adult life. Most aphids transferred from susceptible to resistant plants died within the first week following the transfer. Their most advanced embryos matured and were born, but subsequent embryo growth was quickly reduced. The reproductive strategies adopted by *S. avenae* when facing plant resistance, and the hypothesis of a resistant mechanism based on a poor nutritional state of the resistant plants are discussed. [References: 33].

1215 D'Addabbo, T.; Sasanelli, N. (Consiglio Nazionale delle Ricerche, Bari (Italy). Istituto di Nematologia Agraria Applicata ai Vegetali) (1994) [Race and resistance studies on two Italian populations of *Heterodera avenae* (Basilicata, Sardinia)]. *Studi sulla razza e sulla resistenza in due popolazioni italiane di Heterodera avenae* [Basilicata, Sardegna]. *Nematologia Mediterranea (Italy)* v. 22(1) p. 79-82. 2 tables; 12 ref. English. (AGRI 95-014234).

Twenty five near-isogenic lines of wheat, oat and barley were tested for their resistance to two Italian populations of *Heterodera avenae* in a glasshouse experiment. All of the lines were resistant to both populations, which were identified as pathotype Ha51 (from Basilicata) and Ha41 (from Sardinia), with the possibility that the latter might be one of the Spanish pathotypes Ha71 or Ha81.

1216 Dong, H.; Quick, JS.; Brigham, DL.; Bjostad, LB.; Rudolph, JB.; Peairs, FB. (1994) LEAF UNROLLING OF 3 WHEAT GENOTYPES IN RUSSIAN WHEAT APHID EXTRACTS. *Cereal Research Communications*. 22(4):375-379. English. [COLORADO STATE UNIV DEPT AGRON FT COLLINS, CO 80523 USA].

The Russian wheat aphid (RWA) is an important pest on wheat and barley in several areas of the world. It would be desirable to have an indirect screening test for resistance when aphids are not available. Three wheat genotypes, one susceptible Carson and two resistant, CORWA1 and PI294994, to the Russian wheat aphid, were used to test their in vitro responses to aphid extracts. Etiolated seedlings at single leaf stage about 10 to 15 cm tall were cut into 1.5 to 2 cm long segments. The segments just above the coleptile were incubated in crude RWA extract or buffer. The degree of unrolling of the leaf segments was scored. Significant differences existed in unrolling between the leaf segments incubated in buffer only and buffer plus RWA extract. There were also significant differences between the susceptible genotype and the two resistant ones. No significant difference was detected between the two resistant genotypes in leaf unrolling. This Laboratory leaf unrolling test shows promise for genotype selection and needs further testing.

1217 Gillespie, RL.; Kemp, WP. (1994) COMPARISON OF AGE STRUCTURE OF THREE MELANOPLUS SPP (ORTHOPTERA, ACRIDIDAE) IN WINTER WHEAT AND ADJACENT RANGELAND. *Canadian Entomologist*. 126(6):1277-1285. English. [WASHINGTON STATE UNIV COOPERAT EXTENS COURTHOUSE BOX 37 EPHRATA, WA 98823 USA].

Significant differences in age structure of grasshopper populations [*Melanoplus sanguinipes* (Fabricius), *M. bivittatus* (Say), and *M. packardii* Scudder] occurred in winter wheat and adjacent rangeland. In 1988, age structure differences were associated with density shifts in winter wheat between sample periods suggesting that older instars dispersed into the crop but younger instars remained in rangeland. In 1989 there was some partitioning of age classes between the two habitats, but no pattern emerged as in 1988. In 1990, significantly more older instars were collected in winter wheat than in rangeland. There were shifts in percentage density of the three grasshopper species in winter wheat but again no patterns emerged. [References: 29].

1218 Givovich, A.; Niemeyer, HM. (1994) EFFECT OF HYDROXAMIC ACIDS ON FEEDING BEHAVIOUR AND PERFORMANCE OF CEREAL APHIDS (HEMIPTERA, APHIDIDAE) ON WHEAT. *European*

Journal of Entomology. 91(4):371-374. English. [UNIV CHILE FAC CIENCIAS DEPT CIENCIAS ECOL CASILLA 653 SANTIAGO CHILE].

The feeding behaviour of five cereal aphid species in wheat seedlings (measured by the time taken by an aphid to penetrate the phloem and the time spent in committed phloem ingestion) and their performance (measured as mean relative growth rates) were determined as a function of hydroxamic acid concentrations in the seedlings. Lower mean relative growth rates and higher times to attain a committed phloem ingestion were associated with higher hydroxamic acid values. Duration of committed phloem ingestion was not influenced by hydroxamic acid values.

1219 Guo Peizong; Miao Lianhe; Yin Shaozhong (Yanjin County Station of Plant Protection, Henan (China)) (1994) The special biological behavior of bollworms in the wheat fields. *China Cottons (China)* (no. 2) p. 18-19. 2 ref. Chinese. (AGRIC 95-004302).

1220 Guseva, O.G.; Tanskij, V.I. (1993) [Simulation model for prognostication of noctuid moth (*Apamea anceps*) harmfulness [for wheat]]. Imitatsionnaya model' prognoza vredonosnosti zernovoj sovki. *Zashchita rastenij (Russian Federation)* (no.9) p. 39-40. Russian. (AGRIC 95-014180).

1221 Hasken, KH.; Poehling, HM. (1995) EFFECTS OF DIFFERENT INTENSITIES OF FERTILISERS AND PESTICIDES ON APHIDS AND APHID PREDATORS IN WINTER WHEAT. *Agriculture Ecosystems & Environment*. 52(1):45-50. English. [UNIV GOTTINGEN INST PLANT PATHOL DEPT ENTOMOL GRISEBACHSTR 6 D-37077 GOTTINGEN GERMANY].

The population dynamics of cereal aphids and some aphid predators were compared in winter wheat fields of farming systems with different inputs. Aphid and predator densities were estimated using visual counts (150 tillers per plot) and D-VAC suction trap. In 1992 an aphid gradation occurred with large differences in aphid density between farming systems. In a plot without insecticide under intensive farming, aphids reached a peak density of up to 300 aphids per tiller. Aphid abundance was much lower under integrated (150 aphids per tiller) and extensive (80 aphids per tiller) systems. The decrease in farming intensity was clearly related to lower infestations of wheat plants with *Metopolophium dirhodum* (Walker), but not with *Sitobion avenae* (Fabricius). The abundance of the latter was only regulated by insecticide applications. Few aphid-specific predators occurred late in the vegetation period. It seems probable that the missing synchronisation of syrphid oviposition with the beginning of the increase of aphid abundance was the main cause for the high aphid infestation. [References: 13].

1222 Josephides, C.M. (Agricultural Res. Inst., Nicosia (Cyprus)) (1993) Infestation of Cyprus durum wheat by suni-bug, and its effect on the physical dough properties. *Technical Bulletin (Cyprus)*; no. 156 8 p. 2 tables; 2 illus. 6 ref. English. (AGRIC 95-014233).

Grain infestation by suni-bug reached 32 for early sown and 44 for late sown durum wheat. Dough produced from grain infested by more than 5 had seriously impaired development, stability and softening.

1223 Knudsen, GR.; Schotzko, DJ.; Krag, CR. (1994) FUNGAL ENTOMOPATHOGEN EFFECT ON NUMBERS AND SPATIAL PATTERNS OF THE RUSSIAN WHEAT APHID (HOMOPTERA, APHIDIDAE) ON PREFERRED AND NONPREFERRED HOST PLANTS. *Environmental Entomology*. 23(6):1558-1567. English. [UNIV IDAHO DEPT PLANT SOIL & ENTOMOL SCI MOSCOW, ID 83843 USA].

Effects of plant-host type, either wheat, *Triticum aestivum* L., or oat, *Avena sativa* L., and the fungal entomopathogen *Beauveria bassiana* (Balsamo) Vuillemin, on numerical and spatial distributions of Russian wheat aphid, *Diuraphis noxia* Kurdyumov, populations were investigated. Untreated adult aphids or aphids inoculated with conidial suspensions of the pathogen were released onto the center seedlings of an 81-seedling grid in a cage. After 17 d, the numbers of live adults, live nymphs, and sporulating cadavers were recorded for each plant, along with plant height and dry weight. Aphid populations were consistently lower on oat than on wheat, and lower in *B. bassiana* treatments. Spatial statistics (geostatistics) were used to compare patterns of aphid

distribution on plants. On wheat without the pathogen present, adult aphid populations were highest in approximately concentric rings near the outermost plants in grids. Addition of *B. bassiana* to the system reduced the amount of variation caused by spatial orientation, thereby changing the spatial distribution of aphid populations. On oat, aphid populations generally were highest near the center of the grid, but addition of the pathogen changed the spatial structure of the aphid population. Results suggest that aphid movement behavior, which is intimately linked to host-plant quality, is an important determinant of epizootic proliferation. Elucidation of these relationships may eventually lead to a synergistic use of microbial control agents and host-plant resistance in pest management strategies. [References: 28].

1224 Kucerova, Z.; Stejskal, V. (1994) SUSCEPTIBILITY OF WHEAT CULTIVARS TO POSTHARVEST LOSSES CAUSED BY SITOPHILUS-GRANARIUS (L) (COLEOPTERA, CURCULIONIDAE). *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection*. 101(6):641-648. English. [FOOD RES INST PRAGUE DEPT PEST CONTROL RADIOVA 7 CS-10231 PRAGUE 10 CZECH REPUBLIC].

Eleven cultivars of winter wheat were tested in the laboratory for their susceptibility to post-harvest attack by the granary weevil *Sitophilus granarius*. The number of F1 generation, the duration of development, the course of adult emergence and the weight loss of infected grain were investigated, and indices of susceptibility calculated, for each cultivar. Significant differences in the susceptibility of tested cultivars to the granary weevil were found. According to the values of index of susceptibility (IS), the cv. 'S-d-211' was most resistant (IS = 7.46), followed by 'Vlada' (IS = 8.31) and 'Hana' (IS = 8.51). 'Viginta' was most susceptible (IS = 9.09). There were no significant differences in other cultivars. We found correlation between F1 progeny production (PP) and average annual qualitative parameters of tested cultivars (PP vs. protein content $r = -0.79$, PP vs. vitreousness $r = -0.77$, PP vs. gluten content $r = -0.61$, PP vs. index of technological quality $r = -0.42$). There were no significant differences in the development time among tested cultivars (range 56-58 days). Grain weight losses were positively correlated with the number of weevils emerging. [References: 21].

1225 Legg, DE.; Nowierski, RM.; Feng, MG.; Peairs, FB.; Hein, GL.; Elbertson, LR.; Johnson, JB. (1994) BINOMIAL SEQUENTIAL SAMPLING PLANS AND DECISION SUPPORT ALGORITHMS FOR MANAGING THE RUSSIAN WHEAT APHID (HOMOPTERA, APHIDIDAE) IN SMALL GRAINS. *Journal of Economic Entomology*. 87(6):1513-1533. English. [UNIV WYOMING DEPT PLANT SOIL & INSECT SCI LARAMIE, WY 82071 USA].

A sequential-interval procedure was developed to calculate upper and lower stop values of binomial sequential sampling models for the Russian wheat aphid, *Diuraphis noxia* (Kurdjumov), infesting small grains. This procedure was developed for economic thresholds of 5, 10, and 20% infested tillers and will calculate upper and lower stop values for most proportions of maximum allowable sequential errors between 0.01 and 0.5. Average sample number and proportion of incorrect classification curves were established with three binomial sequential sampling models. In addition, the influence of maximum allowable number of samples and three terminal-error philosophies on the proportion of incorrect classifications was investigated. The sequential-interval procedure was tested via computer-simulated sampling experiments and field evaluations in Colorado, Idaho, Montana, Nebraska, and Wyoming. A computer program enabled users to produce easily sequential sampling stop values via the sequential-interval procedure. [References: 29].

1226 Liu Shaoyou; Hou Youming (Northwestern Univ., Xian, Shaanxi (China). Research Centre. of Ecological Economics) (1993) Comprehensive effect of compound chemicals on heading period of wheat. *Shaanxi Journal of Agricultural Sciences (China)* (no. 4) p. 22-23. 2 tables, 6 ref. Chinese. (AGRIC 95-004304).

1227 Miller, HL.; Neese, PA.; Ketrang, DL.; Dillwith, JW. (1994) INVOLVEMENT OF ETHYLENE IN APHID INFESTATION OF BARLEY. *Journal of Plant Growth Regulation*. 13(4):167-171. English. [OKLAHOMA STATE UNIV DEPT ENTOMOL STILLWATER, OK 74078 USA].

The recently arrived Russian wheat aphid (RWA) is a major pest of wheat and barley in the United States. RWA induced ethylene production in Morex, a barley variety susceptible to RWA, but induced little ethylene production in PI 366450, a barley resistant to RWA. Greenbugs, another aphid pest, induced ethylene production in PI 366450 and Morex, both of which are susceptible to greenbugs. RWA infestation results in pronounced symptoms on barley including leaf streaking, stunting of growth, and rolled leaves. Incubation of barley in ethylene (5 and 50 $\mu\text{mol/l}$) or other plant hormones (auxin, gibberellic acid, zeatin, kinetin, and abscisic acid at 10^{-4} M) failed to produce streaking or rolling in uninfested plants or to alter the production of these symptoms in infested plants. Incubation of Morex and PI 366450 in ethylene caused some stunting of the leaves and internodes that emerged during or soon after ethylene incubation. However, the leaf and internode that emerged 9 days after incubation showed some compensatory, or increased, growth. [References: 22].

1228 Niehoff, B.; Poehling, H.M. (1995) POPULATION DYNAMICS OF APHIDS AND SYRPHID LARVAE IN WINTER WHEAT TREATED WITH DIFFERENT RATES OF PIRIMICARB. *Agriculture Ecosystems & Environment*. 52(1):51-55. English. [UNIV GOTTINGEN INST PLANT PATHOL DEPT ENTOMOL GRISEBACHSTR 6 D-37077 GOTTINGEN GERMANY].

The effects of different rates of pirimicarb on aphids and syrphid larvae in winter wheat were studied from 1991 to 1993. The numbers of aphids and pre-imaginal stages of aphid-specific predators were determined visually in four replicated randomised plots. The years showed strong differences in aphid infestation, syrphid migration and oviposition, and larval density probably because of different weather conditions. The results indicate high efficacy of pirimicarb to aphids but also to syrphid larvae at the currently recommended rate (100 g a.i. ha⁻¹) and even at 50 g a.i. ha⁻¹. A certain degree of selectivity was obtained at 25 g a.i. ha⁻¹. [References: 16].

1229 Quisenberry, S.S.; Schotzko, D.J. (1994) RUSSIAN WHEAT APHID (HOMOPTERA, APHIDIDAE) POPULATION DEVELOPMENT AND PLANT DAMAGE ON RESISTANT AND SUSCEPTIBLE WHEAT. *Journal of Economic Entomology*. 87(6):1761-1768. English. [UNIV IDAHO DEPT PLANT SOIL & ENTOMOL SCI MOSCOW, ID 83844 USA].

The resistant wheat plant introductions PI 137739 and PI 262660 and the susceptible wheat (*Triticum aestivum* L.) cultivar 'Stephens' were used to determine the effects of varying Russian wheat aphid, *Diuraphis noxia* (Kurdjumov), population densities (0, 10, and 40 aphids per plant) on plant growth and aphid population development. Aphid population development and plant growth were evaluated by destructively sampling plants and aphids at 1, 5, 10, and 15 d after infestation. Plant parameters measured included height, dry weight, and damage. D. noxia feeding damage was determined by counting the number of leaves that were rolled and were chlorotic. The numbers of live and dead aphids were counted to measure D. noxia population development. D. noxia densities on susceptible 'Stephens' wheat were greater than on the resistant accessions at 5, 10, and 15 d after infestation. The impact of aphid feeding was less on PI 137739 and PI 262660 than on 'Stephens' wheat. When the initial D. noxia density was 40 aphids per plant, the total number of aphids produced was higher at days 5 and 10 than the other aphid density, and the reproductive rates were lower on all dates. Plants initially infested with 10 aphids supported larger populations on day 15, because of lower mortality, higher aphid reproductive rates, and fewer dying plants. [References: 27].

1230 Tanigoshi, L.K.; Pike, K.S.; Miller, R.H.; Miller, T.D.; Allison, D. (1995) SEARCH FOR, AND RELEASE OF, PARASITIDS FOR THE BIOLOGICAL CONTROL OF RUSSIAN WHEAT APHID IN WASHINGTON STATE (USA). *Agriculture Ecosystems & Environment*. 52(1):25-30. English. [WASHINGTON STATE UNIV DEPT ENTOMOL PULLMAN, WA 99164 USA].

Parasitoids of Russian wheat aphid, *Diuraphis noxia* (Kurdjumov), from Morocco, and the Middle East were imported, reared, and mass produced for classical biological control use in Washington State. In total, more than 200 000 parasitoids were released over 53 sites from 1988 to 1992. Some species have established, but the long term effect of the program has yet to be documented. [References: 23].

1231 Wang Mingzu; Yan Jiakun (Huazhong Agricultural Univ., Wuhan (China). Dept. of Plant Protection) (1993) Studies on the wheat disease caused by cyst nematode II. Hatching of the nematode *Heterodera avenae*. *Journal of Huazhong Agricultural University (China)* v. 12(6) p. 561-565. 4 tables, 6 ref. Chinese. (AGRIC 95-004303).

1232 Weyman, G.S.; Jepson, P.C. (1994) THE EFFECT OF FOOD SUPPLY ON THE COLONISATION OF BARLEY BY AERIALY DISPERSING SPIDERS (ARANEAE). *Oecologia*. 100(4):386-390. English. [UNIV SOUTHAMPTON DEPT BIOL BASSETT CRESCENT E SOUTHAMPTON SO9 3TU HANTS ENGLAND].

A field experiment was carried out to determine whether different levels of food availability affected the retention rate of ballooning spiders landing in trays of seedling barley plants, half of which were infested with aphids from laboratory cultures. The trays were placed within bases in the field, then collected sequentially and spider numbers assessed in each tray. Deposition trays, containing trapping fluid only, were used to measure ballooning activity throughout the experimental period. The experiment was repeated four times. Overall, ballooning spiders were more likely to be retained in trays where aphid prey were present, with a total of 340 spiders found in the infested trays and 251 in the aphid-free trays, over the four experiments. Most of the spiders found were of the family Linyphiidae. In the second and fourth experiments the increased retention of spiders in the aphid-infested trays was statistically significant. Immature linyphiids alone also showed significantly higher retention in the infested trays in those two experiments and in the fourth experiment were largely responsible for the higher numbers found in the infested trays. There was also a statistically significant trend for a higher retention rate of female spiders, compared to males, in the barley trays than would have been expected from the ratios of females to males caught in the deposition trapping trays alone. [References: 14].

1233 Wilson, M.J.; Glen, D.M.; George, S.K.; Pearce, J.D.; Wiltshire, C.W. (1994) BIOLOGICAL CONTROL OF SLUGS IN WINTER WHEAT USING THE RHABDITID NEMATODE PHASMARHABDITIS-HERMAPHRODITA. *Annals of Applied Biology*. 125(2):377-390. English. [UNIV BRISTOL INST ARABLE CROPS RES DEPT AGR SCI LONG ASHTON RES STN BRISTOL BS18 9AF AVON ENGLAND].

A field experiment on winter wheat in autumn 1991 investigated the effect of the rhabditid nematode, *Phasmarhabditis hermaphrodita*, applied to soil at five dose rates (10/8) - 10/10 infective larvae ha⁻¹) immediately after seed sowing, on slug populations and damage to seeds and seedlings. The nematode was compared with methiocarb pellets broadcast at recommended field rate immediately after drilling and no molluscicide treatment. Slug damage to wheat seeds and seedlings was assessed 6 and 13 wk after drilling. Seedling survival increased and slug grazing damage to seedlings declined linearly with increasing log nematode dose. These two measures of slug damage were combined to give an index of undamaged plant equivalents, which also increased linearly with increasing log nematode dose. ANOVA showed that, after 6 wk, there were significantly more undamaged plant equivalents on plots treated with the two highest nematode doses (3 x 10/9) and 1 x 10/10 ha⁻¹) than on untreated plots, but the number of undamaged plant equivalents on methiocarb-treated plots was not significantly greater than that on untreated plots. Slug populations were assessed by refuge trapping and soil sampling. *Deroceras reticulatum* was the commonest of several species of slugs recorded. During the first 4 wk after sowing, significantly more slugs were found under refuge traps on plots treated with certain doses of *P. hermaphrodita* than under traps on untreated plots and more showed signs of nematode infection than expected from the prevalence of infection in slugs from soil samples, suggesting that the presence of *P. hermaphrodita* altered slug behaviour. Application of *P. hermaphrodita* had no significant impact on numbers or biomass of slugs in soil during a 27 wk period after treatment, except after 5 wk when slug numbers were inversely related to log nematode dose. However, by this time, numbers in soil samples from untreated plots had declined to levels similar to those in plots treated with the highest dose of nematodes. During the first 5 wk after treatment, c. 20% of slugs in soil samples from untreated plots showed symptoms of nematode infection. It is suggested that this represented the background level of infection in the experimental field rather than spread of infection from treated plots. The apparent lack

of impact of *P. hermaphrodita* on slug numbers and biomass in soil suggests that its efficacy in protecting wheat from slug damage was through inhibition of feeding by infected slugs. [References: 30].

1234 Yang Jianye (Shaanxi Provincial Inst. of Plant Protection, Yangling (China)) (1993) A path analysis on influence of climate factors on the growth and decline of aphid community at wheat seedling stage and the occurrence of alate. *Shaanxi Journal of Agricultural Sciences (China)* (no. 6) p. 4-5, 42. 2 ill., 4 tables, 3 ref. Chinese. (AGRI 95-004305).

H2O PLANT DISEASES

1235 [Financial analysis of winter wheat disease control [in Belgium]]. *Maladie du froment. Analyse financière de la lutte* (1993) Ministère de l'Agriculture, Bruxelles (Belgium). Service de Vulgarisation des Nouvelles Technologies. *Agricollecta (Belgium); Courrier du Ministère de l'Agriculture* (no.256) p. 3-9. 7 tables. French. (AGRI 95-014626).

1236 Afanasenko, OS.; Khartleb, K.; Guseva, NN.; Minarzhikova, V.; Yanosheva, M. (1994) INTERNATIONAL COLLECTION OF TEST VARIETIES FOR THE POPULATIONS OF NET SPOT OF BARLEY CAUSAL AGENT. *Mikologiya i Fitopatologiya*. 28(4):34-42. Russian. [ALL RUSSIAN PLANT PROTECT INST ST PETERSBURG RUSSIA].

1237 Anceau, C.; Lepoivre, P.; Semal, J. (1994) [Vitroculture and plant pathology. Results of researches performed between 1982 and 1992 [in Belgium]]. *Vitroculture et phytopathologie. Synthèse des recherches 1982-1992*. 16 ill.; 4 tables; 54 ref. 87 p. French. (AGRI 95-004608).

1238 Bekesi, P.; Jakabné Kondor, M. (Orszagos Mezogazdasági Minőség Int., Budapest (Hungary)) (1994) [Resistance tests of winter wheat varieties to *Fusarium culmorum* and *F. graminearum* in simulation trials. Study of the correlation between the resistance to both pathogens]. *Oszi búzafajta Fusarium culmorum-mal és Fusarium graminearum-mal szembeni rezisztenciájának vizsgálatá provokációs kísérletben. A két korokozó iránti rezisztencia összefüggésének vizsgálata*. 40. Novenyvédelmi Tudományos Napok; Budapest (Hungary); 22-23 Feb 1994. *Novenyvédelmi Tudományos Napok (Hungary)* (no.40) p. 100. Hungarian. (AGRI 95-014724).

On 1 June 1993, 85 winter wheat varieties belonging to 3 groups of ripening, sown in autumn 1992, were inoculated with *Fusarium culmorum* and *Fusarium graminearum*, resp. Results showed that the early ripening varieties were infected by *F. culmorum* from 16 to 56 % and by *F. graminearum* from 22 to 55 % resp., the analogous figures being for medium-early ripening varieties 11-43 and 15-55 %, for late ripening varieties 18-45 and 22-55 resp. Behaviour to both pathogens was mostly similar: varieties highly infected by one of them were generally highly infected also by the other one, and the other way round.

1239 Chalhoub, BA.; Sarrafi, A.; Beuve, MA.; Lapierre, HD. (1994) DIFFERENTIAL INTERACTION BETWEEN PAV-LIKE ISOLATES OF BARLEY YELLOW DWARF VIRUS AND BARLEY (*Hordeum vulgare* L) GENOTYPES. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 142(3-4):189-198. English. [INRA PATHOL VEGETALE STN ROUTE ST CYR F-78026 VERSAILLES FRANCE].

Four PAV-like isolates of barley yellow dwarf virus (BYDV) were identified as causing very severe (RG), severe (2t), moderately severe (3b) and mild symptoms (13t) in barley (*Hordeum vulgare*) cultivar Plaisant in a growth chamber at 25 days after inoculation. These isolates had different effects on a range of barley genotypes. Cultivar Vixen, which contains the Yd2 resistance gene, and 80-81BQCB10 were not affected by any isolate. Five other genotypes were significantly affected by at least one of the isolates. Line Ea52 (which is a mutant of the Japanese cultivar Chikurin Ibaraki) was more susceptible to BYDV-PAV than Chikurin Ibaraki 1. No serological differences were detected between the four isolates using monoclonal or polyclonal antibodies. Virus antigen concentration, estimated by enzyme-linked immunosorbent assay (ELISA), was correlated with the decrease in the shoot fresh weight for all isolates and all genotypes except for Vixen and 80-81BQCB10. In field tests, the severity of symptoms induced by the BYDV-PAV isolates was in accordance with that estimated in the growth chamber. However isolate

2t was more severe on cultivar Vixen and overcame the partial resistance of Chikurin Ibaraki 1 to the three other isolates. The results show that virus antigen concentration not only contributes to characterizing the resistance levels of barley genotypes but also the severity of BYDV-PAV isolates. [References: 25].

1240 Corazza, L.; Balmas, V. (Istituto Sperimentale per la Patologia Vegetale, Rome (Italy)); Rizzo, V.; Maiorana, M. (Istituto Sperimentale Agronomico, Bari (Italy)) (1993) [Development of foot rot on durum wheat in continuous cropping after different management of crop residues]. *Sviluppo di "mal di piede" su frumento duro in monosuccessione in relazione ad interventi agronomici sui residui vegetali*. *Agricoltura Ricerca (Italy)* v. 15(151-152) p. 263-266. 1 table; 1 graph; 13 ref. Italian. (AGRI 95-014743).

1241 Cotterill, PJ.; Park, RF.; Rees, RG. (1995) PATHOGENIC SPECIALIZATION OF PUCCINIA HORDEI OTTH IN AUSTRALIA, 1966-1990. *Australian Journal of Agricultural Research*. 46(1):127-134. English. [QUEENSLAND WHEAT RES INST DEPT PRIMARY IND POB 2282 TOOWOOMBA QLD 4350 AUSTRALIA].

One hundred and fifty-four isolates of the leaf rust pathogen (*Puccinia hordei*), collected from infected barley plants in Australia between 1966 and 1990, were typed to determine virulence with respect to the resistance genes Rph1 to Rph9, Rph12 (Triumph) and several uncharacterized resistance sources. The Australian cultivar, Prior, reacted differentially to the isolates examined, and is believed to possess a gene which is also present in addition to Rph2 in Reka 1. Virulence and avirulence on Prior were designated P+ and P- respectively. Eleven distinct pathotypes (pt) were identified, with pt 243 P+ and 243 P- predominating in samples collected between 1966 and 1979. In the 1980s, pt 210 P+ was most commonly isolated from samples collected in Queensland and northern New South Wales, and although a range of different pathotypes was present in southern Australia, pt 200 P+ was most frequent in this region. Virulences to genes Rph1, Rph2, Rph4, Rph5, Rph6, Rph8, Rph9 and Rph12 have been detected, and only Rph3 and Rph7 are likely to be of value in protecting future Australian barleys from the disease. [References: 31].

1242 Cotterill, PJ.; Rees, RG.; Platz, GJ. (1994) RESPONSE OF AUSTRALIAN BARLEY CULTIVARS TO LEAF RUST (PUCCINIA HORDEI). *Australian Journal of Experimental Agriculture*. 34(6):783-788. English. [QUEENSLAND WHEAT RES INST QUEENSLAND DEPT PRIMARY IND POB 2282 TOOWOOMBA QLD 4350 AUSTRALIA].

Thirty-eight Australian commercial cultivars of barley were screened as seedlings against 11 pathotypes of the leaf rust pathogen (*Puccinia hordei* Otth.) detected in Australia, and as adult plants in the field against the 2 predominant pathotypes (210 P+ and 200 P+) present in the eastern mainland states. Most cultivars were susceptible as seedlings to 10 of the pathotypes of *P. hordei* (with infection types of 3 or 4 on a 0-4 scale) but only 17 were susceptible to pathotype 253 P-. Abyssinian, Franklin, Tallon and Triumph were susceptible to none, Skiff only to 210 P+, Grimmer and Shannon only to 210 P+ and 253 P- and Ulandra to pathotypes 202 P+, 243 P-, 243 P+, 253 P- and 262 P+. Cutter, Ketch, Prior, Schooner and Weeah were susceptible to all except 200 P-, 201 P-, 243 P-, and 253 P-, and Yerong to all except 200 P-, 201 P-, 202 P+, 220 P+ and 262 P+. Some cultivars, notably Malebo, but also Corvette, Galleon, Schooner and, to a lesser extent, Yerong were not as susceptible (infection types of 3 to 3(+)/4(-)) to most pathotypes of *P. hordei*. As adult plants in the field, Abyssinian, Franklin, Tallon and Triumph were resistant, and Malebo and Ulandra moderately resistant/moderately susceptible to both pathotypes tested. [References: 15].

1243 Danial, D.L.; Kirigwi, F.M. (N.P.B.R.C., Njoro (Kenya)); Broers, L.H.; Kiriswa, F. (1994) Sources of Resistance to Yellow and Stem Rust in CIMMYT Bread Wheat Derivatives in Kenya. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 171-176. CIMMYT. 4 tables; 4 ref. English. (AGRI 95-004593).

In Kenya, a total of 879 bread wheat cultivars and lines were screened for their reaction to yellow rust and stem rust. Fifteen entries were

identified as having a high level of resistance to both rust populations. The selected entries were also observed to be highly resistant to yellow rust populations in Mexico and Ecuador. This indicates that the resistance genes to yellow rust in these cultivars and lines were effective against pathogen populations with a broad range of virulence. In addition, the selected entries were characterized by good agronomic performance and were well adapted to Kenyan growing conditions. Component yield analysis revealed that mean 1000 grain weight, head weight and number of tillers per plant of the selected entries were 43.0, 2.1 and 6.9 while the corresponding values for the check cultivar Pasa were 37.0, 2.2 and 5.8, respectively. Such resistant cultivars and lines are promising sources of resistance, and therefore, can be recommended for use in breeding programs.

1244 Dubois, D.; Jenny, E. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Reckenholz (Switzerland)) (1994) [PCR in the diagnosis of plant viruses]. PCR-Methode zur Diagnose von Pflanzenviren. *Agrar Forschung (Switzerland)* v. 1(9) p. 415-418. 2 graphs, 1 photograph. German. (AGRIS 95-004525).

The polymerase chain reaction (PCR) represents a promising new method for diagnostic purposes. It recognizes plant pathogens by their genome and shows a high specificity and sensitivity.

1245 Duffy, BK.; Weller, DM. (1994) A SEMISELECTIVE AND DIAGNOSTIC MEDIUM FOR *GAEUMANNOMYCES GRAMINIS* VAR *TRITICI*. *Phytopathology*. 84(12):1407-1415. English. [ETH ZURICH INST PLANT SCI PHYTOMED ZURICH SWITZERLAND].

Isolation of *Gaeumannomyces graminis* var. *tritici*, causal agent of take-all, from wheat tissues often is complicated by the presence of *Pythium* spp., *Rhizoctonia* spp., *Fusarium* spp. or secondary fungal colonists. Because *G. g. tritici* does not typically sporulate in culture, identification of putative isolates is based on cultural characteristics, pathogenicity tests, and production of perithecia on infected tissue. A semiselective medium designated R-PDA was developed that aids in the isolation and identification of *G. g. tritici*. The medium consists of dilute potato-dextrose agar amended with 100 μ g ml⁻¹ rifampicin and 10 μ g ml⁻¹ tolcllofosmethyl. Identification of *G. g. tritici* is aided based on its ability to alter the color of rifampicin in R-PDA from orange to purple. This reaction occurs in as little as 24 h. R-PDA was more effective in isolating putative isolates of *G. g. tritici* from wheat with symptoms of take-all than was SM-GGT3, another semiselective medium for *G. graminis* var. *tritici*. [References: 33].

1246 Dupla, B.; Kaptas, T. (Heves megyei Növényegészségügyi és Talajvéd. All., Eger (Hungary)) (1994) [Results of monitoring the resistance of *Erysiphe graminis* to fungicides in 1993]. Gabonáliszharmat (*Erysiphe graminis*) SBG fungicidekkel szembeni rezisztencia monitoring 1993. évi eredményei. 40. Növényvédelmi Tudományos Napok; Budapest (Hungary); 22-23 Feb 1994. *Növényvédelmi Tudományos Napok (Hungary)* (no.40) p. 104. Hungarian. (AGRIS 95-014725).

In 1993, the susceptibility of 44 *Erysiphe graminis* isolates /41 of them having been isolated from winter wheat and 3 from winter barley/, collected in 11 counties of Hungary, to the active agents triadimefon /DMII/ and tridemorf /morfolin/ were tested. The log ED 50 mg/ml values were determined as well. The tests showed that *E. graminis* isolates, especially the ones taken from wheat, were sensitive to both active agents.

1247 Dyer, PS.; Papaikononou, M.; Lucas, JA.; Peberdy, JF. (1994) ISOLATION OF R-TYPE PROGENY OF *TAPESIA YALLUNDIAE* FROM APOTHECIA ON WHEAT STUBBLE IN ENGLAND. *Plant Pathology*. 43(6):1039-1044. English. [UNIV NOTTINGHAM DEPT LIFE SCI UNIV PK NOTTINGHAM NG7 2RD ENGLAND].

Apothecia of *Tapesia yallundiae* were collected from a set-aside straw stubble site in Lincolnshire in March 1993. Single ascospore isolates were obtained which produced colonies with morphologies and growth rates characteristic of the R-pathotype of *Pseudocercospora herpotrichoides*. Isolates were confirmed to be R-type by the use of randomly amplified polymorphic DNA (RAPD) markers. These observations confirm that *T. yallundiae* is the teleomorph of the R-type of *P. herpotrichoides* and

represent the first detection of the sexual stage of the R-type in the UK. [References: 29].

1248 Fandlova, M. (Ustredny Kontrolny a Skusobny Ustav Polnohospodarsky, Bratislava (Slovak Republic)) (1994) [Experiences with Alto 100 SL and Alto Combi 420 SC fungicides in cereals]. Skusenosti s ochranou obilnin proti chorobam s pripravkami Alto 100 SL a Alto Combi 420 SC. *Agrochémia (Slovak Republic)* v. 34(4) p. 87-88. 3 tables. Slovak. (AGRIS 95-014730).

1249 Filippova, G.G.; Kashemirova, L.A.; Chiburova, I.V. (1993) [Phytoexamination of spring barley seeds [examination of fungus infection]]. O fitoehkspertize semyan yarovogo yachmenya. *Zashchita rastenij (Russian Federation)* (no.11) p. 29-30. Russian. (AGRIS 95-014654).

1250 Formanova, M.; Sebesta, J. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyně (Czech Republic)) (1994) Assessment of adult plant resistance of winter wheat to powdery mildew. *Ochrana Rostlin (Czech Republic)* v. 30(3) p. 189-198. 4 tables; 14 ref. English. (AGRIS 95-014721).

1251 Gallenberg, D.J. (1993) Wheat scab. *Extension extra (USA)*; no. 8097 1 p. In subseries: Plant Science. English. (AGRIS 95-014732).

1252 Gao Bida; Wu Wei; Cheng Hui (Shenyang Agricultural Univ. (China). Lab. of Plant Immunity) (1993) Ultrastructure of leaf tissues of resistant or susceptible wheat exposed to toxin produced by *Helminthosporium sativum*. *Acta Phytopathologica Sinica (China)* v. 23(2) p. 107-113. 18 ill., 7 ref. Chinese. (AGRIS 95-004589).

1253 German, SE.; Kolmer, JA. (1994) VIRULENCE PHENOTYPES OF *PUCCINIA RECONDITA* F SP *TRITICI* IN URUGUAY. *Plant Disease*. 78(12):1139-1141. English. [AGR AGRIFOOD CANADA WINNIPEG RES CTR 195 DAFOE RD WINNIPEG MB CANADA].

Samples of wheat leaves infected with leaf rust, caused by *Puccinia recondita* f. sp. *tritici*, were collected in Uruguay in 1989, 1991, 1992, and 1993. The leaf rust collections were processed and evaluated for identification of virulence phenotypes on Thatcher wheat Lines near-isogenic for leaf rust resistance genes. During the 4 yr, 37 virulence phenotypes were identified from a total of 316 single-uredinium isolates. The largest number of phenotypes were identified in 1989 when rust samples were collected from the near-isogenic lines. Rust collections from 1991-1993 were collected from local breeding lines and cultivars and were less diverse for virulence phenotypes. Virulence frequencies were very low or were not detected to lines with resistance genes Lr9, Lr16, Lr19, Lr21, Lr24, Lr25, Lr29, and Lr32. Phenotypes with virulence to Lr26 increased in frequency from 1989 to 1993. Certain virulence phenotypes of *P. tritici* in Uruguay were distinct from those reported in North America. [References: 13].

1254 Gilligan, CA. (1994) THE DYNAMICS OF INFECTION BY THE TAKE-ALL FUNGUS ON SEMINAL ROOTS OF WHEAT - SENSITIVITY ANALYSIS OF A STOCHASTIC SIMULATION MODEL. *New Phytologist*. 128(3):539-553. English. [UNIV CAMBRIDGE DEPT PLANT SCI DOWNING ST CAMBRIDGE CB2 3EA ENGLAND].

The effects and interactions of inoculum density (I_{rho}), rate of fungal growth (k_f) and the maximum distances for primary ($w(p)$) and secondary ($w(g)$) infection on the temporal progress of infection of the take-all fungus, *Gaeumannomyces graminis*, in small populations of contiguous wheat plants are examined in factorial combination using a stochastic simulation model. The effects are analyzed in relation to infection progress curves for the percentage infected roots, the total length of infected root, the density of separate infection and the mean length of separate infections as well as the densities of primary and cross infections. Linear models are used to analyze the effects of changing parameter values on components of the infection progress curves. Non-linear, logistic models are used to summarize infection progress curves and to map the effects of changing simulation model parameters onto the parameters of the simpler, growth curve function. The proportion of infected roots was most influenced by I_{rho} and $w(p)$ with a negligible effect due to $w(g)$. The density and length of infections on roots was principally controlled by k_f . Changes in infection length were non-monotonic. The average length of infections increased towards a

temporary maximum, following the first wave of primary infections, dipped as infections overlapped and then increased rapidly as root colonization progressed. The first wave of cross infection occurred 7 d after the initiation of primary infection. The density of primary infections was controlled principally by I_{rho} and $w(p)$. The density of cross infections was controlled not only by k_f and $w(s)$, which are directly involved in cross infection, but also by I_{rho} and $w(p)$ which affect the amount of infected and susceptible tissue. The asymptotic parameter of the logistic model for the infection progress curves was the most frequently affected parameter, followed by the delay parameter, with relatively few changes affecting the rate parameter. Some problems in the use of complex, stochastic simulation models to simulate experimental conditions are discussed. [References: 25].

1255 Gilligan, C.A.; Brassett, P.R.; Campbell, A. (1994) MODELLING OF EARLY INFECTION OF CEREAL ROOTS BY THE TAKE-ALL FUNGUS - A DETAILED MECHANISTIC SIMULATOR. *New Phytologist*. 128(3):515-537. English. [UNIV CAMBRIDGE DEPT PLANT SCI DOWNING ST CAMBRIDGE CB2 3EA ENGLAND].

A stochastic model is constructed to simulate the spatial and temporal spread of infection of the take-all fungus, *Gaeumannomyces graminis* var. *tritici* (Sacc.) Arx and Olivier var. *tritici* Walker on seminal roots of wheat. The model is designed to synthesize information on the dynamics and spatial orientation of the growth of main seminal root axes of wheat and the dynamics of primary and secondary infection of the pathogen. Primary infection is initiated by the soil inoculum. Three types of secondary infection by runner hyphal growth are distinguished; re-infection of the same root, infection of another root on the same plant via the crown, and cross-infection between roots on different plants. There are nine pathogen parameters, 14 host parameters, as well as four system parameters in addition to the location and orientation of seedlings. The pathogen parameters comprise estimates for the size and density of inoculum, the rate of growth of the fungus on roots, and the mean distances and probability of occurrence for primary and secondary infection. The host parameters concern orientation, density, emergence, rates of growth and size of roots. The principal output variables are total and infected root length, numbers of infections, proportion of infected roots and the numbers of primary and cross infections. Results of sensitivity analysis of the output variables to selected input parameters are presented. The model is tested against independent data-sets from inoculum-density experiments for different soil temperatures and ranges of inoculum density. Statistical methods of response curve analysis are used to compare the behaviour of inoculum density-disease response curves for the simulated and experimental data. The model fitted the data satisfactorily for the majority of host and infection variables. Inclusion of secondary infection in the model improved the goodness-of-fit but the density of secondary infections was small relative to primary infections. Practical and conceptual problems in the validation of complex simulation models for fungal infection are discussed. The advantages and limitations of this and related models are critically assessed. [References: 50].

1256 Gindrat, D.; Frei, P.; Maillard, A. (Station federale de recherches agronomiques, Changins (Switzerland)) (1994) [Experiments of the control of diseases of winter wheat in French-speaking Switzerland]. *Essais de lutte contre les maladies du ble d'automne en Suisse romande. Revue suisse d'agriculture (Switzerland)* v. 26(5) p. 303-309. 6 tables, 3 graphs, 8 ref. French. (AGRIS 95-004514).

In 4 regions of the French speaking part of Switzerland, conclusions from 18 experiments, carried out from 1987 to 1991 were confirmed in 8 field experiments in 1992 and 1993. A fungicide spray against eyespot is likely to cause a significant yield increase.

1257 Habermeyer, J.; Hoffmann, G.M. (1994) STRATEGY AND REALIZATION OF INTRODUCTION THE PLANT PROTECTION DECISION-MODEL (IPS WEIZENMODELL) AGAINST FUNGAL DISEASES OF WHEAT IN THE FARMING PRACTICE. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection*. 101(6):617-633. German. [TECH UNIV MUNICH WEIHENSTEPHAN LEHRSTUHL PHYTOPATHOL D-85350 FREISING WEIHENST GERMANY].

The several years development and proof of the "IPS WEIZENMODELL" finished with the progressively introduction in the farming practice in Bavaria during 1990-1993. At first, we found a close co-operation with the governmental stations of agriculture (regional level) in respect of the whole project, the collective realization of the trials in the fields and interpretation of their results. With two years experiences, the colleagues could independently use the "IPS WEIZENMODELL", which was incorporated into the working-programme of the advisory service. During the second phase, in some districts single farmers were selected and well trained in handling of the model under our supervision (pilot project). On the basis of this co-operation, working groups were organized in the last stage (about 10 farmers from a smaller district), trained and advised in using the model during the vegetation period with assistance of the advisory service (district level). During 1992, about 500 farmers in 53 working groups participated in this programme. The results and experiences of this stepwise introduction are presented, the advantages for the advisory service and the farming practice is accentuated; the acceptance by the farmers ascertained by questioning and comments are given to further possibilities of data-coordination and enlargement. The "IPS WEIZENMODELL" is discussed in relation to prognose systems of the German meteorological service and the EIPRE programme. [References: 28].

1258 Hill, J.P.; Blunt, D.L. (1994) WHEAT SEEDLING RESPONSE TO ROOT INFECTION BY *COCHLIOBOLUS SATIVUS* AND *FUSARIUM ACUMINATUM*. *Plant Disease*. 78(12):1150-1152. English. [COLORADO STATE UNIV DEPT PLANT PATHOL & WEED SCI FT COLLINS, CO 80523 USA].

Noncontaminated seedling roots of winter wheat cultivars Sandy and CO86 were inoculated with single germinated conidia of *Cochliobolus sativus* and/or macroconidia of *Fusarium acuminatum* to determine if resistance to these fungi could be identified. Four days after inoculation, seedlings were transplanted to soil and placed in a growth chamber at 18 or 29 C with or without water stress. Height, total leaf length, dry shoot weight, dry root weight, and root/crown discoloration were recorded for each plant after 4 wk. At 29 C, infection of CO86 with *C. sativus* resulted in a significant height reduction compared with Sandy. These cultivars are field rated as susceptible and resistant, respectively, to dryland root rot in Colorado. There were no consistent significant differences in other traits between cultivars, whether inoculated with *C. sativus* or not. Inoculation with *F. acuminatum* did not significantly ($P = 0.05$) affect any traits or enhance the effects of *C. sativus* when inoculated on the same seedling. The current experimental procedure, although providing some information, does not seem to be able to consistently select genotypes for increased general resistance to these pathogens. [References: 16].

1259 Huang Changhua; Li Jianhong; Zhang Yuqun (Huazhong Agricultural Univ., Wuhan (China). Dept. of Plant Protection) (1993) A study of the control effect of the yeast liquid of bacillus-HCH to scab of wheat. *Journal of Huazhong Agricultural University (China)* v. 12(6) p. 566-569. 2 tables, 3 ref. Chinese. (AGRIS 95-004588).

1260 Jacobs, T.; Hee, F.P. van (Wageningen Agricultural Univ. (Netherlands). Dept. of Plant Breeding); Engels, F.M. (1993) The ultrastructure of the interface between susceptible, partially resistant spring wheat genotypes and wheat leaf rust. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen, Universiteit Gent (Belgium)* v. 58(1) p. 1-9. 10 ill.; 16 ref. English. (AGRIS 95-014720).

The ultrastructure of host cell wall appositions was studied in the highly susceptible genotype Morocco and in the partially resistant genotype Akabozu shortly after inoculation with wheat leaf rust. The ultrastructure of the haustorium and the host cell of Morocco, Akabozu and another partially resistant genotype Westphal 12A was studied just before sporulation. The cell wall appositions in Morocco and Akabozu were narrow and long. The majority of cell wall appositions of Morocco consisted of a layer of dark entities. The majority of cell wall appositions in Akabozu consisted of a fibrillar network. Just before sporulation no differences could be detected in extrahaustorial membrane, matrix or haustorial wall between the susceptible and partially resistant genotypes. No collars were observed around the haustorial neck. The cell contents in the highly susceptible Morocco appeared degenerated as if the cells were

empty. In the partially resistant genotypes the amount of cytoplasm was higher and the condition of chloroplasts was better.

1261 Jana, S.; Bailey, K.L. (1995) RESPONSES OF WILD AND CULTIVATED BARLEY FROM WEST ASIA TO NET BLOTCH AND SPOT BLOTCH. *Crop Science*. 35(1):242-246. English. [AGR CANADA RES STN 107 SCI PL SASKATOON SK S7N 0X2 CANADA].

Wild species and cultivated landraces from the center of crop origin may provide new sources of resistance to a variety of plant diseases that plague genetically uniform crops around the world. This study was conducted to assess resistance to Canadian isolates of three foliar pathogens [*Cochliobolus sativus* (Ito and Kurib.) Drechs. ex Dastur., *Pyrenophora teres* (Died.) Drechs. f. *teres*, and *P. teres* f. *maculata*] in wild and cultivated landrace barley [*Hordeum vulgare* L. subsp. *spontaneum* (C. Koch) Thell. and *H. vulgare* L. subsp. *vulgare*] from Turkey and Jordan and to determine whether disease resistance was preserved by in situ conservation of the two barley species. Seedlings were inoculated separately with the pathogens in growth cabinet tests. More wild barley accessions were resistant to *C. sativus* (4.5% vs 0.3%) and *P. teres* f. *teres* (21.8% vs. 0.5%) than cultivated barley. An equal number of wild and cultivated barley accessions was resistant to *P. teres* f. *maculata*. A larger percentage of wild barley accessions (10.5%) had at least moderate resistance to all three leaf diseases as compared to only 1.3% in cultivated barley. The average disease rating on these accessions was lower for wild barley (65%) but not significantly different from cultivated barley (73%). Chi-square statistics showed significant associations for disease reactions of (i) *C. sativus* with *P. teres* f. *maculata*, and (ii) *P. teres* f. *teres* with *P. teres* f. *maculata* that were larger in cultivated barley, indicating stronger associations due to agricultural selection. Disease reactions were independent for *C. sativus* and *P. teres* f. *teres* in both wild and cultivated barley. In situ conservation of cultivated barley in the Middle East was successful in preserving resistance in either single or multiple combinations in cultivated landrace populations, but it was less effective in preserving the diversity for resistance than in wild barley. [References: 13].

1262 Jin, Y.; Steffenson, B.J. (1994) INHERITANCE OF RESISTANCE TO PUCCINIA HORDEI IN CULTIVATED AND WILD BARLEY. *Journal of Heredity*. 85(6):451-454. English. [N DAKOTA STATE UNIV DEPT PLANT PATHOL FARGO, ND 58105 USA].

The inheritance of resistance to *Puccinia hordei* in several accessions of *Hordeum vulgare* and *H. spontaneum* was studied using leaf rust isolates whose combination of virulence genes would overcome resistance due to Rph1-Rph12. The results from this study indicated the presence of the Rph3 resistance gene in cultivar Aim. This gene was dominant for resistance to isolate ND8702 but recessive for resistance to ND89-3. Allelism tests suggested that the Rph3 allele occurred in a high frequency in barley originating from Egypt and the Mediterranean region. The following accessions of *H. vulgare* possess gene(s) that are likely different from Rph1-Rph12: CI 10506 (one dominant gene), PI 531849 (one dominant gene), and PI 531990 (a recessive gene in addition to Rph3). The *H. spontaneum* accessions were more diverse than the *H. vulgare* accessions, in both the number of genes for resistance to *P. hordei* and the types of interactions with rust isolates. Most of the *H. spontaneum* accessions tested had more than one resistance gene, with both dominant and recessive genes being common. [References: 13].

1263 Jing Jinxue; Shang Hongsheng; Li Zhenqi (Northwestern Agricultural Univ., Yangling, Shaanxi (China). Dept. of Plant Protection) (1993) The biological effects of ultraviolet ray radiation on wheat stripe rust (*Puccinia striiformis* West.). *Acta Phytopathologica Sinica (China)* v. 23(4) p. 299-304. 5 tables, 10 ref. Chinese. (AGRI 95-004592).

1264 Juza, L. (Sega, Ceske Budejovice (Czech Republic)) (1994) [Alto Combi 420 SC - a multispectral fungicide for cereals]. Alto Combi 420 SC - širokospektrální fungicid proti chorobám obilovin. *Agrochemia (Slovak Republic)* v. 34(5) p. 98-100. 3 tables; 5 ref. Czech. (AGRI 95-014731).

1265 Kamel, A.H.; Misri, G. (ICARDA, Aleppo (Syria)) (1994) [Field guide of major pests of wheat and barley]. Principaux ravageurs du ble et de l'orge: Guide d'identification au champ. International Center for

Agricultural Research in the Dry Areas, Aleppo (Syria). ICARDA. 95 p. ICARDA-020. French. (AGRI 95-014653).

1266 Kampmann, H.H.; Hansen, O.B. (1994) USING COLOUR IMAGE ANALYSIS FOR QUANTITATIVE ASSESSMENT OF POWDERY MILDEW ON CUCUMBER. *Euphytica*. 79(1-2):19-27. English. [L DOEHNFELDT AS BREEDING STN DANEFELD ODENSEVE] 82 DK-5290 MARSLEV DENMARK].

Visual assessment, black and white image analysis and colour image analysis of the severity of powdery mildew (*Sphaerotheca fuliginea*) infection on leaves of cucumber (*Cucumis sativus*) were compared. The extent of infection with powdery mildew was expressed as the number of spores per cm². Statistical treatment of the data showed colour image analysis to be superior to the other two methods of evaluation. Major veins, light reflections and variations in the colour of leaves can degrade the accuracy of colour image analysis somewhat. These problems are, however, surmountable. Colour image analysis qualifies as a valuable new tool for accurate, objective, reproducible and detailed quantitative assessment of disease on leaves of plants. [References: 17].

1267 Kari, A.G. (Agricultural Res. Inst., Nicosia (Cyprus)) (1994) Foliar diseases of barley in Cyprus. *Technical Bulletin (Cyprus)*; no. 165 8 p. 5 tables; 31 ref. English. (AGRI 95-014652).

The most prevalent foliar diseases of the two commercial barley varieties i. e. Athenais and Kantara, were: powdery mildew (*Erysiphe graminis*), net blotch (*Helminthosporium teres*) and scald (*Rhynchosporium secalis*).

1268 Kehlenbeck, H. (Hannover Univ. (Germany). Inst. fuer Pflanzenkrankheiten und Pflanzenschutz) (1993) [Yield of resistance induced winter barley and peas after mildew infestation]. Zur Ertragsbildung induziert resistenter Wintergerste und Erbsen nach Mehltaubefall. Hannover Univ. (Germany). Fachbereich Gartenbau. 16 ill., 18 tables. Bibliography 118 ref. 104 p. German. (AGRI 95-004528).

1269 Kiriswa, F.L. (N.P.B.R.C., Njoro (Kenya)); Jacobs, Th. (1994) The Effect of Leaf Age on Two Components of Partial Resistance to Leaf Rust in Wheat and Barley. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 164-170. CIMMYT. 5 tables; 6 ref. English. (AGRI 95-004532).

The effect of development stage on latency period (LP) and infection frequency (IF) was examined in 5 wheat and 3 barley genotypes inoculated with wheat leaf rust, *Puccinia recondita*, and barley leaf rust, *P. hordei*, respectively. Both in wheat and barley, there was a significant developmental stage effect on LP. Relative LP was more clearly expressed at the adult plant stage than in the seedling stage. There was a good correlation between the flag leaf and the seedling leaves. IF was highly variable, and is unsuitable for use as a selection component. The variation for IF in barley was less than that in wheat.

1270 Kohli, Man Mohan (CIMMYT, Asuncion (Paraguay)); Reis, Erlei Melo (1994) Wheat Diseases in South America and Strategies for their Control. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa*. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 153-163. CIMMYT. 8 tables; 19 ref. English. (AGRI 95-004516).

Disease occurrence and intensity vary according to specific environmental conditions in the different countries of the Southern Cone. In Argentina the main diseases are the three rusts, scab, speckled leaf blotch, and yellow spot; in Chile - the three rusts, take-all, and speckled leaf blotch; in Bolivia - leaf rust, powdery mildew, and spot blotch; in Brazil - common root rot, take-all leaf and stem rust, powdery mildew, yellow spot, spot blotch, septoria leaf blotches, scab, blast, and soil-borne wheat mosaic virus; in Paraguay - leaf and stem rust, spot blotch, yellow spot, common root rot, and scab; and in Uruguay - leaf and stem rust, yellow spot, speckled leaf blotch, and scab. An integrated disease control strategy, combining the following aspects, has been recommended and utilized fully or in part by several countries of the region: (a) use of

resistant varieties for rusts, powdery mildew, and soil-borne wheat mosaic virus, and improved genetic resistance to blast, scab, and leaf blotches; (b) crop rotation has successfully controlled common root rot, take-all, and leaf blotches; (c) seed dressing has been used to control powdery mildew in susceptible varieties, and to avoid the transmission of leaf blotch pathogens from seeds to leaves; and (d) fungicides are applied to above-ground plant parts to control rusts and leaf blotches.

1271 Kummert, J. (Faculté des Sciences Agronomiques de Gembloux (Belgium). Unité de Phytopathologie) (1993) [Diagnosis and characterization of Barley Yellow Mosaic agents by ELISA serological tests]. *Diagnostic et caractérisation des agents de la mosaïque jaune de l'orge par le test sérologique ELISA. Parasitica (Belgium) v. 49(3-4) p. 69-87. 4 ill., 5 tables; 5 ref. French. (AGRI 95-014651).*

Barley Yellow Mosaic Virus is caused by 2 different viruses: Barley Yellow Mosaic Virus (BaYMV) and Barley Mild Mosaic Virus (BaMMV). Field infected barley plants generally contain a mixture of strains of both viruses in proportions which may vary during cultural season according to barley cultivar, environmental conditions or geographic localization of the diseased plants. At the practical level, the differentiation of viruses or viral strains causing barley mosaic is important since both viruses seem to be relevant of different resistance factors. Furthermore, in different European areas, viral strains serologically related or not to typical BaYMV and BaMMV strains have been shown capable to infect barley cultivars or hybrid lines till now resistant to these viruses. It is thus important to dispose of diagnostic tools able to differentiate these various strains, and we have chosen, to use the ELISA serological technique to reach this objective. Purified virus preparations obtained from infected barley plants harvested from field in Gembloux have been used for production of monoclonal antibodies by classical and intrasplenic immunization, followed or not by adoptive transfer. Among the antibodies producing clones which are specific of the antigenic preparation used, and permitting the sensitive and specific detection of viral antigens in diluted extracts of virus-infected barley plants, some have been selected on basis of their reactivity in s-ELISA tests. s-ELISA using various antibodies or combination of antibodies, either for coating or as conjugates, revealed to be able to differentiate viral isolates maintained by multiplication in a sensitive barley yellow mosaic, according to the site and the date of sampling, as of the barley cultivar used.

1272 Liao, YC.; Kreuzaler, F.; Reisener, HJ.; Tiburzy, R. (1994) CHARACTERIZATION OF A WHEAT CLASS IB CHITINASE GENE DIFFERENTIALLY INDUCED IN ISOGENIC LINES BY INFECTION WITH PUCCINIA GRAMINIS. *Plant Science. 103(2):177-187. English. [RHEIN WESTFAL TH AACHEN INST BIOL 1 WÖRRINGER WEG 1 D-52056 AACHEN GERMANY].*

Plant chitinases have been recognized to be involved in defense against pathogens. A class Ib genomic chitinase gene was isolated from a wheat (*Triticum aestivum* L.) genomic library using a wheat chitinase sequence amplified from DNA by PCR. The nucleotide sequence analysis showed that the wheat chitinase gene (*Wchl*) contains a 960-bp long coding region with no intron. The derived polypeptide includes a signal peptide, a cysteine-rich domain and a catalytic domain without a carboxy terminal extension. Primer extension experiments identified a single transcription start site 33 bp upstream of the translation initiation site. Southern blot analysis indicated that *Wchl* is one member of a small gene family in wheat. Northern blot hybridization and histological investigation of wheat leaves infected by *Puccinia graminis* f. sp. *tritici* revealed a close correlation between the accumulation of the chitinase transcripts and the inhibition of fungal growth when two isogenic wheat lines (Prelude Sr6 and Prelude sr6) differing at the sr6 locus for race-specific incompatibility with the fungus were studied. The massive accumulation of the chitinase mRNA occurred only in the incompatible sr6/P6 interaction, in parallel with a severe inhibition of mycelial growth in the leaves. In contrast, in the compatible sr6/P6 interaction the fungus grew rapidly throughout the leaf tissue and the chitinase transcripts were not detected. The chitinase mRNA was detectable in non-infected stems but not in non-infected leaves or roots. [References: 45].

1273 Macnish, GC.; Carling, DE.; Sweetingham, MW.; Brainard, KA. (1994) ANASTOMOSIS GROUP (AG) AFFINITY OF PECTIC ISOZYME (ZYMOTYPE) GROUPS (ZG) OF RHIZOCTONIA SOLANI

FROM THE WESTERN AUSTRALIAN CEREAL-BELT. *Mycological Research. 98(Part 12):1369-1375. English. [DEPT AGR PMB 50 ESPERANCE WA 6450 AUSTRALIA].*

Over 4250 isolates of *X. solani* obtained from the cereal growing belt of Western Australia have been characterized using pectic isozyme patterns (zymograms). With few exceptions, all can be placed in one or other of 10 zymogram groups (ZG), four of which (ZG1-1, ZG1-2, ZG1-4, and ZG1-5) have previously been identified as members of anastomosis group AG-8 and cause rhizoctonia bare patch disease of cereals, legumes and forage pastures. Another (ZG5) has been identified as AG-2-1. The latter identification is confirmed in this study and the anastomosis group affinity of the remaining five ZGs reported. ZG4 and ZG10 are placed in AG-2-2, ZG6 in AG-2-1 and ZG9 in AG-10. ZG3, although it reacts in a very limited way with some isolates of AG-2-1 and AG-8, appears to represent an as yet unreported AG. The potential value of zymograms as an aid to disease management and as a research tool for identifying subgroups within AGs is discussed. Integration of the AG and ZG systems, and use of ZGs to subdivide AGs is also discussed. [References: 27].

1274 Michalikova, A.; Kulichova, R.; Michrina, J. (Vysoka Skola Polnohospodarska, Nitra (Slovak Republic)) (1994) [Effect of Vitavax 200 FF on the health condition of spring barley]. *Vplyv Vitavaxu 200 FF na zdravotny a kondicny stav jarneho jarmena. Agrochémia (Slovak Republic) v. 34(3) p. 58-61. 2 ill., 4 tables; 9 ref. Slovak. (AGRI 95-014655).*

1275 Nelson, KE.; Burgess, LW. (1994) REACTION OF AUSTRALIAN CULTIVARS OF OATS AND BARLEY TO INFECTION BY FUSARIUM-GRAMINEARUM GROUP-1. *Australian Journal of Experimental Agriculture. 34(5):655-658. English. [UNIV SYDNEY DEPT CROP SCI SYDNEY NSW 2006 AUSTRALIA].*

The incidence of infection of *Fusarium graminearum* Group 1 and the incidence of crown rot were compared for various cultivars of oats, wheat and barley in glasshouse and field experiments. In glasshouse studies, the incidence of infected plants was lower in oats than in wheat or barley at 6 weeks after sowing. Crown rot symptoms were not observed in oats of any cultivar. The incidence and severity of crown rot in barley was similar to that in wheat cv. Banks. Between 17 and 29 genotypes of oats, wheat and barley were assessed in field trials over 3 years. Stem browning, a symptom of crown rot, was common in wheat and barley but was not observed in any cultivar of oats. Among plants of wheat and barley, the effect of cultivar on incidence of crown rot was significant ($P = 0.05$) in 3 of 4 trials. Results suggest that oats are a symptomless host. This should be considered when growing oats in rotation to reduce crown rot inoculum. The barley cultivars assessed all developed moderate-severe crown rot symptoms and thus may incur yield limitations where crown rot is prevalent. [References: 15].

1276 Newton, AC.; Hackett, CA. (1994) SUBJECTIVE COMPONENTS OF MILDEW ASSESSMENT ON SPRING BARLEY. *European Journal of Plant Pathology. 100(6):395-412. English. [SCOTTISH CROP RES INST DEPT BACTERIOL & MYCOL DUNDEE DD2 5DA SCOTLAND].*

The severity of mildew on barley is usually assessed visually and this leads to variation between different scorers. Field assessments by four assessors were analysed to determine the nature and degree of subjective discrepancies between assessors. Two inexperienced assessors failed to detect a major effect of nitrogen due to differences in the interpretation of a scoring system. A computer-based training programme was evaluated for standardising assessments, and was found to improve assessors' accuracy. Linear regression analysis was used here to resolve the error variance into components representing the accuracy and precision of the assessors. Plots of the cumulative differences between the estimate of disease severity by each assessor and the best estimate were used to display how the discrepancies varied with the level of disease. Some modifications to the barley field scoring system are suggested to improve comparability between assessors. [References: 32].

1277 Niks, RE.; Rubiales, D. (1994) AVIRULENCE FACTORS CORRESPONDING TO BARLEY GENES PA3 AND PA7 WHICH CONFER RESISTANCE AGAINST PUCCINIA HORDEI IN RUST FUNGI OTHER THAN P-HORDEI. *Physiological & Molecular Plant Pathology. 45(4):321-331. English. [AGR UNIV WAGENINGEN DEPT PLANT BREEDING POB 386 6700 A] WAGENINGEN NETHERLANDS].*

The interactions between near-isogenic lines of barley line L94 containing the resistance genes Pa3 or Pa7 and one isolate each of *Puccinia hordei*, *Uromyces viennot-bourginii*, *P. hordei-murim*, *P. recondita* f.sp. *agropyrina* and two isolates of *P. recondita* f.sp. *tritici* were examined. The infection types and the development of the rust fungi suggested that the avirulence genes *Avr3* and *Avr7* corresponding to the two resistance genes were absent from the isolate of *U. viennot-bourginii* but present in the *P. hordei-murim* isolate. In both near-isogenic lines the development of the *P. recondita* f.sp. *tritici* isolates appeared to be affected quantitatively. The apparent presence of *Avr3* and *Avr7* in *P. hordei-murim* supports other reports that a pathogen biotype may possess avirulence genes that correspond with resistance genes in non-host plant species. [References: 43].

1278 Obst, A. (Landesanstalt fuer Bodenkultur und Pflanzenbau (Germany)) (1994) [Diagnostic helps and forecastings for wheat diseases]. *Weizenkrankheiten. Diagnosehilfe und Entscheidungshilfe zum Weizenmodell Bayern. dlz. Die landwirtschaftliche Zeitschrift fuer Produktion - Technik - Management (Germany) v. 45(3) p. 22-26, 28-30, 32, 34-37. num ill., 1 table. German. (AGRIS 95-004515).*

1279 Pancaldi, D. (Bologna Univ. (Italy). Dipartimento di Protezione e Valorizzazione Agroalimentare); Alberti, I. (Bologna Univ. (Italy)) (1994) [Effectiveness and persistence of S.B.I. [sterol biosynthesis inhibitors] fungicides against brown rust of wheat (Emilia-Romagna)]. *Attivita' e persistenza di fungicidi I.B.S. [inibitori della biosintesi degli steroli] nei confronti della ruggine bruna del frumento [Emilia Romagna]. Informatore Fitopatologico (Italy) v. 44(4) p. 48-53. 6 tables; 1 graph; 11 ref. Italian. (AGRIS 95-014728).*

The effectiveness and persistence of triadimenol, propiconazole and fenpropimorph against brown rust on wheat (*Puccinia recondita* Rob. ex Desm. f. sp. *tritici* Eriks et Henn.) was assessed in comparison with that of more recent triazole fungicides (tebuconazole, tetraconazole, cyproconazole and flutriafol). In several field trials carried out between 1989 through 1992 on common wheat (cv. Gemini), all fungicides showed a very good effectiveness. Nevertheless, differences could be observed with regard to their persistence, being tebuconazole, cyproconazole and tetraconazole the most persistent (25-30 days), followed by flutriafol (20-25 days) and by propiconazole. triadimenol and fenpropimorph (18-20 days). On the whole, for their longer persistence the new fungicides appear as the most effective tool for the control of the brown rust.

1280 Paul, Y.S.; Bekele Hunde; Mesele Alemu; Melkamu Ayalew (IAR, Addis Abeba (Ethiopia)) (1994) Studies on Seed-borne Mycoflora of Wheat in Ethiopia. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa: Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 305-306. CIMMYT. 1 table. English. (AGRIS 95-004518).*

Seed-borne mycoflora comprise various storage and field fungi, including plant pathogens. Knowledge of the various fungi associated with seed helps to understand seed quality as well as the possibility of plant diseases being transmitted through seed. Twenty-one wheat seed samples were collected from 7 locations in northwestern Ethiopia, and were subjected to a modified standard blotter test, and germination and accelerated aging vigor tests. Out of a total of 32 fungi recorded, *Alternaria tenuis*, *Cladosporium herbarum*, *Fusarium moniliforme*, *Fusarium* sp., *Penicillium* sp. and *Rhizopus stolonifer* were present in almost all the seed were samples in varying proportions. Various wheat pathogens recorded on seed were *Drechslera sativus*, *Fusarium graminearum*, *Mycosphaerella graminicola*, *Septoria nodorum*, *Tilletia foetida*, *T. caries*, and *Puccinia striiformis*. Seeds associated with *D. sativus* either failed to germinate or produced abnormal seedlings. *Fusarium* and *Penicillium* species were positively correlated with ungerminated seed and abnormal seedlings, and were negatively correlated with germination percentage. Except *Aspergillus* species and *Fusarium moniliforme*, all fungi reduced root and shoot length. *Curvularia lunata*, *Fusarium graminearum*, *F. roseum* and *Penicillium* species were found to be positively correlated with thousand grain weight and thousand grain volume.

1281 Paul, Y.S.; Melkamu Ayalew; Melese Alemu; Bekele Hunde (Addis Abeba (Ethiopia)) (1994) Aerobiology of Wheat with Special Reference to Stripe Rust. 8. Regional Wheat Workshop for Eastern, Central and Southern Africa: Kampala (Uganda); 7-10 Jun 1993. *Developing Sustainable Wheat Production Systems: Regional Wheat Workshop for Eastern, Central and Southern Africa. Tanner, D.G. (CIMMYT, Nairobi (Kenya)) (ed.) p. 298-300. CIMMYT. 1 table. English. (AGRIS 95-004517).*

Aerobiology of two wheat fields at the Adet R.C. was studied using slide traps from the end of August to mid October, 1992. A total of 10 fungal species namely *Puccinia striiformis*, *P. graminis*, *P. recondita*, *P. hordei*, *Drechslera* spp. *Alternaria* spp., *Epicoccum purpurascens*, *Ascochyta* sp., *oidium* sp. and *Ustilago* spp. were trapped. *P. striiformis* urediospores were observed to be dominant throughout the period studied. Two peaks of *P. striiformis* urediospores were recorded: the end of August, and after the first week of October. Thus indicated an influx of spores during August, the establishment of yellow rust by September, and spore release after October. Easterly followed by westerly wind directions contributed the maximum influx of spores; after disease establishment, maximum spore densities were trapped from the north and east directions. Yellow rust was first observed on the highly susceptible variety Morocco at the end of August, and attained 95 percent severity by the last week of October. The wheat variety ET13 was immune throughout the study period while surrounding farmers' fields with the variety Dashen were highly infected.

1282 Pikushova, E.A.; Veretel'nik, E.Yu.; Moskaleva, N.A. (1993) [Seed disinfection on the basis of phytoexamination [determination of fungus infection in common winter wheat seeds]]. *Protravlivanie semyan na osnove fitoehkspertizy. Zashchita rastenij (Russian Federation) (no.11) p. 28-29. Russian. (AGRIS 95-014729).*

1283 Popletaeva, E.B.; Chkanikov, D.I. (1994) ERGOSTERINE AND POLIOL ACCUMULATION IN THE LEAVES OF WHEAT VARIETIES WITH DIFFERENT LEVEL OF SUSCEPTIBILITY TO SEPTORIOSIS. *Mikologiya i Fitopatologiya. 28(2):50-53. Russian. [ALL RUSSIAN PHYTOPATHOL RES INST MOSCOW RUSSIA].*

1284 Schwartz, H.F.; Mcmillan, M.S.; Lancaster, G.K. (1994) VOLUNTEER BEANS WITH RUST AND WHITE MOLD INOCULA IN WINTER WHEAT. *Plant Disease. 78(12):1216. English. [COLORADO STATE UNIV DEPT PLANT PATHOL & WEED SCI FT COLLINS, CO 80523 USA].*

1285 Sebesta, J.; Bartos, P. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyně (Czech Republic)) (1994) [Breeding cereals for disease resistance in the Czech Republic]. *Slechtění obilnin na rezistenci k chorobám v České republice. Ochrana Rostlin (Czech Republic) v. 30(3) p. 233-242. 24 ref. Czech. (AGRIS 95-014723).*

1286 Singh, R.P.; Huertaespino, J. (1995) INHERITANCE OF SEEDLING AND ADULT PLANT RESISTANCE TO LEAF RUST IN WHEAT CULTIVARS CIANO 79 AND PAPAGO 86. *Plant Disease. 79(1):35-38. English. [CIMMYT CTR INT MAIZE & WHEAT IMPROVEMENT LISBOA 27 APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].*

Wheat (*Triticum aestivum*) cultivars Ciano 79 and Papago 86 have maintained high levels of resistance to leaf rust, caused by *Puccinia recondita* f. sp. *tritici*, since their release during 1979 and 1986, respectively, in leaf rust-prone northwestern Mexico. Because inheritance of leaf rust resistance for these cultivars is unknown, Ciano 79 and Papago 86 were intercrossed, crossed with the susceptible cultivar Sonora 64, and crossed with the adult plant resistant cultivar Frontana to evaluate the resistance relationship. Inheritance studies were conducted in seedling and/or adult plant growth stages using the parents, F-1 plants, F-2 populations, and F-3 and F-5 lines. The resistance to *P. r. tritici* pathotype TCB/TD in seedlings of Ciano 79 and Papago 86 was conferred by a single gene, *Lr16*. When present alone, *Lr16* confers only moderate resistance in adult plants to the same pathotype. The adult plant resistances of both cultivars were based on the additive interaction between gene *Lr16* and a minimum of two other slow-rusting genes. Besides *Lr16*, one of the two slow-rusting genes was also common in Ciano 79 and Papago 86. The adult plant resistance genes in these cultivars differed from the resistance genes in Frontana. [References: 19].

1287 Smiley, RW.; Ingham, RE.; Uddin, W.; Cook, GH. (1994) CROP SEQUENCES FOR MANAGING CEREAL CYST NEMATODE AND FUNGAL PATHOGENS OF WINTER WHEAT. *Plant Disease*. 78(12):1142-1149. English. [OREGON STATE UNIV COLUMBIA BASIN AGR RES CTR POB 370 PENDLETON, OR 97801 USA].

In the Pacific Northwest, *Heterodera avenae* is spreading to soils infested with root-infecting fungal pathogens of wheat. A poorly drained, silty clay loam infested with multiple pathogens was used to examine productivity of winter wheat in 11 crop sequences. Breaks between wheat crops included summer fallow or crops of pea, barley, rape, alfalfa, or Kentucky bluegrass. In the fifth year, winter wheat was planted in all sequences, after one-half of each plot was treated with aldicarb. Yield of annual winter wheat was always 40-60% less than wheat alternated with fallow or any other crop, except alfalfa contaminated with grass weeds. Wheat yielded equally following 1- or 2-yr breaks from wheat. Effective breaks included summer fallow, pea, and weed-free alfalfa. *H. avenae* was the most important individual constraint to yield. Combined damage from *H. avenae* and *Gaeumannomyces graminis* var. *tritici* caused highest overall yield loss, whereas *H. avenae* and *Pythium* spp. had the greatest negative effect on number of roots. During the fifth year, where aldicarb was applied, root damage by *H. avenae* decreased but damage by *Rhizoctonia solani* and *Pythium* spp. increased, resulting in no yield improvement. [References: 36].

1288 Svec, M.; Miklovicova, M.; Sykora, M.; Krippel, E. (1995) FUNGICIDE SENSITIVITY OF POPULATIONS OF WHEAT POWDERY MILDEW (*ERYSIPHE GRAMINIS* F SP *TRITICI*) IN CENTRAL EUROPE IN 1993. *Pesticide Science*. 43(1):47-52. English. [COMENIUS UNIV BRATISLAVA DEPT GENET MLYNSKA DOLINA B1 BRATISLAVA 84215 SLOVAKIA].

In 1993 we observed the sensitivity of wheat powdery mildew populations (*Erysiphe graminis* DC f.sp. *tritici* Marchal) from the Czech Republic, Austria, Hungary and Slovakia to the fungicides triadimenol, tebuconazole, propiconazole, flutriafol and fenpropimorph. The highest resistance value was shown to triadimenol, which attained a mean resistance factor (MRF) of 29 (expressing how many times the population is more resistant than are standard sensitive isolates) in the mildew population from the Czech Republic. The mildew populations from eastern Slovakia and eastern Hungary, populations geographically isolated from the other populations, showed very high sensitivity to all fungicides tested. There was most sensitivity to fenpropimorph (smallest MRF values) compared with the other fungicides. Cross-resistance was established among all triazoles used, but not between triazoles and fenpropimorph. Sensitivity of wheat powdery mildew populations from Central Europe to these fungicides is considered adequate, and the development of resistance has shown a decreasing tendency in recent years. [References: 20].

1289 Sykora, M.; Krippel, E.; Svec, M.; Miklovicova, M. (1994) VIRULENCE GENES ANALYSIS AND FUNGICIDE-SENSITIVITY OF BARLEY POWDERY MILDEW POPULATION (*ERYSIPHE-GRAMINIS* F-SP *HORDEI*) IN HUNGARY IN 1993. *Novenytermeles*. 43(5):379-385. Hungarian. [COMENIUS UNIV BRATISLAVA FAC NAT SCI DEPT GENET MLYNSKA DOLINA B-1 CS-84215 BRATISLAVA SLOVAKIA].

In 1993 the frequency of virulence genes and fungicide - sensitivity in regional populations of barley powdery mildew was found in Hungary. Samples of pathogen spores were trapped by jet spore sampler mounted on a car roof. In all observed regions we found high virulence frequencies against resistance genes M1-g, M1-k, M1-a6, M1-a12 and M1-La. We found the lowest virulence frequency against resistance genes M1-a7, +AB and M1(W) with considerable regional differences. No isolate of pathogen virulence against recessive resistance gene m1-o throughout Hungary was found. Population of powdery mildew from Hungary has a decreased sensitivity against fungicides of the triazole group. The lowest sensitivity against triadimenol (Bayfidan) and flutriafol (Impact) was found. The most resistant pathogen population from western Hungary was found against propiconazole (Tilt). At triazole fungicides the highest sensitivity of pathogen population against tebuconazol (Folicur) was observed. Population of pathogen is sensitive against morpholine compound - fenpropimorph (Corbel) on the level of standard control isolates.

1290 Talukdar, NC.; Germida, JJ. (1994) GROWTH AND YIELD OF LENTIL AND WHEAT INOCULATED WITH THREE GLOMUS ISOLATES FROM SASKATCHEWAN SOILS. *Mycorrhiza*. 5(2):145-152. English. [UNIV SASKATCHEWAN DEPT SOIL SCI SASKATOON SK S7N 0W0 CANADA].

The vesicular-arbuscular mycorrhizal fungi (VAMF) *Glomus clarum* (Nicol, and Schenck) isolate NT4, *G. mosseae* (Nicol, and Gerd.) Gerd. and Trappe isolate NT6 and *G. versiforme* (Karst.) Berch isolate NT7 coexist in wheat field soils in Saskatchewan. This study assessed the response of lentil (*Lens esculenta* L.) and wheat (*Triticum aestivum* L.) to monospecific and mixed cultures of these VAMF isolates. Seedlings were inoculated with 100 spores of a VAMF isolate, or an equal mixture of spores of two isolates, and grown in a sterile soil mix in a growth chamber. Both crops responded differently to these different VAMF isolates. In the case of lentil, *G. clarum* NT4 was more effective than *G. mosseae* NT6 and *G. versiforme* NTT, and significantly increased ($P < 0.05$) the shoot dry weight (43%) and grain yield (57%) compared with the uninoculated control. There was a significant positive correlation between the percentage of VAMF colonized roots and shoot dry weight ($r = 0.672^{***}$) and shoot phosphorus concentration ($r = 0.608^{***}$) of lentil. In the case of wheat, *G. clarum* NT4 had no effect on shoot dry weight, but produced significant ($P < 0.08$) increases in grain yield (12%) and the phosphorus concentration of the shoot and grain. Although *G. clarum* NT4 and *G. mosseae* NT6 both produced similar levels of VAM colonization in wheat, the only response of wheat to isolate NT6 was an increase in plant height at harvest. The efficacy of *G. clarum* NT4 on both crops appeared to be related to its ability to produce more arbuscular colonization than *G. mosseae* NT6. Dual inoculation of seedlings with *G. clarum* NT4 and *G. mosseae* NT6 resulted in competition between these two isolates. This was evident from a comparison of plant shoot dry weight and grain yield, and VAMF spore production on the two crops inoculated either with isolate NT4 alone or in combination with NT6. *G. mosseae* NT6 reduced the efficacy of *G. clarum* NT4 by 16% when dual inoculated on lentil, but had no effect when the host was wheat. Based on spore production, it was found that *G. clarum* NT4 was more competitive than *G. mosseae* NT6 when dual inoculated on lentil or wheat. Isolate NT4 produced ca. 2000 and 500 spores/100 g substrate, respectively, in the lentil and wheat pots, which was approximately 2-3 times more spores than those produced by isolate NT6 with either crop. When the plants were dual inoculated, there was a 15-19% reduction in spore production by *G. clarum* NT4 and a 50-70% decrease in spore production by *G. mosseae* NT6. Our results show that *G. clarum* NT4 was more competitive and effective in its ability to colonize and increase the growth and yield of lentil and wheat than *G. mosseae* NT6 or *G. versiforme* Nn. The relative performance of isolate NT4 with different host plants suggests that this VAMF isolate exhibits a host preference for lentil. [References: 44].

1291 Tan Wanzhong (Southwest Agricultural Univ. Chongqing (China). Dept. of Plant Protection) (1993) Effects of leaf rust infection on carbon metabolism in barley plants. *Acta Phytopathologica Sinica (China)* v. 23(4) p. 349-354. 4 tables, 11 ref. Chinese. (AGRI 95-004527).

1292 Teng, P.S. (1993) Disease management in relation to sustainability in food production. 24. Annual Scientific Meeting of the Pest Management Council of the Philippines, Inc.; Cebu City (Philippines); 4-7 May 1993. *Proceedings of the Twenty Fourth Annual Scientific Meeting of the Pest Management Council of the Philippines, Inc. Pest Management Council of the Philippines, Inc., College, Laguna (Philippines)* p. 29-39. 22 ref. English. (AGRI 95-004582).

In this paper, an assessment is made of how sustainable present disease management practices are; recent events that have shaped thinking on sustainability are discussed and a preferred scenario for developing disease management practices that are sustainable is proposed. Present disease management practices may be grouped into the following broad categories: a) biological practices, including host plant resistance and the use of biological agents or products; b) cultural, mechanical and physical practices; c) chemical practices; and d) regulatory/exclusion practices. The many common goals and characteristics shared between sustainable agricultural systems and IPM-based disease management systems are discussed.

1293 Troshina, NB. (1994) INFLUENCE OF PREINOCULATION OF THE WHEAT PLANTS WITH CAUSATIVE AGENTS OF HELMINTHOSPORIOSIS AND SEPTORIOSIS ON DEVELOPMENT OF SECONDARY INFECTION AND ON THE PROTEIN CONTENT OF LEAVES. *Izvestiia Akademii Nauk SSSR. Seriya Biologicheskaya*. (6):951-953. Russian. [RUSSIAN ACAD SCI UFA SCI CTR DEPT BIOCHEM & CYTOCHEM UFA RUSSIA].

The intensity of symptoms of septorios and helminthosporiosis was estimated and the protein content was assayed in the 2nd leaf of wheat plants at different times after preinoculation of the 1st leaf. At the interval of 1 - 5 days between inoculations the symptoms of diseases were weaker than in the control. At the same time the protein content of leaves increased. It remained at a high level during the subsequent four days of the experiment. The increased concentration of the pathogen spores used for preinoculation did not affect the course of the disease. [References: 7].

1294 Troshina, NB. (1994) INTENSITY OF SEPTORIOSIS SYMPTOMS IN WHEAT PLANTS PREINOCULATED BY THE FUSARIAL ROOT ROT. *Izvestiia Akademii Nauk SSSR. Seriya Biologicheskaya*. (6):949-951. Russian. [RUSSIAN ACAD SCI UFA SCI CTR DEPT BIOCHEM & CYTOCHEM UFA RUSSIA].

The intensity of septorios symptoms was estimated on the 2nd leaf of wheat plants preinoculated by *Fusarium gramineum*. Under the conditions of weak infection with *F. gramineum* the intensity of septorios decreased as compared with the control. In the case of strong infection with *F. gramineum* leading to the deep damage of cells of the cortex and parenchyma of the conducting system at the stem base, resistance of plants to the septorios causative agent was not induced. [References: 9].

1295 Tvaruzek, L.; Klem, K. (1994) VARIETIES AND LINES OF WINTER WHEAT WITH STABLE TOLERANCE AND LOW YIELD LOSS TO SEPTORIA-NODORUM (BERK). *Cereal Research Communications*. 22(4):369-374. English. [CEREAL RES INST CS-76701 KROMERIZ CZECH REPUBLIC].

Inoculated field tests determined the reaction of winter wheat to *Septoria nodorum* during 1991-93. Tolerance to the pathogen was found in only 4 % of the 750 entries screened. Only 11 varieties and one breeding line showed very stable tolerance. In eight of these entries, the ears were more infected than the flag leaves. The variety Turda was the most tolerant entry, as determined by low loss of yield. In this group of entries, there was no significant correlation between visual symptoms of infection and yield reduction. Six entries were highly susceptible and gave consistently high yield losses. These entries and the stable tolerant ones could be used as comparative standards for screening tests on the field.

1296 Tzvetkova, NA.; Simon, AM. (1994) HARMFULNESS OF WINTER WHEAT EAR SEPTORIOSIS IN NECHERNOZEMIE. *Mikologiya i Fitopatologiya*. 28(4):70-74. Russian. [ALL RUSSIAN PLANT PROTECT INST ST PETERSBURG RUSSIA].

1297 Ueng, PP.; Cunfer, BM.; Alano, AS.; Youmans, JD.; Chen, WD. (1995) CORRELATION BETWEEN MOLECULAR AND BIOLOGICAL CHARACTERS IN IDENTIFYING THE WHEAT AND BARLEY BIOTYPES OF STAGONOSPORA NODORUM. *Phytopathology*. 85(1):44-52. English. [USDA ARS PLANT MOLEC BIOL LAB BARC-W BLDG 006 BELTSVILLE, MD 20705 USA].

Thirty-five isolates of *Stagonospora nodorum* from barley, wheat, and other hosts were identified as either the barley or wheat biotypes based on cultural characters and host specificity. Identification of the biotypes based on these phenotypic criteria was compared with genetic identification by analysis of restriction fragment length polymorphisms (RFLPs). Twenty-six probes randomly isolated from genomic DNA of a barley biotype isolate were used in the hybridization to differentiate the barley and wheat biotypes. Eighteen and 17 of the 26 probes detected no variation among 14 isolates of the barley biotype and 13 isolates of the wheat biotype, respectively, and unambiguously differentiated the two biotypes. Genetic distance, an estimate of accumulated number of allele substitutions per locus, is 2.286 between the barley and wheat biotypes. The genetic similarity was very high (>0.82) within each of the two biotypes and was very low (0.12) between the two biotypes. Clustering of the isolates based on individual hybridizing DNA bands correlated with

biotype identification based on biological characters. The wheat and barley biotypes were then compared with isolates of *Stagonospora avenae* f. sp. *triticea* and an isolate of *Stagonospora arenaria* by hybridizing with 31 anonymous DNA probes (11 from a wheat biotype, 12 from a barley biotype, and eight from *S. a. triticea*). Two isolates of *S. nodorum* of unknown biotype, SN91-X and SN038NY-89, used in a previous study, were considered to be the wheat biotype based on DNA banding patterns. Based on allele frequencies of the 31 RFLP loci, the estimated genetic distance between the barley biotype and the wheat biotype of *S. nodorum* was as great as between any of the two biotypes and *S. a. triticea*. Likewise, analysis based on discrete hybridizing bands showed that the barley biotype had a closer relationship with *S. a. triticea* than with the wheat biotype. Two probes from the barley biotype were specific for the barley biotype and did not detect any DNA bands in the wheat biotype. These barley biotype-specific probes may be used as natural markers for identification of the barley biotype. [References: 47].

1298 Weber, A.; Kranz, J. (1994) INVESTIGATIONS ON SIDE EFFECTS OF FUNGICIDES ON DISEASES IN THE AGROECOSYSTEM WINTER WHEAT (TRITICUM-AESTIVUM L.). *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection*. 101(6):604-616. German. [JUSTUS LIEBIG UNIV WZ TROPENINST BISMARCKSTR 16 D-35390 GIESSEN GERMANY].

During two years (1989, 1990), experiments were carried out to study the influence of fungicides and genetically different cultivars (cvs.: "Vuka", "Sorbas", "Ares") on diseases in the agro-ecosystem of winter wheat. Main topic was the detection of side effects on single diseases which resulted in so called iatrogenic effects. Apart from generally satisfactory effects on target-pathogens of the fungicides applied a number of positive and negative side-effects on non-target pathogens were observed: Pyrazophos reduced and Carbendazim inhibited severity of *Septoria* spp., whilst the latter fungicide seems to favour *Puccinia striiformis*. Propiconazol seems to favour *Puccinia recondita*. The reasons for these side-effects are discussed as well as the prospects of iatrogenic diseases in case of favouring effects. [References: 65].

1299 Widmark, AK.; Oxelfelt, P. (1994) DETECTION OF BARLEY YELLOW DWARF VIRUS AND ITS RNA BY FILTER HYBRIDIZATION - A STUDY OF FACTORS AFFECTING SENSITIVITY. *Swedish Journal of Agricultural Research*. 24(3):101-108. English. [SWEDISH UNIV AGR SCI DEPT PLANT & FOREST PROTECT POB 7044 S-75007 UPPSALA SWEDEN].

A study was carried out in order to evaluate conditions for detection of barley yellow dwarf virus (BYDV) and its RNA by filter hybridization. A probe representing half the genomic RNA of an MAV-like BYDV isolate was used. Purified virus, viral RNA, sap from infected leaves, and RNA preparations from infected leaf tissue were tested. Virus gave a stronger signal on nitrocellulose than on nylon membranes whereas the opposite was observed with RNA. Denaturation in formaldehyde/ formamide increased the sensitivity with all types of samples. Hybridization at 65 degrees C in aqueous solution gave a stronger signal than at 42 degrees C in 50% formamide. Under appropriate conditions the sensitivity of detection in sap samples by filter hybridization was greater than that of ELISA. [References: 33].

1300 Worasatit, N.; Sivasithamparam, K.; Ghisalberti, EL.; Rowland, C. (1994) VARIATION IN PYRONE PRODUCTION, LYTIC ENZYMES AND CONTROL OF RHIZOCTONIA ROOT ROT OF WHEAT AMONG SINGLE-SPORE ISOLATES OF TRICHODERMA KONINGII. *Mycological Research*. 98(Part 12):1357-1363. English. [UNIV WESTERN AUSTRALIA SCH AGR NEDLANDS WA 6009 AUSTRALIA].

Fifty-four single-spore isolates were obtained from two wheat field strains of *Trichoderma koningii*. These isolates inhibited the growth of *Rhizoctonia solani* to varying levels when tested on potato dextrose agar. 6-Pentyl-alpha-pyrone was isolated only from the extracts obtained from those isolates which showed strong inhibition of the pathogen on agar. Six isolates, three pyrone producers and three non-producers, were tested for protection of wheat against rhizoctonia root rot under controlled conditions. Only the pyrone producers significantly reduced root rot when applied to the soil and incubated for 14 d with the pathogen before planting. Those not producing pyrone did not reduce the disease when applied to the soil either with or without an incubation period in soil.

There was no relationship between the disease protection ability of the isolates and their mycoparasitic ability or their production of chitinase, glucanase, cellulase or xylanase. This indicates that the pyrone antibiotic may have an important role in the reduction of rhizoctonia root rot of wheat by the effective strains and that the ability to produce the antibiotic may vary among asexually produced progenies. [References: 36].

1301 Wu Liren; Yang Huaan (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Plant Protection) (1993) On the physiologic specialization of stripe rust of wheat in China during 1985-1990. *Acta Phytopathologica Sinica (China)* v. 23(3) p. 269-274. 3 tables, 9 ref. Chinese. (AGRIC 95-004591).

1302 Xie Shuixian; Wang Kening; Chen Yanglin (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Plant Protection) (1993) Preliminary studies on the relationship between epidemics of wheat stripe rust and the upper air current in China. *Acta Phytopathologica Sinica (China)* v. 23(3) p. 203-209. 7 tables, 10 ref. Chinese. (AGRIC 95-004590).

1303 Zhao Guidong (Huaiyin Inst. of Agricultural Sciences, Jiangsu (China)); Li Qingxian (1993) Species, distribution and pathogenetic difference of the sharp eyespot isolates from barley in Jiangsu [China]. *Acta Phytopathologica Sinica (China)* v. 23(1) p. 17-22. 13 tables, 10 ref. Chinese. (AGRIC 95-004526).

H50 MISCELLANEOUS PLANT DISORDERS

1304 [On reasons of variations of frost resistance in winter rye and wheat]. O prichinakh razlichij v morozostojkosti ozimoz rzhii i pshenitsy (1993) *Fiziologiya rastenij (Russian Federation)* v. 40(4) p. 627-635. 27 ref. Russian. (AGRIC 95-015140).

1305 Bajorat, B. (Hannover Univ. (Germany). Inst. fuer Pflanzenkrankheiten und Pflanzenschutz); Blumendeller, C.; Kraska, T.; Schoenbeck, F. (1993) [Efficiency of injured root systems]. Zur Leistungsfahigkeit geschaedigter Wurzelsysteme. *Oekophysiologie des Wurzelraumes; Borkheide (Germany); 30 Aug - 1 Sep 1993. (Proceedings of the 4th scientific workshop). Merbach, W. Deutsche Landakademie "Thomas Muentzer", Borkheide (Germany); Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion no. 4, p. 37-40. Selbstverlag. 1 ill., 2 tables; 1 ref. German. (AGRIC 95-004860).*

1306 Chirkova, T.V.; Saakov, V.S.; Semenova, A.V.; Avdeeva, A.V. (1993) [Effect of anoxia on structural and biochemical variations of root mitochondria proteins in rice and wheat seedlings]. Vliyanie anoksii na strukturno-biokhimicheskie izmeneniya belkov mitokhondrij kornej prorstkov pshenitsy i risa. *Fiziologiya rastenij (Russian Federation)* v. 40(4) p. 650-655. 13 ref. Russian. (AGRIC 95-015137).

1307 Dunaeva, M.V.; Bocharova, M.A.; Klyachko, N.L. (1993) [Effect of cold stress and hardening on polysomes in winter cereal seedlings [Triticum aestivum, Secale cereale]]. Vliyanie kholodovogo stressa i zakalivaniya na polisomy prorstkov ozimykhlakov. *Fiziologiya rastenij (Russian Federation)* v. 40(4) p. 599-606. 21 ref. Russian. (AGRIC 95-015138).

1308 Ignat'ev, L.A. (1993) [Character of induced heat resistance development under retardant CCC treatment in spring wheat]. Kharakter formirovaniya indutsirovannoj zharoustojchivosti yarovoj pshenitsy posredstvom retardanta SSS. *Sibirskij biologicheskij zhurnal (Russian Federation) (no.3)* p. 29-35. 17 ref. Russian. (AGRIC 95-015141).

Threatment of the seeds and plants of the spring wheat by means of the retardant CCC primarily led to its injury. Later, in optimum conditions this injury is changed by the adaptation, more high heat resistance of the plants. Effect of the adaptation was increased with increase of the measure of the plant injuries. Thermoadaptation was accompanied by relative increase of the wheat crop only in the case, when it coincided with the acting of the high temperature.

1309 Jian Lingcheng; Sun Longhua (Academia Sinica, Beijing (China). Inst. of Botany) (1993) Electron microscopic observation on changes of lipids and glycoproteins distribution in plasmalemma during cold acclimation of winter wheat. *Acta Botanica Sinica (China)* v. 35(5) p. 337-341. 10 ill., 9 ref. Chinese. (AGRIC 95-004856).

1310 Khokhlova, L.P.; Kucherenkova, N.N.; Abdрахimova, J.R. (1993) [Seasonal variations of mitochondria in stress-hardened and unhardened plants of winter wheat]. Sezonnnye izmeneniya mitokhondrij u zakalennykh i nezakalennykh k kholodu rastenij ozimoz pshenitsy. *Fiziologiya rastenij (Russian Federation)* v. 40(4) p. 607-612. 18 ref. Russian. (AGRIC 95-015139).

1311 Kralovic, J. (Slovenska Akademia Vied, Ivanka pri Dunaji (Slovak Republic). Ustav Experimentalnej Fytopatologie a Entomologie) (1994) [Relationship between macrobiogenic elements of mineral nutrition to lodging of cereals]. Vzťah makrobiogennych prvkov mineralnej vyzivy k polahnutosti obilnin. *Polnohospodarstvo (Slovak Republic)* v. 40(3) p. 174-185. 7 tables; 8 ref. Slovak. (AGRIC 95-015133).

The results of chemical analysis (N, P, K, Ca, Mg) of lodged and erected plants of various species and cultivars of cereals are presented. Lodged plants in comparison with the erected ones contained from +44.94 %, to -34.72 % of N, from +100.00 % to -38.69 % of P, from +107.58 % to -4.7 % of K, from +71.35 % to -39.96 % of Ca and from +32.61 % to -44.68 % of Mg. Lodged cereals showed unambiguously lower ratio of Ca and Mg to K. Total ratio of Ca and Mg to K is a lodging coefficient of cereals. Cereals are heavily lodged at low value of lodging coefficient in the interaction with intensive rainfalls.

1312 Lu Congming; Zhang Qide; Kuang Tingyun (Academia Sinica, Beijing (China). Inst. of Botany) (1993) The effects of water stress on photosystem II in wheat. *Acta Botanica Sinica (China)* v. 35(2) p. 93-98. 5 ill., 15 ref. Chinese. (AGRIC 95-004868).

1313 Minaeva, S.V.; Soldatov, S.E.; Talanova, V.V.; Titov, A.F. (1992) [Study of cucumber and wheat seedlings response on chloride salinization]. Issledovanie reaktsii prorstkov ogurtsa i pshenitsy na khlordidnoe zasolenie. *[Biological research of plant and animal systems]* p. 17-23. 5 ref. Russian. (AGRIC 95-015159).

1314 Prusakova, L.D.; Lukman Al' Karim; Meshcheryakov, A.B. (1993) [Effect of chlorocholine chloride on spring wheat tolerance to chloride salination]. Vliyanie khlorkholinkhlorda na ustojchivost' yarovoj pshenitsy k khlordidnomu zasoleniyu. *Fiziologiya rastenij (Russian Federation)* v. 40(5) p. 776-780. 15 ref. Russian. (AGRIC 95-015142).

1315 Sopina, N.F.; Samygin, G.A. (1993) [On mechanism of protecting action of plasmolysing saccharose solutions during wheat cell suspension freezing [Triticum timopheevii]]. O mekhanizme zashchitnogo dejstviya plazmoliziruyushchikh rastvorov sakharozy pri zamorazhivani suspenzii kletok pshenitsy. *Fiziologiya rastenij (Russian Federation)* v. 40(4) p. 636-641. 25 ref. Russian. (AGRIC 95-015117).

1316 Vojnikov, V.K.; Korytov, M.V. (1993) [Effect of hypothermia conditions on the synthesis of stress proteins in winter wheat seedlings]. Vliyanie uslovij gipotermii na sintez stressovykh belkov v prorstkakh ozimoz pshenitsy. *Fiziologiya rastenij (Russian Federation)* v. 40(4) p. 589-595. 24 ref. Russian. (AGRIC 95-015136).

1317 Zhang Qigang; Liu Jun; Wang Shengbing (Beijing Agricultural Univ. (China). Coll. of Biology) (1993) Study on wheat growth and absorption of nutrient in different drought stress using 15 N and 32 P. *Journal of Nuclear-Agricultural Sciences (China)* v. 14(5) p. 228-233, 237. 4 ill., 6 tables, 6 ref. Chinese. (AGRIC 95-004857).

1318 Zhao Kefu; Zhang Baoze; Yi Jianlong (Shandong Teachers' Univ., Jinan (China). Dept. of Biology) (1993) Influence of calcium alleviating NaCl-induced injury effects in wheat seedlings. *Acta Botanica Sinica (China)* v. 35(1) p. 51-56. 4 ill., 2 tables, 19 ref. Chinese. (AGRIC 95-004867).

1319 Blackshaw, R.E. (1994) ROTATION AFFECTS DOWNY BROME (BROMUS TECTORUM) IN WINTER WHEAT (TRITICUM AESTIVUM). *Weed Technology*. 8(4):728-732. English. [AGR & AGR FOOD CANADA RES CTR LETHBRIDGE AB T1J 4B1 CANADA].

Downy brome control in winter wheat is often inadequate. The effects of three crop rotations and two tillage intensities on downy brome populations and associated crop yields were determined in an experiment at Lethbridge, Alberta from 1987 to 1993. Downy brome densities in continuous winter wheat increased from 24 to 970 plants/m² between 1988 and 1993; and were often higher with zero tillage. Inclusion of fallow or spring canola in rotation with winter wheat suppressed downy brome densities to less than 55 and 100 plants/m², respectively, over the six years. In continuous winter wheat, yields decreased as downy brome densities increased progressively over years, indicating that monoculture winter wheat production will not be viable in regions where downy brome is prevalent unless effective herbicides are developed. In the more and areas of the Canadian prairies, a winter wheat-fallow rotation may be most suitable but in higher precipitation areas, a winter wheat-canola rotation is a viable alternative. Crop rotation is a key component of an improved management system for control of downy brome.

1320 Chilot Yirga; Hailu Beyene; Rezene Fesehaie (IAR, Addis Abeba (Ethiopia)) (1993) Economics of Alternative Weed Control Practices in Wheat, Barley and Faba Bean at Wolmera Red Soil Zone. 8. Annual Conference of the Ethiopian Weed Science Committee; Addis Abeba (Ethiopia); 20-21 Mar 1990. *Proceedings of the 8th Annual Conference of the Ethiopian Weed Science Committee*. Rezene Fesehaie (IAR, Addis Abeba (Ethiopia)) (ed.) p. 32-39. EWSC. 8 tables; 5 ref. English. (AGRI 95-005029).

Weeds are identified as one of the major crop production constraints reducing yields substantially in the Wolmera area. However, farmers could not adequately weed their crops due to overlapping of farming operations over several enterprises. To overcome this, effective pre-emergence herbicides, terbutryn in wheat and faba bean and linuron in barley were taken out for on-farm verification. In this trial the herbicides with and without one supplementary hand weeding were compared with the recommended one hand weeding and farmers' current weeding practice in the 1989 crop season. The combined analysis of variance showed significant difference among treatments in the three crops. The application of the respective herbicides gave a yield advantage of 26.8 percent in wheat, 17.6 percent in barley and 12.4 percent in faba bean. The economic analysis showed that the use of pre-emergence herbicides in wheat and barley is cost effective compared to the recommended one hand weeding as well as farmers' weeding practices. The cooperator farmers showed positive attitude towards the herbicide technology because it minimized drudgery, increased yields through timely weed control and releases labor that can be used to perform other tasks.

1321 Giref Sahile; Tanner, Douglas G.; Amanuel Gorfu (IAR, Addis Abeba (Ethiopia)) (1993) Assessment of Weed Control Methods in Bread Wheat on Farmers' Fields. 8. Annual Conference of the Ethiopian Weed Science Committee; Addis Abeba (Ethiopia); 20-21 Mar 1990. *Proceedings of the 8th Annual Conference of the Ethiopian Weed Science Committee*. Rezene Fesehaie (IAR, Addis Abeba (Ethiopia)) (ed.) p. 17-21. EWSC. 5 tables; 4 ref. English. (AGRI 95-015272).

Weed control trials were located on farmers' fields in Dosha and Gondie in Arsi region in 1988 and 1989 in bread wheat to compare different combinations of hand weeding with and without grass and/or broadleaf herbicides. The combined analysis of variance indicated significant (P less than 0.05) difference amongst treatments in terms of grain yield. The unweeded treatment (1380 kg ha⁻¹) was significantly outyielded only by diclofopmethyl (Illoxan 28 percent EC) without supplementary hand weeding (2191 kg ha⁻¹) and the Illoxan plus Brittox 52.5 percent EC (ioxynil + bromoxynil + MCPP) combination (2724 kg ha⁻¹). Efficacy data from the same trials that illoxan reduced the annual grass weed populations by 74 percent to 95 percent across all sites, while Brittox reduced the broadleaf weed populations by 54 percent to 93 percent. Economic analyses indicated that, using the official grain price Illoxan alone gave a marginal rate of return (MRR) of 423 percent and 588

percent using the local market price. Sensitivity analyses for herbicide pricing indicated that at double the official price, herbicide treatments were still the most profitable, but the single hand weeding treatment was no longer dominated. At three times the official price, Illoxan alone was still the most profitable treatment with an acceptable MRR of 62 percent and 113 percent relative to a single hand weeding using official and local prices, respectively.

1322 Marshall, EJP.; Arnold, GM. (1994) WEED SEED BANKS IN ARABLE FIELDS UNDER CONTRASTING PESTICIDE REGIMES. *Annals of Applied Biology*. 125(2):349-360. English. [UNIV BRISTOL INST ARABLE CROPS RES DEPT AGR SCI LONG ASHTON RES STN BRISTOL BS18 9AF AVON ENGLAND].

Viable weed seed banks on a clay soil were estimated for five years from 11 arable fields receiving one of three levels of pesticide application. Low seed densities, averaging 2000 m⁻², were recorded, but dicotyledonous weed seed numbers usually increased following oilseed rape crops, reaching 26 000 m⁻² in one field. Field-to-field variability was large. Samples could be grouped using multivariate techniques into those dominated by grass weed seeds and those containing mainly dicotyledonous weed seeds. Within TWINSpan classifications, most fields maintained similar seed banks during the study period, indicating relative stability of communities. Differences present at the outset of the experiment, including variation between fields in the same treatment area, were maintained for the five years. Patterns were not associated with straw disposal or spring herbicide application. Oilseed rape crops did not cause qualitative change in seed bank communities, but allowed certain species, notably *Stellaria media* and *Sonchus asper*, to increase seed numbers. Smaller and less diverse seed banks in the area receiving most herbicide were not statistically significant. Seed banks gave poor predictions of following weed populations. [References: 20].

1323 Mukhin, V.P.; Spiridonov, Yu.Ya.; Mishchenko, L.N. (1993) [Effect of simazine on spring wheat and barley plants depending on matically different quality of seeds]. *Dejstvie simazina na rasteniya yarovoj pshenitsy i yachmenya, vyrashchennye iz matrikal'no raznokachestvennykh semyan. Izvestiya Timiryazevskoj sel'skokhozyajstvennoj akademii (Russian Federation) (no.3) p. 13-29. 52 ref. Russian. (AGRI 95-015277).*

Specific features in the response of wheat plants of Ivolga variety and of barley variety Zazersky 85 to the effect of herbicide simazine depending on different quality of seed are described; the seeds were divided into fractions according to their position in the ear (in layers), arrangement of flowers in the ear (wheat), as well as to orientation of rows in barley, and to the weight of 1000 grains. Test-criterion is the damp mass of above-ground plant organs. As a result of determining ED20, ED50 and ED70, considerable and reliable difference has been found between individual fractions both with respect to their own and to general check.

1324 Olofsdotter, M. (1992) [Herbicide-bioassay in cell culture and tissue culture [ethametsulfuron, chlorsulfuron, metsulfuron, tribenuron, imazamethabenz, including 3 articles]. *Herbicid-bioassay i celle-og vaevskultur. Kongelige Veterinaer- og Landbohøjskole, Copenhagen (Denmark). Inst. for Jordbrugsvidenskab. KVL. 26 ill., 23 tables; 107 ref. 117 p. Danish. (AGRI 95-005042).*

1325 Regasa Ensermu; Aleligne Kefyalew; Bekele Hundie (IAR, Addis Abeba (Ethiopia)) (1993) Economics of Alternative Weed Control Methods on Barley in Bahir Dar Awraja. 8. Annual Conference of the Ethiopian Weed Science Committee; Addis Abeba (Ethiopia); 20-21 Mar 1990. *Proceedings of the 8th Annual Conference of the Ethiopian Weed Science Committee*. Rezene Fesehaie (IAR, Addis Abeba (Ethiopia)) (ed.) p. 40-45. EWSC. 5 tables; 3 ref. English. (AGRI 95-004976).

Farmers in Bahir Dar Awraja do not weed their barley fields. June and early July is the appropriate time for barley weeding but this is the main labor peak period in the region. Farmers give priority to other tasks such as land preparation and planting for tef. An experiment consisting four alternative weed control methods (2, 4-D, Brittox 52.5 percent (bromoxynil + ioxynil + mcp), Brittox + diclofopmethyl and one hand weeding) was conducted in 16 sites in 1988 and 1989. Overall treatment effect on yield was not significant but there was a significant interaction

between treatments and locations. The economic analysis of the data over all sites revealed that the current farmers' practice of not weeding barley is optimal. Brittox and diclofopmethyl effectively controlled annual broad-leaved and grass weeds, respectively. But the latter had a damaging effect on barley particularly when used with the surfactant Agral 90. For locations where harmful annual broadleaved weeds such as *Guizotia scabra* and *Galinsoga parviflora* dominate, the use of Brittox is economic.

1326 Salonen, Jukka (1993) Reducing herbicide use in spring cereal production. Helsinki Univ. (Finland). *Agricultural science in Finland, Supplement (Finland)*; v. 2 no. 2 88 p. Agricultural Research Centre of Finland. Bibliography p. 34-40. English. (AGRIS 95-015275).

1327 Scott, RC.; Peeper, TF. (1994) ECONOMIC RETURNS FROM BROADLEAF WEED CONTROL IN HARD RED WINTER WHEAT (*TRITICUM AESTIVUM*). *Weed Technology*, 8(4):797-806. English. [OKLAHOMA STATE UNIV DEPT AGRON STILLWATER, OK 74078 USA].

Seventeen on-farm and two experiment station experiments were conducted to evaluate farmers' decisions to apply broadleaf weed control herbicides to tillered hard red winter wheat in February or March with or without urea-ammonium nitrate (28-0-0) fertilizer carrier. The herbicides and rates varied by farm, but all farmers applied a residual sulfonylurea herbicide and four added a phenoxy herbicide. Most farmer-selected herbicide treatments controlled target weeds including bushy wallflower, flaxweed, henbit, plains coreopsis, smallflowered bittercress, and wild buckwheat. Controlling these weeds increased wheat yield on only two farms. Farmer-selected, commercially applied treatments increased net returns at two of seventeen farms, decreased net returns at seven farms, and did not affect returns at eight farms. Net returns were increased over the farmer-selected treatments at two farms when half the farmer-selected rate of herbicide was used. Half-rate herbicide treatments controlled weeds up to 25% less than farmer-selected treatments. Weed control with the half-rate treatments ranged from 60 to 98%. None of the farmers expected that herbicide use would increase yield. Their primary objective was to have weed-free fields at harvest. Nitrogen rates appeared to be selected without a rational basis for decision making.

1328 Shi Chunxi (Shaanxi Provincial Inst. of Plant Protection, Yangling (China)) (1993) Estimation of yield losses on *Desculainia sophia* (Cruciferae) harm to common wheat and controlling strategy. *Shaanxi Journal of Agricultural Sciences (China)* (no. 5) p. 21-23. 3 tables, 3 ref. Chinese. (AGRIS 95-005002).

1329 Srivastava, A.; Gupta, KC.; Singh, G. (1995) DISSIPATION OF TRALKOXYDIM HERBICIDE FROM WHEAT CROP AND SOIL UNDER SUB-TROPICAL CONDITIONS. *Pesticide Science*, 43(1):53-55. English. [GOVIND BALLABH PANT UNIV AGR & TECHNOL DEPT CHEM PANTNAGAR 263145 UTTAR PRADESH INDIA].

The persistence of tralkoxydim herbicide in wheat crop and in soil was evaluated under Indian sub-tropical field conditions at two application rates (400 g ai ha⁻¹ and 800 g ai ha⁻¹). At 400 g ai ha⁻¹, tralkoxydim persisted up to 28 days in soil but became non-detectable only after 45 days in the crop. However, at 800 g ai ha⁻¹, tralkoxydim residues persisted for 45 days in both soil and crop. The dissipation of the herbicide from both soil and crop appeared to occur in two phases at both rates of application. Each phase followed first-order kinetics. The values of DT50 and DT90 for both soil and crop are reported. [References: 7].

1330 Stahlman, PW.; Elhamid, MA. (1994) SULFONYLUREA HERBICIDES SUPPRESS DOWNY BROME (*BROMUS TECTORUM*) IN WINTER WHEAT (*TRITICUM AESTIVUM*). *Weed Technology*, 8(4):812-818. English. [KSU AGR RES CTR HAYS, KS 67601 USA].

In separate studies in west-central Kansas, a prepackaged mixture of chlorsulfuron + metsulfuron (5:1 w/w) and triasulfuron alone or in combination with metribuzin as a sequential or tank mix treatment were evaluated two years for downy brome control in winter wheat. Downy brome and wheat responses to each herbicide alone PRE or plus metribuzin POST varied between years. Visually, downy brome biomass was reduced 32 to 79% by chlorsulfuron + metsulfuron at 16 to 26 g ai/ha and 58 to 76% by triasulfuron at 30 g ai/ha applied PRE. Metribuzin

POST at 158 g ai/ha following chlorsulfuron + metsulfuron PRE at 26 g/ha and metribuzin POST at 140 g/ha or more following triasulfuron PRE at 30 g/ha reduced downy brome biomass in both years more than PRE treatments alone. Chlorsulfuron + metsulfuron at 11 or 16 g/ha plus metribuzin at 105 or 158 g/ha applied POST affected downy brome less in 1992 than chlorsulfuron + metsulfuron applied PRE at 21 or 26 g/ha. Conversely in 1993, POST treatments except for chlorsulfuron + metsulfuron at 11 or 16 g/ha plus metribuzin at 105 g/ha affected downy brome more than PRE treatments. Triasulfuron plus metribuzin POST in late fall controlled downy brome better than a sequential application in one of two years; late-fall POST was better than early-spring POST applications in both years. Despite some treatments retarding growth, no treatment in either study reduced wheat yield in 1992. However in 1993, chlorsulfuron + metsulfuron PRE at 26 g/ha, chlorsulfuron + metsulfuron at 16 g/ha plus metribuzin at 105 or 158 g/ha applied POST, and metribuzin POST at 315 g/ha reduced wheat yields. Triasulfuron at 30 g/ha plus metribuzin at 140 g/ha or higher applied PRE, sequentially, or POST in late fall and metribuzin applied POST in early spring at 280 g/ha also reduced wheat yields.

1331 Tanner, DG.; Sahile, G.; Dejene, D. (1993) POTENTIAL BENEFITS OF HERBICIDAL WEED CONTROL FOR BREAD WHEAT PRODUCTION IN THE PEASANT FARMING SYSTEMS OF SOUTH-EASTERN ETHIOPIA. *Tropical Agriculture*, 70(3):260-266. English. [INT MAIZE & WHEAT IMPROVEMENT CTR POB 5689 ADDIS ABABA ETHIOPIA].

Peasant farmers in Ethiopia rely on labour-intensive cultural practices for weed control in wheat, limiting both cropped area and grain yields. Herbicides available for wheat production in the peasant sector decreased over the past decade as their impact on smallholders' grain yields had not been demonstrated. On-farm trials were therefore conducted during 1988 and 1989 to assess the effects of two post-emergence herbicides on weed-infested wheat fields in two regions of southeastern Ethiopia. Brittox(R) and Illoxan(R) reduced annual broadleaf and grass weed stands by 80 and 81%, respectively. Grain yield increased by 78% relative to the current farmers' practice of selective and partial hand weeding. Under high weed competition, herbicides were economically superior to hand weeding even at triple the current official herbicide prices. Thus, increased usage of herbicides by peasant farmers has the potential to raise grain yields, decrease labour requirements, and increase profitability. [References: 11].

1332 Terekhova, I.V.; Chernyad'ev, I.I.; Rakhimberdieva, M.G.; Karapetyan, N.V. (1993) [Effect of norflurazon on the activity of enzymes of photosynthetic carbon metabolism, in barley seedling]. *Izmeneniya aktivnosti fermentov fotosinteticheskogo metabolizma proroskov yachmeniya, vyrashchennykh s norflurazonom. Prikladnaya biokhimiya i mikrobiologiya (Russian Federation)* v. 29(3) p. 455-461. 30 ref. Russian. (AGRIS 95-015245).

The effect of norflurazon on the activity of enzymes of photosynthetic carbon metabolism was studied in barley seedling grown in darkness or under pulse light. In the latter case, norflurazon stimulated the activity of the key photosynthetic enzyme ribulose biphosphate carboxylase, and the activities of NADP-glyceraldehyde dehydrogenase complex and NAD-malate dehydrogenase, but had no effect on phosphoenolpyruvate carboxylase. The level of all the enzymes did not change when barley seedling were in darkness. Changes are supposed to be an adaptive response of plants to norflurazon stress.

1333 Thill, DC.; Odonovan, JT.; Mallorysmith, CA. (1994) INTEGRATED WEED MANAGEMENT STRATEGIES FOR DELAYING HERBICIDE RESISTANCE IN WILD OATS. *Phytoprotection*, 75(Suppl 5):61-70. English. [UNIV IDAHO DEPT PLANT SOIL & ENTOMOL SCI MOSCOW, ID 83844 USA].

Herbicide-resistant biotypes of wild oats (*Avena fatua*) infest most major cereal producing regions in the western United States and Canada. This paper reviews potential integrated weed management strategies that can be used to prevent or delay selection of herbicide-resistant wild oats plants. An integrated wild oats management strategy to delay or prevent the development of herbicide resistance should be based on preventing the movement of wild oats seed into the soil. Two ways to achieve this are by preventing the immigration of seed into the field from external sources, and by reducing or eliminating seed production by wild oats already in

the field. It is becoming increasingly clear that reliance on continuous herbicide use as the sole means of weed control will fail to eliminate wild oats and other weed seed from the soil seedbank. On the contrary, evidence is mounting that this practice will select for biotypes that are resistant to the herbicides used, especially where herbicides of the same mode of action are used continuously. It is essential, therefore, that herbicides be considered as just one component of an overall integrated system together with cultural control and other management strategies, and that agronomic principles be considered when developing this system. [References: 42].

1334 Tumans, V.; Vanags, I. (Latvia State Plant Protection Centre, Riga (Latvia)) (1993) [The investigation of the herbicide Granstar and Preparation 1 in barley fields]. *Herbicidu granstara un preperata 1 izpete mizu sejumos. Raziba (Latvia) (no.6) p. 22-24. 2 tables. Latvian. (AGRI 95-015244).*

1335 Xie, HS.; Quick, WA.; Hsiao, AI. (1994) **SPRING CEREAL RESPONSE TO IMAZAMETHABENZ AND FENOXAPROP-P-ETHYL AS INFLUENCED BY ENVIRONMENT.** *Weed Technology. 8(4):713-716. English. [UNIV REGINA DEPT BIOL REGINA SK S4S 0A2 CANADA].*

The influence of temperature, soil moisture, and light intensity on the tolerance of spring wheat, durum wheat, and spring barley to imazamethabenz and safened fenoxaprop-p-ethyl was determined in growth chamber experiments. Imazamethabenz at 500 g/ha reduced plant height and shoot fresh weight of durum and spring wheats grown under prolonged 70% shade. The height of durum and spring wheats was reduced by imazamethabenz under a low temperature regime. Compared to the plants grown under standard conditions, the shoot weight of spring and durum wheat plants was not reduced by imazamethabenz under drought, or high and low temperature conditions. Barley tolerance to imazamethabenz was not affected by environment. All three spring cereals were tolerant to fenoxaprop-p-ethyl plus a safener at 92 g/ha; and such tolerance was not greatly affected by various environments examined.

J10 HANDLING, TRANSPORT, STORAGE AND PROTECTION OF AGRICULTURAL PRODUCT

1336 Arthur, FH. (1994) **CYFLUTHRIN APPLIED WITH AND WITHOUT PIPERONYL BUTOXIDE AND PIPERONYL BUTOXIDE PLUS CHLORPYRIFOS-METHYL FOR PROTECTION OF STORED WHEAT.** *Journal of Economic Entomology. 87(6):1707-1713. English. [USDA ARS STORED PROD INSECTS RES & DEV LAB 3401 EDWIN ST SAVANNAH, GA 31405 USA].*

Soft red winter wheat treated with 0.5, 1.0, 1.5, or 2.0 ppm cyfluthrin, all rates + 8.0 ppm piperonyl butoxide, and all rates with piperonyl butoxide + 6.0 ppm chlorpyrifos-methyl was stored for 10 mo at ambient conditions in southern Georgia. Samples of wheat were bioassayed with lesser grain borer, *Rhyzopertha dominica* (F.), and rice weevil, *Sitophilus oryzae* (L.), every 2 mo. Lesser grain borer survival on wheat treated with cyfluthrin alone ranged from 0-37.0%, whereas survival in the cyfluthrin + piperonyl butoxide and cyfluthrin + piperonyl butoxide + chlorpyrifos-methyl combinations ranged from 0 to 16.0%. No F-1 adults or ground flour (dockage) was present in incubated samples. Rice weevil survival on wheat treated with 0.5 and 1.0 ppm cyfluthrin steadily increased to a maximum of 94.5 and 43.5%, respectively, after 10 mo. Survival was reduced on wheat treated with 1.5 and 2.0 ppm cyfluthrin, and beetles did not survive in the piperonyl butoxide-chlorpyrifos-methyl combinations. The number of F-1 rice weevils and the amount of dockage were greatest in the two lowest rates of cyfluthrin. F-1 adults and dockage weight were positively correlated with initial survival. [References: 9].

1337 Schwab, CV.; Ross, JJ.; White, GM.; Colliver, DG. (1994) **WHEAT LOADS AND VERTICAL PRESSURE DISTRIBUTION IN A FULL-SCALE BIN 1. FILLING.** *Transactions of the ASAE. 37(5):1613-1619. English. [IOWA STATE UNIV SCI & TECHNOL DEPT AGR & BIOSYST ENGN AMES, IA USA].*

Flat-bottom cylindrical grain bins are subjected to unique loads and pressures during the filling process. The vertical and lateral loads

imposed on a bin wall and the vertical load on a bin floor by wheat during piling were measured. The radial distribution of vertical pressure during piling was also measured. The vertical pressure was determined to be dependent on the radial location and was not uniformly distributed. The load distribution in a bin with an H/D ratio of 3 was 83% on the floor and 17% on the walls. Three widely used prediction equations of Janssen, Reimbert, and Walker were compared to the measured loads and pressures and were determined to have similar shapes but different parameters for a best fit to observed data. [References: 22].

1338 Sun, DW.; Woods, JL. (1994) **LOW TEMPERATURE MOISTURE TRANSFER CHARACTERISTICS OF BARLEY - THIN-LAYER MODELS AND EQUILIBRIUM ISOTHERMS.** *Journal of Agricultural Engineering Research. 59(4):273-283. English. [UNIV SHEFFIELD DEPT MECH & PROC ENGN POB 600 MAPPIN ST SHEFFIELD S1 4DU ENGLAND].*

1339 Sun, DW.; Woods, JL. (1994) **LOW TEMPERATURE MOISTURE TRANSFER CHARACTERISTICS OF WHEAT IN THIN LAYERS.** *Transactions of the ASAE. 37(6):1919-1926. English. [UNIV SHEFFIELD DEPT MECH & PROC ENGN SHEFFIELD S YORKSHIRE ENGLAND].*

Wheat was dried in thin layers in the temperature range 3.5 to 23.4 degrees C, with additional points at 30.4, 40.2, and 49.7 degrees C for comparison with previous work. Each sample was dried for about one week. The exponential Newton model was fitted to the data and the resulting drying constant fitted to the Arrhenius equation to describe the temperature effect. The solution for diffusion in a sphere was also fitted giving the diffusivity, which was again fitted to the Arrhenius equation. The diffusion model [standard error = 0.0031 db. (dry basis)] fitted the data better than the Newton model (standard error 0.0067 db.). The fitted dynamic equilibrium moisture content was compared with previous static equilibrium moisture content data and was generally higher, as would be expected for a dynamic value. The results are particularly relevant to moisture transfer during the cooling of stored grain, which provides a useful alternative to pesticide use. [References: 28].

J11 HANDLING, TRANSPORT, STORAGE AND PROTECTION OF PLANT PRODUCT

1340 Orriss, G.D. (1993) **HACCP [Hazard Analysis Critical Control Point]: Wheat.** 11 p. FAO-ESN--TCP/DRK/2251. English. (AGRI 95-015364).

1341 Sokolov, I.I.; Chigrin, V.V. (1993) [Detection of *Fusarium graminearum*, mycelial proteins in wheat grain by enzyme immunoassay]. *Opređenje mitseljal'nykh belkov griba Fusarium graminearum v zeme pshenitsy pri pomoshchi immunofermentnogo analiza. Prikladnaya biokhimiya i mikrobiologiya (Russian Federation) v. 29(3) p. 462-467. 26 ref. Russian. (AGRI 95-015363).*

The possibility of quantitative detection of *Fusarium graminearum* proteins in wheat grain by enzyme immunoassay is shown. A detailed procedure for antiserum preparation and assaying is given.

L02 ANIMAL FEEDING

1342 Al Athari, A.K.; Mohammed, A.H. (Ipa Agriculture Res. Center, Baghdad (Iraq)) (1993) [Effect of enzyme supplementation on the nutritive value of IPA-99 barley in chicken diets]. *Ta't'i'r: 'id: a: fat al-'anzi: ma: 3ala al-qi: mah al-g'id: a' i: ah lil-s' a3i: r: ('iba: -99) fi: 3ala: q al-daj' aj' j'. Mij' alat 'iba: ' lil' abh' a: t' al-zira: 3iyyat (Iraq); Ipa Journal of Agricultural Research v. 1(no.3) p. 86-102. 7 tables; 21 ref. Arabic. (AGRI 95-006124).*

A new dual purpose barley (*H. vulgare* L.) variety IPA-99, recently released in Iraq, was evaluated for its nutritional value in poultry diets supplemented with enzyme complex (Roxazyme). IPA-99 barley was found to contain 11.8 crude protein and 3288 kcal/kg true metabolizable energy. One 49-day feeding trial was conducted with 750 one-day old males of broiler parent stock. Experimental diets with five levels of barley (13, 26, 39, 52, and 65) were fed with or without the addition of roxazyme.

1343 Aneur, A.; Picard, M.; Bouchot, C. (1992) [The interest of the layer rationing in function of a thermic cycle and using a triticales]. Interet du rationnement des poudeuses en fonction d'un cycle thermique et utilisation d'un triticales. *Bulletin Technique I.T.P.E (Algerie) (no.4) p. 22-29.* 5 tableaux; 8 ref. French. (AGRIS 95-016349).

1344 Angelovicova, M.; Kredatus, S. (Vysoka Skola Polnohospodarska, Nitra (Slovak Republic)) (1994) [Utilization of calcium and phosphorus from feeding mixtures with triticales in forming egg shell in laying hens]. Utilizacia vapnika a fosforu z krmnych zmesi a triticales pri tvorbe vajcovej skrupiny sliepok. *Polnohospodarstvo (Slovak Republic) v. 40(4) p. 294-303.* 8 tables; 18 ref. English. (AGRIS 95-016366).

Calcium and phosphorus utilization from feeding mixtures, in which wheat (35 %) was replaced with triticales (1/2, 1/4 and all) in a feeding-balance trial with laying hens Shaver Starcross 288 was studied. The trial was realized in the 1st phase of laying cycle. The highest egg shell weight was in the group fed with mixtures containing 17.5 % of triticales (1/2 of wheat was replaced with triticales). 3.15 g calcium, 0.77 g phosphorus was utilized in this group and the ratio of calcium : phosphorus was 4 : 1. Calcium retention was 2.36 g and the content of calcium in blood serum was 2.95 mmol.l⁻¹ (-1), retention of phosphorus 0.18 g, its content in blood serum 1.32 mmol.l⁻¹ (-1) and activity of ALP in blood serum was 13.06 mkat.l⁻¹ (-1) in this group. Excreta in this group reached the highest amount (94.44 g), the highest amount of Ca (0.24 g) and lowest quantity of phosphorus (0.58 g).

1345 Anon. (1994) [Tryptophan and isoleucine in the pig fattening]. Tryptophan und Isoleucin in der Schweinemast. *Deutsche Geflugetwirtschaft und Schweineproduktion (Germany) v. 46(30) p. 17-18.* 1 ill. German. (AGRIS 95-006073).

1346 Arieli, A.; Adin, G. (University of Jerusalem (Israel)) (1994) [Effect of wheat silage maturity on digestion and milk yield in dairy cows]. Efecto de la madurez del ensilaje de trigo sobre la produccion de leche. *Frisona Espanola (Espana) (no. 82) p. 80-81.* Il., 1 tab. Spanish. (AGRIS 95-016189).

1347 Bedford, M.R. (1993) Mode of action of feed enzymes. *The Journal of applied poultry research (USA) v. 2(1) p. 85-92.* references. English. (AGRIS 95-016357).

1348 Benghedalia, D.; Halevi, A.; Miron, J. (1995) DIGESTIBILITY BY DAIRY COWS OF MONOSACCHARIDE COMPONENTS IN DIETS CONTAINING WHEAT OR RYEGRASS SILAGES. *Journal of Dairy Science.* 78(1):134-140. English. [AGR RES ORG VOLCANI CTR INST ANIM SCI IL-50250 BET DAGAN ISRAEL].

Digestibility by dairy cows of monosaccharide constituents in rations based on wheat or ryegrass silage as the sole roughage component was examined in this study. Six cows in early lactation were divided into two groups with similar performance data at the onset of the experiment and fed for ad libitum intake for two 28-d periods in a change-over design. Cows were fed a TMR of concentrate plus either wheat or ryegrass silage, contributing 19% of silage NDF in the TMR. Digestibilities of ration DM and total carbohydrate were 3.3 and 3.1 percentage units higher, respectively, for ryegrass than for the wheat silage. The digestibility of ration NDF was 64.1% in ryegrass silage and 49.6% in wheat silage. The trend was similar for digestibilities of NDF monosaccharide components. Ration NDF carbohydrate digestibility was 74.8% for ryegrass silage versus 59.7% for wheat silage. For both TMR, the digestibility of NDF xylose was lower than that for NDF glucose and arabinose. Based on carbohydrate digestibility, ryegrass silage can be considered to be a successful roughage alternative for wheat silage in TMR for lactating cows. [References: 25].

1349 Bolduan, G. (Fachhochschule Neubrandenburg (Germany)) (1994) [Enzymes in feeding stuffs: the non plus ultra in future?]. Enzyme im Futter: Das Nonplusultra der Zukunft. *Deutsche Geflugetwirtschaft und Schweineproduktion (Germany) v. 46(31) p. 11-14.* 3 ill., 4 tables. German. (AGRIS 95-006074).

1350 Castrillo, C.; Fondevila, M.; Guada, J.A.; Devesa, A. (1995) EFFECT OF AMMONIA TREATMENT AND CARBOHYDRATE SUPPLEMENTATION ON THE INTAKE AND DIGESTIBILITY OF

BARLEY STRAW DIETS BY SHEEP. *Animal Feed Science & Technology.* 51(1-2):73-90. English. [UNIV ZARAGOZA DEPT PROD ANIM & CIENCIA ALIMENTOS M SERVET 177 E-50013 ZARAGOZA SPAIN].

The changes in straw voluntary intake and apparent digestibility caused by the ammoniation of straw and energy supplementation in diets fed to adult, non-productive sheep were studied in two experiments. In Experiment 1, untreated (US) or ammonia treated (TS) barley straw were given as the only feed to four ewes in a cross-over design. Ammoniation increased straw dry matter (DM) intake from 30.2 to 50.6 g kg⁻¹ LW(0.75), organic matter digestibility (OMD) from 0.438 to 0.519 and digestible organic matter intake (DOMI) from 12.5 to 24.7 g kg⁻¹ LW(0.75), allowing energy maintenance requirements to be met. In Experiment 2, three groups of four ewes received US, with another three groups of four receiving TS, both supplemented with meadow grass hay (H), rolled barley (B) or sugar-beet pulp (P) in a 2 X 3 factorial design. Each supplement was given in amounts of 150, 300, 450 and 600 g day⁻¹, in a Latin-square design. The type of supplement did not significantly affect straw intake at any level of inclusion. The level of supplementation scarcely affected US intake, whereas DM intake of TS diminished linearly. Substitution rates were 0.49 +/- 0.0881 0.61 +/- 0.085 and 0.55 +/- 0.131 for TS-H, TS-B and TS-P diets, respectively (P>0.05). Apparent digestibility of straw was not significantly affected by supplementation. Increases in total DOMI when the level of supplementation was augmented were lower in TS than in US diets, and with H than with B or P as supplements. To reach the DOMI obtained with TS as the only feed, US has to be supplemented with 420, 272 or 269 g DM of H, B or P, respectively. [References: 42].

1351 Duncan, A.J.; Hartley, S.E.; Iason, G.R. (1994) FINE-SCALE DISCRIMINATION OF FORAGE QUALITY BY SHEEP OFFERED A SOYABEAN MEAL OR BARLEY SUPPLEMENT WHILE GRAZING A NITROGEN-FERTILIZED HEATHER (CALLUNA VULGARIS) MOSAIC. *Journal of Agricultural Science.* 123(Part 3):363-370. English. [MACAULAY LAND USE RES INST ABERDEEN AB9 2QJ SCOTLAND].

The ability of 12 Scottish Blackface ewes to discriminate and concentrate grazing activity in nitrogen-fertilized heather patches was determined. The nitrogen content of a stand of heather (*Calluna vulgaris*) was increased and the fibre content decreased by adding ammonium nitrate fertilizer (7.5 g N/m²) 3 months prior to grazing, in Scotland during August 1991, to selected areas within a patchwork array. The sheep were offered either a high protein (300 g soyabean meal) or low protein (285 g ground barley) supplement daily before being allowed to graze within the heather mosaic during November 1991. The proportion of time spent grazing in fertilized and control patches (patch selection) and the proportion of daylight hours spent grazing (proportion of time spent grazing) was estimated for individual sheep for 6 days. Rumen ammonia concentrations were determined at the end of the grazing period. All animals spent approximately twice as much time grazing in fertilized as in control patches. About half of the daylight hours were spent grazing. The nature of the supplement did not influence patch selection, the proportion of time spent grazing or rumen ammonia concentrations. It was concluded that sheep are able to discern differences in the chemical composition of heather on a fine scale and that their foraging behaviour is not influenced by the type of supplement offered. [References: 32].

1352 Fiems, L.O.; Boucque, C.V.; Cottyn, B.G. (1995) WHEAT GLUTEN FEED IN DIETS FOR INTENSIVE BULL BEEF PRODUCTION. *Annales de Zootechnie.* 44(1):41-47. English. [AGR RES CTR GHENT NATL INST ANIM NUTR SCHELDWEWEG 68 B-9090 MELLE GONTRODE BELGIUM].

The use of wheat gluten feed in concentrate diets for beef bulls has been investigated in 3 experiments. Sugar-beet pulp was replaced by 15% wheat gluten feed in the first experiment and by 15, 30 or 45% in the second. Higher levels of wheat gluten feed initially reduced growth rate as a consequence of a lower feed intake. Afterwards, the animals fed these diets ate more and underwent a partial compensatory gain. For the entire period, growth rate was not significantly different. There was a small improvement of dry matter conversion when sugarbeet pulp was replaced by wheat gluten feed. Carcass data were not affected by the inclusion of wheat gluten feed in the diet. Regarding initial and overall growth rate and feed intake, the best results were obtained when 15% wheat gluten feed was incorporated in the diet. In a third experiment the

voluntary intake of concentrate containing 15% wheat gluten feed was lower than for concentrate with no wheat gluten feed, when both were offered free choice. The dry matter digestibility of the diets, determined with sheep, was slightly but not significantly improved when wheat gluten feed was incorporated. [References: 10].

1353 Guenter, W. (1993) Impact of feed enzymes on nutrient utilization of ingredients in growing poultry. *The Journal of applied poultry research (USA)* v. 2(1) p. 82-84. references. English. (AGRI 95-016360).

1354 Hautala, Marja; Vuorenmaa, Juhani (1993) [Rolled barley and sodiumpolyacrylate supplement in pig feeds - effects on gastric lesions and performance of growing pigs]. *Valssattu ohra ja natriumpolyakrylaattilisäys lihasikojen rehussa - vaikutus mahahaavaumien esiintyvyyteen, sikojen kasvuun ja rehun hyvaeksikaeytöön. Suomen eläinlääkärilehti (Finland)* v. 99(12) p. 741-747. 23 ref. Finnish. (AGRI 95-016327).

1355 Horn, GW.; Cravey, MD.; Mccollum, FT.; Strasia, CA.; Krenzer, EG.; Claypool, PL. (1995) INFLUENCE OF HIGH-STARCH VS HIGH-FIBER ENERGY SUPPLEMENTS ON PERFORMANCE OF STOCKER CATTLE GRAZING WHEAT PASTURE AND SUBSEQUENT FEEDLOT PERFORMANCE. *Journal of Animal Science*. 73(1):45-54. English. [OKLAHOMA STATE UNIV DEPT ANIM SCI OKLAHOMA AGR EXPT STN STILLWATER, OK 74078 USA].

A 3-yr study was conducted to determine effects of high-starch (HS) or high-fiber (HF) energy supplements on performance of fall-weaned steer calves (n = 192, Exp. 1 and 2; n = 84, Exp. 3) grazing winter wheat pasture (*Triticum aestivum* variety 2157) and subsequent feedlot performance. The steers received 1) no supplement (CL) other than free-choice access to a commercial mineral mixture or 2) were hand-fed 6 d/wk either a corn-based HS supplement, or 3) a soybean hull/wheat middling-based HF supplement. In Exp. 1 (1989-1990), a fourth treatment provided ad libitum access to the HF supplement (SFHF). Supplements contained 88 mg of monensin/kg and the combination of ionophore, minerals and salt (8%) was used to limit intake of the SFHF supplement. Target level of daily consumption of all supplements was .75% of mean BW. Stocking density was increased by 33% (i.e., from 1.24 to 1.65 steers/ha) in Exp. 1 and 3, and by 22 to 44% in Exp. 2 when supplements were fed. Subsequent to grazing wheat pasture in Exp. 2 and 3, feedlot performance and carcass quality (Exp. 2 only) of the cattle were measured. Over the 3-yr period (pooled analysis), mean daily supplement consumption was .65% BW. Daily gains were increased ($P < .001$) .15 kg by supplementation and were .92, 1.06, and 1.08 kg for CL, HS, and HF, respectively. Daily gains were not influenced ($P > .45$) by type of energy supplement. Mean supplement conversions (kilograms as-fed kilogram of increased gain(-1).hectare(-1)) were 5.4 for HS and 5.0 for HF and did not differ ($P > .95$). Subsequent feedlot daily gain was decreased .09 kg($P < .05$) by supplementation in Exp. 2 but not in Exp. 3 ($P > .80$). This supplementation program for growing cattle on wheat pasture allowed stocking density to be increased by approximately one-third and increased daily gains by .15 kg. [References: 46].

1356 Hubilla, P.R.L. (1994) Enzyme supplementation of feed grains in broiler diets. Philippines Univ., Los Banos, College, Laguna (Philippines). 11 graphs; 49 tables. Bibliography (76 ref.). Appendices. Received Jul 1994. 81 leaves. English. (AGRI 95-006112).

Results obtained showed a marked improvement in the apparent coefficient of digestibility and consequently an increased metabolizable energy content of the feed grains when enzymes were added. Feed consumption of birds fed with either corn:wheat or corn:barley diet decreased significantly ($P < 0.01$) with the addition of enzymes. Greatest reduction in feed consumption among broilers fed corn:wheat diet was observed in those given Kemzyme while among broilers fed corn:barley diet, greatest reduction in feed consumption was observed in those given optzyme and because of the reduced feed intake, there was also a reduction in the metabolizable energy, crude protein, lysine and methionine + cystine intake of the birds. On the other hand, body weight and feed conversion efficiency was significantly ($P < 0.01$) improved with the addition of enzymes. Greatest improvement in body weight among broilers fed corn:wheat diet was observed in those given avizyme while among broilers fed corn:barley diet, greatest improvement in body weight

was observed in those given avizyme. Greatest improvement in feed utilization among broilers fed corn:wheat diet was observed in those given Kemzyme while among broilers fed corn:barley diet, most efficient birds were those given avizyme and optzyme. Enzyme supplementation had no effect on the health of the birds as shown by the very low incidence of mortality. Similarly, income over feed and chick cost was improved with the addition of enzymes.

1357 Inborr, Johan (1994) Supplementation of pig starter diets with carbohydrate-degrading enzymes - stability, activity and mode of action. Helsinki Univ. (Finland). *Agricultural science in Finland, Supplement (Finland)*; v. 3 Supplement no. 2 113 p. Agricultural Research Centre of Finland. Bibliography p. 18-20. English. (AGRI 95-016333).

1358 Jeroch, H.; Peter, W. (1994) THE EFFECTIVENESS OF MICROBIAL PHYTASE ADDITION TO LAYER RATIONS ON MAIZE AND WHEAT BASIS. *Bodenkultur*. 45(4):361-368. German. [UNIV HALLE WITTENBERG INST TIERERNAHRUNG & VORRATSHALTUNG EMIL ABDERHALDEN STR 25B D-06108 HALLE GERMANY].

In two feeding trials with laying hens the effectiveness of a microbial phytase addition to maize soybean and wheat soybean rations was tested. Both feed mixtures contained 3.3 g/kg total P and 2.2 g/kg phytate P. Each ration was fed without additions, with phytase addition and with a mineral P supplementation. By phytase or mineral P supplementation to the maize based diet the performance of the hens was kept on a significantly higher level. However, the additions to the wheat based diet did not influence the performance parameters. The hens getting the phytase added ration obtained a better stability of egg shell.

1359 Koreleski, J. (Instytut Zootechniki, Krakow (Poland)) (1993) [Nutritive value of hulled and hullless barley for broiler chickens with dietary enzyme supplementation]. *Wartość jeczmiennia oplewionego i nie oplewionego w żywieniu kurcząt oraz skuteczność dodatku enzymów. Roczniki Naukowe Zootechniki (Poland); Annals of Animal Science* v. 20(1) p. 207-224. 13 ref. Polish. (AGRI 95-016356).

Four experiments on Astra B broiler chickens fed a diet containing 69.14-74.63 percent of ground common (Dema and Roland v.) or hullless (Poa-2 and POA-3 v.) barley were carried out. Enzyme preparations: Novozym 343 and Biofeed-Plus as well as acid preservative, Cytronix as a feed additives were evaluated. The highest protein efficiency index for Poa-2 and that the lowest for Dema in rat growth-tests was stated. No effect of barley varieties on broiler chicken growth performance was observed. Effect of grain non-starch carbohydrate content but not crude fibre level on barley nutritive value was obtained. Beneficial effect of all of tested feed additives on weight gain and feed conversion efficiency in broiler chickens was stated.

1360 Miller, MC.; Froseth, JA.; Wyatt, CL.; Ullrich, SE. (1994) EFFECT OF STARCH TYPE, TOTAL BETA-GLUCANS AND ACID DETERGENT FIBER LEVELS ON THE ENERGY CONTENT OF BARLEY (*HORDEUM VULGARE* L) FOR POULTRY AND SWINE. *Canadian Journal of Animal Science*. 74(4):679-686. English. [WASHINGTON STATE UNIV DEPT ANIM SCI PULLMAN, WA 99164 USA].

Effects of starch type, total beta-glucans and ADF levels on DMD, nitrogen-corrected TME for poultry and DE for swine were evaluated in four experiments utilizing synthetic barley mixtures produced by differential pearling and milling. Forty-seven mature roosters were used in exp. 1 and 45 were used in exp. 3 to determine DMD and TME for poultry and 3 duodenally cannulated pigs were used in exps. 2 and 4 to determine DMD and DE for swine utilizing the MNBT. In exps. 1 and 2, synthetic barley (normal starch) with 11.0% ADF contained lower TME (2733 kcal kg(-1)) and DE (3278 kcal kg(-1)) compared to barley with 3.5% ADF (3371 and 3943 kcal kg(-1), respectively). Increasing total beta-glucans from 3.4 to 6.8% decreased TME from 3248 to 2855 kcal kg(-1) and DE from 3679 to 3542 kcal kg(-1). In exps. 3 and 4, there was an interaction between ADF and starch type. With normal starch, increasing ADF from 2.1 to 12.0% reduced TME from 3301 to 2630 kcal kg(-1) and DE from 4018 to 3247 kcal kg(-1) but with waxy starch, increasing ADF had no effect on either TME (2996 vs. 3086 kcal kg(-1)) or DE (3918 vs. 3712 kcal kg(-1)). These data suggest that the energy content of barley for poultry and swine is decreased greatly by high ADF and less by high total beta-glucans, that beta-glucans have a larger negative effect on energy for poultry than for

swine, but that high ADF has a minimal effect on energy when barley starch is waxy regardless of the level of beta-glucans. The negative effects of high beta-glucans from waxy barley in expts. 3 and 4 were more apparent when the diets were low in ADF. [References: 33].

1361 Penny, R.H.C. (1994) [The inconveniences of the use of wheat flour in the swine feeding]. Inconvenienti derivanti dall'utilizzo della farina di frumento nell'alimentazione suina. *Selezione Veterinaria (Italy)* v. 35(5) p. 489-490. Italian. (AGRI 95-016335).

1362 Pettersson, T.; Martinsson, K.A. (1994) DIGESTIBILITY OF WHOLE OR ROLLED ENSILED BARLEY GRAIN FED TO HEIFERS OR LACTATING COWS. *Swedish Journal of Agricultural Research*. 24(3):109-113. English. [SWEDISH UNIV AGR SCI DEPT AGR RES NO SWEDEN ROBACSDALEN 4097 S-90403 UMEA SWEDEN].

Barley grain was harvested when the moisture content was about 44%. The grain was ensiled with or without rolling. After ensiling the rolled grain was fed without further processing, while the whole grain was fed without further treatment or after rolling. The cows were offered feed at 3.5 times the requirement for maintenance energy. The dry matter (DM) of the ration comprised 39% barley while the remainder was clover-grass silage, hay and protein concentrate. The heifers were fed at 1.5 times maintenance. The ration consisted of 46% barley and 54% clover-grass silage (DM). Total digestibility of energy, organic matter, protein and starch plus sugar was determined by the Acid-Insoluble Ash method. There was no difference in digestibility between rations when the barley was rolled before or after ensiling. With unprocessed barley the digestibility was significantly lower ($p < 0.05$). Rolling the barley increased its digestibility of energy and organic matter equally for both cows and heifers. Whole kernels found in faeces contained more starch and less ash and protein than the barley in the feed. It was concluded that rolling increased the energy value of ensiled barley grain by 26%. [References: 18].

1363 Reddy, D.V. (1994) EFFECT OF SUPPLEMENTATION OF CAGED POULTRY DROPPINGS AND WHEAT BRAN ON RUMEN DEGRADATION KINETICS AND NUTRIENT UTILIZATION IN BUFFALO CALVES FED RICE STRAW. *Indian Journal of Animal Sciences*. 64(12):1388-1389. English. [ANDHRA PRADESH AGR UNIV TIRUPATI 517502 ANDHRA PRADESH INDIA].

1364 Rekib, A.; Shukla, N.P. (1995) EVALUATION OF SESBANIA SESBAN AS A PROTEIN SUPPLEMENT TO LOW-GRADE ROUGHAGE (BARLEY BHUSA) FOR GROWING CALVES. *Indian Journal of Animal Sciences*. 65(1):113-116. English. [INDIAN GRASSLAND & FODDER RES INST JHANSI 284003 UTTAR PRADESH INDIA].

1365 Robinson, P.H.; Mcniven, M.A. (1994) INFLUENCE OF FLAME ROASTING AND FEEDING FREQUENCY OF BARLEY ON PERFORMANCE OF DAIRY COWS. *Journal of Dairy Science*. 77(12):3631-3643. English. [FREDERICTON RES CTR ATLANTIC RUMINANT RES GRP POB 20280 FREDERICTON NB E3B 4Z7 CANADA].

In Experiment 1, 24 multiparous cows in early lactation were fed a basal diet for ad libitum intake consisting of 24.3% (DM) corn silage, 25.9% whole crop barley silage, 33.1% alfalfa silage, and 16.7% of a protein supplement. Raw barley grain, or barley flame roasted to reduce its rate of rumen degradation, was fed twice daily or seven times daily. Of the 24 cows offered roasted barley, 3 refused to consume it even after 2 wk. Thus, results are for the 21 cows that consumed raw and roasted barley. Cows fed raw barley seven times ate more DM, OM, NDF, and CP than cows fed raw barley twice daily and also produced more milk, protein, and lactose. Cows fed roasted barley twice daily ate more NDF than those fed raw barley twice daily and also produced more milk, protein, and lactose. No benefit resulted from increasing the feeding frequency of roasted barley from two to seven times daily. Experiment 2, conducted to investigate the apparent unpalatability of roasted barley, showed that cows fed a TMR containing 40% (DM) of the roasted barley used in Experiment 1 consumed less NDF but tended to produce more lactose. Based on results of both experiments, if raw barley is fed alone, it should be fed multiple times per day to maximize production. However, infrequent feeding of roasted barley is an acceptable alternative, if the cows will consume the roasted barley. When barley can be fed multiple

times per day or in a TMR, benefits of roasting appear to be negligible. [References: 23].

1366 Rothmaier, D.A.; Kirchgessner, M. (1994) INFLUENCE OF WHEAT BRAN AND ALFALFA MEAL ON THE THIAMIN METABOLISM OF SOWS PROVIDED WITH A SUBOPTIMAL THIAMIN SUPPLY. *Journal of Animal Physiology & Animal Nutrition-Zeitschrift für Tierphysiologie Tierernährung und Futtermittelkunde*. 72(2-3):115-122. German. [TECH UNIV MUNICH INST ERNÄHRUNGSPHYSIOL FREISING GERMANY].

Two experiments were designed with 12 adult non gravid sows in each of three groups to determine the influence of increasing supplements of wheat bran (0, 225, 675 g/day) and alfalfa meal (0, 575, 1150 g/day) in a low thiamin compound feed on fecal and urinary thiamin excretion, thiamin balance (=intake minus excretion), availability of native or bacterially synthesized thiamin, and on the extent of bacterial synthesis. The experiments were carried out in two series with sows weighing 180 kg, on average. Fecal thiamin concentration, which was not influenced by the fibre supplements, amounted to 10-11 $\mu\text{g/g}$ dry matter, whereas total excretion increased with each supplementation. More than 95% of the excreted thiamin was excreted via faeces. Fecal thiamin concentration was similar when the same quantities of wheat bran and alfalfa meal were given. The bacterially fermentable substances from wheat bran and alfalfa meal induced a higher bacterial thiamin synthesis than with pectin. The availability of wheat-bran thiamin was better than that of alfalfa-meal thiamin. From the results of the biochemical analyses (thiamin concentration in blood, ThDP-effect) it was calculated that thiamin maintenance requirements of sows can be met by 1.20 mg thiamin/d. [References: 8].

1367 Russo, V.; Bosi, P.; Casini, L.; Seguenza, S. (Bologna Univ. (Italy). Istituto di Allevamenti Zootecnici); Macchioni, P. (Bologna Univ. (Italy). Istituto di Zootecnica) (1993) [Assessment of the necessity of P supplementation in feeding heavy pigs]. Verifica delle necessita' dell'integrazione fosforica nell'alimentazione del suino pesante. [Associazione Scientifica di Produzione Animale. 10. Annual meeting]; Bologna (Italy); 31 May - 3 Jun 1993. *Atti dell'Associazione Scientifica di Produzione Animale (Italy)* v. 10 p. 465-470. 4 tables; 12 ref. Italian. (AGRI 95-006081).

The trial was carried out with the aim of assessing the necessity of P supplementation in the diet of the heavy pig in the finishing phase. 48 LxLW pigs, in three groups, were fed, from 65 to 160 kg LW, with compound feeds with the same composition (maize, soybean meal, barley and wheat bran) but three different levels of P: 0.457 (no supplementation), 0.492 and 0.543 (% as feed). The mineral was added as dicalcium phosphate dihydrate. Daily LW gain, feeding efficiency and lean meat percentage were 679, 696 and 703 g, 4.32, 4.21 and 4.17 and 43.4, 44.6 and 42.7% resp. for the low, medium and high P levels in the compound feeds and were not statistically different. At the same time, the chemical, physical and mechanical characteristics of the third and fourth metatarsal and metacarpal bones, did not vary despite modifying the level of P in the diet. These results suggest that beyond 65 kg LW, the addition of inorganic P to a cereal/soybean diet containing 0.45% P, does not improve the performance of heavy pigs in the finishing phase.

1368 Vanderklis, J.D.; Kwakernaak, C.; Dewit, W. (1995) EFFECTS OF ENDOXYLANASE ADDITION TO WHEAT-BASED DIETS ON PHYSICO-CHEMICAL CHYME CONDITIONS AND MINERAL ABSORPTION IN BROILERS. *Animal Feed Science & Technology*. 51(1-2):15-27. English. [DLO INST ANIM SCI & HLTH SPELDERHOLT 9 POB 15 7360 AA BEEKBERGEN NETHERLANDS].

Four wheat cultivars, differing in in vitro viscosity and water-soluble arabinoxylan content, were added to a basal diet on a 50:50 weight basis. These wheat-based diets were fed to male broilers from 3 weeks of age, with and without the addition of 75 mg endoxylanase (70 000 EXU g(-1) enzyme) per kg feed. The broilers were killed at 4.5 weeks of age, and the jejunal and ileal contents were sampled. The absorption of sodium, potassium, calcium, phosphorus, and magnesium was calculated based on the contents of the last 10 cm of these intestinal segments, using Cr₂O₃ as a reference substance. The pH, osmolality and viscosity were measured in the remaining jejunal and ileal contents. Dietary addition of high viscosity wheats (HVW) resulted in higher intraluminal viscosities than on the low viscosity wheat (LVW) diets. The osmolality of the chyme

supernatant of the birds fed the HVW diets declined less as the chyme moved from the jejunum into the ileum, compared with the LVW diets. This indicates a less efficient absorption of osmo-active soluble chyme components at higher intraluminal viscosities, as complex formation in the intestinal lumen could not account for this effect. Linear regression analysis revealed a clear negative relationship between the viscosity of the chyme supernatant and the absorption of dry matter and minerals in either one or both of the intestinal segments. Addition of endoxylanase lowered the viscosity of the chyme supernatant to similar levels on all wheat-based diets. Furthermore, is enhanced the apparent absorption of calcium, magnesium, sodium and potassium from the jejunal lumen. However, at the lower ileal level only magnesium absorption was improved by dietary endoxylanase addition. [References: 15].

1369 Wyatt, C.L.; Goodman, T. (1993) Utilization of feed enzymes in laying hen rations. *The Journal of applied poultry research (USA)* v. 2(1) p. 68-74. references. English. (AGRIS 95-016358).

1370 Yadav, B.S.; Virk, A.S.; Sagar, V. (1994) ROLE OF DIFFERENT ENERGY SOURCES ON INVITRO NITROGEN FIXATION FROM UREA TREATMENT OF WHEAT STRAW. *Indian Journal of Animal Sciences*. 64(12):1385-1387. English. [CCS HARYANA AGR UNIV MADHUBANI 125004 INDIA].

1371 Zaman, M.S.; Owen, E. (1995) THE EFFECT OF CALCIUM HYDROXIDE AND UREA TREATMENT OF BARLEY STRAW ON CHEMICAL COMPOSITION AND DIGESTIBILITY IN VITRO. *Animal Feed Science & Technology*. 51(1-2):165-171. English. [UNIV PRINCE EDWARD ISL ATLANTIC VET COLL DEPT HLTH MANAGEMENT CHARLOTTETOWN PE C1A 4P3 CANADA].

An experiment was conducted to investigate the effectiveness of calcium hydroxide (Ca(OH)(2)) and urea treatment of straw. Chopped barley straw was treated with mixtures of Ca(OH)(2) (0, 30 and 60 g kg(-1) straw dry matter, DM) and urea (0, 30 and 60 g kg(-1) straw DM) dissolved in 0.81 water kg(-1) straw DM and 'ensiled' in a polythene bag (1.0 kg per bag) at 15 degrees C or 25 degrees C for 60 days. Control treatment at each temperature involved untreated straw and treatment with 30 or 60 g NaOH kg(-1) straw DM dissolved in 0.81 water kg(-1) straw DM. Ensiled straws were examined for mould, chemically analysed and assessed for organic matter digestibility (OMD) in vitro. Mould occurred in Ca(OH)(2)-alone and water-alone ensiled straw, but other ensiled straws were apparently mould free. In the presence of Ca(OH)(2) with urea treatment, the nitrogen content of ensiled straw increased more than urea-alone treatment. Analysis of variance of OMD in vitro results showed that Ca(OH)(2), urea and temperature interact significantly (P<0.01). Interactions were found to be non-significant for other parameters (nitrogen, acid detergent fibre and hemicellulose). However, straw ensiled at 15 degrees C with 30 g urea + 60 g Ca(OH)(2) kg(-1) straw DM, 60 g urea + 60 g Ca(OH)(2) kg(-1) straw DM or 30 g NaOH kg(-1) straw DM had similar OMD in vitro (67%). Untreated straw OMD was 48.5%. It can be concluded that mixtures of Ca(OH)(2) and urea would be the alternative chemicals to NaOH or ammonia for improvement of the nutritive value of straw. [References: 22].

L20 ANIMAL ECOLOGY

1372 Panghal, J.S.; Grewal, R.S.; Chand, M. (Haryana Agricultural University, Hisar (India). Department of Agricultural Economics) (1994) Constraints in the adoption of recommended practices in wheat production under training and visit system. *International Journal of Tropical Agriculture (India)* v. 12(1, 2) p. 77-82. 4 tables; 10 ref. English. (AGRIS 95-006420).

L51 ANIMAL PHYSIOLOGY- NUTRITION

1373 Casado Garcia, P. (1993) [Wheat phosphorus availability in monogastrics: genetic and agronomic variation]. Disponibilité du phosphore du blé chez les monogastriques: variation d'origine génétique et agronomique. [Disponibilidad del fósforo del trigo en monogastricos: variación de origen genético y agronomico]. Centre

International de Hautes Etudes Agronomiques Mediterraneennes, Zaragoza (Spain). Institut Agronomique Mediterranéen. 12 ill. 28 graphs. 24 tables. 223 ref. 120 p. French. (AGRIS 95-006546).

1374 Flachowsky, G. (Jena Univ. (Germany). Biologisch Pharmazeutische Fakultät. Inst. fuer Ernährung und Umwelt) (1994) [Maize starch feedstuffs for cattle feeding]. Einsatz von maisstaerkehaltigen Futtermitteln. *Kraftfutter (Germany)* (no.6) p. 224-232, 238. 7 ill., 12 tables. German. (AGRIS 95-006573).

1375 Hadorn, R. (Eidgenoessisches Technisches Hochschulzentrum, Zuerich (Switzerland). Inst. fuer Nutztierwissenschaften. Gruppe Ernährung); Wenk, C. (1994) [The effect of different sources of dietary fibre on energy and nitrogen utilization in broilers]. Der Beitrag verschiedenartiger Nahrungsfasern auf die Energie- und N-Verwertung bei Broilern. Proceedings of the Society of Nutrition Physiology (Germany); no. 2 p. 41. DLG. 1 table. p. 41. German. (AGRIS 95-006627).

1376 Liebert, F. (Kiel Univ. (Germany). Inst. fuer Tierernaehrung und Stoffwechselphysiologie); Hartmann, R.; Tittmann, G.; Koehler, R.; Wecke, C. (1994) [Comparative investigations about evaluation of feed treatment factors in the nutrition of chickens]. Vergleichende Untersuchungen zur ernahrungsphysiologischen Bewertung von Futterbearbeitungsfaktoren in der Broilerernaehrung. Proceedings of the Society of Nutrition Physiology (Germany); no. 2 p. 39. DLG. 1 table. p. 39. German. (AGRIS 95-006625).

1377 Mannerkorpi, P. (Institute of Animal Production, Jokioinen (Finland). Agricultural Research Centre); Brandt, M. (1993) Feeding value of whole-crop wheat silage for ruminants related to stage of maturity and cutting height. *Archives of Animal Nutrition (Germany)* v. 45(1) p. 89-100. 5 tables; 45 ref. English. (AGRIS 95-006592).

1378 Mathot, P.; Lassoie, S.; Baudart, E.; Thewis, A.; Brakel, J. (Faculte des Sciences Agronomiques de Gembloux (Belgium)) (1993) Solid state fermentation of barley: crude protein and amino acid digestibility for pigs. Seventh Forum for Applied Biotechnology; Gent (Belgium); 30 Sep - 1 Oct 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium)* v. 58(4a) p. 1707-1711. 2 tables; 3 ref. English. (AGRIS 95-016823).

Solid state fermentation of agricultural surpluses or residues is of interest to produce high protein content feed. A simple and non-aseptic solid state fermentation process of barley grain was developed in our laboratory. A cement mixer was adapted as a pilot scale fermentor. Using a selected strain of *Aspergillus niger*, all the amino acid contents increased after 48 hours of fermentation. However, the amino acid balance was modified (increase of lysine, methionine, cystine, threonine, isoleucine, tyrosine, serine, glycine and alanine part). During the pig experiment, the fermented barley was compared with the initial barley in complete-mixed diets. Except proline, all the amino acids of the fermented barley diet showed higher apparent digestibility. Thus the fermented barley contained more true proteins and the main part of them showed upgraded digestibility.

1379 Morgan, A.J.; Bedford, M.R. (1993) Advances in the use of xylanolytic enzymes in the feed industry. Seventh Forum for Applied Biotechnology; Gent (Belgium); 30 Sep - 1 Oct 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium)* v. 58(4a) p. 1699-1703. 3 ill.; 7 ref. English. (AGRIS 95-016828).

There is no substantial evidence that supplementary enzymes for poultry diets based on wheat, rye or triticale function, at least in part, by hydrolysing soluble arabinoxylans thereby reducing digesta viscosity. In +the case of wheat and rye-based diets fed to poultry, it has been shown that as much as 60-70 per cent of the variation in body weight and FCR can be described by intestinal viscosity alone (Bedford and Classen, 1992). Further investigation of the relationship between enzyme dose, broiler performance and intestinal viscosity when fed a wheat/triticale diet has revealed that there is an optimum dose for feed efficiency. One plausible explanation for this is that increasing enzyme levels result in higher levels of monomer D-xylene or L-arabinose, which are known to exert negative effects on performance of young broilers. If this hypothesis is true, the extent of hydrolysis of cereal arabinoxylans relative to viscosity reducing

activity becomes an important criterion in the selection of xylanolytic enzymes for feed use.

1380 Vukic Vranjes, M. (Eidgenossische Technische Hochschule, Zuerich (Switzerland). Inst. fuer Nutztierwissenschaften. Gruppe Ernaehrung); Wenk, C. (1994) [Influence of extruded vs untreated barley on broiler performance in the feed with and without dietary enzyme supplement]. Einfluss der extrudierten vs unbehandelten Gerste im Futter mit und ohne Enzymzusatz auf Mast- und Stoffwechselformparameter von Broilern. Proceedings of the Society of Nutrition Physiology (Germany); no. 2 p. 46. DLG. 1 table. p. 46. German. (AGRIS 95-006630).

P05 ENERGY RESOURCES AND MANAGEMENT

1381 Abiye Astatke (1993) Research on the draught animal power systems in Ethiopia. 4. Workshop of the West Africa Animal Traction Network; Kano (Nigeria); 9-13 Jul 1990. Research for development of animal traction in West Africa. Proceedings of the fourth workshop of the West Africa Animal Traction Network. Lawrence, P.R.; Lawrence, K.; Dijkman, J.T.; Starkey, P.H. (eds.). ILCA, Addis Ababa (Ethiopia) p. 199-204. ILCA. 2 fig., 2 tables; ref. English. (AGRIS 95-018397).

In Ethiopia animal traction has been an integral part of agricultural production for centuries. Pairs of Oxen have been employed to pull an ard plough ('Maresha') for seedbed preparation. Implement development for primary and secondary cultivation was the main focus until the end of the 70s. Some work on transport, earth movement and land shaping started in the mid-80s. But there has been little adoption by farmers of the new implements developed. This might be partly due to researchers not addressing the pertinent issues, to inadequacy of the extension system and to the reluctance of farmers to change traditional practices.

P10 WATER RESOURCES AND MANAGEMENT

1382 Rodriguez, A. (ICARDA, Aleppo (Syria)); Shah, N.A.; Afzal, M.; Mustafa, U.; Ali, I. (Arid Zone Research Inst., Quetta (Pakistan)) (1992) Economics of water-harvesting trials with cereal crops in highland Balochistan. MART/AZR project: high elevation research in Pakistan: research report no. 78. International Center for Agricultural Research in the Dry Areas, Aleppo (Syria); USAID, Washington (USA); Arid Zone Research Institute, Quetta (Pakistan). AZRI. 7 Tables; 2 fig., 1 appendix, 14 ref. 37 p. English. (AGRIS 95-018548).

P33 SOIL CHEMISTRY AND PHYSICS

1383 Fern, M. (1993) Ammonia emissions from two fertilised wheat fields. IVL Rapport. B (Sweden); Institutet foer Vatten- och Luftvaardsforskning; no. 1106 12 p. 6 ref. English. (AGRIS 95-018781).

P34 SOIL BIOLOGY

1384 Altimirska, R.; Karev, K. (Institut po Pochvoznianie i Agroekologiya "N. Pushkarov", Sofia (Bulgaria)) (1994) [Inoculation of wheat with bacteria of Azospirillum under field conditions. I. Effect on the grain yield]. Inokulatsiya na pshenitsa s bakterii ot rod Azospirillum pri polski usloviya I. Vliyanie v'rkhu dobiva na z'rno. Selskostopanska Akademiya, Sofia (Bulgaria). Pochvoznianie, Agrokhimiya i Ekologiya (Bulgaria); Soil Science Agrochemistry and Ecology v. 29(1-2) p. 24-27. 1 ill., 3 tables; 9 ref. Bulgarian. (AGRIS 95-018844).

1385 Krol, M.; Kobus, J. (Instytut Uprawy Nawozenia i Gleboznawstwa, Pulawy (Poland)) (1992) [Oxidation of elemental and organic (cysteine) sulphur by barley rhizosphere microorganisms]. Utenianie siarki elementarnej i organicznej (z cysteiny) przez drobnoustroje ryzosfery jeczmiennia. Pamietnik Pulawski (Poland) (no.101) p. 109-122. 40 ref. Polish. (AGRIS 95-018839).

Microorganisms isolated from barley rhizosphere and rhizoplane were tested. The study included 169 isolates of bacteria 55 strains of

actinomycetes and 156 isolates of fungi. Elemental sulphur was oxidized by 80 percent of bacteria and actinomycetes and by about 90 percent of fungi. The tested fungi were generally more potent oxidizers of S, particularly organic S, than the examined strains of bacteria and actinomycetes. The most active fungi belonged to the following genera: Verticillium, Trichoderma, Peecilomyces and Penicillium.

1386 Remus, R. (Zentrum fuer Agrarlandschafts und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion); Jacob, H.J. (1993) [Determination of bacterial population parameters with help of DAS-ELISA (Double Antibody Sandwich-Enzyme Linked Immunosorbant Assay) in Pantoea agglomerans-cereal crops-interactions]. Bestimmungen bakterieller Populationsgrossen mittels eines DAS-ELISA bei Pantoea agglomerans-Getreide-Interaktionen. Oekophysiologie des Wurzelraumes; Borkheide (Germany); 30 Aug - 1 Sep 1993. (Proceedings of the 4th scientific workshop). Merbach, W. Deutsche Landakademie "Thomas Muentzer", Borkheide (Germany); Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion no. 4, p. 112-117. Selbstverlag. 1 ill.; 9 ref. German. (AGRIS 95-008517).

1387 Schlöter, M. (GSF Forschungszentrum fuer Umwelt und Gesundheit Muenchen, Neuherberg (Germany). Inst. fuer Bodenoekologie); Kirchhof, G.; Heinzmann, U.; Doeberleiner, J.; Hartmann, A. (1993) [Comparison of wheat root settlement by Azospirillum brasilense Sp7 and Sp245 with immunological methods]. Vergleich der Besiedelung von Weizenwurzeln durch Azospirillum brasilense Sp7 und Sp245 mit immunologischen Methoden. Oekophysiologie des Wurzelraumes; Borkheide (Germany); 30 Aug - 1 Sep 1993. (Proceedings of the 4th scientific workshop). Merbach, W. Deutsche Landakademie "Thomas Muentzer", Borkheide (Germany); Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion no. 4, p. 108-111. Selbstverlag. 2 tables; 14 ref. German. (AGRIS 95-008514).

1388 Wulff, K. (Kiel Univ. (Germany). Inst. fuer Pflanzenernaehrung und Bodenkunde); Sattelmacher, B. (1993) [Influence of crop rotation and of field accompanying flora on vesicular arbuscular mycorrhiza of agricultural used crop areas]. Der Einfluss der Fruchtfolge und der Ackerbegleitflora auf die VA-Mykorrhiza in landwirtschaftlich genutzten Kulturflaechen. Oekophysiologie des Wurzelraumes; Borkheide (Germany); 30 Aug - 1 Sep 1993. (Proceedings of the 4th scientific workshop). Merbach, W. Deutsche Landakademie "Thomas Muentzer", Borkheide (Germany); Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion no. 4, p. 84-87. Selbstverlag. 3 ill.; 11 ref. German. (AGRIS 95-008519).

P95 SOIL FERTILITY

1389 Kim, C.B.; Park, N.K.; Lee, S.H.; Park, S.D.; Choi, B.S. (Rural Development Administration, Taegu (Korea Republic). Gyeongpook Provincial Rural Development Administration) (1994) Changes in barley yield and some physico-chemical properties of upland soil by longterm application of silicate fertilizer and compost. Journal of Korean Society of Soil Science and Fertilizer (Korea Republic) v.27(3) p.195-200. 3 illus.; 6 tables; 20 ref. Korean. (AGRIS 95-018897).

1390 Wang Jieyuan; Wang Yingyu; Chen Hongbing (Hebei Agricultural Teachers Coll., Changli (China)) (1993) Soil conditions in main grain fields in Eastern Hebei Province, China. Chinese Journal of Soil Science (China) v. 24(3) p. 121-122. 1 ill., 2 tables, 2 ref. Chinese. (AGRIS 95-008600).

P40 METEOROLOGY AND CLIMATOLOGY

1391 Wang Anzhu (Shaanxi Provincial Inst. of Grain Crops, Yangling (China)) (1993) A preliminary study on wheat field water characters and its productivity under different precipitation in dryland area in Heyang

Q01 FOOD SCIENCE AND TECHNOLOGY

1392 Alvarez, JB.; Martin, LM. (1994) VARIATION FOR BREADMAKING QUALITY CHARACTERS IN SEVERAL CROSSES OF HEXAPLOID TRITORDEUM-NIXTRITORDEUM ASCHERSON ET GRAEBNER) WITH A COMMON PARENT. *Cereal Research Communications*. 22(4):285-291. English. [UNIV CORDOBA ESCUELA TECN SIUPER INGN AGRONOM & MONTES DEPT GENET APDO 3048 E-14080 CORDOBA SPAIN].

The grain, flour and dough quality of several crosses of hexaploid tritordeum, amphiploid derived from the cross *Hordeum chilense* Roem. et Schulz. x *Triticum turgidum* conv. durum Desf. em. M.K., were studied along with their common tritordeum parent. Small-scale tests, commonly used for evaluating quality in cereals, together with the alveograph, were performed. In general, the hexaploid tritordeum exhibited quality characteristics similar to those of bread wheat and very different of durum wheat. Nevertheless, some genetics differences were found between the crosses used in this work. H. chilense seems to be the cause of the most of these differences. Furthermore, because the wide range of variation for some quality characters in the small sample of tritordeums investigated in this study, it seems feasible the attainment of good quality tritordeum, using the broad collection of new synthesized tritordeums and well-established breeding procedures.

1393 Andrews, J.L.; Hay, R.L.; Skerrett, J.H.; Sutton, K.H. (1994) HPLC AND IMMUNOASSAY-BASED GLUTENIN SUBUNIT ANALYSIS - SCREENING FOR DOUGH PROPERTIES IN WHEATS GROWN UNDER DIFFERENT ENVIRONMENTAL CONDITIONS. *Journal of Cereal Science*. 20(3):203-215. English. [GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

The relationship between dough properties, loaf parameters and data from three approaches [HPLC, immunoassay and high M(r) glutenin subunit quality score (determined by SDS-polyacrylamide gel electrophoresis)] were compared in order to assess both their relative values in quality screening, and to determine the relationships between the parameters. Total high M(r) and low M(r) glutenin subunits were quantified by reversed-phase HPLC in two sets of flour samples: (1) 27 wheat cultivars grown at each of three Australian sites in 1989; and (2) 14-15 cultivars grown at one site in 1986 under three levels of nitrogen fertilisation. The sets of samples were also analysed using two antibody assays, the results of which had earlier been shown to provide correlations with dough strength. With each set of samples, antibody binding, the amounts of high M(r) glutenin subunits and high M(r) glutenin subunit quality scores were each correlated to a similar extent with maximum resistance. In contrast, Farinograph dough development time was much more closely related to high M(r) glutenin subunit content and antibody binding than high M(r) glutenin subunit composition. This is probably due to the former two measures taking into account environmental effects as well as genotype. Extensibility tended to be related to the total amount of glutenin subunits and its major components, the low M(r) glutenin subunits. When grouped across sites and nitrogen fertiliser treatments, these trends were less apparent because of the dominant effect of variation in protein content. Statistical incorporation of the effect of variation in flour protein content improved prediction of maximum resistance but not loaf volume. Total gliadin content only maintained correlations with dough development time, which was also consistently correlated with flour protein content. The studies confirm earlier immunoblotting and ELISA data suggesting that the antibody assays selectively quantify high M(r) glutenin subunits. They also indicate differential relationships between particular gluten protein fractions and theological parameters, such as strength and extensibility. [References: 33].

1394 Barnwell, P.; McCarthy, P.K.; Lumley, I.D.; Griffin, M. (1994) THE USE OF REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY TO DETECT COMMON WHEAT (TRITICUM AESTIVUM) ADULTERATION OF DURUM WHEAT (TRITICUM

DURUM) PASTA PRODUCTS DRIED AT LOW AND HIGH TEMPERATURES. *Journal of Cereal Science*. 20(3):245-252. English. [NOTTINGHAM TRENT UNIT DEPT LIFE SCI CLIFTON LANE NOTTINGHAM NG11 8NS ENGLAND].

This investigation describes the development of an analytical method for the detection of common wheat (*Triticum aestivum* L.) adulteration of durum wheat (*Triticum durum* Desf.) pasta dried at low (60 degrees C) and high (92+78 degrees C and 100 degrees C) temperatures. Gliadin proteins were extracted in 70% (v/v) aqueous ethanol containing 1.0% (w/v) dithiothreitol and concentrated in order to maximise protein levels before analysis by reversed-phase high-performance liquid chromatography (RP-PPLC). A mixture of gamma/beta-gliadins were eluted as a single peak between 46-47 min on the common wheat pasta profiles, but were absent over the same time period on elution profiles obtained from durum wheat pasta. Adulteration was detectable at levels as low as 1-2% (w/w) for pasta dried at 60 degrees C and 92+78 degrees C, and 3% (w/w) for 100 degrees C dried pasta. Furthermore, the adulterant gamma/beta-gliadins peak was not affected substantially by common wheat intercultivar polymorphism, and the accuracy of this method was not reduced by the presence of commercially relevant levels of egg in the pasta sample. [References: 16].

1395 Beal, AD.; Mottram, DS. (1994) COMPOUNDS CONTRIBUTING TO THE CHARACTERISTIC AROMA OF MALTED BARLEY. *Journal of Agricultural & Food Chemistry*. 42(12):2880-2884. English. [UNIV READING DEPT FOOD SCI & TECHNOL WHITEKNIGHTS READING RG6 2AP BERKS ENGLAND].

The volatiles from malt, sampled at stages during roasting, were examined by GC odor-port evaluation and by GC-MS. The technique of odor dilution was applied to volatile extracts from samples exhibiting strong malt-like characteristics. Seven odors from the GC column persisted through several dilutions. 3- and 2-methylbutanal were responsible for the odors with the highest dilution factors which had malty characteristics. The other five odors were malty or cereal-like; ethylmethylpyrazines and maltol may contribute to these odors, but other compounds responsible were present at very low concentrations and have not yet been identified. The levels of 2- and 3-methylbutanal increased dramatically in malt during roasting. [References: 25].

1396 Bennett, GA.; Nelsen, TC.; Miller, BM. (1994) ENZYME-LINKED IMMUNOSORBENT ASSAY FOR DETECTION OF ZEARELENONE IN CORN, WHEAT, AND PIG FEED - COLLABORATIVE STUDY. *Journal of AOAC International*. 77(6):1500-1509. English. [USDA ARS NATL CTR AGR UTILIZAT RES 1815 N UNIV ST PEORIA, IL 61604 USA].

A direct competitive enzyme-linked immunosorbent assay (ELISA) screening method for zearalenone in corn, wheat, and feed at 500 ng/g was evaluated by 23 collaborators (22 laboratories) in an international collaborative study. Eighteen samples of spiked or naturally contaminated corn, wheat, and pig feed were prepared by the sponsoring laboratory and sent for testing with complete test kits to participating collaborators in Canada, Italy, Sweden, The Netherlands, and the United States. Test samples were extracted with methanol-water solution (70 + 30) by shaking on a wrist-action shaker for 3 min. A portion of the extract was mixed with an equal volume of zearalenone-enzyme conjugate, and the mixture was incubated with zearalenone-specific monoclonal antibodies coated onto microtiter wells. All test samples were assayed in duplicate. One of 52 (2%) blanks was reported positive. Thirty-nine of the 52 (75%) samples that were spiked at 500 ng/g were reported as positive. Forty-nine of the 51 (96%) samples with concentrations at or above 1000 ng/g were reported as positive. The overall incidence of false negatives was 6.0% and the incidence of false positives was 22.7% by the ELISA method. Only one (3.4%) false negative was reported for samples containing greater than or equal to 800 ng/g. In the spectrophotometric method, 8 collaborators determined approximate levels of zearalenone in test samples from standard curves constructed from spiked extracts (0-3000 ng/g of each commodity tested). This method gave an overall incidence of false negatives of 5.7% and false positives of 17.8%. Average relative standard deviations, RSD(r) (repeatability) and RSD(R) (reproducibility), were 11.6 and 25.1% for spiked samples and 11.7 and 33.1% for naturally contaminated samples, respectively. Standard curves were constructed with each set of samples assayed. Comparison of

absorbance values from these standard curves indicate the performance of reagents and antibody used in the assay. The ELISA method has been adopted first action by AOAC INTERNATIONAL as a screening method for zearalenone at greater than or equal to 800 ng/g in corn, wheat, and pig feed. [References: 19].

1397 Bergman, C.J.; Gualberto, D.G.; Weber, C.W. (1994) DEVELOPMENT OF A HIGH-TEMPERATURE-DRIED SOFT WHEAT PASTA SUPPLEMENTED WITH COWPEA (VIGNA UNGUICULATA (L) WALP) - COOKING QUALITY, COLOR, AND SENSORY EVALUATION. *Cereal Chemistry*. 71(6):523-527. English. [UNIV ARIZONA DEPT NUTR & FOOD SCI TUCSON, AZ USA].

High-temperature (HT) dried soft wheat pasta (SP) supplemented with 10, 20, and 30% cowpea meal (CM) was produced. Pasta with cowpea (CP) contained up to 30% more protein than did the SP. Ash reached a maximum of 1.3% in the 30% CP. After 10 min, the CP treatments' cooking loss decreased with additional CM, and the 30% CP had a cooked weight lower than that of the SP. CM addition improved pasta color scores and integrity during cooking, and breakage decreased during storage. No difference in acceptability was found between samples made with CP and 100% wheat. Results demonstrate that HT drying and CM addition can overcome some of the constraints of using soft wheat flour in pasta production. [References: 37].

1398 Bhatnagar, S.; Hanna, M.A. (1994) AMYLOSE LIPID COMPLEX FORMATION DURING SINGLE-SCREW EXTRUSION OF VARIOUS CORN STARCHES. *Cereal Chemistry*. 71(6):582-587. English. [UNIV NEBRASKA DEPT BIOL SYST ENGN LINCOLN, NE USA].

Commercial corn starches containing 0-70% amylose were extruded with and without various lipids (myristic, stearic, and behenic acids; monoglyceride Dimodan PV; and tristearin) in a single-screw laboratory extruder at 110 degrees C, 110 rpm, 19% moisture, and 4% lipid. X-ray diffractograms, iodine-binding capacity, and iodine spectrum of the soluble fractions of the extrudates were determined. Additions of fatty acids and monoglyceride resulted in V-patterns in X-ray diffractograms and decreased iodine-binding capacity of the extruded starches, indicating formation of complexes between amylose and lipids. Maximum binding was observed for myristic acid and 70% amylose starch. No binding was observed with tristearin. Physico-chemical properties of starches (expansion ratio, water-soluble carbohydrates, and water-solubility index) decreased. Bulk density increased upon addition of complexing lipids before extrusion. These properties reached limiting values as the percentage of complexed amylose increased above 20, 15, and 10% for 25, 50, and 70% amylose starches, respectively. [References: 33].

1399 Bhatnagar, S.; Hanna, M.A. (1994) EXTRUSION PROCESSING CONDITIONS FOR AMYLOSE LIPID COMPLEXING. *Cereal Chemistry*. 71(6):587-593. English. [UNIV NEBRASKA DEPT BIOL SYST ENGN LINCOLN, NE USA].

Normal corn starch containing 25% amylose was extruded with and without stearic acid and at various combinations of barrel temperatures, screw speeds, and moisture contents. The presence and amount of starch-stearic acid complexing was measured using iodine binding capacity, apparent amylose content (iodine spectra of soluble fraction of extrudates in 0.5N KOH), and differential scanning calorimetry. Maximum complexing was observed at 110-140 degrees C barrel temperatures, 140 rpm screw speed, and 19% moisture content. Physical properties of extruded starches were also evaluated. The addition of stearic acid before extrusion decreased expansion ratio and water solubility index and increased bulk density. [References: 23].

1400 Branlard, G.; Dardevet, M. (1994) A NULL GLI-D1 ALLELE WITH A POSITIVE EFFECT ON BREAD WHEAT QUALITY. *Journal of Cereal Science*. 20(3):235-244. English. [INRA AMELIORAT PLANTES STN F-63039 CLERMONT FERRAND FRANCE].

The French wheat cultivar Darius (Da) has very good bread-making quality even though it possesses the high M(r) glutenin subunit combination 2, 7 and 12, which is associated with poor quality, and a null allele at the Gli-D1 locus. Darius was crossed with three cultivars, Corin (Cor), Capitole (Cap) and Courtot (Cou), of poor, medium, and good quality, respectively. The three progenies (Cor x Da, Cap x Da and Da x

Cou) were used to investigate the genetic basis of the good quality of Darius. Gliadin and glutenin compositions were analysed by acid polyacrylamide gel electrophoresis (A-PAGE) and SDS-PAGE, respectively, from half F2 grains, and the quality was evaluated using six technological criteria for the corresponding plants. The high M(r) glutenin subunit alleles of Darius produced a negative effect on quality. The null allele of Darius, characterised by the absence of the Gli-D1 encoded omega-gliadins, was associated significantly with higher dough tenacity P, and strength W (up to 40% in the Cor x Da progeny). Darius had a higher amount of B zone low M(r) glutenin subunits than the three other cultivars. The null allele of Darius reduced the dough extensibility in the two first progenies, and probably increased the ratio of aggregated glutenin to unaggregated gliadins. These results demonstrated that using only one locus breeders can improve particular quality traits. [References: 33].

1401 Carver, B.F. (1994) GENETIC IMPLICATIONS OF KERNEL NIR HARDNESS ON MILLING AND FLOUR QUALITY IN BREAD WHEAT (VOL 65, PG 125, 1994). *Journal of the Science of Food & Agriculture*. 66(4):577. English.

1402 Cubadda, R.; Carcea, M. (1994) EVALUATION OF GLUTEN STRENGTH IN DURUM WHEAT AND SEMOLINA BY RAPID METHODS. *Industria Alimentari*. (Suppl 4):15-20. English. [UNIV MOLISE DEPT FOOD SCI TECHNOL & MICROBIOL CAMPOBASSO ITALY].

1403 Defrancisci, M.P.; Salgado, J.M.; Leitao, R.F.F. (1994) CHEMICAL, NUTRITIONAL AND TECHNOLOGICAL CHARACTERISTICS OF BUCKWHEAT AND NON-PROLAMINE BUCKWHEAT FLOURS IN COMPARISON OF WHEAT FLOUR. *Plant Foods for Human Nutrition*. 46(4):323-329. English. [UNIV SAO PAULO ESCOLA SUPER AGR LUIZ QUEIROZ SECTOR NUTR HUMANA & ALIMENTOS AV PADUA DIAS 11 PIRACICABA SP BRAZIL].

Chemical, nutritional, and technological characteristics of buckwheat and non-prolamine buckwheat flours in comparison to wheat for celiac patients use have been studied. The results suggested the following conclusions: the 56.5% extraction value for flour obtention is considered good; the buckwheat flour presents methionine and cystine as first limiting amino acids followed by threonine as the second limiting amino acid; the buckwheat flour presents higher content of lysine amino acids than the wheat flour; the buckwheat flour is superior to the wheat flour regarding iron, copper, and magnesium minerals; the buckwheat flour does not present haemagglutinin activity and the tannin content is negligible. Rheological assays indicate that the buckwheat flour does not contain gluten.

1404 Degidio, M.G.; Vallega, V. (1994) BREAD BAKING AND DOUGH MIXING QUALITY OF DIPLOID WHEAT TRITICUM-MONOCOCCUM L. *Industria Alimentari*. (Suppl 4):6 ff. English. [IST SPERIMENTALE CEREALICOLTURA VIA CASSIA 176 I-00191 ROME ITALY].

Baking, farinograph and mixograph tests were made to evaluate the quality of eight germplasm accessions of diploid wheat, *Triticum monococcum* L. (einkorn), in comparison with that of four modern cultivars of common and durum wheat. Doughs of *T. monococcum* were weak in regard to mixing requirements but strong with respect to gas retention capacity. Flours of *T. monococcum* produced sticky doughs, difficult to handle and characterized by a low mixing tolerance. Loaf volumes of *T. monococcum* were decidedly high, analogous to those recorded for the polyploid wheat checks. Bread made from einkorn flours presented a relatively fine and uniform texture, intermediate between that of the common wheat and durum wheat controls. Crumb color of *T. monococcum* loaves was distinctly yellowish. In general, the quality level of the eight germplasm accessions of *T. monococcum* was well within the range encountered for doughs and loaves obtained from polyploid wheat species and from other cereals currently utilized to produce leavened foodstuffs.

1405 Ding, K.; Gunasekaran, S. (1994) SHAPE FEATURE EXTRACTION AND CLASSIFICATION OF FOOD MATERIAL USING COMPUTER VISION. *Transactions of the ASAE*. 37(5):1537-1545. English. [UNIV WISCONSIN DEPT AGR ENGN MADISON, WI USA].

Food material shape is often closely related to its quality. Due to the demands of high quality, automated food shape inspection has become an important need for the food industry. Currently, accuracy and speed are two major problems for food shape inspection with computer vision. Therefore, in this study, a fast and accurate computer-vision based feature extraction and classification system was developed. In the feature extraction stage, a statistical model based feature extractor (SMB) and a multi-index active model-based (MAM) feature extractor were developed to improve the accuracy of classifications. In the classification stage, first the back-propagation neural network was applied as a multi-index classifier. Then, to speed up training, some minimum indeterminate zone (MIZ) classifiers were developed. Corn kernels, almonds, and animal-shaped crackers were used to test the above techniques. The results showed that accuracy and speed were greatly improved when the MAM feature extractor was used in conjunction with the MIZ classifier. [References: 23].

1406 Foschino, R.; Galli, A.; Pagani, M.A. (Milan Univ. (Italy). Dipartimento di Scienze e Tecnologie Alimentari e Microbiologiche) (1993) [Lactobacillus fermentum bacteriophages isolated from sour dough [of wheat bread]]. Batteriofagi di Lactobacillus fermentum isolati da impasto acido [di pane di frumento]. *Annali di Microbiologia ed Enzimologia (Italy)* v. 43(pt.2) p. 225-234. 3 tables; 4 graphs; 20 ref. English. (AGRIS 95-008709).

Two different bacteriophages active against strains of Lactobacillus fermentum were isolated, for the first time, from a sour dough of a regional wheat bread. They belong to A1 and B1 Ackermann morphotypes; physiologically they showed a different behaviour (adsorption rate, burst size and host range).

1407 Glenn, GM.; Johnston, RK. (1994) WATER VAPOR DIFFUSIVITY IN VITREOUS AND MEALY WHEAT ENDOSPERM. *Journal of Cereal Science*. 20(3):275-282. English. [USDA ARS WESTERN REG RES CTR 800 BUCHANAN ST ALBANY, CA 94710 USA].

The water vapor diffusivities of vitreous and mealy wheat endosperms were measured using diffusion cells containing wax-sealed cylinders of endosperm. The diffusion cells were incubated in a chamber that was maintained at a constant temperature and relative humidity. A water vapor gradient was created by filling each diffusion cell with desiccant. A steady-state condition was achieved within 24h. The mean diffusivities for the vitreous endosperm samples of cvs Arizona and Len were 2.0×10^{-8} cm²/s. The diffusivities for mealy samples of cvs Logan and Titan were 3.5 and 9.1×10^{-8} cm²/s, respectively. The liquid water diffusivities of whole caryopses were similar for five vitreous and five mealy wheat samples tested. No change was detected in the diffusion mechanism for any of the samples in the temperature range tested. The energy of activation (E) was significantly ($P < 0.05$) higher for endosperm for cv. Len, a vitreous sample, than for cv. Titan, a mealy sample. [References: 20].

1408 Grafelman, DD.; Meagher, MM. (1995) LIQUEFACTION OF STARCH BY A SINGLE-SCREW EXTRUDER AND POST-EXTRUSION STATIC-MIXER REACTOR. *Journal of Food Engineering*. 24(4):529-542. English. [UNIV NEBRASKA DEPT BIOL SYST ENGN LINCOLN, NE 68583 USA].

The production of ethanol has increased rapidly during the past few years, especially since enactment of the 1990 Clean Air Act. Production costs, however, are high, requiring improved conversion technologies. The gelatinization of starch with conventional jet cookers requires a minimum moisture content of 65% by weight. An alternative to jet cookers is extrusion, which requires significantly less moisture to gelatinize starch. Starch gelatinization and liquefaction was achieved using single-screw extrusion and a post-extrusion static-mixer reactor. The effects of moisture content, reactor temperature, reactor length, and enzyme concentration on liquefaction were evaluated using response surface methodology. The use of a static-mixer reactor tube improved mixing of the gelatinized slurry and increased residence times, resulting in increased starch degradation and reduced viscosity. Comparison of costs for extrusion and conventional technology indicates extrusion has potential as a cost-effective alternative. [References: 31].

1409 Hargreaves, J.; Lemeste, M.; Cornec, M.; Popineau, Y. (1994) ELECTRON SPIN RESONANCE STUDIES OF WHEAT PROTEIN FRACTIONS. *Journal of Agricultural & Food Chemistry*. 42(12):2698-2702. English. [INRA BIOCHIM & TECHNOL PROT LAB LA GERAUDIERE BP 527 F-44026 NANTES 03 FRANCE].

Gluten was fractionated according to its extractability in dilute acid, generating fractions that differed in their gliadin/glutenin ratio and polymer composition. The fractions were characterized by SE-HPLC and by densitometry of electrophoregrams. The hydrated fractions were studied by electron spin resonance spectroscopy. Spin-probing was carried out with nitroxide radicals of various sizes, giving knowledge on the mobility and distribution of molecules in the system. The existence of at least two different aqueous environments was established within the system. Specific spin-labeling of the sulfhydryl or amine groups of protein enabled comparative studies of the rigidity of the protein chains. A factor of variation was found to be the quantity and size of prolamine, but this was not the only criterion. [References: 24].

1410 Heddleson, SS.; Hamann, DD.; Lineback, DR.; Slade, L. (1994) PRESSURE-SENSITIVE ADHESIVE PROPERTIES OF WHEAT FLOUR DOUGH AND THE INFLUENCE OF TEMPERATURE, SEPARATION RATE, AND MOISTURE CONTENT. *Cereal Chemistry*. 71(6):564-570. English. [N CAROLINA STATE UNIV DEPT FOOD SCI BOX 7624 RALEIGH, NC 27695 USA].

Using the method of reduced variables, probe tack test data on wheat flour-water doughs was shifted into a series of master curves. This illustrated the equivalent influence of increasing temperature, increasing moisture content, and decreasing separation rate on adhesive behavior. An adhesive-cohesive failure transition occurred at 25-30 degrees C (43% moisture content). This transition occurs 50-70 degrees C above the T-g of a pressure-sensitive adhesive and is associated with a shift in viscoelastic behavior from the rubbery state (entanglement network present) to the flow state (entanglement network disappears due to slippage). Low molecular weight plasticizers (such as water) shift the location of the rubbery-flow state transition to lower temperatures and faster rates. Thus, as the moisture content of the dough increased, the adhesive-cohesive failure transition shifted to lower temperatures and faster separation rates. Processors could prevent cohesive failure, and thus a residue-buildup on equipment, by changing either the formulations or the processing rate-temperature conditions to favor the adhesive side of the failure transition zone. [References: 38].

1411 Helin, J.; Maaheimo, H.; Seppo, A.; Keane, A.; Renkonen, O. (1995) STEPWISE TRANSFER OF ALPHA-D-GALP-(1-3)-BETA-D-GALP-(1-4)-BETA-D-GLCPNAC SEQUENCES TO 3-OH AND 6-OH OF DISTAL GALACTOSE RESIDUES IN BI-, TRI-, AND TETRA-ANTENNARY ASIALO-GLYCANS OF N-LINKED COMPLEX TYPE. *Carbohydrate Research*. 266(2):191-209. English. [UNIV HELSINKI INST BIOTECHNOL POB 45 SF-00014 HELSINKI FINLAND].

The hydroxyl groups 3 and 6 of distal galactose units in bi-, tri-, and tetra-antennary asialo-glycans of N-linked complex type were substituted stepwise by transferase reactions with the sequence (alpha-D-Galp-(1->3)-beta-D-Galp-(1->4)-beta-D-GlcPNAc. The products of each transferase reaction were purified chromatographically and the structures were confirmed by H-1 NMR spectroscopy. Molecular weights of the final products were determined by matrix-assisted laser-desorption mass spectrometry (MALDI-MS). [References: 73].

1412 Hoover, R.; Vasanathan, T. (1994) THE FLOW PROPERTIES OF NATIVE, HEAT-MOISTURE TREATED, AND ANNEALED STARCHES FROM WHEAT, OAT, POTATO AND LENTIL. *Journal of Food Biochemistry*. 18(2):67-82. English. [MEM UNIV NEWFOUNDLAND DEPT BIOCHEM ST JOHNS NF A1B 3X9 CANADA].

The effect of heat-moisture treatment (30% moisture, 100C, 16 h) and annealing (75% moisture, 50C, 72 h) on the flow behavior of gelatinized starch pastes from wheat, oat, lentil and potato starches were studied at a concentration of 6% starch with a cone and plate viscometer (Wells Brookfield RVTDV II CP 200). The power law rheological model ($\sigma = K(\dot{\gamma})^n$) was used to describe the flow behavior of the above starch pastes. All native starches exhibited a non-Newtonian shear thinning behavior. A thixotropic loop was evident only in oat starches and native potato starch. Among native starches, the magnitude of the shear thinning

index (n) followed the order: oat > wheat > lentil > potato, while the corresponding order for the consistency index (K) was: potato > lentil > wheat > oat. Heat-moisture treatment decreased the K value of all starches. On annealing, K decreased in wheat and lentil starches, but increased in potato and oat starches. Heat-moisture treatment and annealing increased the n value of wheat, lentil and potato starches, but decreased that of oat starch. In all starches, the modification to the flow behavior was more marked on heat-moisture treatment than on annealing. [References: 27].

1413 Ida, El.; Finardifilho, F.; Lajolo, FM. (1994) **PURIFICATION AND PARTIAL CHARACTERIZATION OF 2 PROTEINACEOUS ALPHA-AMYLASE INHIBITORS FROM TRITICALE.** *Journal of Food Biochemistry*. 18(2):83-102. English. [UNIV SAO PAULO FAC CIENCIAS FARMACEUT DEPT ALIMENTOS & NUTR EXPTL C POSTAL 66083 BR-05389 SAO PAULO SP BRAZIL].

A total of six alpha-amylase inhibitory proteins (isoinhibitors) were extracted from triticale (*Triticum x Secale*) seeds and two of them were purified to homogeneity. The isoinhibitors were extracted by 70% ethanol and produced, by Sephadex G-100 chromatography, two peaks that exhibited alpha-amylase inhibitory activity. Further purification of the most active peak by DEAE-cellulose chromatography resulted in six active fractions. Two of them designated as TAI-5 and TAI-6, considered to be homogeneous by both acidic and alkaline electrophoresis, were partially characterized. The isoelectric points were 4.80 and 4.70, and the molecular weights 39, 200 and 29, 200, respectively. Under dissociating conditions the molecular weights were 13, 500 and 13, 000, suggesting that the isoinhibitors are composed of three and two subunits, respectively. Both isoinhibitors were stable at different pHs, relatively stable at 98°C, and resistant to proteolysis by trypsin, chymotrypsin and pepsin. The optimum interaction pH for both isoinhibitors with human salivary amylase was 7.9. They exhibited specificity to human salivary and porcine pancreatic alpha-amylases, but had no inhibitory activity on *Bacillus subtilis*, *Aspergillus oryzae* and endogenous triticale alpha-amylases. [References: 41].

1414 Keregero, MM.; Mtebe, K. (1994) **ACCEPTABILITY OF WHEAT SORGHUM COMPOSITE FLOUR PRODUCTS - AN ASSESSMENT.** *Plant Foods for Human Nutrition*. 46(4):305-312. English. [SOKOINE UNIV AGR MOROCORO TANZANIA].

The acceptability of sorghum as human food has been a problem in Tanzania even in regions showing promising potential for its production and utilization. Reasons given for low acceptability of sorghum products as human foods include unpleasant colour, aroma, mouthfeel, taste, unpleasant aftertaste and stomachfeel. An acceptability test of selected sorghum products was, therefore, conducted in the Department of Food Science and Technology, Sokoine University of Agriculture, Morogoro, Tanzania. The objective of the test was to determine consumers' preference for the following wheat-sorghum composite flour products: bread and buns or 'maandazi'. The products were prepared using sorghum flour composited with wheat flour in the following proportions: 100% brown sorghum flour (standard products); and 80:20%; 60:40%; 40:60% and 20:80% for wheat/sorghum (white and brown) composite flours. Results indicated that in the case of composite flour bread, preference for the product improved as the amount of sorghum flour decreased. In the case of buns or 'maandazi' the 100% sorghum flour products of both white and brown were equally preferred. Buns prepared from 100% sorghum flour of white and brown varieties showed promising potential in the improvement of the acceptability of sorghum products. Taking advantage of such products, especially in villages, could enhance sorghum utilization in rural communities.

1415 Kraszewski, AW.; Nelson, SO. (1994) **MICROWAVE RESONATOR FOR SENSING MOISTURE CONTENT AND MASS OF SINGLE WHEAT KERNELS.** *Canadian Agricultural Engineering*. 36(4):231-238. English. [USDA ARS RICHARD B RUSSELL AGR RES CTR ATHENS, GA 30613 USA].

Principles for determining moisture content and mass of individual wheat kernels by microwave resonator measurements are discussed and data are presented showing the application of these principles. By measuring the shift in the resonant frequency and the change in the resonator transmission characteristics when a wheat kernel is inserted

into the resonator, moisture content of the kernel may be determined independent of its mass and apparently independent of wheat variety. The same measurement can simultaneously determine the kernel mass. Moisture contents in the range from 10 to 21%, wet basis, were determined with an uncertainty of 0.8% moisture. Uncertainty in the mass determination was less than 1 mg. [References: 11].

1416 Liao, K.; Paulsen, MR.; Reid, JF. (1994) **REAL-TIME DETECTION OF COLOUR AND SURFACE DEFECTS OF MAIZE KERNELS USING MACHINE VISION.** *Journal of Agricultural Engineering Research*. 59(4):263-271. English. [UNIV ILLINOIS DEPT AGR ENGN 360B AGR ENGN SCI BLDG 1304 W PENN AVE URBANA, IL 61801 USA].

1417 Lorenz, K. (1995) **PHYSICO-CHEMICAL CHARACTERISTICS AND FUNCTIONAL PROPERTIES OF STARCH FROM A HIGH BETA-GLUCAN WAXY BARLEY.** *Starch-Stärke*. 47(1):14-18. English. [COLORADO STATE UNIV DEPT FOOD SCI & HUMAN NUTR FT COLLINS, CO 80523 USA].

The physicochemical properties and functional characteristics of starch from a high beta-glucan waxy barley were compared with those of starches isolated from normal and high amylose barleys. Amylose content of the starches ranged from 1.9 to 34.8%. There was no relationship between amylose content and water binding capacity and gelatinization temperature of the starches. Amylose content and swelling power as well as enzyme susceptibility were negatively correlated. Waxy barley starches had a lower solubility than amylose-containing starches. High amylose barley starch registered no swelling in the Amylograph. Amylose content in starch proved to be very important for good bread- and cake baking quality. Waxy starches did not produce acceptable breads and cakes. The starch from the high beta-glucan barley variety "Shonkin" will be suitable as a thickening agent, but not as an ingredient in bakery products. [References: 30].

1418 Macgregor, AW.; Macri, LJ.; Schroeder, SW.; Bazin, SL. (1994) **LIMIT DEXTRINASE FROM MALTED BARLEY - EXTRACTION, PURIFICATION, AND CHARACTERIZATION.** *Cereal Chemistry*. 71(6):610-617. English.

Limit dextrinase was prepared from malted barley with a high degree of purity and a yield of 17% of the total limit dextrinase. Enzyme activity was not affected by dithiothreitol, indicating that limit dextrinase is not a sulphydryl enzyme. However, enzyme levels were enhanced significantly in the presence of proteins such as bovine serum albumen (BSA); the pH optimum of the enzyme was also affected by BSA. The enzyme was inhibited strongly by low levels (100 µg/ml) of beta-cyclodextrin. Low levels of enzyme activity were present in barley, but enzyme levels increased rapidly during germination in a manner similar to that of α-amylase. A significant proportion of malt limit dextrinase was present in malt extracts in a soluble but inactive form. Conditions were established for the complete extraction of active limit dextrinase from malt and from barley germinated for varying periods of time (one to eight days). [References: 41].

1419 Martinezanaya, MA. (1994) **REVIEW - FACTORS INFLUENCING THE QUALITY OF WHEAT SOURDOUGH PROCESSES, AND THE USE OF CHEMOMETRICS IN QUALITY ASSESSMENT [Review].** *Revista Espanola de Ciencia y Tecnologia de Alimentos*. 34(5):469-493. English. [CSIC INST AGROQUIM & TECNOL ALIMENTOS JAIME ROIG 11 E-46010 VALENCIA SPAIN].

Sour doughs are essential in controlling the quality of rye and rye-wheat breads. In wheat bread production, sour doughs enhance bread flavour, crumb grain and structure, and extend bread shelf-life. Sourdough processes are governed by numerous external and internal factors. Flour extraction rate and differences in flour quality are of primary importance when wheat flours are considered. Interactions between internal and external conditions affect in a complex way biochemical characteristics of sour doughs. In addition to flour, other process conditions such as sourdough process (single, multistage), starter (seed dough, spontaneous dough or microbial starter) and dose of addition determine the quality of resulting doughs and breads. Many fermentative, biochemical, and rheological properties of doughs, as well as physicochemical, sensory characteristics and shelf life of breads, may be affected. Quality sour dough criteria have been established for rye breads.

but they cannot be extrapolated to wheat breads. Actual trends are concerned with two, in some way, opposite directions: improving bread flavor maintaining low levels of sour dough, and extending shelf life by enhancing acetic acid contents of breads. Data generated may difficult the analysis of results, explaining differences in performance and drawing conclusions. Chemometrics, including qualitative and quantitative multivariate statistical techniques have proved to be useful in studying wheat sourdough processes for assigning quality indexes on the basis of objective measures, correlations among process conditions, analytical variables and consumer preferences, and indicating the variables necessary for quality assessment.

1420 Mascaro, AF.; Collar, C. (1994) **PROTEIN ELECTROPHORETIC PATTERN AND BREADMAKING PERFORMANCE OF WHEAT BREAD DOUGHS AND BREAD STARTED WITH PURE AND ASSOCIATED CULTURES OF YEAST AND LACTIC ACID BACTERIA.** *Revista Espanola de Ciencia y Tecnologia de Alimentos.* 34(5):507-526. English. [CSIC INST AGROQUIM & TECNOL ALIMENTOS CEREALES LAB JAIME ROIG 11 E-46010 VALENCIA SPAIN].

Biochemical changes during fermentation and thermal degradation during baking in salt-soluble (SSP) and dioxane-soluble (DSP) polypeptide and protein subunits were correlated with functional dough properties and bread characteristics of straight wheat flour samples started with pure yeast (*Saccharomyces cerevisiae*) and associated populations of yeast and lactic acid bacteria (*Lactobacillus brevis*, *L. plantarum*, *Enterococcus faecium*). Within functional properties, dough extensibility highly correlated ($R(2) = 0.896$) with changes during fermentation of a wide range of different size subunits in SSP and DSP extracts (17000, 24000, 35000, 58000, 67000 D), maximum resistance to the extension closely related ($R(2) = 0.932$) With dynamics in low molecular weight subunits (6000, 8000, 20000, 35000 and 40000 D), and dough level showed high dependence ($R(2) = 0.930$) On changes in 6000, 20000, 21000 and 65000 D subunits. Bread texture ($R(2) = 0.927$) was negatively affected by thermal degradation during baking undergone by 20000 and 21000 D subunits (SSP); whereas, changes in 6000 and 58000 D (SSP) correlated with crumb softness. Improving effects in crumb eatability were dependent ($R(2) = 0.906$) on changes during baking of small size (21000, 25000 D) and high size (90000, 95000 D) DSP-subunits. Overall acceptance of breads ($R(2) = 0.958$) positively related with the depletion during baking in 17000, 20000, 37000 and 43500 D (SSP, DSP) subunits, and negatively correlated with degradation of 37000 (SSP) and 65000 D (DSP) subunits.

1421 McGuire, CF.; Opalka, J. (1995) **SENSORY EVALUATION OF A HARD WHITE COMPARED TO A HARD RED WINTER WHEAT.** *Journal of the Science of Food & Agriculture.* 67(1):129-133. English. [MONTANA STATE UNIV DEPT PLANT & SOIL SCI BOZEMAN, MT 59717 USA].

Traditionally bread wheats grown in the USA have been hard red genotypes. Introduction of hard white genotypes provides an opportunity for the comparison of the products and evaluation of consumer acceptance. MT 7811, a hard white wheat, and 'Norwin', a hard red winter wheat, were grown in adjacent plots in each of two years. Grain from each was divided, with half milled into whole wheat flour (wholemeal) and the other half milled into white flour (milled flour). Breads made from wholemeal and milled flour from each wheat genotype were tested by panelists for differences. Color differences were easily detected. The Wilcoxon-Mann Whitney rank sums test was used to evaluate signal detection data. Both crust and crumb differences between the two wheats could be detected by some panelists. Differences could be detected between the two wheat types in either wholemeal or milled flour bread. Crust differences were often greater than crumb differences. Trained panelists commented on some bitterness in red wheat products and a sweetness in white wheat products. [References: 8].

1422 Politz, ML.; Timp, JD.; Wasserman, BP. (1994) **QUANTITATIVE MEASUREMENT OF EXTRUSION-INDUCED STARCH FRAGMENTATION PRODUCTS IN MAIZE FLOUR USING NONAQUEOUS AUTOMATED GEL-PERMEATION CHROMATOGRAPHY.** *Cereal Chemistry.* 71(6):532-536. English. [RUTGERS STATE UNIV COOK COLL DEPT FOOD SCI NEW JERSEY AGR EXPT STN NEW BRUNSWICK, NJ 08903 USA].

Automated gel-permeation chromatography (GPC), with application of the universal calibration concept, was used to investigate the mechanism of extrusion-induced starch fragmentation in corn. High-amylose and high-amylopectin corn flours were subjected to twin-screw extrusion. The effects of moisture content, die temperature, screw speed, mass flow rate, and amylose-amylopectin ratio were investigated. Nonaqueous GPC, using a refractive index monitor and viscometer, yielded quantitative size profiles of native and extruded starches, as well as information describing branching patterns of the starch. Fragmentation was most pronounced in amylo-pectins with a molecular weight of 10(7)-10(9), which yielded fragments of 10(4)-10(7). Consistent with gravity-flow GPC with dimethyl sulfoxide, separation indicated that fragmentation was promoted at low temperatures. However, a correlation between degree of fragmentation and specific mechanical energy was not observed. Formulations containing high amylopectin levels were most prone to fragmentation. Die temperature significantly affected such textural properties as cohesiveness, springiness, gumminess, and chewiness of the extruded flours. [References: 22].

1423 Rattan, O.; Lzydorczyk, MS.; Biliaderis, CG. (1994) **STRUCTURE AND RHEOLOGICAL BEHAVIOUR OF ARABINOXYLANS FROM CANADIAN BREAD WHEAT FLOURS.** *Food Science & Technology-Lebensmittel-Wissenschaft & Technologie.* 27(6):550-555. English. [ARISTOTLE UNIV SCI AGR DEPT FOOD SCI & TECHNOL GR-54006 THESSALONIKI GREECE].

Water-soluble arabinoxylans from 10 flours of eight different varieties of the Canada western red spring (CWRS) wheat class (Neepawa, Katepwa, Roblin, Columbus, Benito, Laura, Lancer, and Selkirk) were isolated and purified. Chemical analyses indicated only a small variation in the degree of branching among arabinoxylans; arabinose to xylose ratios ranged from 0.62 to 0.68. In contrast, substantial differences were found in the content of ferulic acid (0.93 to 1.52 mg/g), molecular size distribution, and in molecular weight (134, 700-201, 600) of the 10 arabinoxylan preparations. Oxidative gelation studies (using H₂O₂ peroxidase) revealed significant differences in the capacity of these polymers to form gels via intermolecular cross-linking. The values of elastic modulus, G', of arabinoxylan gels (10 g/L) varied from 5.8 Pa to 43.0 Pa. The high molecular weight arabinoxylans formed more rigid gels at low polymer concentration than did their low molecular weight counterparts. In addition to molecular weight, the ferulic acid content was an important determinant of gel network rigidity. [References: 26].

1424 Rogers, DE.; Gelroth, JA.; Langemeier, JM.; Ranhotra, GS. (1994) **EVALUATION OF STARCH DAMAGE VALUES DETERMINED ENZYMATICALLY OR AMPEROMETRICALLY.** *Cereal Chemistry.* 71(6):578-581. English. [AMER INST BAKING MANHATTAN, KS USA].

Damaged starch values were determined in six commercially produced flours (three each from hard winter and soft wheats) using two enzymatic methods and a modified rapid iodometric method. All flours were intentionally damaged with a ball mill for varying lengths of time, or with additional passes through reduction rolls. For the hard and soft wheat flours, respectively, the damaged starch values averaged 11.7 and 7.4% by the reducing sugar determination (AACC method 76-30A); 7.2 and 4.7% by the spectrophotometric method (AACC method 76-31); and 9.6 and 7.4% by the Chopin Rapid Flour Test method. High degrees of correlation were observed between the Chopin electric current (E(c)) and the reducing sugars determination ($r = 0.94$) or the spectrophotometric method ($r = 0.95$). Those correlations improved slightly when hard and soft wheat flours were analyzed separately, or when the data were analyzed with quadratic equations. Eliminating the ball-milled samples from consideration also improved most of the correlations between E(c) and the enzymatic methods. Therefore, the Chopin electric current value can be used as an appropriate indicator of flour starch damage. [References: 26].

1425 Ryu, GH.; Walker, CE. (1995) **THE EFFECTS OF EXTRUSION CONDITIONS ON THE PHYSICAL PROPERTIES OF WHEAT FLOUR EXTRUDATES.** *Starch-Starke.* 47(1):33-36. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT GRAIN SCI & IND SHELLENBERGER HALL MANHATTAN, KS 66506 USA].

The effects of extrusion conditions (feed moisture content and rate, process temperature, screw speed and geometry, and die diameter) on

expansion ratio, bulk density, and breaking strength of wheat flour extrudates were investigated. Extrudate samples were prepared by using a Brabender single-screw extruder. Higher feed moisture content and process temperature were required for proper expansion. At 3.18mm die opening, the relationship between expansion and bulk density was positive. Feed rate was the most effective factor for increasing bulk density. Breaking strength was significantly decreased with increasing process temperature. Under extrusion conditions of 22% feed moisture, 110g/min feed rate, 160 degrees C process temperature, and 130rpm screw speed with 5:1 CR, wheat flour was puffed with low bulk density and breaking strength. [References: 22].

1426 Scarpa, J. (1993) Grains: amaranth, t'ef, spelt, kamut, quinoa, and triticale are moving onto New-Wave menus. *Restaurant business (USA)* v. 92(14) p. 162. English. (AGRI 95-008700).

1427 Schipper, A. (1994) RHEOLOGICAL PROPERTIES AND BAKING QUALITY OF WINTER WHEAT IN DEPENDENCE ON THE STAGE OF GRAIN MATURITY. *Zeitschrift für Lebensmittel-Untersuchung und -Forschung*. 199(6):437-441. German. [UNIV GIESSEN INST PFLANZENBAU & PFLANZENZUCHTUNG 1 LUDWIGSTR 23 D-35390 GIESSEN GERMANY].

Grains of several wheat varieties in different stages of maturity were investigated for rheological properties and baking quality. Crude protein content was found to be very high at the beginning and in the middle of milk ripeness of the grain; later crude protein decreases strongly. Sedimentation values and relative sedimentation values (sed.-val.: protein content of the grain) are higher in the earlier stages of grain development, too. Mineral content of the grain decreases, flour yield (type 550) increases with processing grain development and increasing thousand kernel weights. - The dough properties (farinograph and extensigraph) of the flours of the unripe and the full ripe grains mostly differed markedly; type and extent of this changes are in dependence on the genotype. For instance genotype "Monopol" with a genetical caused excellent baking quality has the best rheological properties in the flour of the full ripe grain. On the other hand the genotypes in the flour of the full ripe grain. On the other hand the genotypes "Benno" and "Clement" with genetical caused adhesive doughs and poorer baking quality develop their very negative rheological properties primarily in the later stages of ripeness. - Baking tests with four other cultivars demonstrate genotypical differences in sensory determined dough properties and in bread quality in dependence on stage of grain maturity. These four genotypes show comparable baking results for flours from grains in the wax-ripe stage and in the full ripeness. [References: 8].

1428 Seguchi, M.; Higasa, T.; Mori, T. (1994) STUDY OF WHEAT STARCH STRUCTURES BY SONICATION TREATMENT. *Cereal Chemistry*. 71(6):636-639. English. [KOBE WOMENS UNIV FAC DOMEST SCI KOBE HYOGO 614 JAPAN].

1429 Shi, YC.; Seib, PA.; Bernardin, JE. (1994) EFFECTS OF TEMPERATURE DURING GRAIN-FILLING ON STARCHES FROM 6 WHEAT CULTIVARS (VOL 71, PG 369, 1994). *Cereal Chemistry*. 71(6):640. English.

1430 Shibamura, K.; Takeda, Y.; Hizukuri, S.; Shibata, S. (1994) MOLECULAR STRUCTURES OF SOME WHEAT STARCHES. *Carbohydrate Polymers*. 25(2):111-116. English. [KAGOSHIMA UNIV FAC AGR DEPT BIOCHEM SCI & TECHNOL 1-21-24 KORIMOTO KAGOSHIMA 890 JAPAN].

Molecular structures of amyloses and amylopectins from three varieties of Japanese wheat, Chihoku, Horoshiri, and Norin-61, and two wheat classes, Australian standard white (ASW) and Western white (WW), were characterized. WW amylose was the largest (number-average degree of polymerization (SSS) over bar nc 1570) and Chihoku amylose was the smallest (dp(n) 830). ASW and Chihoku amyloses had higher amounts of branched molecules (similar to 42% by mole) with lower average numbers of chains (SSS over bar nc similar to 13), than those of others (similar to 28% by mole, (SSS) over bar nc similar to 19). The structural features of amylopectins by iodine affinity and chain-length distribution were also characterized by varieties and classes. The amylose contents of the starches were in the range of 21.7-27.4% for ASW

and WW, respectively. A lower amylose content and a higher amount of the branched amylose molecule with a lower (SSS) over bar nc may produce better quality Japanese-type noodle. [References: 41].

1431 Souza, E.; Kruk, M.; Sunderman, DW. (1994) ASSOCIATION OF SUGAR-SNAP COOKIE QUALITY WITH HIGH MOLECULAR WEIGHT GLUTENIN ALLELES IN SOFT WHITE SPRING WHEATS. *Cereal Chemistry*. 71(6):601-605. English. [UNIV IDAHO ABERDEEN RES & EXTENS CTR DEPT PLANT SOIL & ENTOMOL SCI MOSCOW, ID 83843 USA].

High molecular weight glutenins (HMW-Glu) affect the quality of leaven breads produced from wheat (*Triticum aestivum* L.) flour. However, effects of these proteins on pastry quality are poorly understood. Sugar-snap cookie quality was compared to HMW-Glu alleles of soft white spring wheat breeding lines and cultivars from multiple trials over four years at Aberdeen, ID. Sugar-snap cookie quality was affected less by the composition of the flour protein than by the quantity of flour protein. Individual alleles did not have significant effects on cookie diameter, except for the 13+19 allele of the Glu-1B locus, which was associated with smaller cookie diameters. The glutenin strength of alleles at the three HMW-Glu loci was estimated using a glutenin rank sum (GRS) derived from previously published research. The glutenin strength (GRS score) of cultivars and breeding lines was negatively correlated to cookie diameter ($b = 0.02 \text{ cm unit}^{-1}$; $P < 0.05$). The negative correlation between GRS score and cookie diameter was greatest in the year with the lowest average flour protein content and least in the year with the highest average protein content. The effect of allelic variation was probably masked in the years with high average protein content due to the overriding effects of total protein content. Selection for cultivars with low GRS scores may produce cultivars with better and more predictable sugar-snap cookie quality. [References: 15].

1432 Sreeramulu, G.; Singh, NK. (1994) HIGH M(R) GLUTENIN SUBUNITS OF INDIAN WHEAT CULTIVARS - ASSOCIATION OF SUBUNITS 5+10 WITH THE 1BL 1RS WHEAT-RYE TRANSLOCATION. *Journal of Cereal Science*. 20(3):217-225. English. [CENT FOOD TECHNOL RES INST MOLEC BIOL UNIT MYSORE 570013 KARNATAKA INDIA].

The seed proteins of 16 commercially-released Indian wheat cultivars were fractionated using sodium dodecyl sulphate polyacrylamide gel electrophoresis (SDS-PAGE) to determine their high M(r) glutenin subunit compositions. Amongst the cultivars, three alleles were identified for the Glu-A1 locus (subunits 1, 2* and the null phenotype), eight alleles for the Glu-B1 locus (7, 7+8, 7+9, 6+8, 20, 13+16, 17+18 and a new allele) and two for the Glu-D1 locus (2+12 and 5+10). Nine of the cultivars were heterogeneous and possessed two or more 'biotypes' with respect to high M(r) subunits. The cultivars were also analysed for the presence of the 1BL/1RS wheat-rye translocation by SDS-PAGE of unreduced prolamins and hybridisation of DNA dot blots with a rye-telomere specific repetitive DNA probe, pAW-161. Both methods revealed that the majority of newly-released Indian wheat cultivars carry this translocation, thus confirming the agronomic superiority of these lines. While most of the normal wheat cultivars possessed high M(r) subunits 2+12, 14 of the 18 translocation cultivars had the allelic subunits 5+10, even though no selection was made for these subunits during the breeding process. This suggests that the subunits 5+10 may play a compensating role for the loss of dough strength associated with the 1BL/1RS translocation. [References: 30].

1433 Strecker, TD.; Cavalieri, RP.; Pomeranz, Y. (1994) WHEAT GLUTEN AND GLUTENIN THERMAL CONDUCTIVITY AND DIFFUSIVITY AT EXTRUDER TEMPERATURES. *Journal of Food Science*. 59(6):1244 ff. English. [KELLOGG CO BATTLE CREEK, MI 49016 USA].

Thermal properties (thermal conductivity and diffusivity) of gluten and glutenin were measured in the temperature range 60-175 degrees C typically used in extrusion processing. Thermal conductivity and diffusivity of gluten decreased with increasing temperature and increased with increasing moisture content. Thermal conductivity and diffusivity of glutenin increased with temperature and moisture content. Thermal conductivity of gluten was 0.06-0.35 W/m.C and glutenin was 0.29-0.49 W/m.C for the temperature range 60-175 degrees C and moisture content range of 0-30%. [References: 14].

1434 Suhasini, AW.; Malleshi, NG. (1994) STUDIES ON PREPARATION, POPPING AND FUNCTIONAL PROPERTIES OF BULGUR WHEAT. *Nahrung*. 38(6):568-577. English. [CENT FOOD TECHNOL RES INST DEPT GRAIN SCI & TECHNOL MYSORE 570013 KARNATAKA INDIA].

Wheat was steeped to 36% moisture and agitated for 2 min in sand heated to 170 degrees C. This dry heat bulgur was comparable to bulgur prepared by steam treatment. The dry heat bulgur of 14% moisture content was popped in hot (230 degrees C) sand medium. The expansion ratio of popped bulgur was 2.1. Some of the functional properties of popped bulgur flour were compared with native, 48 h malted and roller dried wheat flours. Water absorption index was highest for roller dried followed by popped and malted wheat, whereas water solubility index was highest for malted followed by roller dried and popped wheat. Roller dried wheat exhibited higher cold paste viscosity (360 BU) than popped (30 BU) wheat. Popped wheat had a peak viscosity of 300 BU. The viscogram of malted wheat was typical of cereal flours when the enzyme activity of malt was inhibited. The gel permeation chromatograms of popped and roller dried wheat indicated thermal degradation of starch during popping and roller drying. The in vitro carbohydrate digestibility of popped wheat was higher than roller dried and malted samples. The scanning electron microscopic examination of native and popped bulgur revealed that the endosperm of bulgur wheat was a homogenous mass containing gelatinized starch whereas that of popped bulgur was made up of thin layers of popped starch with irregular air spaces. [References: 24].

1435 Sutherawattananonda, M.; Bhattacharya, M.; Moore, W.; Fulcher, RG. (1994) DIFFERENCES IN PHYSICAL PROPERTIES AND MICROSTRUCTURE OF WHEAT CULTIVARS IN EXTRUSION QUALITIES. *Cereal Chemistry*. 71(6):627-631. English. [UNIV MINNESOTA DEPT FOOD SCI & NUTR 1334 ECKLES AVE ST PAUL, MN 55108 USA].

Three cultivars of hard red spring wheat, grown in Glyndon, MN, and Casselton, ND, were extruded at 17, 21, and 25% moisture content with barrel temperatures of 120, 150, and 180 degrees C and a screw speed of 350 rpm to produce expanded extrudates. Pasta-like products of the same cultivars were obtained by extruding the flour at 28, 32, and 36% moisture content with barrel temperatures of 100, 110, and 120 degrees C and a screw speed of 140 rpm. The expanded extrudates from both locations showed significant differences ($\alpha = 0.05$) in expansion ratio, bulk density, protein particles, and air cell size. Unexpanded extrudates were significantly different among wheat cultivars and growing locations. [References: 22].

1436 Suvarnalatha, G.; Narayan, MS.; Ravishankar, GA.; Venkataraman, LV. (1994) FLAVOUR PRODUCTION IN PLANT CELL CULTURES OF BASMATI RICE (ORYZA SATIVA L.). *Journal of the Science of Food & Agriculture*. 66(4):439-442. English. [CENT FOOD TECHNOL RES INST DEPT PLANT CELL BIOTECHNOL MYSORE 570013 KARNATAKA INDIA].

Callus cultures of naturally flavoured rice (*Oryza sativa* var 370) called basmati were obtained on Murashige and Skoog medium with 2, 4-dichlorophenoxyacetic acid and kinetin. There was a perceptible basmati flavour in fresh callus. The volatile flavour components of basmati rice and callus were obtained by steam distillation-solvent extraction and were analysed on GC-MS. A qualitative comparison of volatile flavour components of callus cultures and natural basmati rice was also made. The results show the presence of 29 major compounds in rice and 23 in callus. The identified compounds include hydrocarbons, ketones, aldehydes, alcohols and esters. This demonstrated the potential of callus of basmati rice for flavour development. [References: 22].

1437 Wang, SM.; Watts, BM.; Betker, SE.; Lukow, OM.; Bushuk, W. (1994) A SENSORY METHOD OF DOUGH STICKINESS MEASUREMENT. *Cereal Foods World*. 39(11):831-834. English. [UNIV MANITOBA DEPT FOODS & NUTR WINNIPEG MB R3T 2N2 CANADA].

A quantitative sensory method for dough stickiness assessment was developed and tested. Dough handling and mixing characteristics were rated on continuous line scales, and measurements were added to give a total score for stickiness. Scoring of unknown samples by an experienced evaluator gave highly reproducible results. Scores of trained but inexperienced assessors correlated well with those of the experienced

evaluator ($r = 0.94$). Scores based on use of anchored continuous line scales represent valid measurements that can be analyzed statistically. Preparation of flour/water doughs for stickiness testing was standardized on the basis of farinograph water absorption (FAB) and mixograph development time (MDT). Best conditions for distinguishing control wheats from 1BL/1RS lines and distinguishing 1BL/1RS lines, which were sticky at their optimum development time, from those that became sticky only when overmixed were water at FAB minus 3% and a mixing time of 1.2 MDT. [References: 20].

1438 Weegels, PL.; Marseille, JP.; Bosveld, P.; Hamer, RJ. (1994) LARGE-SCALE SEPARATION OF GLIADINS AND THEIR BREAD-MAKING QUALITY. *Journal of Cereal Science*. 20(3):253-264. English. [POB 392 6500 AJ NIJMEGEN NETHERLANDS].

A separation procedure was developed using S-Sepharose cation exchange chromatography under mildly acidic conditions to establish the effect of 70% (v/v) ethanol extractable proteins on breadmaking quality. The separation of a 70% (v/v) ethanol extract of gluten was scaled up successfully from 3 mg to 60 g protein. The use of denaturing and dissociating agents, such as urea or guanidine-HCl, was unnecessary. The pilot-scale fractionation yielded five fractions that were bound to, and eluted from, the column. The fractions differed in gliadin composition as evidenced by lactate-PAGE, SDS-PAGE and RP-HPLC. The fractions were virtually free of lipid. Isolated fractions were evaluated for their effects on bread-making quality using a pan loaf baking test. The unbound fraction (D) contained lipids, mainly mono- and digalactosyldiacylglycerols, and it increased (cv. Obelisk flour) or decreased (cv. Camp Remy flour) loaf volume at additions of up to 0.5% on flour weight. At higher levels of addition it had a strong negative effect on loaf volume. The unfractionated extract (containing some fraction D) or the recombined fractions improved loaf volume. All individual fractions improved loaf volume, but to different extents. For four out of five fractions the improvement corresponded to the statistical prediction of loaf volume by RP-HPLC gliadin peak areas. [References: 43].

002 FOOD PROCESSING AND PRESERVATION

1439 Abd El Hady, E. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); El Samahy, S.K.; Seibel, W.; Bruemmer, J. M. (1994) [Deep freezing of wheat bread doughs]. *Tiefkuehlung von Weizenbrotteig ohne Vorgaerung. Getreide Mehl und Brot (Germany)* v. 48(4) p. 30-35. 4 ill., 5 graphs, 3 tables; 13 ref. German. (AGRI 95-008917).

1440 Beer, G.; Balk, G.; Krottenthaler, M.; Narziss, L.; Ketterer, M.; Brand, O. (1994) [Malting and brewing trials with the winter barley cultivar Astrid]. *Maelzungs- und Brauversuche mit der Wintergerstensorte Astrid. Brauwelt (Germany)* v. 134(28) p. 1360, 1361-1368. 8 ill., 10 tables. German. (AGRI 95-019109).

1441 Giovanelli, G.; Polo, R. (Milan Univ. (Italy). Dipartimento di Scienze e Tecnologie Alimentari e Microbiologiche) (1994) [Formation of fermentation products and reduction in phytic acid in wheat and rye flour breadmaking]. *Formazione di prodotti di fermentazione e riduzione dell'acido fitico nella panificazione di farina di frumento e di segale. Italian Journal of Food Science (Italy)* v. 6(1) p. 71-83. 5 tables; 1 graph; 25 ref. English. (AGRI 95-019117).

Straight dough and sour dough breads were produced using white wheat and rye flour. Fermenting microorganisms were *Saccharomyces cerevisiae*, *Lactobacillus brevis* or *Lactobacillus plantarum*. Fermentable sugar changes, as well as production of organic acids, ethanol and glycerol, were followed during fermentation of the doughs and acidification of the liquid acid slurries (flour and water slurries inoculated with acidifying bacteria) by HPLC analysis. Phytic acid concentration was also determined at various stages of the breadmaking process. Results showed that the composition of the fermented dough and of the resulting bread was strictly dependent on the kind of inoculated microorganisms and on the fermentation substrate, as regards both sugars and organic acids. Phytic acid was completely or almost completely hydrolyzed by the straight dough and by the sour dough process for wheat dough. For rye

doughs, reduction of phytic acid was greater when the sour dough process was used.

1442 Gobbetti, M.; Corsetti, A.; Rossi, J. (Perugia Univ. (Italy). Istituto di Micologia e Microbiologia Lattiero Casearia); Rosa, F. la (Perugia Univ. (Italy). Dipartimento di Igiene); Vincenzi, S. de (Perugia Univ. (Italy). Istituto di Zootecnica Generale) (1994) [Identification and clustering of lactic acid bacteria and yeasts from wheat sourdoughs of central Italy [for breadmaking, Umbria]]. Identificazione e raggruppamento di batteri lattici e lieviti di impasti acidi da farina di grano dell'Italia centrale [per panificazione dopo impasti acidi, Umbria]. *Italian Journal of Food Science (Italy)* v. 6(1) p. 85-94. 2 tables; 4 graphs; 27 ref. English. (AGRI 95-019063).

The microflora composition of 24 wheat sourdoughs from the region of Umbria (Italy) was characterized. The number of lactic acid bacteria and yeasts ranged from 5×10^7 to 5×10^9 and from 3×10^4 to 5×10^7 cfu/g, respectively. About 20% of the 493 and 384 isolated strains of presumptive *Lactobacillus* and yeasts was identified using conventional physiological and biochemical characteristics. As a whole, 49% of the *Lactobacillus* strains was identified as *Lactobacillus brevis* subsp. *lidneri*, 21% as *L. plantarum*, 14% as presumptive *L. farciminis*, 4% both as *L. acidophilus* and *L. fermentum*, 3% both as *L. fructivorans* and *L. alimentarius* and 2% as *L. brevis*. Sixty six percent as *Saccharomyces cerevisiae*, 17% as *Candida krusei*, 16% as *S. exiguus* and 1% as *Hansenula anomala* were identified among the yeast cultures. The phenetic relationships within all the identified strains were established and are discussed using the results from the cluster analysis. A microbial map of the 24 sourdoughs was plotted on the basis of the characterized lactic acid bacteria and yeasts species.

1443 Handreck, B. (TU Berlin (Germany). Fachgebiet Aufbereitung und Muellereitechnologie); Poetschke, L. (1994) [Sizing of wheat semolina with and without intermediate sieving]. Aufloesen von Weizengriess mit und ohne Zwischenabsieben. *Getreide Mehl und Brot (Germany)* v. 48(4) p. 17-22. 10 graphs, 7 tables. German. (AGRI 95-008788).

1444 Huber, H. (1994) [Wheat bread - always actual]. Das Weissbrot - aktueller denn je. *Baeckermeister (Germany)* v. 49(10) p. 8-9. 4 ill. German. (AGRI 95-008918).

1445 Huebner, G. (1994) [Malting barley in Rhineland-Palatinate: further on successful course]. Braugerste Rheinland-Pfalz: weiter auf Erfolgskurs. *Brauwelt (Germany)* v. 134(6) p. 253. 1 table. German. (AGRI 95-008778).

1446 Kalinowski, R. (1994) [Modern germinating equipment]. Moderne Keimanlagen. *Brauerei-Forum (Germany)* v. 9(15) p. 99-100. German. (AGRI 95-019038).

1447 Kim, H.Y. (National Institute of Health, Seoul (Korea Republic)); Cho, D.J. (Dongseo Engineering University, Pusan (Korea Republic). Department of Food Science and Technology); Hur, J.W. (Gyeongsang National University, Chinju (Korea Republic). Department of Food Science and Technology) (1993) Drying characteristics of fluidized bed drying of naked barley. *Korean Journal of Food Science and Technology (Korea republic)* v. 25(5) p. 558-564. 14 illus.; 2 tables; 19 ref. Korean. (AGRI 95-008780).

1448 Kretschmer, H. (1994) [Concept of automation in Neumarkter Lammsbraeu. Building stage malthouse]. Automatisierungskonzept der Neumarkter Lammsbraeu. Baustufe Maelzerei. *Brauwelt (Germany)* v. 134(19) p. 891-893. 3 ill. German. (AGRI 95-008897).

1449 Lang, W.; Sokhansanj, S. (1993) Bulk volume shrinkage during drying of wheat and canola. *Journal of food process engineering (USA)* v. 16(4) p. 305-314. references. English. (AGRI 95-008790).

1450 Moll, M. (1994) [Sensorial evaluation of the brewing quality of malt]. Application et signification des techniques d'analyses en vu de l'evaluation de la qualite brassicole du malt. *Cerevisia and Biotechnology (Belgium)* v. 19(2) p. 31-35. 52 ref. French. (AGRI 95-008896).

1451 Pozsonyi, F.; Pandi, F. (1993) [Suggestions for producing and introducing renewable and environment-friendly fuel (bioalcohol)]. Megujulo es kornyezetbarat uzemanyag (bioalkohol) eloallitasara es bevezetesere vonatkozó javaslatok. *Szeszipar (Hungary)* v. 41(1) p. 1-4. 1 table. Hungarian. (AGRI 95-019108).

FAO analysts think that by the turn of the century approximately 1 thousand million hectares of today's arable land will not be needed for food production. If half of this land was used to grow plants with high sugar or starch content, and the crop was used to produce bioethanol 30-40 of crude oil consumption could be substituted and the carbon-dioxide emission would decrease by one-third. Advantages of ethanol as a fuel are: high octane number, there is no need for lead in the fuel, and it doesn't contain sulfur. Disadvantage is the higher fuel consumption since combustion heat of ethanol is only half of that of petrol. For these reasons a mixture of ethanol and petrol can be used. 10 ethanol improves the octane number by 4. Leaders in utilizing ethanol as a fuel are Brazil and the United States. According to their experience the alcohol yield of different plants is as follows: sugar-cane: 36.3 hl/ha; sugar beet: 35.0 hl/ha; corn: 22.0 hl/ha; wheat: 7.7 hl/ha. The mass production of bioalcohol is technically solved but without subvention the price of it is competitive with the price of petrol only if the price of crude oil is higher than 40 USD/barrel. The following technology is suggested in the case of corn, wheat, barley or rye. The raw material is elevated up to a 10 m high tower from where it falls down while being separated from iron, stone, and dust. Then it goes through a scale and arrives to the wet grinder where it is mixed with water, recirculated watery slop, and an enzyme that fluidifies the mixture. A screw pump forwards the suspension to the reactor where lime powder is added to set the pH to the desired level. After three hour's stay the fluidified hydrolysate goes to the saccharification reactor where the saccharifying enzyme saccharifies it. The hydrolysate is cooled down to the fermentation temperature in a heat exchanger then it is distributed into the fermenting tank.

1452 Ruch, D. (Bayerische Baeckerfachschule, Lochham (Germany)) (1994) [Ciabatta - a speciality from Italy]. Ciabatta - eine Spezialitaet aus Italien. *Baeckermeister (Germany)* v. 49(20) p. 7. 3 ill., 1 table. German. (AGRI 95-008915).

1453 Sacher, B.; Back, W. (1994) [Malts, worts and beers from barleys of the 1993 crop]. Malze, Wuerzen und Biere aus Gersten der Ernte 1993. *Brauwelt (Germany)* v. 134(19) p. 872, 874-880. 13 tables. German. (AGRI 95-009040).

1454 Schildbach, R.; Burbidge, M. (Berlin Technische Univ. (Germany). Research Inst. for Raw Materials) (1994) Barley varieties and their relationships between barley, malt and beer quality. *Cerevisia and Biotechnology (Belgium)* v. 19(1) p. 34-39. 16 tables; 9 ref. English. (AGRI 95-008777).

1455 Seiffert, M. (Isernhaeager Landkost, Isernhagen (Germany)) (1994) [Safe and reproducible production of wheat sour dough]. Sichere und reproduzierbare Weizensauerteigfuehrung. *Getreide Mehl und Brot (Germany)* v. 48(4) p. 27-29. 1 ill., 3 graphs, 5 tables; 7 ref. German. (AGRI 95-008916).

1456 Singh, D.S.; Singh, B.P.N. (Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur (India)) (1992) Effect of mill speed and time on batch grinding of wheat straw. *Indian Journal of Agricultural Engineering (India)* v. 2(3) p. 186-191. 2 tables; 5 ill., 6 ref. English. (AGRI 95-008789).

1457 Sinnaeve, G.; Dardenne, P.; Biston, R. (Centre de Recherches Agronomiques de l'Etat, Libramont (Belgium). Station de Haute Belgique) (1994) [Determination of the malting quality of barley and the quality assessment of malt by Near Infrared Reflectance Spectroscopy]. Potentielle de la Spectrometrie dans le Proche Infrarouge (SPIR) pour l'evaluation de la qualite brassicole des orges et de la qualite des malts. *Cerevisia and Biotechnology (Belgium)* v. 19(2) p. 21-25. 6 tables. French. (AGRI 95-008776).

Results are presented regarding the determination of the malting quality of barley and the quality assessment of malt by Near Infrared Reflectance Spectroscopy (NIRS). The extract yield, the protein and soluble nitrogen contents of malt can be assessed by NIRS. This technique is

already widespread for the evaluation of barley quality in the trade (moisture and protein contents). The extract yield as well as the protein contents usually determined on malts can be predicted from the corresponding barleys. Other quality criteria need further investigations.

1458 Waesberghe, J.W.M. van (1993) [Pils malt technology future developments]. *Pils-mouttechnologie in de toekomst. Cerevisia and Biotechnology (Belgium)* v. 18(3) p. 38-52. 10 ill. Dutch. (AGRI 95-019206).

1459 Zimmermann, H. (1994) [Purity of malting barley varieties. Separation of parts demanded (by trade)]. *Sortenreinheit von Braugerste. Partientrennung gefordert. Brauwelt (Germany)* v. 134(23) p. 1092-1094. 5 tables. German. (AGRI 95-008779).

Q03 FOOD CONTAMINATION AND TOXICOLOGY

1460 Brueggemann, J. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) [Heavy metal binding forms in grain - New results. Part I: Cadmium binding forms]. *Schwermetallhaltige Bindungsformen in Getreide - Neuere Erkenntnisse: I. Cadmiumhaltige Bindungsformen. Getreide Mehl und Brot (Germany)* v. 48(3) p. 26-32. 1 ill., 7 graphs, 3 tables; 6 ref. German. (AGRI 95-009096).

1461 Donhauser, S. (1994) [Gushing. State of research on reasons and avoidance]. *Gushing. Stand der Forschung zu Ursachen und Vermeidung. Doemensianer (Germany)* v. 34(2) p. 62-69. 8 ill., 1 table. German. (AGRI 95-019478).

1462 Hofmann, G. (Hohenheim Univ., Stuttgart (Germany)). Inst. fuer Tierernaehrung; Mueller, H.M. (1994) [Occurrence of *Penicillium* species in cereal grain and formation of ochratoxin A and citrinin under laboratory conditions]. *Vorkommen von *Penicillium*-Arten in Getreide und Bildung von Ochratoxin A und Citrinin unter Laborbedingungen. Proceedings of the Society of Nutrition Physiology (Germany)*; no. 2 p. 38. DLG. 1 table; 1 ref. p. 38. German. (AGRI 95-009095).

1463 Lauber, U. (Hohenheim Univ., Stuttgart (Germany)). Inst. fuer Tierernaehrung; Huegel, C.; Mueller, H.M. (1994) [Formation of ergosterol, xanthomegnin and viomellein during ambient air drying of wheat]. *Bildung von Ergosterin, Xanthomegnin und Viomellein waehrend der Lagerbelueftungstrocknung von Weizen. Proceedings of the Society of Nutrition Physiology (Germany)*; no. 2 p. 31. DLG. 1 table. p. 31. German. (AGRI 95-009097).

Q04 FOOD COMPOSITION

1464 Durum wheat flour and semolina. Determination of yellow pigment content. Prepared by Technical Committee ISO/TC 34: Agricultural Food Products, Sub-Committee SC 4: Cereals and Pulses (1994) International Organization for Standardization, Geneva (Switzerland). *ISO International Standard (ISO)*; no. 11052 5 p. ISO. 1. ed. ISO-11052-1994(E). English. (AGRI 95-019611).

1465 [Durum wheat flour and semolina. Determination of yellow pigment content]. *Farines et semoules de ble dur. Determination de la teneur en pigments jaunes. Elaboree par le Comite Technique ISO/TC 34: Produits Agricoles Alimentaires, Sous-Comite SC 4: Cereales et Legumineuses (1994) Organisation Internationale de Normalisation, Geneva (Switzerland). Norme Internationale ISO (ISO)*; no. 11052 5 p. ISO. 1. ed. ISO-11052-1994(F). French. (AGRI 95-019612).

1466 Bolling, H. (1994) [Wheat quality - Change and development in the 20th century]. *Weizenqualitaet - Wandel und Fortschritt im 20. Jahrhundert. Muehle + Mischfuttertechnik (Germany)* v. 131(15) p. 188, 191. German. (AGRI 95-009245).

1467 Bosch, H.; Tessin, N.; Bellmer, H. G.; Baessler, H.M.S. (1994) Examination of the suitability of enzyme immunoassays (ELISA) for mycotoxin analysis in the brewing industry. *Examen sur l'aptitude des*

essais immunoenzymatiques (ELISA) pour l'analyse de mycotoxines en brasserie. Ueberpruefung der Eignung von Enzymimmunoassays (ELISA) fuer die Mykotoxinanalytik in der Brauwirtschaft. Monatsschrift fuer Brauwissenschaft (Germany) v. 47(6) p. 196-202. 4 ill., 10 tables; 30 ref. German. (AGRI 95-009530).

1468 Corbellini, M.; Canevara, M.G. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) [Estimate of moisture and protein content in whole grains of bread wheat (*T. aestivum* L.) by near infrared reflectance spectroscopy]. *Determinazione in umidita' e proteine in cariossidi intere di frumento tenero (T. aestivum L.) mediante spettroscopia di riflettanza nel vicino infrarosso. Italian Journal of Food Science (Italy)* v. 6(1) p. 95-102. 1 table; 5 graphs; 15 ref. English. (AGRI 95-019504).

Calibrations were developed for moisture and protein content prediction in whole grain of bread wheat by means of near infrared reflectance spectroscopy (NIR) and compared with those obtained for ground wheat. The wavelengths chosen were quite different. For protein content determination, in the case of intact grains, four wavelengths, two of them close to 1200 nm and two close to 1700 nm were used, while in the case of ground wheat, four wavelengths close to 2000 nm were used. The curves obtained were used for constituent prediction in thirty samples and compared with the traditional chemical results. Coefficients of determination both for moisture and protein were high ($R_{\text{sup}}(2)=0.98$) and the standard errors of prediction were 0.17 for moisture and 0.41 for protein. The level of precision obtained is more than adequate for breeding purposes.

1469 Donhauser, S.; Wagner, D.; Geiger, E. (1994) [Malts and worts form the barley crop 1993. Examinations on the content of amino acids and free-amino-nitrogen (FAN)]. *Malze und Wuerzen aus der Gerstenernte 1993. Untersuchungen zu Aminosaeuren und FAN-Gehalten. Brauwelt (Germany)* v. 134(22) p. 1018, 1020-1023. 5 ill., 6 tables; 4 ref. German. (AGRI 95-009222).

1470 Eisenberg, B. (Univ. Hamburg, Hamburg (Germany)). Inst. fuer Biochemie und Lebensmittelchemie; Steinhart, H.; Bosselmann, A. (1994) [Calculation model for the prediction of the loaf volume (RMT) of wheat]. *Berechnungsmodell zur Vorhersage des Backvolumens (RMT) bei Weizen. Getreide Mehl und Brot (Germany)* v. 48(3) p. 48-52. 2 graphs, 3 tables; 22 ref. German. (AGRI 95-009244).

1471 Fretzdorff, B. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) [Comparison of two lipolytic enzyme activity assays for bread cereals]. *Vergleich zweier Methoden zur Bestimmung lipolytischer Enzymaktivitaeten im Brotgetreide. Getreide Mehl und Brot (Germany)* v. 48(2) p. 34-38. 8 graphs, 2 tables; 7 ref. German. (AGRI 95-009238).

1472 Fretzdorff, B. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) [Development of lipolytic enzyme activities during germination of triticale, wheat and rye]. *Entwicklung lipolytischer Enzymaktivitaeten waehrend der Keimung von Triticale im Vergleich zu Weizen und Roggen. Getreide Mehl und Brot (Germany)* v. 48(3) p. 13-18. 7 graphs, 1 table; 13 ref. German. (AGRI 95-009235).

1473 Fuchs, W. (Halle Wittenberg Univ., Halle (Germany)). Inst. fuer Acker und Pflanzenbau; Zabel, S. (1993) [Investigation of the malting quality of two-row winter barley]. *Untersuchungen zur Brauqualitaet von zweizeiliger Wintergerste. Archives of agronomy and soil science (Germany)* v. 37(4) p. 247-255. 4 tables; 31 ref. German. (AGRI 95-009225).

1474 Gaal, O.; Kontraszti, M.; Gergely, A. (1993) [Examination of breads from whole wheat flour]. *Teljes kiorlesu lisztekbol keszult kenyervelek vizsgalata. Sutoipar (Hungary)* v. 40(4) p. 132. Hungarian. (AGRI 95-019615).

The minerals, vitamins, and fibres of whole wheat flour are very important in nourishment. According to literature in societies where breads from unfermented whole wheat flour are consumed serious microelement deficiency has occurred. Presumably vegetable fibres are responsible for this deficiency. In an experiment Yemen Wheat Bread

(YWB) and Hungarian Wheat Bread (HWB) was used to decide how microelements can be absorbed from different breads. The environment of the digestive system was imitated during the "in vitro" experiments. In both samples (YWB and HWB) the absorbability of Cu and Zn was around 80. The absorbance was not influenced by the presence of the other ion.

1475 Graeber, S. (Univ. Hohenheim, Stuttgart (Germany). Inst. fuer Lebensmitteltechnologie); Kuhn, M. (1994) [Rheology of wheat doughs before and after freezing]. Rheologie von Weizenmehlteigen vor und nach dem Frosten. *Getreide Mehl und Brot (Germany)* v. 48(3) p. 33-37. 11 graphs; 9 ref. German. (AGRI 95-009365).

1476 Haber, T. (SSGW Landwirtschaftliche Univ., Warschau (Poland). Fak. fuer Lebensmitteltechnologie) (1994) [Characteristics and uses of Polish triticale cultivars]. Charakteristika und Verwendungsmoeglichkeiten der polnischen Triticaleorten. *Getreide Mehl und Brot (Germany)* v. 48(2) p. 9-14. 3 graphs, 6 tables; 24 ref. German. (AGRI 95-009234).

1477 Hozova, B.; Danisova, C.; Holotnakova, H. (Slovenska Technicka Univ., Bratislava (Slovak Republic). Chemickotechnologicka Fakulta) (1994) [Vitamins B in macrobiotic food]. B vitaminy v makrobiotickej strave. *Potravinarske Vedy - UZPI (Czech Republic)* v. 12(3) p. 197-201. 1 table; 9 ref. Slovak. (AGRI 95-009243).

1478 Hutter, K. J. (1994) [Use of the biophotone analysis for the quality identification of malting barley]. Einsatz der Biophotonenanalyse fuer die Braugersten-Qualitaetskontrolle. *Brauwelt (Germany)* v. 134(29) p. 1404-1409. 7 ill., 2 tables; 9 ref. German. (AGRI 95-019498).

1479 Hutter, K. J.; Benkel, C.; Herter, T.; Popp, F. A. (1994) Study of different species of barley with the help of the luminescence method. Examen de differentes varietes d'orges a l'aide procede luminescence. Untersuchungen an verschiedenen Gerstensorten mit Hilfe von Lumineszenz-Verfahren. *Monatsschrift fuer Brauwissenschaft (Germany)* v. 47(7-8) p. 237-242. 5 ill., 1 table; 11 ref. German. (AGRI 95-019499).

1480 Kohlus, R.; Zuerner, L.; Bottlinger, M.; Jansen, H. D. (1994) [Neural networks for the interpretation of NIR spectra (Part 1 and 2)]. Neuronale Netzwerke zum Auswerten von NIR-Spektren (Teil 1 und 2). *ZfL. Zeitschrift fuer die Lebensmittelwirtschaft (Germany)* v. 45(3) p. 55-56, 59-60, (4) p. 50-52, 54. 8 graphs, 2 tables; 9 ref. German. (AGRI 95-009236).

1481 Kraus, I.; Prokes, J.; Susta, J. (Vyzkumny Ustav Pivovarsky a Sladarsky, Brno (Czech Republic). Sladarsky Ustav) (1994) [Barley crops (1993)]. Jecmen sklizne 1993. *Kvasny Prumysl (Czech Republic)* v. 40(2) p. 38-41. 6 graph., 7 tables. Czech. (AGRI 95-009223).

1482 Lorenz, K. (Colorado State Univ., Fort Collins (USA). Dept. of Food Science and Human Nutrition) (1994) [Alkylresorcinols in cereal grains]. Alkylresorcinole in Getreide. *Getreide Mehl und Brot (Germany)* v. 48(3) p. 19-25. 7 tables; 42 ref. German. (AGRI 95-009239).

1483 M'ngova, M. (Institut po Introduktsiya i Rastitelni Resursi, Sadovo (Bulgaria)) (1994) [Wheat varieties with high and increased quality of the grain]. Sortove pshenitsa s visoko i povisheno kachestvo na z'mnoto. Firma Prokom, Plovdiv (Bulgaria). *Khlyab (Bulgaria); Bread* v. 2(4) p. 7. Bulgarian. (AGRI 95-019505).

1484 Metzger, M. (1994) [Barley analysis]. Gerstenuntersuchung. *Brauerei-Forum (Germany)* v. 9(3) p. 15-17. 2 tables. German. (AGRI 95-009220).

1485 Narziss, L.; Miedaner, H.; Krottenthaler, M. (1994) Development of a selection method with serial suitability for increasing the quality of beer and which can be applied as standard barley quality parameters which influence the beer flavour Part 1. Developpment d'une methode de selection en serie pour l'amelloration de la qualite de la biere et des parametres de qualite de l'orge qui influencent le gout de la biere. Partie 1. Entwicklung einer Selektionsmethode mit Serieneignung zur Anhebung der Bierqualitaet und der den Biergeschmack beeinflussenden Qualitaetsparameter der Gerste. Teil 1:

Untersuchungen an Micro-, Klein- und Pilotsudwerken -Einfluss des Gaerverlaufs auf den Biergeschmack. *Monatsschrift fuer Brauwissenschaft (Germany)* v. 47(7-8) p. 232-236. 8 ill., 3 tables; 4 ref. German. (AGRI 95-019741).

1486 Neumann, L. (1994) Tests on brewery or malt raw materials, respectively, as well as on wort, fresh beer/beer before filtration and on filtered beer. Proposals by MEBAK for minimum extent testing under quality assurance. 1st notification. Examen des matieres premieres de la brasserie et de la malterie ainsi que des mouts, biere verte/biere avant la filtration et de la biere filtree. Proposition de la MEBAK pour un examen minimum dans le cadre de l'assurance qualite. 1 ere communication. Pruefungen an Brauerei- bzw. Maelzereirohstoffen sowie an Wuerze, Jungbier/Bier vor der Filtration und an filtriertem Bier. Vorschlaege der MEBAK fuer einen Mindestpruefumfang im Rahmen der Qualitaetsicherung. 1. Mitteilung. *Monatsschrift fuer Brauwissenschaft (Germany)* v. 47(6) p. 203-206. 12 tables; 10 ref. German. (AGRI 95-009531).

1487 Pollhamer, S. (1994) [The quality of winter wheat cultivars in Hungary]. Die Qualitaet der Winterweizensorten in Ungarn. *Getreide Mehl und Brot (Germany)* v. 48(2) p. 3-8. 8 graphs, 7 tables; 10 ref. German. (AGRI 95-009242).

1488 Schwabe, M.; Fenz, R.; Kraemer, J.; Rath, F. (1994) Evidence of fusarium on brewing barley determined by the EPS latex agglutination test. Detection de fusarium sur l'orge de brasserie per le test EPS-Latex d'agglutination. Nachweis von Fusarium auf Braugerste mit dem EPS-(extrazellulaere Polysaccharide) Latex-Agglutinations-Test. *Monatsschrift fuer Brauwissenschaft (Germany)* v. 47(5) p. 160-164. 4 ill., 1 table; 10 ref. German. (AGRI 95-009221).

1489 Seibel, W. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Bruemmer, J. M.; Morgenstern, G. (1994) [Quality of rye and wheat milled products in the grain economic year 1992/93]. Qualitaet der Roggen- und Weizenmahlzerzeugnisse im Getreidewirtschaftsjahr 1992/93. *Getreide Mehl und Brot (Germany)* v. 48(2) p. 28-33. 2 graphs, 7 tables; 12 ref. German. (AGRI 95-009363).

1490 Velisek, J.; Davidek, J. (Vysoka Skola Chemickotechnologicka, Prague (Czech Republic). Ustav Chemie a Analyzy potravin); Kvasnicka, F. (1994) Prediction of baking and milling quality characteristics of Czechoslovak wheat. *Potravinarske Vedy - UZPI (Czech Republic)* v. 12(4) p. 243-256. 5 graphs, 5 tables; 7 ref. English. (AGRI 95-019506).

1491 Wagner, S. (Univ. Hohenheim, Stuttgart (Germany). Inst. fuer Lebensmitteltechnologie, Fachgebiet Getreidetechnologie); Kuhn, M. (1994) [Changes in composition during the germination of cereals and amaranthus, studies on phytic acid degradation in wholemeal doughs]. Aenderung in der Zusammensetzung von keimendem Getreide und Amaranth, Studien zum Abbau von faellbarem Phytat in Weizenmehlteigen. *Getreide Mehl und Brot (Germany)* v. 48(4) p. 6-10. 14 graphs. German. (AGRI 95-009237).

1492 Weddeling, K.; Baessler, H.M.S.; Doerk, H.; Baron, G. (1994) Orientated tests for the application of the enzymimmunological process for evidencing deoxynivalenol, ochratoxin A and zearalenon in brewing barley, malt. Essais d'orientation de l'application pour la recherche de Desoxynivalenol, Ochratoxine A et Zearalenone par procede immunologique dans l'orge de brasserie, le malt et la biere. Orientierende Versuche zur Anwendbarkeit enzymimmunologischer Verfahren zum Nachweis von Deoxynivalenol, Ochratoxin A und Zearalenon in Braugerste, Malz und Bier. *Monatsschrift fuer Brauwissenschaft (Germany)* v. 47(3) p. 94-98. 4 ill., 2 tables; 23 ref. German. (AGRI 95-009524).

Q05 FOOD ADDITIVES

1493 Bruemmer, J. M. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany));

Morgenstern, G.; Neumann, H. (1994) [Limits and possibilities of reduction of baking additives by use of alternate raw materials for production of wheat bread and smalls]. *Grenzen und Möglichkeiten der Verminderung von Zusatzstoffen durch Einsatz anderer backaktiver Rohstoffe bei Weizenbrot und -Kleingebäck. Getreide Mehl und Brot (Germany) v. 48(3) p. 38-47. 10 ill., 2 graphs, 7 tables; 20 ref. German. (AGRI 95-009579).*

1494 Maziadixon, BB.; Klopfenstein, CF. (1994) **NUTRITIONAL PROPERTIES OF HARD WHITE AND HARD RED WINTER WHEATS AND OATMEAL .1. EFFECTS ON CHOLESTEROL LEVELS AND FECAL FAT, NEUTRAL STEROLS, AND BILE ACIDS IN CHOLESTEROL-FED RATS.** *Cereal Chemistry. 71(6):539-543. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT GRAIN SCI & IND MANHATTAN, KS 66506 USA].*

The effects of hard white and hard red winter wheats (whole flour, bran, straight-grade flour) and oatmeal on rat weight gains, serum and liver cholesterol levels, fecal fat, neutral sterols, and bile acids were compared. No differences in weight gains or feed efficiencies were noted for animals fed red versus white whole flours, brans or straight-grade flours. Only animals fed the white wheat bran diet gained less weight than the control animals. The bran diets were the least efficient feeds. By the end of week 8, animals fed red wheat diets tended to have lower serum cholesterol levels than those fed respective white wheat diets, but the difference was significant only in animals fed whole wheat flour. The wheat brans, whole red flour, red straight-grade flour, and oatmeal diets were hypocholesterolemic compared to the control diet. No significant differences occurred in liver cholesterol levels between groups fed respective hard white versus hard red wheat diets. Animals fed bran diets had significantly lower liver cholesterol concentrations than did those fed whole flour or straight-grade flour, but concentrations were similar to those of animals fed the oatmeal diet. Correlation analysis showed significant inverse relationships between total serum cholesterol and dietary fiber (especially soluble fiber), amount of fecal fat and neutral sterols excreted daily, dietary phenolics and phytic acid, and diet viscosity. The relationships were stronger for liver cholesterol. All of these factors may contribute to the hypocholesterolemic properties of grain diets. [References: 31].

1495 Maziadixon, BB.; Klopfenstein, CF. (1994) **NUTRITIONAL PROPERTIES OF HARD WHITE AND HARD RED WINTER WHEATS AND OATMEAL 2. EFFECTS ON FECAL WATER-HOLDING CAPACITY AND LOSS OF PROTEIN, ASH, CALCIUM, AND ZINC IN CHOLESTEROL-FED RATS.** *Cereal Chemistry. 71(6):544-547. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT GRAIN SCI & IND MANHATTAN, KS 66506 USA].*

The effects of oatmeal and various fractions from a hard white and hard red winter wheat on rat weight gains and fecal loss of protein, ash, calcium, and zinc were compared. Oatmeal diets produced weight gains similar to those of the whole wheat flour diets. No significant differences occurred in weight gains between animals fed diets containing whole flour, straight-grade flour, or bran of the hard white wheat and those fed respective hard red winter wheat diets. Although caloric contents of the wheat bran diets were lower than those of the other diets and bran-fed rats lost more protein and ash in feces, animals fed the bran diets gained as much weight as those fed straight-grade flour diets. Feed intake was highest in bran-fed animals, and the bran diets were the least efficient feeds. Animals fed bran diets had the highest wet and dry fecal weight and highest fecal water-holding capacity; no differences occurred between the hard white and hard red winter bran diets. Fecal water-holding capacity was strongly correlated with total dietary fiber ($r = 0.9738$, $P = 0.0001$). Animals fed oatmeal lost the least amount of calcium per day, had the lowest percent loss of calcium, and absorbed more calcium than those fed red or white wheat diets or the control diet, which contained cellulose. Greatest daily loss of zinc occurred with the wheat bran diets, but zinc concentration and daily amounts of zinc absorbed also were highest with those diets. More zinc was absorbed per day from the oatmeal diet than from all other diets, except those containing wheat brans. An inverse relationship was observed between percent calcium loss and soluble dietary fiber ($r = -0.4996$, $P = 0.003$), whereas no significant correlation occurred between insoluble and total dietary fiber or phytic acid and percent calcium loss. However, significant correlations were

observed between the daily amount of zinc in feces and insoluble dietary fiber ($r = 0.8709$, $P = 0.0001$), total dietary fiber ($r = 0.9137$, $P = 0.0001$), and phytic acid ($r = 0.9552$, $P = 0.0001$). The amounts of calcium and zinc absorbed daily were strongly correlated with intake ($r = 0.9124$, $P = 0.0001$ and $r = 0.9134$, $P = 0.0001$, respectively). [References: 23].

Q52 FEED PROCESSING AND PRESERVATION

1496 Hnilica, P. (Vysoka Skola Zemedelska, Prague (Czech Republic)) (1994) [Specific energy consumption of hammer mill and the character of its breaking function for cereal grain]. *Merna spotreba energie kládívkového mlyna a charakter jeho lomové funkce pro obilni zrno. Zemedelska Technika - UZPI (Czech Republic) v. 40(3) p. 203-218. 21 graphs, 1 scheme, 1 table; 23 ref. Czech. (AGRI 95-019780).*

1497 Zeman, S. (Vysoka Skola Polnohospodarska, Nitra (Slovak Republic)) (1994) [The effect of thickness of ground material on specific energy consumption in grinding]. *Vplyv hrúbky srotu na mernú spotrebu energie pri srotovaní. Zemedelska Technika - UZPI (Czech Republic) v. 40(3) p. 219-228. 3 graphs, 1 scheme, 1 table; 13 ref. Slovak. (AGRI 95-019781).*

Q53 FEED CONTAMINATION AND TOXICOLOGY

1498 Wang Jinglin; Zhang Zhidong; Yin Shixing (Chinese Academy of Agricultural Sciences, Lanzhou (China). Inst. of Veterinary Medicine) (1994) Detecting the mycotoxin zearalenone (ZEN) in corn, wheat and feedstuffs with competitive indirect ELISA plus anti-ZEN McAb. *Chinese Journal of Veterinary Sciences (China) v. 14(2) p. 154-158. 4 ill., 3 tables, 5 ref. Chinese. (AGRI 95-009618).*

Q54 FEED COMPOSITION

1499 Landry, J.; Delhay, S. (1994) **SUITABILITY OF THE LINEAR RELATIONSHIPS FOR PREDICTING TRYPTOPHAN OF FEEDSTUFFS FROM NITROGEN CONTENT - A CRITICAL STUDY OF LITERATURE DATA.** *Journal of the Science of Food & Agriculture. 66(4):521-525. English. [INRA CTR GMP CHIM BIOL LAB F-78850 THIVERVAL GRIGNON FRANCE].*

The tryptophan contents of 20 samples of various feedstuffs, determined by using assay procedures which were proved to give quantitative results, were compared with those predicted from the relationships between nitrogen and tryptophan published by three laboratories. The ratio of predicted tryptophan to the observed tryptophan, expressed as percentage, ranged from 65% (pea) to 137% (fishmeal). These differences were shown to be related to a systematic underestimation of tryptophan regarding data from two laboratories associated with a variability of tryptophan content for a given nitrogen content and a given type of feedstuff. [References: 14].

1500 Michalik, I.; Galova, Z.; Holeckova, J. (Vysoka Skola Polnohospodarska, Nitra (Slovak Republic)) (1994) [Hydrolysis of wheat grain proteins]. *Hydrolyza bielkovin zrna ozimnej pšenice. Polnohospodarstvo (Slovak Republic) v. 40(3) p. 161-173. 3 graphs, 5 tables; 12 ref. Slovak. (AGRI 95-019818).*

Proteolytic enzymes (nitrazym, trypsin, protease Fc-I, maxatase) in ground wheat grain were determined under in vitro conditions. Thermal treatment of wheat meal directly influences the enzymatic hydrolysis of proteins. 55 % of proteins were hydrolyzed using trypsin. The chemical hydrolysis of wheat meal proteins (Ethanol-HCL) for 24 hours resulted in 43 % of hydrolyzed proteins in the sample. 3 chromatographic gluten subunits were identified by RP-HPLC. The highest hydrolytic decomposition of HMW-glutenin subunits was achieved using the new proteolytic enzyme nitrazym.

1501 Moeller, E.; Hostrup, S.B.; Hvelplund, T. (1994) [Winter rye and winter wheat as roughage]. *Vinterrug og vinterhvede som grovfoder.*

Q70 PROCESSING OF AGRICULTURAL WASTES

1502 Bucko, J.; Geffert, A. (Technicka Univ., Bratislava (Slovak Republic). Fakulta Ekologie) (1994) [Semichemical treatment of wheat straw]. Spracovanie psenicnej slamy polochemickym postupom. Produkcia a Vyuzitie Polnohospodarskej a Lesnej Biomasy na Energiu; Zvolen (Slovak Republic); 13-14 Apr 1994. Production and utilization of agricultural and forest biomass for energy. Proceedings of the seminar. Lesnický Vyskumný Ústav, Zvolen (Slovak Republic) p. 54-62. Lesnický Vyskumný Ústav. 5 tables; 8 ref. Slovak. (AGRI 95-019922).

1503 Mathot, P.; Brakel, J. (Faculte des Sciences Agronomiques de Gembloux (Belgium). Unite de Microbiologie. Centre d'Etude sur l'Optimisation Microbienne) (1994) [Residues, wastes, surpluses: on farm valorization]. Residus, dechets, excedents: valorisation a la ferme. Agricontact (Belgium); Courrier du Ministere de l'Agriculture (no.257) p. 1-2. French. (AGRI 95-019930).

S20 PHYSIOLOGY OF HUMAN NUTRITION

1504 Dahiya, S.S.; Kapoor, A.C. (Haryana Agricultural University, Hisar (India). Department of Foods and Nutrition) (1994) Some antinutritional factors and protein (in vitro) digestibility of home processed supplementary foods: effect of domestic processing methods. International Journal of Tropical Agriculture (India) v. 12(1, 2) p. 148-157. 3 tables; 31 ref. English. (AGRI 95-009847).

S30 DIET AND DIET-RELATED DISEASES

1505 Schneider, M. (1994) [Usual baking products are taboo for coeliac patients]. Fuer Zoeliakie-Kranke sind herkoemmliche Backwaren tabu. Baecker Zeitung (Germany) (3) p. 18. German. (AGRI 95-009961).

U10 MATHEMATICAL AND STATISTICAL METHODS

1506 Madry, W. (1993) [Statistical study on multivariate evaluation of quantitative characters diversity in cereal germplasm collections]. Studia statystyczne nad wielowymiarowa ocena zroznicowania cech ilosciowych w kolekcjach zasobow genowych zboz. Szkoła Główna Gospodarstwa Wiejskiego, Warszawa (Poland). Katedra Statystyki Matematycznej i Doswiadczalnictwa. Rozprawy Naukowe i Monografie (Poland); Treatises and Monographs; [no number] 108 p. Wydawnictwo SGGW. 12 fig., 17 tables; Bibliography p. 93-102. Polish. (AGRI 95-010211).

The author decided to consider separate analyses within "subcollections" coming from a given complete cereal germplasm collection. The multivariate analysis of variance, cluster analysis with simultaneous tests procedure T exp (2) sub (max) based on Roy's union-intersection rule and canonical variate analysis were considered. As an underlying model for diversity analysis in a "subcollection" the mixed model of Manova with fixed effects for accessions and random effects for years was assumed. The application of the proposed procedures is illustrated by two numerical examples from the collections of winter rye and spring barley. Also some practical aspects of the phenotypic diversity evaluation in cereal germplasm collections using proposed statistical methods were shown.

1507 McMaster, G.S. (United States Dept. of Agriculture, Fort Collins, Colorado. Great Plains Systems Research) (1993) [Another wheat (Triticum s.p.) model? Progress and applications of crop modeling]. Un altro modello sul frumento (Triticum s.p.)? Progresso ed applicazioni dei modelli matematici delle colture. Societa Italiana di Agronomia. 26. Annual meeting on crop physiology; Udine (Italy); 22-25 Sep 1992. Rivista di Agronomia (Italy) v. 27(4) p. 264-272. 2 tables; 4 graphs; 46 ref. English. (AGRI 95-010240).

Crop modeling has multiple capabilities in the analysis and quantification of physiological relationships, in the synthesis of existing information and in the identification of knowledge gaps. Simulation models can also test hypotheses and try to extrapolate beyond existing data bases. This paper describes these and other goals partly using SHOOTGRO, a model developed to synthesize recent research on wheat growth and phenology, as a working example. The future of crop modeling is outlined, emphasizing the necessity of increased and continuous interchange of knowledge between modelers and non-modelers and suggesting the main characteristics that future models should incorporate.

AUTHOR INDEX

- Aahman, I. 948
 Ababneh, M. 849
 Abate Tedla 701, 702, 703, 745, 879
 Abbo, S. 919
 Abd El Hady, E. 1439
 Abdin, MZ. 1112
 Abdrakhimova, J.R. 1310
 Abiye Astatke 1381
 Abrams, SR. 1099, 1203
 Abrol, YP. 1112
 Acevedo, E. 886, 1131
 Acharya, CL. 1113
 Adams, J. 1191
 Adary, A.H. 682
 Adin, G. 1346
 Adner, A. 699
 Afanasenko, OS. 1236
 Afzal, M. 1382
 Aggarwal, R. 897
 Agola, A.H. 764
 Ahmad, S. 951
 Ahmad, Z. 956, 1010
 Aioub, AAA. 1201
 Akhtar, J. 1114
 Aksel, R. 887
 Akunda bweni, L. 954
 Al Athari, A.K. 1342
 Al Fahady, M.Y. 682
 Al Hakim, A. 888
 Al Khatib, M. 889
 Alano, AS. 1297
 Alberti, I. 1279
 Albertini, L. 892
 Aleligne Kefyalew 1325
 Aleshchenko, P.I. 890
 Ali, AM. 891
 Ali, I. 1382
 Ali, ZI. 1115
 Alizadeh, A. 892
 Allen, E. 678
 Allison, D. 1230
 Alston, JM. 670
 Altunurska, R. 1384
 Alvarez, JB. 1392
 Amaducci, M.T. 881
 Amaha Sebsibe 702, 703
 Amanuel Gorfu 689, 744, 850, 1321
 Ameer, A. 1343
 Amsal Tarekegne 683
 An Chengli 906
 Anceau, C. 1237
 Andersen, A. 851
 Andersen, R. 1209
 Andersen, WR. 1012
 Andrejnska, I. 852, 853
 Andrews, JL. 1393
 Andrzejczukhybel, J. 1116
 Andualem Taye 766
 Angelovicova, M. 1344
 Angers, DA. 827
 Angus, JF. 867
 Anikeeva, L.A. 893
 Annicchiarico, P. 894
 Anon. 676, 684, 685, 1345
 Antonacci, M. 895, 896
 Apel, K. 1157
 Appel, T. 765
 Appleford, NEJ. 1159, 1160
 Arieli, A. 1346
 Arnold, GM. 1322
 Arrigoni, O. 895
 Arthur, FH. 1336
 Aschalew Tsegahun 702, 703
 Asefa Taa 850
 Asgelil Dibabe 766
 Aslam, M. 936, 1117
 Aspegren, Kristian 1013
 Attene, G. 999
 Augustin, J. 1107
 Avalakki, UK. 767
 Avdeeva, A.V. 1306
 Awad, F. 1118
 Awasthi, U.D. 1075
 Awawdeh, F.T. 849
 Ayiecho, P.O. 954
 Ayyadi, M. 849
 Azimuddin, M. 992
 Back, W. 1453
 Baessler, H.M.S. 1467, 1492
 Baeumer, K. 854
 Bahadu, P. 897
 Bailey, KL. 1261
 Bajorat, B. 1305
 Baker, RJ. 1129
 Bakker, PAHM. 1057
 Balk, G. 1440
 Balmas, V. 1240
 Balsevich, JJ. 1099
 Bandursska, H. 1142
 Banevidiene, Z. 733
 Bansal, KC. 1112
 Bao Heping 1003
 Barasebwa, L. 768
 Barasebwa, Liberate 686
 Barasits, T. 687
 Barbanti, L. 881
 Barbaro, NO. 770
 Barclay, KD. 1076
 Barkan, A. 1119
 Barnwell, P. 1394
 Baron, G. 1492
 Barrault, G. 892
 Bartling, PNS. 819
 Bartos, P. 1285
 Bartoszewicz, K. 1116
 Bason, ML. 1120
 Basu, U. 1121
 Baudart, E. 1378
 Bauer, A. 1135
 Baum, BR. 898
 Baumgaertel, G. 779
 Baumhardt, RL. 1156
 Bazin, SL. 1418
 Beal, AD. 1395
 Becker, M. 1077
 Beckhove, U. 1153
 Bedford, M.R. 1347, 1379
 Bedo, Z. 961, 997, 1092
 Beer, E. 769
 Beer, G. 1440
 Beese, G. 688
 Begum, I. 951
 Behl, R.K. 791
 Bekele Geleta 689
 Bekele Hunde 1280, 1281
 Bekele Hundie 1325
 Bekesi, P. 1238
 Belcheva, S. 694
 Belford, RK. 840
 Belkhodja, R. 899
 Bell, KO. 1213
 Bellmer, H. G. 1467
 Belova, LI. 994, 1002
 Belyaeva, A.I. 1103
 Benbi, DK. 773
 Benetti, V. 892
 Benghedalia, D. 1348
 Benkel, C. 1479
 Bennett, GA. 1396
 Bequette, RK. 979
 Berezkin, A.N. 758
 Berezkina, L.L. 758
 Bergman, CJ. 1397
 Bernard, M. 900, 963, 980
 Bernard, S. 900, 980
 Bernardin, JE. 1429
 Bernardvaille, MA. 1078
 Bertholdsson, N.O. 948
 Berti, A. 1139
 Besle, JM. 1078
 Betker, SE. 1437
 Beuve, MA. 1239
 Bezzola, LC. 770
 Bhagwat, MD. 901
 Bhan, S. 1075
 Bhatnagar, GS. 855
 Bhatnagar, S. 1398, 1399
 Bhattacharya, M. 1435
 Bhattacharya, S.K. 1098
 Biancardi, A.M. 983
 Biederbeck, VO. 1052
 Bielawski, W. 1116, 1122
 Biggs, S.D. 674
 Biaderis, CG. 1423
 Bindi, M. 1168, 1169
 Binding, H. 1157
 Biston, R. 1457
 Bjostad, LB. 1216
 Black, AS. 838
 Blackshaw, RE. 1319
 Blake, NK. 977
 Blake, T. 997
 Blanco, A. 895, 896
 Bland, D. 949
 Blouin, P. 787
 Blum, A. 1123
 Blumendeller, C. 1305
 Blunt, DL. 1258
 Bocharova, M.A. 1307
 Bodicker, M. 1124
 Boeuf, C. 963
 Bogaciovass, V. 733
 Bogdanov, V.P. 1079
 Bojnanska, T. 984
 Bolduan, G. 1349
 Bolland, MDA. 771
 Bolling, H. 1466
 Bomke, AA. 1053
 Bonfil, DJ. 772
 Bonhomme, H. 900
 Borghi, B. 902
 Borin, M. 1139
 Borisenko, L.R. 1094
 Borner, A. 1043
 Borojevic, S. 985
 Borrelli, L. 730
 Bosch, H. 1467
 Bosi, P. 1367
 Boskovic, J. 903
 Boskovic, M. 903
 Bosselmann, A. 1470
 Bosveld, P. 1438
 Bottlinger, M. 1480
 Bouchot, C. 1343
 Boucque, CV. 1352
 Bouguennec, A. 904
 Boulby, G.L. 787
 Bovolenta, S. 823
 Bowling, R. 1213
 Boyadjeva, D. 905
 Brainard, KA. 1273
 Brakel, J. 1378, 1503
 Brand, O. 1440
 Brandt, M. 1377
 Branlard, G. 920, 1400
 Brar, SPS. 773
 Brassett, PR. 1255
 Braun, HP. 1124
 Brazauskas, R. 733
 Brazdovicova, B. 1080
 Breland, TA. 1054
 Brennan, RF. 774
 Bridges, IC. 1180
 Brigham, DL. 1216
 Broers, L.H. 1243
 Brooks, HL. 1213
 Brown, AH. 1059
 Brown, CS. 1174
 Brown, K. 1040
 Bruce, D. 1134
 Brueggemann, J. 1460
 Bruemmer, J. M. 1439, 1489, 1493
 Brunner, H. 873
 Brunold, C. 1201
 Bryngelsson, T. 1027
 Bubryak, I.I. 995
 Bucko, J. 1502
 Bulcke, R. 1064, 1065
 Bungutsiki, B. 707
 Buntin, GD. 949
 Burbidge, M. 1454
 Burgess, LW. 1275
 Bushuk, W. 1437
 Cai Shibin 1046
 Cai Xiwen 1070
 Caillaud, CM. 1214
 Cairns, AJ. 1178
 Callens, D. 1064, 1065
 Camargo, C.E.O. 775, 959
 Camberato, JJ. 776
 Cambron, S. 917
 Cameron, KC. 709
 Campbell, A. 1255
 Campbell, CA. 1052
 Campiglia, E. 856, 857, 858
 Candolo, G. 881
 Canevara, M.C. 1468
 Caporali, F. 856, 857, 858
 Carbonero, P. 1084
 Carcea, M. 1402
 Carling, DE. 1273
 Carter, CA. 671
 Carter, MR. 827
 Carver, BF. 1205, 1401
 Casado Garcia, P. 1373
 Casini, L. 1367
 Cassaniti, S. 1163
 Castagnaro, A. 1084
 Castellani, M. 1168, 1169
 Castelli, F. 690
 Castrillo, C. 1350
 Cattivelli, L. 930, 1109
 Cattle, SR. 824
 Causarano, H. 777, 839, 884
 Cavalieri, RP. 1433
 Cavallaro, V. 1199
 Cavellier, N. 859
 Cenci, A. 911
 Cervato, A. 1125
 Chalhoub, BA. 1239
 Chand, M. 1372
 Chang, H.G. 1081
 Chang, LY. 1192
 Chaplot, PC. 855
 Chapman, DK. 1059
 Chastain, TC. 691
 Chaubey, C.N. 956
 Chaudhary, OP. 759
 Chen Guangdou 906
 Chen Hongbing 1390
 Chen Wenhua 907
 Chen Xueliu 1072, 1126
 Chen Yanglin 1302
 Chen Yichun 1026
 Chen, F. 997
 Chen, FQ. 1127
 Chen, THH. 997
 Chen, WD. 1297
 Cheng Hui 1252
 Cheng Junyuan 908
 Chernyad'ev, I.I. 1332
 Chertova, TS. 1147
 Chiburova, I.V. 1249
 Chigrin, V.V. 1341
 Chilot Yurga 1320
 Chino, M. 1060, 1091
 Chirkova, T.V. 1103, 1306
 Chistyakova, V.N. 993
 Chkanikov, DI. 1283
 Cho, C.H. 909
 Cho, D.J. 1447
 Choi, B.S. 1389
 Christen, O. 1189
 Christensen, H. 1055
 Christensen, S. 1055
 Christerson, P. 1082
 Chung, OK. 979

- Cilg, T. 864
 Clavpool, PL. 1355
 Cleugh, HA. 1056
 Close, TJ. 1128
 Codianri, P. 741
 Colaprico, G. 976
 Colbach, N. 859
 Coleman, DC. 863
 Collar, C. 1420
 Collinge, DB. 1204
 Colliver, DG. 1337
 Convertini, G. 692, 724
 Cook, GH. 1287
 Corazza, L. 1240
 Corbellini, M. 1468
 Cornec, M. 1409
 Corsetti, A. 1442
 Cosentino, S. 1199
 Cosic, T. 910
 Cotterill, PJ. 1241, 1242
 Cottyn, BG. 1352
 Cox, TS. 979
 Cravey, MD. 1355
 Crini, M. 737
 Croker, SJ. 1159
 Crosatti, C. 1109
 Crossa, J. 1036
 Cubadda, R. 1402
 Cunfer, BM. 949, 1297
 Curran, SP. 979
 Custic, M. 910
 Cyrus, P. 1083
 D'Addabbo, T. 1215
 D'Ovidio, R. 911
 Dabkevicius, Z. 733
 Dahiya, S.S. 1504
 Dale, MRT. 1066
 Dambergs, E. 912
 Dancak, I. 705
 Danial, D.L. 913, 1243
 Danisova, C. 1477
 Dardenne, P. 1457
 Dardevet, M. 1400
 Darmody, RG. 826
 Darroch, BA. 1129
 Datta, P.S. 1098
 Davidek, J. 1490
 De Freitas, J.G. 775
 Deacon, JW. 1211
 Decarvalho, FIF. 918
 Dedryver, CA. 1214
 Defrancischi, MLP. 1403
 Degidio, MG. 1404
 Degler, H. 693
 Degtyareva, S.S. 1015
 Deidda, M. 1141
 Dejene, D. 1331
 Dekogel, WJ. 1057
 Dekov, D. 694
 Delahoz, PS. 1084
 Delapena, RC. 988
 Delhay, S. 1499
 Delmoral, LFG. 736
 Delmoral, MBG. 736
 Deng, G. 1109
 Deltoro, E. 1036
 Dencic, S. 985
 Deneergaard, E. 1204
 Deng Luguang 1011
 Dennert, J. 873
 Deppert, WR. 1130
 Devega, A. 1350
 Devienne, F. 1104
 Devonpienaar, R. 969
 Devoti, P. 690
 Devyatkina, Eh.P. 994, 1002
 Dewit, W. 1368
 Dhaliwal, H.S. 1021
 Dhaubhadel, S. 1093
 Dhillon, S.S. 806
 Di Bari, V. 692, 724, 860
 Di Fonzo, N. 1100
 Di Vincenzo, G. 1163
 Dib, TA. 1131
 Dietz, K.J. 1085
 Dillwith, JW. 1227
 Dimitrov, I. 783
 Dimitrova, F. 778
 Dinev, NS. 825
 Ding Zhengrong 695
 Ding, K. 1405
 Dmutrakova, L.K. 794
 Doebereiner, J. 1387
 Doerk, H. 1492
 Dohmen, G. 914
 Dong Helin 788
 Dong, H. 1216
 Donhauser, S. 1461, 1469
 Dore, J. 1078
 Douglas, LI. 1211
 Doussinault, G. 915
 Dreschers, J. 1153
 Duan Shuangke 916
 Dubois, D. 1244
 Ducher, M.L. 945
 Dudich, D. 757
 Duffus, CM. 1180
 Duffy, BK. 1245
 Duga Debele 850
 Duhan, JC. 760
 Duijff, BJ. 1057
 Dunaeva, M.V. 1307
 Duncan, AJ. 1351
 Dunin, FX. 1056
 Dunker, RE. 826
 Dunn, MA. 1040
 Dupla, B. 1246
 Dusch, E. 672
 Dusek, DA. 821
 Dutoit, F. 974
 Dvorak, J. 953
 Dweikat, I. 917
 Dyer, PS. 1247
 Eisenberg, B. 1470
 Ekelund, F. 1055
 El Samahy, S.K. 1439
 Elbek Pedersen, H. 862
 Elbersen, LR. 1225
 Elhamid, MA. 1330
 Ellert, BH. 827
 Elsherif, M. 1132
 Emmermann, M. 1124
 Enari, TM. 973
 Ender, M. 918
 Engels, F.M. 1260
 Engqvist, G. 948
 Ercoli, L. 696
 Estiarte, M. 1133
 Fairbanks, DJ. 1012
 Falk, S. 1134
 Fandlova, M. 1248
 Fang Xuanming 907
 Faroda, AS. 874
 Farrington, J. 674
 Federizzi, LC. 918
 Feldman, M. 919
 Felicio, J.C. 775
 Felix, I. 920
 Feller, U. 1067
 Felton, WL. 870
 Feng Chaozhang 1071
 Feng, MG. 1225
 Fenz, R. 1488
 Ferguson, AH. 847
 Fern, M. 1383
 Ficher, RA. 697
 Fiems, LO. 1352
 Fiez, TE. 698
 Filippova, G.G. 1249
 Finardifilho, F. 1413
 Fincher, G.B. 1154
 Fischbeck, G. 873
 Fischer, RA. 1170
 Fischer, T. 861
 Fisher, JM. 1042
 Flachowsky, G. 1374
 Fodor, A. 921
 Fondevila, M. 1350
 Formanova, M. 1250
 Forster, BP. 937
 Foschino, R. 1406
 Frampton, GK. 864
 Franchi, A.S. de 922
 Francki, MG. 923
 Franco, F. 959
 Frank, AB. 1135
 Frankenberger, WT. 1063
 Frederick, JR. 776
 Frei, P. 1256
 French, RJ. 804
 Fretzdorff, B. 1471, 1472
 Fricke, E. 779
 Friebe, B. 924, 946
 Friend, AD. 1136
 Froidmont, F. 925
 Froseth, JA. 1360
 Fuchs, W. 780, 1473
 Fukai, S. 1194, 1195, 1196
 Fukushima, Y. 926
 Fulcher, RG. 1435
 Fursov, O.V. 893
 Fushiya, S. 1091
 Gaal, O. 1474
 Gajdalenok, R.F. 927, 952
 Galasso, I. 1005
 Galiba, G. 1172
 Galili, G. 1188
 Gallenberg, D.J. 1251
 Galli, A. 1406
 Galova, Z. 1500
 Gantar, M. 1058
 Gao Bida 1252
 Gao Mingwei 941
 Gao Yuzhu 1073
 Gaonker, SBN. 1137
 Gara, L. de 895
 Garab, G. 1161
 Garcia, RL. 1133
 Gardstrom, P. 1146
 Gardner, PA. 867
 Garg, GK. 1093
 Gately, TF. 781
 Gawronska, H. 1138
 Gay, G. 900
 Geffert, A. 1502
 Geiger, E. 1469
 Geiger, HH. 914
 Gelroth, JA. 1424
 George, SK. 1233
 Gergely, A. 1474
 German, SE. 1253
 Germida, JJ. 1290
 Gerowitt, B. 699
 Gerts, S.M. 1193
 Getnet Gebeyehu 689
 Gherbin, P. 922
 Ghildiyal, MC. 1187
 Ghisalberti, EL. 1300
 Giardini, L. 1139
 Gil, Z. 928, 929
 Gill, BS. 924, 946, 990
 Gill, KS. 990
 Gill, MA. 782
 Gillespie, RL. 1217
 Gilligan, CA. 1254, 1255
 Gindrat, D. 1256
 Giorgio, D. de 700, 860, 1140
 Giovanelli, G. 1441
 Giref Sahile 701, 1321
 Girma Getachew 702, 703
 Giroux, M. 963
 Giunta, F. 1141
 Giupponi, C. 1139
 Givovich, A. 1218
 Glen, DM. 1233
 Glenn, GM. 1407
 Gniazdowskaskoczek, H. 1142
 Gobbetti, M. 1442
 Godbold, D. 1121
 Goodman, T. 1369
 Goos, RJ. 1143
 Gorham, J. 1114
 Gorpichenko, T.V. 1079
 Gospodinov, M. 783
 Graeber, S. 1475
 Grafelman, DD. 1408
 Gras, PW. 970
 Graser, S. 704
 Gray, L. 1041
 Gray, R. 670
 Graybosch, RA. 962
 Graziano, S.F. 922
 Gregorich, EG. 827
 Grevy, L. 1065
 Grewal, HS. 868
 Grewal, RS. 1372
 Griffin, M. 1394
 Grodzinski, D.M. 995
 Gromova, Z. 705
 Grossi, M. 930
 Grossmann, F. 1132
 Grzelak, K. 1138
 Gu Defeng 931
 Gu Yunjie 1073
 Guada, JA. 1350
 Gualberto, DG. 1397
 Gudmunds, K. 672
 Guenter, W. 1353
 Guivarch, J.P. 706
 Gullner, G. 1201
 Gumisiriza, G. 707
 Gunasekaran, S. 1405
 Guo Jianhua 784
 Guo Peizong 1219
 Gupta, KC. 1329
 Guseva, NN. 1236
 Guseva, O.G. 1220
 Gustafson, J.P. 932
 Gustin, F. 1064, 1065
 Guy, S.O. 723
 Haber, T. 1476
 Habermeyer, J. 1257
 Hackett, CA. 1276
 Hadjichristodoulou, A. 933, 934, 935
 Hadorn, R. 1375
 Haensel, A. 722
 Haensel, A. R. 780
 Hailu Beyene 1086, 1320
 Hakro, AA. 936
 Hald, A.B. 862
 Halevi, A. 1348
 Hamann, DD. 1410
 Hamer, RJ. 1438
 Hammed, M.Y. 708
 Hammer, GL. 1196
 Hammer, K. 1005
 Hammond, JJ. 940
 Han Xincheng 1020
 Han Yang 790
 Han, O.K. 909
 Handley, LL. 937
 Handreck, B. 1443
 Hanhart, H. 738
 Hanna, MA. 1398, 1399
 Hansen, J.F. 785
 Hansen, OB. 1266
 Hansson, L. 1144
 Hanus, H. 1189
 Hao Zhengrong 1008, 1038
 Hargreaves, J. 1409
 Harper, LA. 863
 Harrison, DF. 709
 Harrison, J. 1185
 Harthill, JE. 1087
 Hartley, SE. 1351
 Hartmann, A. 1387
 Hartmann, R. 1376
 Harvey, T. 1213
 Harvey, TL. 978, 979
 Harwood, J. 678
 Hasenkamp, D. 679
 Hasken, KH. 1221
 Hatchett, JH. 979, 982
 Hautala, Marja 1354
 Hay, RL. 1393
 Hayes, PM. 997, 1092, 1127
 He Changyong 822
 He Dexian 938
 He Shixian 939
 He Suiquan 1145
 He Xiong 695
 Heathcote, DG. 1059
 Heddleson, SS. 1410
 Hee, F.P. van 1260
 Heilmann, JL. 1156
 Hein, GL. 1225
 Heinzmann, U. 1387
 Heitefuss, R. 755
 Helin, J. 1411

- Hendrix, PF. 863
 Henke, GE. 981
 Herter, T. 1479
 Hessberg, H. 914
 Heyland, K.U. 786
 Hick, PT. 1191
 Hicks, SK. 1156
 Higasa, T. 1428
 Higuchi, K. 1060, 1091
 Hill, JP. 1258
 Hizukuri, S. 1430
 Hnilica, P. 1496
 Hoffmann, GM. 1257
 Hofmann, G. 1462
 Holeckova, J. 984, 1500
 Holland, JM. 864
 Holm, PB. 753
 Holm, S. 865
 Holotnakova, H. 1477
 Hong, B.H. 1088, 1089
 Hooks, CL. 826
 Hoover, R. 1412
 Horn, GW. 1355
 Horn, M. 974
 Horsch, D. 828
 Horsley, RD. 940
 Hostrup, S.B. 1501
 Hou Youming 1226
 Hozova, B. 1477
 Hsiao, AI. 1335
 Hu Tianci 941
 Huang Changhua 1259
 Huang Jidong 942
 Huang Liye 1037
 Huang Tianrong 1044
 Huber, H. 1444
 Hubilla, P.R.L. 1356
 Huebner, G. 1445
 Huegel, C. 1463
 Huertaespino, J. 1286
 Huffaker, RC. 1117
 Hughes, MA. 1040
 Huner, NPA. 1134
 Huo Qingtao 971
 Hur, J.W. 1447
 Hurry, V. 1146
 Hussain, A. 943
 Hutter, K. J. 1478, 1479
 Hvelplund, T. 1501
 Iacono, E. 911
 Iason, GR. 1351
 Ibragimov, TZ. 1147
 Ida, EI. 1413
 Idso, SB. 1133
 Ignat'ev, L.A. 1308
 Inagaki, M. 944
 Inbort, Johan 1357
 Ingham, RE. 1287
 Islam, H. 992
 Ivanov, I.I. 1090
 Ivanova, I. 694
 Izaurralde, RC. 833
 Izidorczyk, MS. 1423
 Jacob, H.J. 1107, 1386
 Jacobs, T. 1260
 Jaervempaee, Markku 710
 Jakabne Kondor, M. 1238
 Jalil, S.A. 951
 James, RA. 867
 Jana, S. 1261
 Jansen, H. D. 1480
 Janzen, HH. 833, 1052
 Jasper, J. 882
 Jenny, E. 1244
 Jensen, B. 1148
 Jepson, PC. 1232
 Jeraj, A. 869
 Jerkovic, Z. 985
 Jeroch, H. 1358
 Jestin, L. 945
 Jevtic, R. 985
 Jian Lingcheng 1309
 Jiang Jiyun, Fen Beili 817
 Jiang, HY. 829, 830
 Jiang, J. 924, 946
 Jin Ziyu 747
 Jin, Y. 1262
 Jing Jinxue 1263
 Jing Lanhua 1009
 Jing, Z. 947
 Jovic, B. 807
 Jacobs, Th. 1269
 Joensson, R. 948
 Johansson, K. 1144
 Johnson, BE. 1143
 Johnson, D. 1119
 Johnson, DA. 898
 Johnson, JB. 1225
 Johnson, JW. 949
 Johnson, Roy 950
 Johnston, RK. 1407
 Jones, OR. 821
 Jones, SS. 988
 Jonikas, V. 733
 Josephides, C. 711
 Josephides, C.M. 1222
 Jungk, A. 1108
 Juza, L. 1264
 Kaczowski, J. 1116
 Kadir, M.A. 682
 Kahsay Berhe 702, 703
 Kaim, MS. 1112
 Kaiser, WM. 1155
 Kalinina, IG. 1202
 Kalinowski, R. 1446
 Kamel, A.H. 1265
 Kampmann, HH. 1266
 Kanazawa, K. 1060, 1091
 Kaneda, C. 989
 Kapoor, A.C. 1504
 Kaptas, T. 1246
 Karanja, Daniel D. 712
 Karapetyan, N.V. 1332
 Karczmarczyk, S. 713, 714
 Karev, K. 1384
 Kari, A.G. 1267
 Karsai, I. 997, 1092
 Kasai, M. 1208
 Kashemirova, L.A. 1249
 Kashyap, RK. 759, 760
 Kauppinen, V. 754, 973
 Kauppinen, Veli 1013
 Kayonga, J.B. 768
 Keane, A. 1411
 Kehlenbeck, H. 1268
 Kehrler, RL. 1012
 Kemp, WP. 1217
 Kenefick, DG. 1192
 Kerby, NW. 1058
 Keregero, MM. 1414
 Kertikov, T. 866
 Ketova, T.A. 1015
 Ketting, DL. 1227
 Ketterer, M. 1440
 Kettlewell, P.S. 787
 Khajdarova, Zh.S. 893
 Khan, B.R. 673
 Khan, M.A. 951
 Khanna, VK. 1093, 1152
 Khanzada, AK. 936
 Khartleb, K. 1236
 Khokhlova, L.P. 1310
 Khrabrova, M.A. 927, 952
 Kichatinova, S.V. 1149, 1197
 Kidd, G. 953
 Kim, C.B. 1389
 Kim, H.Y. 1447
 Kimball, BA. 1133
 King, LG. 818
 Kinyua, M.G. 954, 955
 Kirby, EJM. 1150
 Kirchgessner, M. 1366
 Kirchhof, G. 1387
 Kirigwi, F.M. 913, 955
 Kiriswa, F. 1243
 Kiriswa, F.L. 1269
 Kirkegaard, JA. 867
 Kirrigwi, F.M. 1243
 Kishor, N. 956
 Kjellerup, V. 785
 Kjer, I. 715
 Kleemola, J. 1151
 Klem, K. 1295
 Klemencic, S. 869
 Klepper, BL. 1179
 Klopfenstein, CF. 1494, 1495
 Klughammer, B. 1085
 Klyachko, N.L. 1307
 Knauer, N. 716
 Knoetzel, J. 1209
 Knudsen, GR. 1223
 Knudsen, S. 753
 Kobus, J. 1385
 Koch, J. 1198
 Kochubej, S.M. 1110
 Kodali, S. 1093, 1152
 Koebner, R.M.D. 957
 Koehler, R. 1376
 Koenig, J. 904, 958
 Kogel, KH. 1153
 Kohli, M.M. 959
 Kohli, Man Mohan 1270
 Kohlus, R. 1480
 Kolar, JS. 868
 Kolev, T. 694, 798
 Kolmer, JA. 1253
 Kolupaev, Yu.E. 1094
 Komissarov, GG. 1202
 Komives, T. 1201
 Koncos, P. 680
 Kondrat'ev, M.N. 1105
 Konishi, T. 926
 Kontraszt, M. 1474
 Koppi, AJ. 824
 Koreleski, J. 1359
 Korytov, M.V. 1316
 Kosar, K. 960
 Kosmacheva, I.A. 993
 Koszanska, E. 713
 Koszanski, Z. 714
 Kovaleva, N.M. 952
 Kraemer, J. 1488
 Krag, CR. 1223
 Kralovic, J. 1311
 Kramberger, B. 869
 Kranz, J. 1298
 Kraska, T. 1305
 Kraszewski, AW. 1415
 Kraus, I. 1481
 Kravtsova, L.A. 1022
 Kredatus, S. 1344
 Krenzer, EG. 1355
 Kretschmer, H. 1448
 Kreuz, E. 831
 Kreuzaler, F. 1272
 Krippel, E. 1288, 1289
 Krol, M. 1385
 Kromer, S. 1146
 Krottenthaler, M. 1440, 1485
 Kruf, V. 1124
 Kruk, M. 1431
 Kuang Tingyun 1312
 Kucerova, Z. 1224
 Kucherenkova, N.N. 1310
 Kudoyarova, G.R. 1090
 Kuhn, M. 1475
 Kuhn, M. 1491
 Kulichova, R. 1274
 Kulik, D. 832
 Kumar, A. 1207
 Kummert, J. 1271
 Kurdyukov, YF. 883
 Kurtboke, DI. 1182
 Kuznetsov, YV. 1202
 Kvasnicka, F. 1490
 Kwakernaak, C. 1368
 Labanderagonzalez, CA. 836
 Lacerenza, N.G. 930
 Lafiandra, D. 976
 Lai, D.M.L. 1154
 Lajolo, FM. 1413
 Lamorte, RL. 1133
 Lancaster, GK. 1284
 Landry, J. 1499
 Lang, B. 1085, 1155
 Lang, L. 961
 Lang, W. 1449
 Langdale, GW. 863
 Langemeier, JM. 1424
 Langne Molnar, M. 921
 Langridge, P. 923, 1000, 1042
 Lanning, SP. 977
 Lapiere, HD. 1239
 Lapitan, NLV. 990
 Larney, FJ. 833
 Lascano, RJ. 1156
 Lassoie, S. 1378
 Lauber, U. 1463
 Lazauskas, S. 733
 Le Blanc, A. 945, 958
 Lebedeva, A.I. 1193
 Lebedinskaya, S.O. 1105
 Lee, DW. 1157
 Lee, JH. 962
 Lee, S.H. 1389
 Leech, RM. 1181
 Lees, AK. 1158
 Legg, DE. 1225
 Leitao, RFF. 1403
 Lejina, B. 717
 Lelo, T. 797
 Lemeste, M. 1409
 Lenton, JR. 1159, 1160
 Leonardi, S. 1163, 1164
 Lepoivre, P. 1237
 Leroy, P. 963
 Leslie, J. 718, 719
 Leviminzi, R. 1061
 Li Biyun 906
 Li Destri Nicosia, O. 741
 Li Famin 720
 Li Guoquan 964
 Li Jianhong 1259
 Li Junyi 788
 Li Keyou 1095
 Li Meng 964
 Li Qingdian 1303
 Li Ruping 721
 Li Wenxiong 965
 Li Xiuyun 742
 Li Zhenqi 1263
 Li Zhenzhen 790
 Liang Jincheng 938
 Liang Zhuqing 941
 Liao, K. 1416
 Liao, YC. 1272
 Liebert, F. 1376
 Liker, E. 1161
 Limpert, E. 966
 Lind, V. 967
 Lindwall, CW. 833
 Lineback, DR. 1410
 Lippold, H. 789
 Litkovskaya, N.P. 927
 Litrico, P.G. 1164
 Little, R. 968
 Littlejohn, GM. 969
 Liu Bo 931
 Liu Changhong 916
 Liu Jun 1317
 Liu Rongkun 790
 Liu Rongrong 788
 Liu Shaoyou 1226
 Liu Yuheng 784
 Liu, CY. 970
 Liu, YG. 987
 Lloyd, JC. 756
 Loboda, T. 1162
 Logvinenko, V.F. 986
 Lombardo, M.G. 1163, 1164
 Lonneborg, A. 1200
 Lopez, SC. 770
 Lorenz, K. 1417, 1482
 Loshchinina, LP. 883
 Loue, A. 1106
 Lu Congming 1312
 Lu Debin 971
 Lucas, JA. 1247
 Lucas, P. 859
 Luehe, H. 722
 Lueschen, G. 746
 Luettger, A.B. 791
 Lukaszewski, AJ. 972
 Lukin, S.M. 812
 Lukman Al' Karim 1314
 Lukow, O.M. 943
 Lukow, OM. 1437
 Lumley, ID. 1394
 Luo, YM. 1165

- Lutz, J. 966
M'ngova, M. 1483
Ma Yuanxi 1062
Maaheimo, H. 1411
Macchioni, P. 1367
Macgregor, AW. 1418
Mackenzie, S. 917
Macnish, GC. 1273
Macri, LJ. 1418
Madry, W. 1506
Mahalakshmi, V. 1115, 1170
Mahler, R.L. 723
Maiana, M.P. 744
Maidl, FX. 873
Maillard, A. 1256
Maiorana, M. 692, 724, 860, 1240
Majeed, A. 818
Makke, A. 725
Malleshi, NG. 1434
Mallorysmith, CA. 1333
Mambelli, S. 881
Mannerkorpi, P. 1377
Mannonen, L. 973
Manske, G.G.B. 791
Mao Yanlin 1050
Mao Zijun 877
Maracchi, G. 1168, 1169
Marais, AS. 975
Maraus, GF. 974, 975
Margiotta, B. 976
Marinetto, J. 736
Mariotti, M. 696
Maroquin, C. 925
Marschner, H. 845, 1118
Marseille, JP. 1438
Marshall, EJP. 1322
Martens, DA. 1063
Martin, BC. 1205
Martin, JM. 977
Martin, LM. 1392
Martin, P.K. 957
Martin, RJ. 870
Martin, TJ. 978, 979
Martinez, I. 980
Martinezanaya, MA. 1419
Martinezcarasco, R. 937
Martinsson, KA. 1362
Masauskas, V. 733
Mascaros, AF. 1420
Mason, MG. 804
Masoni, A. 696, 1096
Massantini, F. 1096
Mathot, P. 1378, 1503
Matsumoto, H. 875, 1208
Matzel, W. 789
Maurantonio, G. 741
Maziadixon, BB. 1494, 1495
Mcbratney, AB. 824
Mccarthy, PK. 1394
Mccollum, FT. 1355
Mcguire, CF. 1421
Mckendry, AL. 981
Mckersie, BD. 1076
McLaren, RG. 709
McMaster, G.S. 1507
Mcmaster, GS. 819, 1166
Mcnullan, MS. 1284
McNeilly, T. 889
McNiven, MA. 1365
Meagher, MM. 1408
Medd, RW. 871
Meharg, AA. 1167
Meier Ploeger, A. 715
Mel'nikova, E.A. 890
Melese Alemu 1281
Melkamu Ayalew 1280, 1281
Mendelhartvig, J. 1119
Mengel, K. 792
Mengistu Huluka 835
Menkovska, M. 1097
Merbach, W. 1107
Merckx, R. 1069
Merkle, OG. 982
Merlino, M. 963
Mesele Alemu 1280
Meshcheryakov, A.B. 1314
Metakovsky, E.V. 983
Metzger, M. 1484
Meyer, D. 1108
Meyer, NC. 1128
Miao Lianhe 1219
Michalik, I. 984, 1500
Michalikova, A. 1274
Michrina, J. 1274
Miedaner, H. 1485
Miglietta, F. 1168, 1169
Mihaljev, I. 985
Mikic, D. 985
Miklovicova, M. 1288, 1289
Miller, BC. 698, 810, 811
Miller, BM. 1396
Miller, HL. 1227
Miller, MC. 1360
Miller, RH. 1230
Miller, TD. 1230
Millet, E. 919
Milosev, D. 872
Minaeva, S.V. 1313
Minarzhikova, V. 1236
Mirali, N. 726
Miron, J. 1348
Mirza, SH. 992
Mishchenko, L.N. 1323
Misic, T. 985
Misri, G. 1265
Modestus, W.K. 834
Moeller, E. 1501
Mohammed, A.H. 1342
Molchanova, LM. 993
Moll, M. 1450
Moller, BL. 1209
Molnar, I. 872
Monneveux, P. 888, 1131
Monreal, CM. 827
Monteleone, M. 922
Moore, W. 1435
Morenomartinez, E. 761
Morgan, A.J. 1379
Morgenstern, G. 1489, 1493
Morgun, V.V. 986
Mori, N. 987, 989
Mori, S. 1060, 1091
Mori, T. 1428
Morozkin, A.D. 1079
Morrison, WP. 1213
Mosaad, MG. 1170
Moshiringwani, N.A. 727
Moskaleva, N.A. 1282
Mottram, DS. 1395
Motzo, R. 1141
Mouritzen, P. 753
Mourya, B.M. 820
Moyer, JL. 844
Mtebe, K. 1414
Mtisi, E. 727
Mueller, A. 780
Mueller, H.M. 1462, 1463
Muench, C. 793
Mujeeb Kazi, A. 1035, 1041
Mujeebkazi, A. 944, 1036
Mukhin, V.P. 1323
Multani, D.S. 1021
Munch, S. 1153
Munns, R. 867
Murray, TD. 988
Musick, JT. 821
Mustafa, U. 1382
Muyanga, Samson 728
Mwangi, H. 797
Mwangi, W. 816
Mwangi, Wilfred 748
Myagmarsuren, Y. 1171
Nabulsi, I. 726
Nachit, M. 888
Nachit, MM. 1131
Nagarajan, S. 897
Nagy, Z. 1172
Nakamura, C. 989
Nakata, N. 891
Namuth, DM. 990
Narayan, MS. 1436
Narziss, L. 1440, 1485
Naumenko, T.L. 991
Naumenko, V.D. 995
Navarrete, R. 761
Neese, PA. 1227
Negre, S. 963
Negri, D. 753
Negusie Tadese 744, 835
Nejkova Bocheva, E. 778
Nelsen, TC. 1396
Nelson, KE. 1275
Nelson, SO. 1415
Nenkova, D. 694
Nessa, D. 992
Netcheva, V. 825
Nettevich, Eh.D. 993
Neumann, H. 1493
Neumann, L. 1486
Nevo, E. 937
Newton, AC. 1276
Nicholson, P. 1158
Nicolas, P. 980
Niehoff, B. 1228
Nielsen, TH. 1173
Nielsen, VS. 1209
Niemeyer, HM. 1218
Nikitishen, V.I. 794
Niks, RE. 1277
Nirno, M. de 741
Nishizawa, NK. 1060, 1091
Nkusi, J.B. 768
Novokhatin, V.V. 893
Nowierski, RM. 1225
Numerova, O.M. 994, 1002
Nurminskaya, L.O. 1079
Nyaki, A.S. 729
Nyborg, M. 833
O'Rourke, A.D. 675
Obenland, DM. 1174
Obst, A. 1278
Obuchowski, W. 929
Odonovan, JT. 1333
Oduor, P.O.S. 764
Ohn, H. 917
Ohtani, K. 989
Okon, Y. 836
Olin, A. 1144
Oliveira, A.J. de 795, 796
Olofsdotter, M. 1324
Olsen, C.C. 851
Olsen, FL. 753
Olson, BM. 833
Onofrii, M. 730
Ooro, P. 797
Opalka, J. 1421
Oquist, G. 1146
Orriss, G.D. 1340
Ortiz Ferrara, G. 1047
Ortizferrara, G. 1115, 1170
Ostapenko, E.K. 995
Otani, M. 996, 1028
Ougham, HJ. 1185, 1186
Owen, E. 1371
Owuoche, J.O. 797
Oxelfelt, P. 1299
Oyanagi, A. 1175
Pachepskaia, L.B. 1193
Pagani, M.A. 1406
Pakniyat, H. 937
Pallotta, MA. 1000
Pan, A. 997
Pan, WL. 698, 810, 811
Panajotova, G. 798
Panayotov, I. 989
Pancaldi, D. 1279
Pande, P.C. 1098
Pandey, A. 1176
Pandi, F. 1451
Panghal, J.S. 1372
Pankovic, L. 985
Panse, A. 873
Paoletta, G. 741
Papa, R. 998, 999
Papaikononou, M. 1247
Papakosta, DK. 799
Park, G.G. 1081
Park, M.W. 909
Park, N.K. 1389
Park, RF. 1241
Park, S.D. 1389
Parry, DW. 1158
Patil, VP. 901
Patterson, F. 917
Paul, Y.S. 1280, 1281
Paull, JG. 1000
Paulsen, MR. 1416
Peacock, JM. 1115
Peairs, FB. 1216, 1225
Pearce, JD. 1233
Pearson, CH. 731
Pearson, JN. 1177
Peberdy, JF. 1247
Pedersen, C. 1027
Peeper, TF. 1327
Peltonen, J. 1001, 1151
Peltonen, Jari 800
Peltonensainio, P. 1001, 1151
Peng Furong 1048, 1049
Penny, R.H.C. 1361
Penson, SP. 1178
Penuelas, J. 1133
Perenzin, M. 894, 902
Permyakov, A.V. 1149, 1197
Perras, MR. 1099
Ferrino, P. 1005
Pershina, L.A. 994, 1002
Peter, W. 1358
Peterson, CJ. 962
Petkov, P. 732
Petkov, S. 732
Petratis, V. 733
Petrova, I. 677
Pettersson, T. 1362
Piao Tefu 1003
Piao Tiefu 1004
Picard, M. 1343
Pick, D. 672
Pignone, D. 1005
Pike, KS. 1230
Pikushova, Eh.A. 1282
Pinter, PJ. 1133
Pinthus, MJ. 772
Pinto, J.M. 712, 1006
Platan, C. 1100
Platz, GJ. 1242
Podlesak, W. 801, 805
Podsiadlo, C. 714
Poehling, HM. 1221, 1228
Poetschke, L. 1443
Pogna, N.E. 983
Politz, ML. 1422
Poljak, M. 910
Pollhamer, S. 1487
Polo, R. 1441
Pomar, MC. 802
Pomeranz, Y. 1433
Pontoppidan, H. 862
Popineau, Y. 1409
Popletaeva, EB. 1283
Popova, ZP. 883
Popp, F.A. 1479
Porceddu, E. 911
Porter, DR. 982, 1018
Porter, R. 1017
Potapova, T.A. 1022
Power, JF. 843
Pozsonyi, F. 1451
Prasanna, BM. 1007
Pritchard, IA. 804
Pritchard, J. 1102
Prokes, J. 1481
Prusakova, L.D. 1314
Pucek, TR. 837
Purnomo, E. 838
Pyl'nev, V.V. 1015
Pys, JB. 837
Qi Jiahua 1008, 1038, 1051
Qi Shiyu 1045, 1111
Qin Zhenjing 734
Qiu Quansheng 1009
Quick, JS. 1216
Quick, WA. 1335

- Quisenberry, SS. 1229
 Qureshi, RH. 1114
 Radik, J. 1128
 Raghavaiah, P. 1007
 RAHMATULLAH. 782
 Raimond, Y. 1065
 Raines, CA. 756
 Rajaram, S. 1035, 1036
 Rajput, S.C. 1010
 Rakhimberdieva, M.G. 1332
 Rakitin, L.Yu. 1079
 Rakotondramannana 735
 Ramanagowda, P. 885
 Ramirezgonzalez, J. 761
 Ramos, JM. 736
 Rana, RK. 1019
 Randhawa, A.S. 1021
 Randrianaivoarivony, J.M. 735
 Randriantsalama, R.A. 735
 Ranhotra, GS. 1424
 Rao, S.K. 1025
 Rascio, A. 1100
 Raso, E. 737
 Ratcliffe, R. 917
 Rath, F. 1488
 Rattan, O. 1423
 Raut, RN. 1007
 Raven, JA. 937
 Ravishankar, GA. 1436
 Rayburn, A.L. 1041
 Redaelli, R. 983
 Reddersen, J. 862
 Reddy, DV. 1363
 Rees, RG. 1241, 1242
 Regasa Ensermu 1325
 Reid, JF. 1416
 Reid, JSC. 1077
 Reis, Erlei Melo 1270
 Reiserer, HJ. 1272
 Rekib, A. 1364
 Remlein, E.I. 966
 Remus, R. 1386
 Ren Changzhong 1011
 Ren Yaoying 1004
 Rengel, Z. 910, 1177
 Renkonen, O. 1411
 Rezanoor, HN. 1158
 Rezene Fesehaie 1320
 Richterharder, H. 1189
 Rickman, RW. 1179
 Riede, CR. 1012
 Riffaldi, R. 1061
 Riffkin, HL. 1180
 Rimmer, DL. 1165
 Rinaldi, M. 860, 1140
 Ritala, Anneli 1013
 Rizza, F. 1109
 Rizzo, V. 692, 700, 724, 860, 1140, 1240
 Roberts, JJ. 949
 Robertson, EJ. 1181
 Robinson, PH. 1365
 Robison, LR. 1012
 Rodriguez, A. 1382
 Rodriguez, A.L. 673
 Rodriguez, D. 802
 Roemer, W. 803
 Rogers, DE. 1424
 Rohringer, R. 755
 Roisin, C. 1065
 Romero, A. 777, 839
 Romheld, V. 1118
 Romme, Y. 1153
 Ronalds, JA. 1120
 Ronga, C. 1100
 Ronn, R. 1055
 Rosa, F. la 1442
 Rose, PA. 1203
 Ross, JJ. 1337
 Rossi, J. 1442
 Rosso, F. 881
 Rothmaier, DA. 1366
 Rouchaud, J. 1064, 1065
 Roue, C. 753
 Rowell, P. 1058
 Rowland, C. 1300
 Rowland, CY. 1182
 Rowland, IC. 804
 Roy, I. 1014
 Roy, M. 713
 Rubiales, D. 1277
 Ruch, D. 1452
 Rudenko, T.I. 1193
 Rudolph, JB. 1216
 Ruhland, W. 738
 Ruppe, J. 805
 Russo, V. 1367
 Rutunga, V. 768
 Ruzieva, R.Kh. 1193
 Ryabchun, N.I. 1094
 Ryu, GH. 1425
 Saakov, V.S. 1306
 Sacher, B. 1453
 Saffigna, PG. 767
 Sagar, V. 1370
 Sah, DN. 1183
 Sahemedhin Sertsu 766
 Sahile, G. 1331
 Sairam, RK. 1184
 Sal'nikova, T.V. 1015
 Salgado, JM. 1403
 Salim, M. 782
 Sall, T. 1027
 Salmenkalliomarttila, M. 754
 Salonen, Jukka 1326
 Samalieva, A. 778
 Samra, JS. 806
 Samygin, G.A. 1315
 Sandukhadze, B.N. 1016
 Sanin, SS. 1147
 Santamaria, GE. 802
 Saric, M.R. 807
 Sarkar, A. 874
 Sarkar, AKD. 1014
 Sarrafi, A. 892, 1239
 Sasaki, M. 875
 Sasanelli, N. 1215
 Sato, K. 829, 830
 Sattelmacher, B. 1388
 Saviozzi, A. 1061
 Sayers, EJ. 1043
 Scarpa, J. 1426
 Schildbach, R. 1454
 Schipper, A. 1427
 Schippers, B. 1057
 Schlöter, M. 1387
 Schmidt, CP. 840
 Schnitz, UK. 1124
 Schneeberger, Walter 739
 Schneider, M. 1505
 Schoenbeck, F. 1305
 Schotzko, DJ. 1223, 1229
 Schroeder, G. 780
 Schroeder, SW. 1418
 Schulman, AH. 1200
 Schunmann, PHD. 1185, 1186
 Schwab, CV. 1337
 Schwabe, M. 1488
 Schwartz, HF. 1284
 Schwarz, PB. 940
 Sciazko, D. 713
 Scott, MP. 1209
 Scott, RC. 1327
 Scrimgeour, CM. 937
 Sears, E.R. 932
 Sears, RG. 979
 Sebesta, EE. 1017, 1018
 Sebesta, J. 1250, 1285
 Segal, G. 1188
 Seguchi, M. 1428
 Seguenza, S. 1367
 Sehrawat, KD. 1019
 Seib, PA. 1429
 Seibel, W. 740, 1439, 1489
 Seid Ahmed 835
 Seifers, DL. 979
 Seiffert, M. 1455
 Sekhon, N.K. 1101
 Selmen, A.A.K. 808
 Semal, J. 1237
 Semenova, A.V. 1306
 Seppo, A. 1411
 Seyoum Bediye 702, 703
 Sha Li 1011
 Shah, N.A. 1382
 Shang Hongsheng 1263
 Shang Junhua 1020
 Shankar, M. 1182
 Sharma, GL. 855
 Sharma, IM. 876
 Sharma, K. 876
 Sharma, PD. 1113
 Sharma, S.K. 1021
 Sharmanatu, P. 1187
 Shaw, AC. 1203
 Shchapova, A.I. 1022
 Shen Jiaheng 1210
 Shen Sile 1030
 Shen Xiuzheng 814
 Shende, ST. 1176
 Sheoran, IS. 759
 Shepherd, KW. 970
 Shevchenko, O.V. 1110
 Shevlyakova, N.F. 1023
 Shi Chunxi 1328
 Shi Xiangyu 939
 Shi, YC. 1429
 Shibanuma, K. 1430
 Shibata, S. 1430
 Shimada, T. 996, 1028
 Shimoni, Y. 1188
 Shukla, NP. 1364
 Shumnyj, V.K. 1002
 Sidhu, AS. 841
 Sieling, K. 1189
 Siman, G. 1144
 Simon, AM. 1296
 Simon, JC. 1214
 Singh, B. 773, 868
 Singh, B.P.N. 1456
 Singh, C.B. 1025
 Singh, D.S. 1456
 Singh, D.V. 897
 Singh, G. 1101, 1329
 Singh, J. 773
 Singh, M. 1115
 Singh, NK. 1432
 Singh, P.P. 1024
 Singh, RP. 1286
 Singh, V. 809
 Sinmena, B. 1123
 Sinnaeve, G. 1457
 Sivasithamparam, K. 1182, 1300
 Skeritt, JH. 1393
 Slade, A.M. 1154
 Slade, L. 1410
 Slaski, JJ. 1190
 Sloderbeck, P. 1213
 Smedegaardpetersen, V. 1204
 Smeekens, S. 1200
 Smiley, RW. 1287
 Smith, EL. 1017, 1018
 Smith, JL. 811
 Smith, RCG. 1191
 Smodis, S. 869
 Smolin, V.P. 993
 Sokhansanj, S. 1449
 Sokolov, I.I. 1341
 Solberg, ED. 833
 Soldatov, S.E. 1313
 Song, I.K. 909
 Sopina, N.F. 1315
 Sorrentino, G. 741
 Souza, E. 1431
 Sowers, KE. 810, 811
 Spanakakis, A. 967
 Spiridonov, Yu.Ya. 1323
 Sreenivasa, MN. 1137
 Sreeramulu, G. 1432
 Srivastava, A. 1329
 Srivastava, A.N. 1025
 Srivastava, K.D. 897
 Stack, RW. 1143
 Stadt, KJ. 1066
 Stahlman, PW. 1330
 Stanca, A.M. 930, 1109
 Steffenson, BJ. 1262
 Steinhart, H. 1470
 Steinhauser, H. 704
 Stejskal, V. 1224
 Stelluti, M. 700
 Stephens, DJ. 1191
 Steppuhn, H. 842
 Stewart, BA. 821
 Steyer, S. 925
 Stieger, PA. 1067
 Stitt, M. 1200
 Stockle, CO. 818
 Stoyanova, SD. 762
 Strasia, CA. 1355
 Strecker, TD. 1433
 Strel'nikov, V.N. 812
 Strong, WM. 767
 Struck, C. 755
 Studdert, GA. 843
 Suhasini, AW. 1434
 Sumner, DA. 670
 Sun Benjin 742
 Sun Guangzu 1026
 Sun Lianfa 1111
 Sun Longhua 1309
 Sun Xianrong 877
 Sun Yanhao 878
 Sun, DW. 1338, 1339
 Sunderman, DW. 1431
 Sur, HS. 841
 Surkus, J. 733
 Susta, J. 1481
 Sutherewattananonda, M. 1435
 Sutherland, IW. 1058
 Sutka, J. 921, 966
 Sutton, F. 1192
 Sutton, KH. 1393
 Suvarnalatha, G. 1436
 Svec, M. 1288, 1289
 Svirashev, S. 1027
 Sweeney, DW. 844
 Sweetingham, MW. 1273
 Swinnen, J. 1068, 1069
 Sykora, M. 1288, 1289
 Szente, K. 1198
 Takeda, Y. 1430
 Takumi, S. 1028
 Talanova, V.V. 1313
 Talbert, L.E. 1029
 Talbert, LE. 977
 Talukdar, NC. 1290
 Tan Wanzhong 1291
 Tanigoshi, LK. 1230
 Tanner, D.G. 743, 744, 850
 Tanner, DG. 1331
 Tanner, Douglas G. 1321
 Tanskij, V.I. 1220
 Tanzarella, O.A. 911
 Tao Dan 1030
 Tao Shouxiong 878
 Tarafdar, J. 845
 Tatarintsev, N.P. 1193
 Taylor, GJ. 1066, 1121
 Teeri, Teemu 1013
 Tekalign Mamo 745, 879
 Teklu Erkosa 745, 879
 Temple, WD. 1053
 Templestuth, KE. 1160
 Teng, P.S. 1292
 Terekhin, M.V. 758
 Terekhova, I.V. 1332
 Terzi, V. 930
 Tesfaye Tesema 748
 Teshome Yizengaw 880
 Tessin, N. 1467
 The, TT. 1000
 Thewis, A. 1378
 Thiel, W. 746
 Thiele, A. 967
 Thill, DC. 1333
 THOMAS, 1194, 1195, 1196
 Thomsen, KK. 1087
 Thomson, E.F. 673, 951
 Thordalchristensen, H. 1204
 Thume, M. 1085
 Tian Guowei 1210
 Tian Xiaoming 1031
 Tiburzy, R. 1272
 Tilahun Geleto 885

- Timpa, J.D. 1422
 Titov, A.F. 1313
 Tittmann, G. 1376
 Tobiaseson, M. 1146
 Tomasoni, C. 730
 Tomcsanyi, A. 687
 Tomita, M. 891
 Tomos, D. 1102
 Tong Mingyao 1030
 Tonti, A. 1100
 Toro, E. del 1035
 Trapeznikov, V.K. 1090
 Travis, R.L. 1117
 Troshina, N.B. 1293, 1294
 Trufanov, V.A. 1149, 1197
 Tsunewaki, K. 987
 Tuba, Z. 1198
 Tudzynski, P. 914
 Tuleen, N. 924
 Tumans, V. 1334
 Turk, K.S. 1186
 Tuttobene, R. 1199
 Tvaruzek, L. 1295
 Tyutyun, A.I. 986
 Tyynela, J. 1200
 Tzvetkova, N.A. 1296
 Uddin, W. 1287
 Ueng, P.P. 1297
 Uhlen, G. 813
 Ullrich, S.E. 1360
 Uotila, M. 1201
 Urbano, M. 896, 976
 Urmanska, D. 984
 Uzik, M. 1032
 Vallega, V. 1404
 Vanags, I. 1334
 Vance, S.L. 826
 Vanderklis, J.D. 1368
 Vanhinne, M. 1064, 1065
 Vanhintum, T.J.L. 1033
 Vanveen, J.A. 1069
 Varghese, P. 901
 Vasanthan, T. 1412
 Vazquezbadillo, M.E. 761
 Velisek, J. 1490
 Venkataraman, L.V. 1436
 Venturi, G. 881
 Veretel'nik, E.Yu. 1282
 Verheye, W. 880
 Veronesi, F. 999
 Vershinin, A. 1027
 Vetelainen, M. 1034
 Vilenskij, E.R. 995
 Villareal, R.L. 1035
 Villareal, R.L. 1036
 Vincent, C. 1077
 Vincenzi, S. de 1442
 Virk, A.S. 1370
 Vizarova, G. 1080
 Vlek, P.L.G. 791
 Voelker, R. 1119
 Vogtmann, H. 715
 Vojnikov, V.K. 1316
 Volatier, C. 963
 Vonboberfeld, W.O. 882
 Vonbothmer, R. 1027
 Voronina, S.S. 1202
 Vorsatz, C. 793
 Voznyakovskaya, Y.M. 883
 Vukic Vranjes, M. 1380
 Vuorenmaa, Juhani 1354
 Waesberghe, J.W.M. van 1458
 Wagner, D. 1469
 Wagner, E. 1130
 Wagner, S. 1491
 Wagoire, W. 707, 968
 Wahl, T.I. 675
 Wahmhoff, W. 1212
 Walker, C.E. 1425
 Walker, M. 1119
 Walkersimmons, M.K. 1203
 Wall, G.W. 1133
 Wall, P.C. 777, 839, 884
 Wang Anzhu 1391
 Wang Bingkui 747
 Wang Caibin 878
 Wang Chenyang 1062
 Wang Futing 938
 Wang Huaguo 822
 Wang Jieyuan 1390
 Wang Jinglin 1498
 Wang Kening 1302
 Wang Kuibo 814
 Wang Mingzu 1231
 Wang Shengbing 1317
 Wang Xinzhang 815
 Wang Yingyu 1390
 Wang Zhifeng 1072
 Wang Zhifeng 1126
 Wang Zhigang 1037
 Wang Zhong 1073
 Wang Zixia 1008, 1038
 Wang, S.M. 1437
 Wanga, H. 954
 Ward, K.J. 691
 Wasserman, B.P. 1422
 Watts, B.M. 1437
 Webb, A. 672
 Weber, A. 1298
 Weber, C.W. 1397
 Webster, J.A. 982, 1017, 1018
 Wecke, C. 1376
 Weddelling, K. 1492
 Weegels, P.L. 1438
 Wei, Y.D. 1204
 Weller, D.M. 1245
 Wenk, C. 1375, 1380
 Wettstein, D. von 1039
 Weyhrich, R.A. 1205
 Weyman, G.S. 1232
 Wheeler, D.M. 846
 White, A.J. 1040
 White, G.M. 1337
 Whitwell, G. 681
 Widmark, A.K. 1299
 Wilde, G. 1213
 Wilhelm, W.W. 819, 843, 1166
 William, M.D.H.M. 1041
 Williams, K.J. 1042
 Willingham, N.M. 756
 Wilson, M.J. 1233
 Wiltshire, C.W. 1233
 Witt, M.D. 979
 Wojcieszka, U. 1206
 Wood, E.A. 1018
 Wood, M. 763
 Woods, J.L. 1338, 1339
 Worasatit, N. 1300
 Workneh Negatu 748, 816
 Worland, A.J. 1043
 Wraith, J.M. 847
 Wratten, S.D. 864
 Wright, S. 997
 Wrigley, C.W. 1120
 Wu Lanpei 1074
 Wu Liren 1301
 Wu Wei 1252
 Wu Xinyuan 1044
 Wulff, K. 1388
 Wyatt, C.L. 1369
 Wyatt, C.L. 1360
 Wysocki, D.J. 691
 Xia Baigen 971
 Xiang Qijun 1074
 Xiao Zhimin 1045, 1111
 Xie Shuixian 1302
 Xie Xiaoyu 815
 Xie, H.S. 1335
 Xin Wenli 1045
 Xing Zhu 784
 Xiong Xinzhou 877
 Xu Yaokui 931, 1003
 Yadav, B.S. 1370
 Yadav, R.D. 820
 Yadav, V.K. 1207
 Yadava, N. 1207
 Yakovleva, G.M. 757
 Yamamoto, Y. 875, 1208
 Yamashita, K. 1208
 Yan Jiakun 1231
 Yan Jianmin 1046
 Yang Chengde 1009
 Yang Huaan 1301
 Yang Jianye 1234
 Yang Xiangdong 720
 Yanoscheva, M. 1236
 Yao Wenguo 939
 Yasumuro, Y. 891
 Yau, S.K. 1047
 Ye Qinfu 721
 Yesanew Ashagrie 885
 Yi Huiying 1048, 1049
 Yi Jianlong 1318
 Yildirim, A. 988
 Yin Shaozhong 1219
 Yin Shixing 1498
 Yoo, S.D. 1088, 1089
 Youmans, J.D. 1297
 Young, H.C. 1017
 Yu Fengyi 749
 Yu Hongbing 1048, 1049
 Yu Meiyao 814, 1126
 Yu Shaohua 964
 Yu Zegao 1071
 Yu, S. 1053
 Yuan Yaping 1004
 Zabel, S. 1473
 Zaborin, A.V. 794
 Zagal, E. 848
 Zaman, M.S. 1371
 Zatkalikova, T. 1080
 Zeller, F.J. 966
 Zeman, S. 1497
 Zeng Hanbing 965
 Zentner, R.P. 1052
 Zhang Baojun 817
 Zhang Baomin 742
 Zhang Baoze 1318
 Zhang Chaomei 1050
 Zhang Fengming 695
 Zhang Maoyin 1051
 Zhang Ping 749
 Zhang Qide 1312
 Zhang Qigang 822, 1317
 Zhang Yuexue 1026
 Zhang Yuqun 1259
 Zhang Zhidong 1498
 Zhao Guidong 1303
 Zhao Kefu 1318
 Zhao Miaozhen 747
 Zhao Wencheng 750
 Zheng Qicheng 907
 Zhon Jize 1062
 Zhou Binxiang 1145
 Zhou Hongjie 749
 Zhu Kezhuang 720
 Zhu Xiandai 1046
 Zhu, X.Z. 1188
 Zhukova, T.M. 1103
 Zimmermann, H. 751, 752, 1459
 Zofajova, A. 1032
 Zounis, S. 1120
 Zuchner, S. 967
 Zuerner, I. 1480

KEYWORD INDEX

(1 >3, 1 >4) BETA GLUCANASES 1087
 (1 >4) BETA D GLUCANS 1077
 (CO₂) C 14 ASSIMILATION 848
 1B/1R TRANSLOCATION 962
 1B/1R TRANSLOCATION WHEATS 1437
 1BL/1RS 962, 1432
 2' DEOXYMUGINEIC ACID 1060, 1091
 2, 4 D 1327
 25 DESACETYLRIFAMPICIN 1245
 2ND CATEGORY TILERS 1189
 3 LEAF BLADES 1112
 3RD WAY 864
 500 MHZ H 1 NMR SPECTROSCOPY 1411
 5S DNA 898
 5S RDNA 898
 A/C I FUNCTION 1198
 ABA 1090, 1099
 ABIOTIC STRESS 1066
 ABSCISIC ACID 1099, 1102, 1123, 1159, 1160, 1172
 ABSCISIC ACID ACCUMULATION 1172
 ABSCISIC ACID LEVELS 1123, 1160
 ABSORPTION CROSS SECTION 1134
 ACCLIMATION 1181, 1198
 ACCUMULATION 1131, 1146, 1165
 ACETIC ACID 1377, 1441
 ACID 910
 ACID PHOSPHATASE 713, 1116
 ACID PHOSPHATASE ACTIVITY 845
 ACID SOILS 775, 797, 812, 959
 ACIDIC SUBSURFACE LAYER 838
 ACIDIFICATION 782, 910, 1455
 ACQUISITION 845, 1057, 1118
 ACTINOMYCETALES 1385
 ACTIVATED HAGEMAN FACTOR 1084
 ACTIVATION 1418
 ADAPTATION 910
 ADENOSINE TRIPHOSPHATASE 1210
 ADENOSINE TRIPHOSPHATE 1085
 ADENYLATE KINASE 1130
 ADP GLUCOSE PYROPHOSPHORYLASE 1200
 ADSORPTION 1144
 ADULT PLANT RESISTANCE 1014
 ADULTS 1219
 AEGILOPS 763, 895, 911, 987, 989, 1285
 AEGILOPS SQUARROSA 1036
 AEGILOPS UMBELLULATA 924
 AEGILOPS VENTRICOSA 1005
 AERIAL PARTS 799, 938
 AESTIVUM 924
 AFFINITIES 1430
 AFFINITY CHROMATOGRAPHY 1418
 AFRICA 684, 1047
 AGAR 757, 1092
 AGE 1349
 AGGLUTINATION 755
 AGRARIAN REFORM 704
 AGRICULTURAL CHEMICALS 1226
 AGRICULTURAL SOILS 1273
 AGRICULTURE 836, 864
 AGROBACTERIUM TUMEFACIENS 973
 AGROINDUSTRIAL COMPLEXES 676
 AGRONOMIC CHARACTERS 682, 904, 908, 909, 922, 938, 948, 1020, 1031, 1035, 1044, 1049, 1051, 1088, 1506
 AGRONOMIC PERFORMANCE 736
 AGRONOMIC VARIATION 1036
 AGRONOMY 673
 AGROPYRON ELONGATUM 946

AGROPYRON ELONGATUM
 CHROMOSOMES 969
 AIR 805, 1447
 AIR FLOW 1302, 1447
 AIR HUMIDITY 1162
 AIR TEMPERATURE 741, 805, 1108, 1125, 1199, 1447
 ALCOHOLIC FERMENTATION 1485
 ALEURONE 1087
 ALEURONE CELLS 1040, 1154
 ALFALFA 863, 1348
 ALFISOL 767, 1113
 ALIPHATIC ACIDS 1061
 ALLELES 1042
 ALLELOPATHY 1061
 ALLEY CROPPING 703
 ALLOZYME 1034
 ALMONDS 1405
 ALPHA AMYLASE 1084, 1159, 1408, 1418, 1472, 1491
 ALPHA ZEARALENOL 1396
 ALTERNATIVE FARMING 715
 ALUMINIUM 846, 910
 ALUMINIUM TOLERANCE 1190
 ALUMINIUM TOXICITY 1080
 ALUMINUM 825
 ALUMINUM RESISTANCE MECHANISMS 1121
 ALUMINUM STRESS 875
 AMARANTHUS 1491, 1504
 AMARANTHUS PROTOPLASTS 875
 AMERICANUM L LEEKE 1194
 AMIGO WHEAT 974
 AMINO ACID 1087
 AMINO ACID COMPOSITION 1499
 AMINO ACID SEQUENCE 1084
 AMINO ACIDS 1063, 1085, 1460, 1469
 AMMI MODEL 894
 AMMONIA 793, 863, 1371, 1377, 1383
 AMMONIA TREATMENT 1350
 AMMONIUM 1155
 AMPHIPLOID 1114, 1392
 AMPLIFICATION 917, 977
 AMPLIFIED POLYMORPHIC DNA 1158
 AMYLASES 893, 1015, 1116, 1349
 AMYLOPECTIN 1081, 1428
 AMYLOPECTINS 1430
 AMYLOSE 1081, 1089, 1412, 1428, 1430
 ANABAENA 1058
 ANABOLISM 747, 749, 1071, 1126
 ANAEROBIC FUNGI 1078
 ANAEROBIOSIS 1103
 ANALOGS 1099, 1203
 ANALYTICAL METHODS 1244, 1460, 1464, 1465, 1471, 1472, 1474, 1478, 1479, 1484, 1485, 1486, 1492
 ANATOMY 1133
 ANCESTRY 961, 1029
 ANDROGENESIS 1002
 ANHYDROUS AMMONIA 767
 ANIMAL DISEASES 1354
 ANIMAL FATS 1493
 ANIMAL FEEDING 702, 730, 1346, 1361
 ANIMAL HUSBANDRY 1367
 ANIMAL NUTRITION 1482
 ANIMAL POWER 1381
 ANION EXCHANGE CHROMATOGRAPHY 1411
 ANNUAL DRESSINGS 1389

ANOXIA 1306
 ANTAGONISM 1132
 ANTAGONISTIC PROPERTIES 1300
 ANTHOR CULTURE 973, 980, 996, 1002, 1008, 1038, 1092
 ANTHOR CULTURE RESPONSE 980
 ANTI NUTRITIONAL FACTORS 1403
 ANTIBIOTICS 1259
 ANTIBODY BASED TEST 1393
 ANTIGEN ANTIBODY REACTIONS 1488
 ANTINEOPLASTIC AGENTS 931, 1004
 APAMEA 1220
 APEX DEVELOPMENT 819
 APHID EXTRACT 1216
 APHID PREDATORS 1221
 APHIDIDAE 1218, 1234
 APHIDS, CEREAL 1221, 1228
 APHIS 1226
 APHIS FABAE 1305
 APICAL DEVELOPMENT 1135, 1151, 1166
 APPEARANCE 1150, 1166
 APPLICATION METHODS 1126
 APPLICATION RATE 838
 APPLICATION RATES 692, 713, 714, 720, 723, 724, 788, 798, 1140, 1248, 1264, 1324, 1326, 1359
 APPROPRIATE TECHNOLOGY 706
 APULIA 741, 1140
 ARABIDOPSIS THALIANA 1040, 1200
 ARABINOGALACTAN PROTEIN 755
 ARABLE SOILS 1383
 ARACHIS HYPOGAEA 878
 ARBITRARY PRIMERS 917
 ARBUSCULAR MYCORRHIZAL FUNGI 845, 1290
 ARCHITECTURE 1255
 AREA 1233
 ARID ZONE 883
 ARM 974, 1432
 AROMA 1395, 1436
 ARREST 1214
 ARTHROPODA 862
 ARTIFICIAL ASSOCIATION 1058
 ASCORBIC ACID 1439, 1475, 1493
 ASEXUAL REPRODUCTION 1158
 ASHES 1443
 ASPARAGINASE 1155
 ASPERGILLUS NIGER 1378, 1503
 ASSESSMENT 1276
 ASSIMILATE DISTRIBUTION 1148
 ASSIMILATED CARBON 1167
 ASSIMILATION 1117
 ASSISTED LASER DESORPTION 1411
 ASSOCIATIONS 1290
 ATMOSPHERIC CARBON DIOXIDE 1198
 ATMOSPHERIC CO₂ 1181
 ATOMIC ABSORPTION SPECTROMETRY 1144
 ATP SYNTHASE 1119
 ATP9 914
 ATPASE 875
 ATRIPLEX 673
 ATTEMPTED PENETRATION 1204
 AUSTRALIA 697, 804, 821
 AUSTRIA 739
 AUTUMN 1053
 AUXIN 1063
 AUXINS 1063
 AVAILABILITY 804, 1066, 1165
 AVENA 717, 912
 AVENA BARBATA 1285

AVENA FATUA L 1333
 AVENA SATIVA 722, 854, 869, 948, 1082, 1215, 1285
 AVENA SATIVA L 977
 AVHRR DATA 1191
 AZOLLA 1058
 AZOSPIRILLUM BRASILIENSE 1384, 1387
 AZOTOBACTER 1176
 BACILLUS 1259, 1385
 BACILLUS SUBTILIS 1268
 BACKCROSSING 994, 1022
 BACTERIA 1385, 1386
 BACTERIAL POPULATIONS 830
 BACTERIOPHAGES 1406
 BACTERIOSES 1265
 BAKERS' YEAST 1475
 BAKERY ADDITIVES 1475, 1493
 BAKERY PRODUCTS 1455, 1476, 1490, 1493, 1505
 BAKING 1438, 1444, 1452, 1470, 1476, 1482, 1487
 BAKING CHARACTERISTICS 906, 928, 929, 984, 1439, 1466, 1470, 1476, 1487, 1489, 1490
 BALANCE OF NUTRIENTS 832
 BALLOONING 1232
 BANDS 924, 972
 BARE PATCHES 1273
 BARE SOIL 1156
 BARLEY 698, 736, 785, 802, 847, 851, 865, 875, 898, 910, 937, 967, 973, 990, 992, 997, 1034, 1039, 1040, 1042, 1055, 1068, 1069, 1091, 1099, 1118, 1119, 1123, 1141, 1142, 1166, 1170, 1186, 1190, 1194, 1195, 1196, 1200, 1241, 1245, 1266, 1276, 1296, 1342, 1345, 1347, 1349, 1353, 1354, 1356, 1357, 1359, 1360, 1367, 1369, 1371, 1374, 1380, 1445, 1446, 1447, 1448, 1450, 1453, 1454, 1457, 1458, 1459, 1461, 1462, 1467, 1469, 1477, 1478, 1479, 1481, 1482, 1484, 1486, 1488, 1491, 1492, 1496, 1497, 1503
 BARLEY (HORDEUM VULGARE L) 1080
 BARLEY ALEURONE LAYERS 1159
 BARLEY GENOME 1027
 BARLEY HORDEUM VULGARE 1146, 1333
 BARLEY ROOTS 1060, 1208
 BARLEY STRAW 702, 703, 1350
 BARLEY STRAW DECOMPOSITION 1054
 BARLEY YELLOW DWARF LUTEOVIRUS 1244
 BARLEY YELLOW DWARF VIRUS 1299
 BASILICATA 922, 1215
 BASMATI 1436
 BAVARIA 1278
 BC1 COMPLEX 1124
 BEAUVERIA BASSIANA 1223
 BEEF PRODUCTION 1352
 BEERS 679, 715, 1440, 1445, 1453, 1454, 1458, 1461, 1467, 1484, 1485, 1486, 1492
 BEHAVIOUR 1406
 BELGIUM 1235, 1503
 BESSARABICUM 1114
 BETA D GLUCANS 1077
 BETA GLUCANASE 1116, 1368
 BETA GLUCANS 1360
 BETA GLUCURONIDASE 988, 1028
 BETA SUBUNIT 1124
 BETA VULGARIS 779, 793, 807, 865, 881, 1108, 1212
 BICARBONATE SOIL TEST PHOSPHORUS 771
 BIND 875
 BINDING 1058, 1130
 BINDING PROTEIN 1127
 BINOMIAL SEQUENTIAL SAMPLING 1225
 BINS LOADS 1337

BIOASSAYS 1324
 BIOAVAILABILITY 1495
 BIOCHEMICAL ENGINEERING 719
 BIODIVERSITY 862, 920, 963
 BIOFUELS 1451
 BIOLOGICAL ACTIVITY 827
 BIOLOGICAL COMPETITION 1023
 BIOLOGICAL CONTAMINATION 758
 BIOLOGICAL CONTROL 1132, 1300
 BIOLOGICAL DEVELOPMENT 1098, 1105, 1107, 1149, 1168, 1169, 1193
 BIOLOGICAL DIFFERENCES 1506
 BIOLOGICAL PROPERTIES 1052, 1164, 1219
 BIOLOGY 1214
 BIOMASS 852, 857, 1055, 1068, 1163
 BIOMASS PRODUCTION 782
 BIOSENSORS 963
 BIOSYNTHESIS 757, 1060, 1091, 1159
 BIOTIN 1477
 BIOTOPES 716, 862
 BIOTYPE 1213
 BIPARTITE PRESEQUENCE 1209
 BITUMEN COATED UREA 874
 BIVALENT METAL IONS 1122
 BLACK BEAN APHID 1214
 BLOAT 1355
 BLOOD GROUP I 1411
 BLOWING SNOW 842
 BOTANY 1024
 BOTRYTIS FABAE 1305
 BOUNDARIES 862
 BOXWORTH 864
 BRAN 1367, 1460, 1482, 1494, 1495
 BRANCHED MOLECULES 1430
 BRASILENSE 836
 BRASSICA CAMPESTRIS 1287
 BRASSICA NAPUS 877, 1108, 1212, 1449
 BRASSINOLIDE 1184
 BRASSINOSTEROIDS 1184
 BRAZIL 775, 959
 BREAD 906, 1406, 1421, 1439, 1441, 1444, 1452, 1455, 1474, 1476, 1493, 1494, 1505
 BREAD BAKING QUALITY 1393
 BREAD MAKING QUALITY 902, 972, 1001, 1409, 1431
 BREAD WHEAT 902, 910
 BREAD WHEATS 962
 BREADMAKING 1409, 1441, 1442
 BREADMAKING QUALITY 970, 1392, 1393
 BREAKFAST CEREALS 1482
 BREEDING BEHAVIOR 977
 BREEDING METHODS 886, 913, 921, 950, 959, 968, 996, 1029
 BREEDING VALUE 993
 BREEDS 1359, 1369, 1374
 BREWERS GRAINS 890
 BREWING 751, 752, 1039, 1440, 1445, 1453, 1454, 1458, 1484, 1488
 BREWING INDUSTRY 1457
 BROILER CHICKENS 1347, 1356, 1359, 1375, 1376, 1379, 1380
 BROTE 1319, 1330
 BROWN CHERNOZEM 1052
 BROWSE PLANTS 702
 BUCKWHEAT 1403
 BUFFERS 790
 BULGARIA 732, 783, 905, 983
 BULK DENSITY 709, 826
 BULK WHEAT 1336
 BULLS 1374
 C 14 848, 1069

C 14 ANALYSIS 1148
 C 14 LABELING 1121
 C 3 1130
 C 3 PLANTS 1198
 C BANDED KARYOTYPES 1027
 C BANDING 924, 946, 969
 C REDUCTASE 1124
 CA 2+ STARVATION 1208
 CADMIUM 1165, 1201, 1460
 CALCAREOUS SOIL 845, 1118
 CALCIUM 875, 910, 1103, 1190, 1311, 1318, 1344
 CALCIUM AMMONIUM NITRATE 793
 CALCIUM CHANNEL 875
 CALCIUM HYDROXIDE TREATMENT 1371
 CALCIUM OXIDE 1451
 CALLI 1028
 CALLUS 939, 941, 1436
 CALLUS INDUCTION 980
 CALMODULIN 1190
 CALVIN CYCLE GENES 756
 CANADA 983
 CANOLA YIELD 1319
 CANOPY 1071, 1195
 CARBENDAZIM 1248, 1259, 1298
 CARBOHYDRATE 1174, 1350
 CARBOHYDRATE METABOLISM 1180, 1200
 CARBOHYDRATES 1377
 CARBON 1052, 1054, 1068, 1107, 1148, 1291
 CARBON CYCLING 1167
 CARBON DIOXIDE 1117, 1136, 1151, 1181, 1451
 CARBON DISCRIMINATION 937
 CARBON FLOW 1167
 CARBOXIN 1274
 CARCASS QUALITY 1352
 CAROTENOIDS 714
 CARPA 1327
 CARYOPSES 1159
 CASE STUDIES 1503
 CATABOLISM 1076
 CATCH CROPPING 851, 854, 860
 CATTLE 1351
 CCN 1042
 CDNA 1209
 CDNA CLONES 1299
 CDNA CLONING 1153, 1272
 CECIDOMYIIDAE 917
 CELL CULTURE 757, 1315, 1324
 CELL DIFFERENTIATION 939
 CELL EXTENSION GROWTH 1185
 CELL MEMBRANES 790, 1085, 1210, 1309, 1315, 1318
 CELL RESPIRATION 1073, 1310
 CELL STRUCTURE 941, 1073, 1260
 CELL SURFACE 755
 CELL SUSPENSION CULTURES 1200
 CELL WALL BIOSYNTHESIS 1077
 CELL WALL MONOSACCHARIDES 1348
 CELL WALL PROTEINS 1153
 CELL WALLS 1077, 1102, 1377
 CELLS 1048, 1092, 1103, 1121
 CELLULASE 1349
 CELLULOSE 1078
 CENTRAL EUROPE 1288
 CEREAL APHIDS 1221, 1223
 CEREAL CROPS 706, 713, 714, 888, 904, 905, 915, 919, 920, 945, 958, 961, 963, 1032, 1104, 1386, 1506
 CEREAL FLOURS 1474, 1476
 CEREAL PROTEIN 983, 1500
 CEREAL STRAWS 1350

CEREALS 736, 873, 967, 1068, 1178, 1233, 1396, 1413
 CHAIN 1430
 CHARA CORALLINA 1117
 CHELATORS 1118
 CHEMICAL COMPOSITION 702, 783, 1441, 1468, 1473, 1474, 1481, 1502
 CHEMICAL CONTROL 1212, 1279, 1326
 CHEMICAL HYBRIDIZING AGENT 902
 CHEMICAL PROPERTIES 773
 CHEMICAL REACTIONS 1471
 CHEMICAL RESISTANCE 991, 1021
 CHEMICOPHYSICAL PROPERTIES 694, 711, 730, 732, 1083, 1222, 1490
 CHEMISTRY 907
 CHENOPodium RUBRUM 1130, 1200
 CHERNOZEMS 778, 783
 CHICKEN, BROILER 1368
 CHICKENS 1342, 1368, 1369
 CHICKPEA 1115, 1194, 1195, 1196
 CHICKPEAS 885
 CHICKS 1353
 CHILLING TOLERANCE 1123
 CHINA 684, 938, 1020, 1301, 1302
 CHITINASE 1272
 CHLAMYDOMONAS REINHARDTII 1119, 1134
 CHLORIDE 1208
 CHLORIDES 1085
 CHLORMEQUAT 1308, 1314
 CHLOROPHYLL 1206
 CHLOROPHYLL A 1134
 CHLOROPHYLL A/B LIGHT HARVESTING ANTENNA COMPLEX 1161
 CHLOROPHYLL B LESS MUTANT 1134
 CHLOROPHYLL CONTENT 1198
 CHLOROPHYLL FLUORESCENCE RATIO F690/F735 1198
 CHLOROPHYLLS 714, 749, 899, 1073, 1110
 CHLOROPLAST 756, 987
 CHLOROPLASTS 1304, 1312
 CHLORSULFURON 1327, 1330
 CHROMATOGRAPHIC METHOD 1396
 CHROMATOGRAPHY 1430
 CHROMOSOMAL LOCATION 974, 1018
 CHROMOSOMAL POLYMORPHISM 1005
 CHROMOSOMAL PROTEINS 1192
 CHROMOSOMAL REARRANGEMENTS 980
 CHROMOSOME 1400
 CHROMOSOME 1R 923
 CHROMOSOME ABERRATIONS 931, 1048
 CHROMOSOME ADDITION AND TRANSLOCATION 924
 CHROMOSOME MAPPING 1084
 CHROMOSOME NUMBER 900, 1074
 CHROMOSOME PAIRING 932, 1074
 CHROMOSOME TRANSLOCATION 1070, 1432
 CHROMOSOMES 896, 911, 927, 932, 952, 957, 966, 1041
 CHYME COMPONENTS 1368
 CICER ARIETINUM 772, 1504
 CICER ARIETINUM L 1194
 CITRIC ACID 1121
 CITRININ 1462
 CITRUS AURANTIUM 1133
 CL 813
 CLASSIFICATION 1247
 CLASSIFIERS 1405
 CLAY SOILS 922
 CLIMATE 1145, 1278
 CLIMATIC FACTORS 1140, 1164, 1234

CLIMATIC REQUIREMENTS 880
 CLINOSTAT 1174
 CLONES 911
 CLOVER 854, 912
 CLUSTER ANALYSIS 1033, 1036
 CME 1084
 CMS SECALE 914
 CO₂ ENRICHMENT 1151
 CO₂ EVOLUTION 1206
 COARSE GRAINS 684
 COASTAL PLAIN SOIL 826
 COASTAL WHEATGRASS 969
 COB 914
 COCHLIOBOLUS SATIVUS 1143
 CODING SEQUENCE 756
 COEFFICIENTS 1033
 COFFEE BEANS 1480
 COLCHICINE 921, 1051
 COLD 719, 930, 1168, 1169, 1307, 1309, 1316
 COLEOPTERA 1336
 COLEOPTILE 1059
 COLEOPTILES 1204
 COLONIZATION 1290
 COLOUR IMAGE ANALYSIS 1266
 COLOUR SEGREGATION 1120
 COMBINE HARVESTERS 710
 COMBINING ABILITY 1025
 COMMUNION 1443
 COMMON ROOT ROT 1143
 COMMON WHEAT 891
 COMMONWEALTH OF INDEPENDENT STATES 684
 COMPACTION 709, 840
 COMPARATIVE MAPPING 990
 COMPARTMENTATION 1130
 COMPETITION 924, 1066, 1211, 1290, 1333
 COMPLEX III 1124
 COMPLEX LHC II 1161
 COMPONENT 1127
 COMPONENTS 1283, 1398, 1399, 1425, 1436
 COMPOST 770
 COMPOSTS 1389
 COMPOUND FEEDS 1344, 1462
 COMPOUND FERTILIZERS 807, 808
 COMPUTER APPLICATIONS 1448, 1480
 COMPUTER SOFTWARE 699
 CONDUCTANCE 1136, 1172
 CONDUCTIVITY 843
 CONSTANT TEMPERATURES 1115
 CONSTRUCTION 997
 CONSUMPTION 1426
 CONTAMINATION 763
 CONTINUOUS CROPPING 1140
 CONTINUOUS LABELLING 1167
 CONTRACTS 739
 CONTROLLED PRICES 680
 CONVERSION 1055
 COOKING 1398, 1399, 1408, 1425, 1435
 COOKING QUALITY 970
 COOLING 1339
 COORDINATION 1179
 COPPER 805, 809, 1066, 1118, 1165, 1305
 COPPER FERTILISER 774
 CORE COLLECTIONS 1033
 CORN 776, 826, 844, 1113, 1355, 1405, 1415
 CORN INHIBITOR 1084
 CORN KERNELS 1405
 CORN ROOT SYSTEMS 1117
 CORN STARCH 1422
 CORRELATION 992
 CORTEX 1211

CORYNEBACTERIUM 1385
 COST ANALYSIS 1212, 1235
 COST BENEFIT ANALYSIS 695, 788
 COSTS 793, 1382
 COTTON 847
 COVER 1054, 1056
 COVER CROP 844
 COVER PLANTS 858, 869
 COW MANURE 1064, 1065
 COW MILK 1374
 COWS 1381
 CRACKERS 1405
 CRLTI 1327
 CROP 709, 811, 840, 1166, 1329
 CROP DEVELOPMENT 1053
 CROP LOSSES 675, 1220, 1328
 CROP MANAGEMENT SYSTEM 873
 CROP MODELS 802
 CROP PRODUCTIVITY 868
 CROP RESIDUE 691
 CROP RESIDUES 692, 724, 745, 792, 1240, 1378
 CROP RESPONSES 1181
 CROP ROTATION 873
 CROP ROTATION CYCLE 1065
 CROP ROTATIONS 827
 CROP SEQUENCE 773
 CROP SUCCESSION 859
 CROP SYSTEMS 1257
 CROP WASTE 1064
 CROP YIELD 683, 688, 694, 695, 701, 702, 708, 711, 713, 716, 717, 720, 722, 723, 732, 734, 738, 740, 741, 745, 746, 778, 779, 780, 783, 784, 788, 791, 792, 794, 796, 798, 801, 803, 808, 812, 814, 815, 828, 831, 851, 852, 853, 854, 856, 857, 858, 862, 877, 878, 886, 909, 912, 919, 922, 930, 934, 948, 956, 960, 984, 985, 1045, 1109, 1140, 1164, 1199, 1274, 1372, 1384
 CROPPING SYSTEMS 858, 872, 884, 942, 1109, 1292
 CROPS 717, 862, 872, 967, 1047, 1053, 1507
 CROPS WASTES 1065
 CROSSES 977
 CROWN ROT 1275
 CRUCIFERAE 1328
 CRUDE FAT 1376
 CRUDE FIBRE 1374
 CRUDE PROTEIN 730, 732, 780, 837, 1342, 1501
 CUCUMBER 1266, 1294
 CUCUMBER ROOTS 1208
 CUCUMIS SATIVUS 1266, 1305, 1313
 CULTIVAR 705, 832
 CULTIVAR IMPROVEMENT 1001
 CULTIVAR RESISTANCE 1224
 CULTIVARS 691, 819, 821, 917, 940, 1033, 1183, 1189, 1194, 1195, 1400, 1431, 1437, 1438
 CULTIVATION 685, 688, 696, 704, 733, 734, 738, 751, 752, 823, 878
 CULTURAL CONTROL 854
 CULTURAL METHODS 748, 857, 1372
 CULTURAL PRACTICES 705
 CULTURE MEDIA 757, 1385
 CULTURES 1058, 1157
 CYANOBACTERIA 1058
 CYCLING 792
 CYPRUS 1267
 CYTOCHROME P 450 1160
 CYTOGENETICS 911, 927, 932, 952, 957, 996, 1005, 1041, 1048
 CYTOKININS 1080, 1090
 CYTOLOGY 907
 CYTOPLASMIC MALE STERILITY 914, 1030

CYTOPLASMIC ORGANELLES 1149
 CZECH REPUBLIC 960, 1264, 1285, 1481, 1490
 D GENOME 990, 1172
 DAIRY CATTLE 730, 1365
 DAIRY COWS 1346, 1348, 1374
 DAMAGE 1114, 1213, 1233
 DARK RESPIRATION 1174
 DARKNESS 1332
 DARLING DOWNS 767
 DATA ANALYSIS 889
 DATABASES 699, 945
 DAUCUS CAROTA 1324
 DAYLENGTH 1135
 DE EARED 1187
 DE NOVO SYNTHESIS 1121
 DEBRANCHING ENZYME 1418
 DECANTING 1079
 DECIMAL CODE 1233
 DECISION MAKING 699
 DECISION MODEL 1257
 DECOMPOSITION 1052, 1054
 DEEP BED SIMULATION 1339
 DEEP TILLAGE 840
 DEFICIENCY 1118
 DEFICITS 1207
 DEFOLIATION 1112
 DEGRADATION 1078, 1491
 DEHYDRATION INJURY 1076
 DELIVERY 1028
 DELTA C 13 937
 DEMAND 670
 DENMARK 785, 851, 862, 865, 1501
 DENOVO SYNTHESIS 1178
 DENSITY 1333
 DEPTH 810
 DESCURAINIA PINNATA 1330
 DESCURAINIA SOPHIA 1330
 DESPI 1330
 DESSO 1327, 1330
 DETERGENT FIBER 1348
 DEVELOPING COUNTRIES 697
 DEVELOPMENT 1186
 DEVELOPMENTAL MUTANT 1185
 DIAGNOSIS 1106, 1299
 DIALLEL 902
 DIALLEL ANALYSIS 892, 980
 DIALLEL CROSSING 1010, 1031
 DIAMMONIUM PHOSPHATE 770
 DICALCIUM PHOSPHATE 1367
 DIET 1342, 1379
 DIET SELECTION 1351
 DIETARY FIBER 1494, 1495
 DIETARY FIBRES 1088, 1482
 DIETETIC FOODS 1505
 DIETS 1360
 DIFFERENT ENDOPHYTES 1290
 DIFFERENTIAL CULTIVARS 1241
 DIFFERENTIAL EXPRESSION 1040
 DIFFERENTIAL TRANSCRIPTION 914
 DIFFERENTIATED PRODUCTS 670
 DIFFUSION 1339
 DIFLUFENICAN 1064, 1065
 DIGESTA 1347, 1379
 DIGESTIBILITIES 1360
 DIGESTIBILITY 1078, 1349, 1353, 1360, 1361, 1369, 1374, 1376, 1377, 1378, 1379, 1501, 1504
 DIGESTIBILITY, BARLEY 1350
 DIGESTION 943, 1078, 1144, 1348, 1349, 1350, 1357, 1418
 DIGESTIVE ABSORPTION 1374
 DIGESTIVE JUICES 1374

DIGESTIVE SYSTEM 1349
 DIGESTIVE SYSTEM DISEASES 1354
 DIGITAL IMAGE ANALYSIS 1416
 DINITROGEN 767
 DIPLOIDY 895
 DIPTERA 1221
 DIRECT DRILLING 867
 DIRECT EXTRACTION METHOD 1052
 DIRECT SOWING 828
 DISC HARROWS 831
 DISCHARGE PARTICLE ACCELERATION 973
 DISCRIMINATION 1172, 1195, 1405, 1416
 DISEASE 1254
 DISEASE CONTROL 699, 769, 854, 1212, 1226, 1235, 1251, 1254, 1256, 1259, 1270, 1281
 DISEASE EPIDEMICS 1255
 DISEASE RESISTANCE 746, 769, 886, 897, 903, 913, 915, 916, 921, 925, 950, 966, 1026, 1153, 1237, 1238, 1243, 1250, 1252, 1260, 1269, 1274, 1292
 DISEASE RISK MODEL 859
 DISEASE SEVERITY 1276
 DISEASE SURVEYS 1267
 DISPERSAL 1232
 DISPERSIONS 999, 1412
 DISSIPATION 1329
 DISTANCE 977
 DISTRAIN 1276
 DISTRIBUTION 1177
 DIURAPHIS NOXIA 974, 1225, 1229
 DIURNAL CYCLE 1161
 DIVERSIFICATION 1503
 DIVERSITY 987, 989, 1261, 1400
 DNA 756, 911, 914, 923, 1009, 1028, 1039, 1041, 1245, 1247, 1299
 DNA BASE COMPOSITION 829
 DNA MARKER ANALYSIS 1012
 DNA MARKERS 917
 DNA PROBES 990
 DOMINANT GENES 908, 1215
 DOT BLOT HYBRIDIZATION 1299
 DOUGH 1409
 DOUGHS 711, 1222, 1439, 1442, 1444, 1452, 1455, 1475
 DOWNY BROME DENSITY 1319
 DRAINAGE 709
 DRAUGHT ANIMALS 1381
 DRESSING PERCENTAGE 1345, 1367
 DROUGHT 741, 872, 888, 905, 1335
 DROUGHT RESISTANCE 899, 954, 1189, 1194
 DROUGHT STRESS 930, 1100, 1138, 1305, 1312, 1317
 DROUGHT SUSCEPTIBILITY INDEX 1131
 DROUGHT TOLERANCE 1131
 DROUGHT TOLERANCE AND BENZYLADENINE 1207
 DRY 1362
 DRY FARMING 933
 DRY MATTER 799, 1187, 1206
 DRY MATTER ACCUMULATION 726
 DRY MATTER AND REPRODUCTIVE ALLOCATION 1198
 DRY MATTER CONTENT 851, 878, 1125, 1140, 1164, 1199, 1268, 1317, 1380
 DRY MULCHES 742
 DRYERS 1447
 DRYING 1447, 1449
 DRYLAND ROOT ROT 1287
 DUAL INOCULATION 1290
 DURATION 1129, 1169
 DURUM WHEAT 894, 910, 1392

DWARF GERMLASM 947
 DYNAMICS 1255
 EAR 1001
 EARS 1205
 EAST AFRICA 744
 EAST ASIA 1047
 EASTERN EUROPE 684
 ECOLOGY 829
 ECONOMIC ANALYSIS 816
 ECONOMIC BEHAVIOUR 675
 ECONOMIC SITUATION 674, 1373
 ECONOMICS 1382
 ECOSYSTEMS 716
 EFFICIENCY 803, 1349
 EFFICIENCY OF PHOSPHORUS UTILIZATION 799
 EGG CELL 753
 EGG HATCHABILITY 1231
 EGG PERFORMANCE 1358
 EGG PRODUCTS 1493
 EGG SHELL 1344
 ELECTRICAL PENETRATION GRAPHS 1218
 ELECTROMAGNETIC WAVES 1415
 ELECTRON SPIN RESONANCE 1409
 ELECTROPHORESIS 893, 896, 943, 983, 1400, 1470
 ELECTROULTRAFILTRATION 765
 ELEVATED ATMOSPHERIC CO₂ 1133
 ELEVATED CO₂ 1151
 ELISA 967, 1271, 1386, 1467, 1498
 ELONGATION 1186
 ELONGATION GROWTH 1102
 ELYTRIGIA ELONGATA 969
 EMBRYO CULTURE 931, 939, 994
 EMBRYOGENESIS 753
 EMBRYOGENIC CELL SUSPENSIONS 973
 EMBRYONAL CARCINOMA CELLS 1411
 EMBRYOS 1099, 1159
 EMERGENCE 691, 1115, 1135, 1169, 1179
 EMILIA ROMAGNA 823, 1109, 1125, 1279
 EMS 1003
 EMULSIFIERS 1439, 1493, 1505
 ENANTIOMERS 1160
 END USE QUALITY 962
 ENDO BETA GALACTOSIDASE 1411
 ENDOCHITINASE 1272
 ENDOHYDROLASES 1087
 ENDOPLASMIC RETICULUM 1188
 ENDOSPERM 1077, 1084, 1149, 1159, 1423
 ENDOSPERM DEVELOPMENT 1180, 1200
 ENERGY 1342, 1360, 1365
 ENERGY BALANCE 881, 1375
 ENERGY CONSERVATION 823
 ENERGY CONSUMPTION 1443, 1496, 1497
 ENERGY EXCHANGE 1380
 ENERGY SUPPLEMENTATION 1355
 ENERGY VALUE 1376
 ENGINEERING 673
 ENGLAND 787, 1053
 ENHANCING PROTEIN 1124
 ENRICHMENT 1133, 1181, 1198
 ENVIRONMENTAL FACTORS 742, 922, 928, 999, 1025, 1104, 1139, 1145, 1163, 1169, 1219
 ENVIRONMENTAL PROTECTION 706, 730
 ENVIRONMENTAL TEMPERATURE 1045, 1343
 ENVIRONMENTAL VARIABLES 894
 ENVIRONMENTS 1047
 ENZYMATIC ANALYSIS 1082
 ENZYMATIC HYDROLYSIS 1500
 ENZYME 1174

ENZYME ACTIVITIES 827
 ENZYME INDUCTION 1201
 ENZYME INHIBITORS 1376
 ENZYME PREPARATIONS 1349, 1359, 1379, 1380
 ENZYMES 756, 1178, 1342, 1347, 1353, 1356, 1357, 1451
 ENZYMIC ACTIVITY 713, 757, 1015, 1046, 1050, 1094, 1105, 1149, 1197, 1332, 1450, 1471, 1472, 1491
 EPIDEMICS 1183, 1301, 1302
 EPIDEMIOLOGY 1254, 1255
 EPIDERMAL PROTOPLASTS 755
 EQUALITY 824
 EQUATIONS 1338
 EQUILIBRIUM MOISTURE CONTENT 1339
 EQUIPMENT 1451, 1475, 1496
 EQUIPMENT PARTS 1083
 EQUIPMENT PERFORMANCE 823
 ERAGROSTIS TEF 880
 ERGOSTEROL 1463
 ERWINIA 1237
 ERYRE 1327
 ERYSIPIHE GRAMINIS 915, 916, 966, 1153, 1246, 1248, 1250, 1267, 1268, 1276, 1285
 ERYSIPIHE GRAMINIS F SP TRITICI 1288
 ESSENTIAL AMINO ACIDS 1378
 ESTERASES 939, 1095, 1471, 1472
 ESTONIA 725
 ETHANOL 1377, 1441, 1451
 ETHIOPIA 683, 689, 701, 702, 743, 745, 748, 766, 816, 835, 850, 879, 880, 1086, 1280, 1320, 1321, 1325, 1381
 EUF 765
 EUROPE 1047
 EUROPEAN COMMUNITIES 684
 EURYGASTER 1222
 EVALUATION 673, 775, 916, 922, 929, 951, 1037, 1470, 1480, 1487, 1489
 EVAPORATION 1191, 1199
 EVAPOTRANSPIRATION 818, 1056
 EVOLUTION 987, 989, 1005, 1070
 EXCHANGE 863
 EXCISED ROOTS 1121
 EXCLUSION 1114
 EXCRETA 1344
 EXCRETION 1107, 1374
 EXOTIC GERMPASM 1034
 EXPANDED RICE 1434
 EXPANSION 1399
 EXPERIMENTATION 943, 1041, 1100
 EXPOSURE 1198
 EXPRESSION 1087, 1099, 1119
 EXTENSION ACTIVITIES 673, 1372
 EXTENSION GROWTH 1102
 EXTENT 1348
 EXTERNAL HYPHAE 1290
 EXTRACTABLE SOIL WATER 1196
 EXTRACTION 847
 EXTRACTS 960, 1067, 1460
 EXTRUDATE PROPERTIES 1435
 EXTRUDER 1433
 EXTRUSION 1376, 1380, 1482
 EXUDATES 1063
 EXUDATION 1121
 EYESPOT 967, 1298
 EYESPOT DISEASE 988
 F SP HORDEI 1153, 1204
 F SP TRITICI 1272, 1286
 FI HYBRIDS 993, 1008, 1038, 1074
 FACTORIES 676

FAECES 1380
 FALL 1053
 FALLOW 882
 FALLOW PERIOD 767
 FAMILIES 887
 FAMILY 1130
 FARM EQUIPMENT 1381
 FARMERS 706
 FARMING SYSTEMS 674, 864, 880, 1221, 1331
 FAT 1365
 FATE 811
 FATTENING 849, 1345, 1349, 1380
 FATTY ACIDS 1304, 1471
 FAUNA 716, 828, 862
 FE DEFICIENCY 1060, 1091
 FEATURE EXTRACTORS 1405
 FECUNDITY 1214
 FEED ADDITIVES 1345, 1349, 1353, 1354, 1359, 1379, 1380
 FEED CEREALS 722, 1345
 FEED CONVERSION EFFICIENCY 1344, 1349, 1354, 1359, 1369, 1379, 1380
 FEED CROPS 704, 745
 FEED GRASSES 854, 869
 FEED INTAKE 1344, 1377
 FEED LEGUMES 703
 FEED PROCESSING 1354
 FEED UNITS 730, 1501
 FEEDING BEHAVIOUR 1218
 FEEDING EQUIPMENT 1497
 FEEDING VALUE 1350
 FEEDS 702, 909, 1378, 1498
 FEEDSTUFFS 1499
 FEMALES 1369
 FERMENTATION 1378, 1439, 1441, 1451, 1455, 1503
 FERTILE 1028
 FERTILITY 824, 896, 908, 994, 1008, 1022
 FERTILIZATION 705, 753, 832, 1210
 FERTILIZER 698, 810, 1113
 FERTILIZER APPLICATION 690, 730, 738, 766, 778, 779, 780, 783, 784, 785, 786, 788, 789, 791, 793, 795, 796, 798, 800, 801, 803, 815, 816, 817, 828, 854, 856, 1062, 1096, 1473
 FERTILIZER COMBINATIONS 806
 FERTILIZER EFFECTIVENESS 770
 FERTILIZER NITROGEN 811
 FERTILIZERS 702, 723, 764, 793, 1144, 1381, 1389
 FESTUCA ARUNDINACEA 730
 FESTUCA PRATENSIS L 848, 1167
 FESTUCA RUBRA 851
 FIBER 1360
 FICOLL 1092
 FIELD 848, 1053, 1064
 FIELD CONDITIONS 1054
 FIELD EXPERIMENTATION 1248, 1264
 FIELD PLOTS 1167
 FIELD SOILS 1290
 FIELD TRIALS 1276
 FIELDS 862, 1334
 FINGER MILLET 1434
 FINLAND 1013, 1326
 FIRMNESS 1439
 FIXATION 804
 FIXED CARBON 1167
 FLAVOBACTERIUM 1385
 FLAVOUR 1436, 1455, 1485
 FLOODED PEA PLANTS 1067
 FLORA 862
 FLORET FERTILITY 1007
 FLOTATION TAILINGS 837

FLOUR 1397, 1424, 1430, 1435, 1438
 FLOUR PROTEIN COMPOSITION 962
 FLOUR PROTEINS 970, 1393
 FLOURS 706, 1417, 1443
 FLOW 1156
 FLOWERING 930
 FLUIDIZED BED PROCESSING 1447
 FLUORESCENCE INHIBITION 1131
 FLUORESCENCE LABELING 755
 FLUORESCENT PSEUDOMONADS 1132
 FLUORIMETRY 1471
 FLUORINE 837
 FOLIAR APPLICATION 805, 815
 FOLIAR APPLICATION / GRAIN 787
 FOOD ADDITIVES 1439, 1505
 FOOD ALLERGIES 1505
 FOOD CROPS 1106
 FOOD ENRICHMENT 1504
 FOOD INDUSTRY EQUIPMENT 1446
 FOOD PRODUCTION 680, 1292, 1455
 FOOD TECHNOLOGY 1444, 1448, 1449, 1458
 FOOT ROT 1211, 1258
 FORAGE 736
 FORAGE INTAKE 1355
 FORAGE LEGUMES 844
 FORCED AIR DRYING 1463
 FORECASTING 684, 1191, 1220
 FORECROP 832
 FOREST SOIL 827
 FOREST SOILS 794
 FORMATE 1078
 FORMULATIONS 814
 FPP PSEUDOMONAS SPP 830
 FRACTIONATION 1079, 1460, 1470, 1482
 FRACTIONS 962
 FRAGMENT 1042
 FRAGMENT LENGTH POLYMORPHISMS 977, 990, 1158, 1297
 FRANCE 904, 920, 945, 958, 1287
 FRASER VALLEY SOIL 1053
 FREEZING 1315, 1439, 1475
 FREQUENCY 1365
 FRON DEIGHTON 967
 FROST 1094, 1304, 1310
 FROST DAMAGE 1265, 1315
 FROST HARDENING 1146
 FRUCTAN 1178
 FRUCTAN METABOLISM 1174
 FRUCTOFURANOSIDASE 1094
 FRUCTOSE 1, 6 BISPHOSPHATASES 756
 FRUCTOSYL TRANSFERASE 1178
 FRUIT DAMAGING INSECTS 1219
 FRUIT JUICES 1493
 FRUITING 930
 FULL SCALE MEASUREMENTS 1337
 FUMIGATION EXTRACTION 848
 FUNGAL DISEASE 1257
 FUNGAL DISEASES 738, 1237, 1249, 1256, 1260, 1265, 1268, 1278, 1282, 1303, 1341
 FUNGI 1280, 1379, 1385
 FUNGICIDE 1288
 FUNGICIDES 738, 854, 1139, 1212, 1246, 1248, 1251, 1256, 1264, 1274, 1279
 FUSARIUM 758, 1237, 1240, 1251, 1274, 1278, 1285, 1341, 1488
 FUSARIUM CULMORUM 1211, 1238, 1264
 FUSARIUM OXYSPORUM 1158
 GA INSENSITIVITY 1043
 GA(3) RESPONSE 947
 GA / SEEDS 1154

GAEUMANNOMYCES GRAMINIS 859, 861, 1211, 1255
 GAEUMANNOMYCES GRAMINIS VAR TRITICI 1132
 GAMETES 996, 1022
 GAMMA IRRADIATION 939, 941, 964, 1003, 1026, 1048, 1049, 1051
 GAS CHROMATOGRAPHY 1144
 GAS EXCHANGE 1136, 1172
 GC MS 1436
 GEL 1428
 GEL CHROMATOGRAPHY 1460
 GELATINIZATION 1412
 GENE 754, 914, 946, 988
 GENE ACTIVATION 1272
 GENE BANKS 719
 GENE EFFECTS 918
 GENE EXPRESSION 756, 932, 1039, 1040, 1185, 1203
 GENE IDENTITY 1297
 GENE INDUCTION 1099
 GENE LOCATION 719, 895, 927, 952
 GENE TRANSFER 973, 1013, 1029
 GENERIC DIFFERENCES 782
 GENES 719, 895, 903, 915, 921, 930, 932, 966, 969, 983, 989, 1018, 1039, 1084, 1161, 1250, 1262, 1285, 1432
 GENETIC ANALYSIS 980
 GENETIC BASIS 937
 GENETIC CODE 1237
 GENETIC CORRELATION 938
 GENETIC DISTANCE 983, 1297
 GENETIC DIVERGENCE 987
 GENETIC DIVERSITY 1033
 GENETIC ENGINEERING 889, 932, 973, 1237
 GENETIC IMPROVEMENTS 1001
 GENETIC INHERITANCE 909, 927, 952, 965, 971, 1011, 1029
 GENETIC MAPPING 1042
 GENETIC MARKERS 896, 957, 1041
 GENETIC POLYMORPHISM 911, 983, 1041
 GENETIC RESOURCES 904, 958, 993, 1033, 1034, 1285, 1506
 GENETIC STABILITY 956, 1010, 1032, 1045
 GENETIC TRANSFORMATION 932, 996, 1029, 1039
 GENETIC VARIABILITY 918, 992
 GENETIC VARIATION 911, 991, 1002, 1003, 1020, 1024, 1049, 1158
 GENETICS 889, 915, 920, 961, 986, 1023, 1286, 1431
 GENOME 914, 989
 GENOME EVOLUTION 990
 GENOME MAPPING 1012
 GENOMES 895, 896, 932, 1000
 GENOMIC IN SITU HYBRIDIZATION 924
 GENOMIC ORGANIZATION 1027
 GENOMIC RELATIONSHIPS 924
 GENOMIC SEQUENCE 1040
 GENOTYPE 887, 1175, 1189
 GENOTYPE ENVIRONMENT INTERACTION 894, 1047
 GENOTYPE X ENVIRONMENT INTERACTION 967
 GENOTYPES 791, 922, 930, 943, 957, 963, 966, 983, 996, 998, 999, 1032, 1035, 1041, 1075, 1185, 1260
 GENOTYPIC DIFFERENCES 1142
 GEOSTATISTICS 1223
 GERMANY 685, 688, 716, 738, 740, 769, 786, 792, 803, 828, 854, 1212, 1489

GERMINABILITY 710, 1015
 GERMINATING BARLEY 1087
 GERMINATION 843, 893, 1050, 1115, 1138, 1154, 1159, 1446, 1472, 1491
 GERMLASM 673, 905, 910, 945, 951, 983, 998, 999, 1035, 1506
 GERMLASM CONSERVATION 945
 GIBBERELLA 1226, 1251
 GIBBERELLIN 1160, 1185, 1186
 GIBBERELLIN(S) 1159
 GLIADIN ELECTROPHOREGRAMS 970
 GLIADINS 976
 GLIOCLADIUM VIRENS 1300
 GLOMUS FASCICULATUM 1137
 GLOMUS MOSSEAE 845
 GLOMUS SPP 1290
 GLUCANS 960, 1081, 1082, 1088, 1089, 1347, 1369
 GLUCOSE 1068, 1374, 1494
 GLUMES 909, 1035, 1071, 1073
 GLUTAMINE SYNTHETASE 1122, 1184
 GLUTATHIONE TRANSFERASE 1201
 GLUTEN 1097, 1409, 1433, 1460, 1470, 1476, 1487, 1500, 1505
 GLUTEN STRENGTH 970, 976
 GLUTENIN 962, 1433, 1438
 GLUTENIN SUBUNITS 1400, 1409
 GLUTENINS 896, 920, 943, 976, 1079, 1470
 GLUTEN STRUCTURE ANALYSIS 1087
 GLYCEROL 1441
 GLYCINE MAX 877, 881, 884, 889
 GLYCOPROTEINS 755, 907, 1309
 GLYCOSIDASES 1349, 1369
 GLYCOSYLTRANSFERASE 1411
 GLYPHOSATE 1324
 GOSSYPIUM HIRSUTUM 788
 GRAIN 682, 688, 694, 711, 717, 722, 732, 733, 739, 798, 817, 853, 857, 933, 934, 971, 1043, 1049, 1067, 1112, 1140, 1145, 1164, 1341, 1407, 1426, 1468, 1471, 1477, 1481, 1482, 1491, 1499, 1500
 GRAIN CROPS 717
 GRAIN CRUSHING 1496, 1497
 GRAIN DEVELOPMENT 1116
 GRAIN FILLING 799
 GRAIN FILLING PERIODS 726
 GRAIN LEGUME CROPS 804
 GRAIN LEGUMES 1115
 GRAIN PROTECTANTS 1336
 GRAIN SAMPLES 1416
 GRAIN SORGHUM 821, 844
 GRAIN YIELD 705, 736, 826, 873, 882, 902, 1141, 1151, 1189, 1191
 GRAINS 1396
 GRAMINEAE 1091, 1186
 GRAMINEOUS PLANTS 1060
 GRAMINIS VAR TRITICI 1254, 1255
 GRANARY WEEVIL 1224
 GRANULES 1412, 1428
 GRASSES 1077, 1178
 GRASSHOPPERS 1217
 GRAVITROPIC RESPONSE 1175
 GREEN FEED 1501
 GREEN MANURE 868, 1064, 1065
 GREEN MANURES 841, 854, 857, 858
 GREENBUG 1036, 1213
 GROUNDNUTS 1504
 GROUNDWATER 706
 GROUNDWATER TABLE 820
 GROUP 7 CHROMOSOMES 980, 990
 GROUPING SCHEME OF BACTERIA 829
 GROWING CATTLE 1355

GROWING MEDIA 1090
 GROWN WHEAT 836
 GROWTH 696, 700, 736, 747, 749, 772, 791, 799, 802, 819, 822, 840, 877, 938, 1001, 1043, 1047, 1050, 1061, 1062, 1066, 1068, 1069, 1104, 1108, 1111, 1112, 1114, 1115, 1125, 1129, 1133, 1140, 1150, 1155, 1163, 1164, 1166, 1179, 1184, 1186, 1191, 1199, 1211, 1219, 1223, 1254, 1255, 1274, 1305, 1317, 1332, 1365, 1376, 1507
 GROWTH CHAMBERS 805, 1163
 GROWTH INHIBITORS 1308
 GROWTH OF SPRING BARLEY 1165
 GROWTH PERIOD 784, 846, 1072, 1126
 GROWTH RATE 878
 GROWTH RATES 1218
 GROWTH STAGE 1183
 GROWTH STAGES 967, 1189, 1233
 GROWTH/ WATER BALANCE 1138
 H 1 NMR 1411
 H+ TRANSPORT 1208
 HABITAT SELECTION 1232
 HAIRY VETCH 844
 HALOPHYTE ATRIPLEX 1208
 HAPLOID 944
 HAPLOID PRODUCTION 1092
 HAPLOIDS 753
 HAPLOIDY 993, 996
 HARDENING 1094, 1304, 1307, 1310
 HARDINESS 997
 HARVEST INDEX 682, 808, 1001
 HARVESTING 740, 1083
 HARVESTING COMPLEX 1134
 HARZIANUM 1300
 HATCHING 1231
 HAY 933
 HEADING 1109, 1168, 1169
 HEAT 1156, 1308
 HEAVY METALS 785, 1165, 1460
 HEBEI 1390
 HEIGHT 741, 927, 1043, 1049
 HEIGHT GENES 1043
 HELIANTHUS ANNUUS 700, 807, 856, 857, 858
 HELICOVERPA ARMIGERA 1219
 HELMINTHOSPORIUM 758, 1252, 1267
 HEMICELLULOSE BIOSYNTHESIS 1077
 HERBICIDE SOIL METABOLISM 1064, 1065
 HERBICIDE TOLERANCE 1335
 HERBICIDES 769, 835, 1086, 1212, 1265, 1321, 1324, 1326, 1331, 1334
 HERITABILITY 918
 HESSIAN FLY 917, 1036
 HETERODERA AVENAE 1042, 1215, 1231
 HETERODERA AVENAE WOLL 1042, 1287
 HETEROGENEITY 1351, 1423
 HETEROSIS 902, 977, 1030
 HEXAPLOID TRITICALE 972
 HEXAPLOID TRITORDEUM 1392
 HEXAPLOID WHEAT 980, 1000
 HEXAPLOIDY 1035, 1070
 HIGH PRESSURE LIQUID CHROMATOGRAPHY 1500
 HIGH TEMPERATURE 1435
 HIGH VELOCITY MICROPROJECTILES 973
 HIGH YIELDING VARIETIES 985
 HIGHER PLANTS 1057
 HIGHLANDS 673, 701, 880, 922, 951, 1382
 HIPPOPHAE 1493
 HISTOCHEMISTRY 1204
 HISTOCYTOLOGICAL ANALYSIS 1215
 HISTOLOGY 1277
 HMW 1400

HOMOBRASSINOLIDE 1184
 HOMOEOLGIOUS CHROMOSOMES 1043
 HOMOEOLGY 969
 HOMOGENEOUS PRODUCT 670
 HOMOPTERA 1214, 1227
 HOPS 715
 HORDEI 1276
 HORDEUM 725, 779, 909, 922, 1027, 1077, 1081, 1088, 1089, 1378, 1388, 1389
 HORDEUM BULBOSUM 1093
 HORDEUM CHILENSE 1392
 HORDEUM GENICULATUM 1002
 HORDEUM SPONTANEUM 937, 1034
 HORDEUM VULGARE 673, 684, 685, 715, 717, 719, 723, 730, 746, 751, 753, 758, 780, 785, 794, 831, 849, 850, 851, 854, 865, 866, 869, 877, 880, 889, 890, 892, 895, 899, 912, 925, 930, 933, 934, 945, 947, 948, 951, 960, 973, 993, 994, 995, 998, 999, 1003, 1004, 1013, 1032, 1033, 1034, 1039, 1073, 1075, 1082, 1084, 1085, 1087, 1099, 1109, 1130, 1157, 1186, 1193, 1200, 1209, 1212, 1215, 1244, 1246, 1248, 1249, 1264, 1265, 1267, 1268, 1269, 1271, 1274, 1285, 1287, 1291, 1303, 1305, 1311, 1320, 1323, 1325, 1326, 1332, 1334, 1335, 1382, 1385, 1386, 1473, 1481, 1506
 HORDEUM VULGARE (BARLEY) 1155
 HORDEUM VULGARE L 973, 1060, 1092, 1151, 1159, 1185, 1245
 HORMONAL REGULATION 1159
 HORTICULTURE 864
 HOST CAPACITY OF CROPS 859
 HOST PARASITE RELATIONS 1237
 HOST PARASITE SPECIFICITY 1277
 HOSTS 1301
 HOVERFLIES 1221
 HPAEC 1411
 HULLESS BARLEY 1360
 HUMAN BEHAVIOUR 706
 HUMAN FEEDING 1482
 HUMAN FOOD 1414
 HUMIDITY 805, 1468, 1471, 1480
 HUMIDITY EQUILIBRIUM 1339
 HUNGARY 921, 961, 966, 1238, 1246, 1451, 1487
 HYBRIDIZATION 732, 738, 921, 961, 1016
 HYBRIDS 906, 921, 1027, 1035, 1051, 1115
 HYDRAULIC CONDUCTIVITY 709
 HYDROLASES 1154, 1472
 HYDROLYSIS 1379, 1441
 HYDROLYZED PROTEINS 1500
 HYDROPHOBIC INTERACTION
 CHROMATOGRAPHY 1438
 HYDROTHERMAL REGIMES 1113
 HYDROXAMIC ACIDS 1218
 HYGIENE 1341
 HYPERSENSITIVE REACTION 1153
 HYPHOSPHERE 845
 HYPOXIA 1114
 I REACTION CENTER 1209
 IATROGENIC EFFECTS 1298
 IDAHO 723
 IDENTIFICATION 895, 917, 924, 974, 990, 997, 1033, 1229, 1245, 1247, 1271, 1272, 1297, 1341, 1394, 1406, 1418, 1436, 1438, 1442
 IMAGE ANALYSIS 1405
 IMAGE PROCESSING 1405
 IMMUNOENZYME TECHNIQUES 1341
 IN SITU HYBRIDIZATION 946, 1027
 IN VITRO 1436
 IN VITRO CULTURE 753, 1026, 1237
 IN VITRO EXPERIMENTATION 1385
 IN VITRO SYNTHESIS 1411

IN VIVO EXPERIMENTATION 1096, 1125
 INCLUSION COMPLEXES 1398
 INCORPORATION DEPTH 1054
 INDEX 1191
 INDIA 791, 1075
 INDICA 926
 INDOLEACETIC ACID 1063
 INDOLES 1193
 INDUCED MUTATION 908, 964, 1003, 1004, 1026, 1049
 INDUCED RESISTANCE 1268, 1318
 INDUCTION 753, 1159, 1174, 1272
 INFECTION 845, 967, 1183, 1211, 1260, 1261, 1277, 1290, 1291, 1298
 INFESTATION 1250
 INFLORESCENCES 1035
 INFLUX 1117
 INFRARED SPECTROPHOTOMETRY 1450, 1457, 1480
 INHERITANCE 974, 1036
 INHIBITION 1198, 1203
 INHIBITORS 1160
 INHIBITORS OF TRYPSIN ALPHA AMYLASES 1084
 INITIATION 1179
 INNOVATION ADOPTION 674, 1372
 INOCULATION 830
 INOCULATION METHODS 1387
 INORGANIC FERTILIZERS 769, 786, 812, 814
 INORGANIC NITROGEN 868
 INPUT 1221
 INSECT RESISTANCE 974
 INSECTICIDES 1212
 INSITU HYBRIDIZATION 989, 1027
 INSOLATION 1169
 INTACT WHEAT SEEDLINGS 1117
 INTEGRATED CONTROL 674, 769, 786, 1212
 INTEGRATED FARMING 864
 INTEGRATED PEST CONTROL 1257
 INTEGRATED PEST MANAGEMENT 1292
 INTEGRATED PLANT PRODUCTION 699, 716, 769, 786, 828, 854, 881
 INTEGRATED WEED MANAGEMENT 1319
 INTENSITY 1066, 1276
 INTENSIVE CROP MANAGEMENT 1053
 INTENSIVE FARMING 1016
 INTERACTION EFFECT 1165
 INTERCROPPING 695, 703, 788, 878, 879
 INTERGENERIC CROSS 944
 INTERGENERIC GENE TRANSFER 975
 INTERGENERIC HYBRIDIZATION 994, 1002, 1022
 INTERGENETIC GENE TRANSFER 974
 INTERMITTENT LIGHT 1134
 INTERSPECIFIC HYBRIDIZATION 888, 900, 919, 1002, 1027, 1035
 INTESTINAL CONTENTS 1368
 INTESTINES 1374, 1378, 1379
 INTEX 864
 INTRACELLULAR EXCHANGE 1040
 INTRACELLULAR PH 1155
 INTRODUCED VARIETIES 1024
 INTRODUCTION IN FARMING PRACTICE 1257
 INTROGRESSION 957, 1034
 INTRON 1028
 INVERTASE 1180
 INVESTMENT 1214
 INVITRO CULTURE 753
 INVITRO SUGAR TRANSPORT 1200
 ION 1155

ION SUPPRESSION 1063
 IONIC STRENGTH 846
 IONIZING RADIATION 986
 IONS 1085
 IPS WEIZENMODEL 1257
 IRON 1091, 1118
 IRON ACQUISITION 1060
 IRON MOBILIZATION 1118
 IRON SULFUR PROTEIN 1124
 IRON(III) COMPLEX 1057, 1060
 IRRADIATION 1050
 IRRIGATION 741, 822, 1047
 IRRIGATION METHODS 820
 IRRIGATION RATES 783
 ISOELECTRIC FOCUSING 1095
 ISOENZYME VARIANTS 1034
 ISOENZYME VARIATION 1027
 ISOENZYMES 939
 ISOFORMS 1122
 ISOGENIC LINES 1190
 ISOLATE 1223, 1299
 ISOLEUCINE 1345
 ISOPROTURON 1021
 ISOZYMES 1043, 1201
 ISRAEL 937, 1241, 1261, 1262
 ITALY 676, 881, 983, 1452
 JAPONICA 926
 JIANGSU 1303
 JORDAN 849
 K+ AND MG2+ 813
 KARYOTYPES 1070
 KEEPING QUALITY 1455
 KENYA 712, 764, 797, 913, 954, 955, 1006, 1243
 KERNEL MASS 1415
 KERNELS 1413, 1418
 KEYS 1276
 KIDNEY BEANS 1320
 KINETICS 1117, 1121
 L CANDARGY 988, 989
 L CV GERBEL 1174
 L TRYPTOPHAN 1063
 LABELLING TIME 1148
 LABORATORY EXPERIMENTATION 1244, 1378, 1462, 1476, 1487
 LACKING PHOTOSYSTEM II 1119
 LACTATING COWS 1365
 LACTIC ACID 1377, 1441
 LACTIC ACID BACTERIA 1442
 LACTOBACILLUS 1406, 1441, 1442
 LAMAM 1327
 LAMBS 849, 1355
 LAND VARIETIES 998, 999
 LARVAE 1219
 LATENT HEAT 1056
 LATHYRUS SATIVUS 951
 LATIUM 856, 857, 1169
 LATVIA 717, 912, 1334
 LAUTENBACH 864
 LAYER CHICKENS 1343, 1344
 LAYING HEN 1358
 LAYING PERFORMANCE 1343
 LEACHING OF NO3 813
 LEAD 1165, 1460
 LEAF 864, 1181, 1186, 1205
 LEAF APPEARANCE 1135, 1179
 LEAF AREA 878, 1109, 1140, 1163
 LEAF AREA INDEX 1194
 LEAF ELONGATION ZONE 1185
 LEAF EMERGENCE 1166, 1170
 LEAF PHOTOSYNTHESIS 1172
 LEAF RUST 969, 1036, 1241, 1277

LEAF SPOT 1276
 LEAF UNROLLING 1216
 LEAKAGE 843
 LEAVES 749, 999, 1035, 1046, 1071, 1096, 1099, 1100, 1109, 1112, 1114, 1131, 1136, 1150, 1157, 1168, 1169, 1172, 1184, 1198, 1199, 1204, 1250, 1252, 1276, 1291, 1297, 1304
 LECITHINS 1493
 LECTIN 755, 1058
 LEGUME 1194
 LEGUME COVER CROPS 863
 LEGUME GREEN MANURE 1054
 LEGUME STRAW INCORPORATION 841
 LEGUMES 868
 LENGTH 1186, 1377
 LENGTH POLYMORPHISM MAP 997
 LENS CULINARIS 673, 951
 LENTIL 1290
 LENTILS 1477
 LEPTOSPHAERIA 1285
 LEPTOSPHAERIA MACULANS 1158
 LEPTOSPHAERIA NODORUM 1297
 LEVEL 1099
 LIFE 864
 LIGHT 756, 1181, 1332
 LIGHT FRACTION 827, 1052
 LIGHT INDUCTION 1209
 LIGHT INTENSITY 1148, 1335
 LIGHT INTERCEPTION 1194
 LIGHT REGIMES 805
 LIGHT USE EFFICIENCY 1194
 LIGHTING 1111
 LIGNIFICATION 1204
 LIGNIN 1078, 1348
 LIMB BONES 1367
 LIMING 812
 LIMING MATERIALS 768
 LINEAR REGRESSION ANALYSIS 1276
 LINES 962, 974, 975, 1432
 LINK IFS 864
 LINKAGE 972, 1043, 1241, 1242, 1262
 LINKED IMMUNOSORBENT ASSAY 1276, 1299
 LINKED OLIGOSACCHARIDES 1087
 LINYPHIIDAE 1232
 LIPID CONTENT 1374
 LIPID METABOLISM 1380, 1472
 LIPID TRANSFER PROTEIN 1040
 LIPIDS 1076, 1304, 1309
 LIPOLYSIS 1471, 1472
 LIPOSOMES 1076
 LIQUID CHROMATOGRAPHY 1396
 LIQUID FERTILIZERS 769
 LITHUANIA 733
 LITTER 1054
 LIVELWEIGHT GAIN 1352
 LMW SUBUNITS 1400
 LOAM SOILS 733, 789
 LOCATION 924, 1000
 LOCI 1033
 LODGING 1311
 LOLIUM MULTIFLORUM 730, 851, 869
 LOLIUM PERENNE 785, 851, 1167
 LOLIUM TEMULENTUM 1185
 LOLIUM TEMULENTUM L 1178
 LOMBARDY 730
 LONG TERM FERTILIZER APPLICATION 773
 LONG TERM TRENDS 824, 827
 LORRAINE 706
 LOW INPUT 1053
 LOW QUALITY ROUGHAGES 1355

LOW TEMPERATURE 1040, 1146, 1185, 1186
 LOW TEMPERATURE DRYING 1339
 LOW WATER POTENTIALS 1102
 LOWER SAXONY 746
 LOWLAND 968
 LYASES 757
 LYSINE 1397
 MACADAMIA INTEGRIFOLIA 1136
 MACHINE LEARNING 1405
 MACULATA 1236
 MADAGASCAR 735
 MAGNESIUM 991, 1085, 1190, 1311
 MAGNETIC RESONANCE SPECTROSCOPY 1155
 MAIZE 753, 845, 914, 990, 1119, 1123, 1172, 1180, 1194, 1356, 1358, 1367, 1374, 1376, 1412, 1451, 1496, 1497, 1499
 MAIZE AND WHEAT 1113
 MAIZE CELLS 1028
 MAIZE COLEOPTILES 1077
 MAIZE ENDOSPERM 1200
 MAIZE INBREDS 977, 1033
 MAIZE ROOTS 1063, 1102
 MAKING QUALITY 970, 1393, 1400
 MALDI MS 1411
 MALE INFERTILITY 908
 MALES 1024
 MALT 751, 752, 960, 1039, 1338, 1440, 1445, 1446, 1448, 1450, 1453, 1454, 1457, 1458, 1459, 1467, 1469, 1478, 1481, 1484, 1485, 1486, 1492
 MALTED BARLEY 1395
 MALTING BARLEY 704, 722, 912, 973, 1440, 1473
 MALTOSE 1092
 MALUS 1237
 MANAGEMENT 698, 819, 1113
 MANGANESE 801, 805, 1066, 1177
 MANIHOT ESCULENTA 1106
 MANIOC STARCH 1398, 1399
 MAP 1000, 1042
 MAPS 990
 MARCHES (ITALY) 1169
 MARKER SYSTEMS 1033
 MARKERS 997, 1012, 1158, 1241, 1242, 1262
 MARKET 670, 672
 MARKET PRICES 678
 MARKETING 679
 MARKETING TECHNIQUES 681
 MARKETS 704, 751
 MARSHLAND SOILS 746
 MASS SPECTROMETRY 1396
 MATHEMATICAL MODELS 750, 792, 971, 1250, 1480, 1507
 MATHEMATICS 1449
 MATTER 1055, 1065
 MATURATION 1109, 1197
 MATURITY 1346, 1348
 MAYS L COLEOPTILES 1059
 MAYS L KERNELS 1200
 MCPA 1327
 MEADOWS 856
 MEAL 1355, 1422, 1435
 MEAL PATTERNS 1426
 MEASUREMENT 1100, 1439, 1471, 1472, 1475, 1480
 MEASURING INSTRUMENTS 1083, 1096
 MEAT YIELD 1379
 MECHANICAL PROPERTIES 1450
 MECHANISM 1121
 MECHANIZATION 734
 MEDIA 753

MEDIATED UPTAKE 1099
 MEDICAGO 849
 MEDICAGO SATIVA 856, 869, 889
 MEDITERRANEAN 1191
 MEIOSIS 994, 995, 1022, 1074
 MEIOTIC STABILITY 1007
 MEMBRANE PROTEINS 1209
 MESH BAG 1054
 MESOPHYLL 1085
 MESSENGER RNA 1272
 METABOLISM 1078, 1098, 1099, 1112, 1146, 1149, 1178, 1203, 1227, 1291
 METABOLITES 1193
 METAL BINDING PEPTIDES 1201
 METAL CONTAMINATED SOIL 1165
 METEOROLOGICAL OBSERVATIONS 1164, 1199
 METHIONINE 1060, 1091
 METHOD VALIDATION 1144
 METHODS 893, 957, 1039, 1100, 1452, 1470, 1471
 METHYLBUTANAL 1395
 METOPLOPHIUM DIRHODUM 1214
 METRIBUZIN 1330
 METSULFURON 1327, 1330
 MI 1042
 MICROBIAL BIOMASS 848, 1052
 MICROBIAL BIOMASS CARBON 827
 MICROBIAL CONTROL 1223
 MICROBIAL FLORA 1249, 1280, 1461
 MICROBIAL METABOLISM 1063
 MICROBIAL RESPIRATION 1068
 MICROBIAL SIDEROPHORES 1057
 MICROBIOLOGICAL ANALYSIS 1406, 1442
 MICROGRAVITY 1059, 1174
 MICRONUTRIENT FERTILIZERS 1106
 MICRONUTRIENTS 1118
 MICROORGANISMS 1057, 1385
 MICROSCOPY 907, 1055, 1309
 MICROSPORE DERIVED EMBRYOIDS 973
 MICROWAVE MEASUREMENT 1415
 MICROWAVE TREATMENT 1048, 1049
 MIDGET CHROMOSOME 923
 MILDEW 1276
 MILDEWS 921, 1264, 1278
 MILK PRODUCTION 1346
 MILK YIELD 1374
 MILLED FLOUR 1421
 MILLET STARCHES 1434
 MILLETS 1374, 1375, 1504
 MILLING 677, 1443, 1456, 1466, 1482, 1496
 MILLING INDUSTRY 677, 1496
 MINERAL WATER 706
 MINERALISATION 845
 MINERALIZATION 789, 1367
 MINERALS 720, 1368, 1495
 MINIMUM DATA SET 827
 MINIMUM TILLAGE 834, 835
 MISDIVISION 975
 MITOCHONDRIA 1040, 1124, 1306, 1310, 1315
 MITOCHONDRIAL 1158
 MITOCHONDRIAL PROCESSING PEPTIDASE 1124
 MITOSIS 1048
 MITOTIC ACTIVITY 1080
 MIXED CROPPING 852, 853, 869, 1023
 MIXING 1443
 MODE OF ACTION PHYTOTOXICITY 1132
 MODEL 1195, 1399
 MODEL PREDICTION 1054
 MODELS 734, 1278, 1374
 MODERNIZATION 763

MOISTURE 1435
 MOISTURE CONTENT 1100, 1415, 1447, 1462, 1481
 MOISTURE STRESS 1184
 MOLECULAR BIOLOGY 930
 MOLECULAR CHARACTERIZATION 1200
 MOLECULAR CLONING 1040, 1119, 1127
 MOLECULAR GENETICS 1029
 MOLECULAR STRUCTURE 1061
 MOLECULAR WEIGHT 1079, 1460
 MOLECULAR WEIGHT SUBUNITS 976, 1393, 1400, 1409, 1432
 MONO AND DIGLYCERIDES 1493
 MONOCLONAL ANTIBODIES 1239, 1498
 MONOCOT 1186
 MONOCULTURE 690, 692, 724, 860, 1240
 MONOGASTRIC ANIMALS 1373
 MONOSACCHARIDES DIGESTIBILITY 1348
 MOROCCO 1260
 MORPHO PHYSIOLOGICAL TRAITS 1001
 MORPHOLOGICAL DEVELOPMENT 1135
 MORPHOLOGY 819, 1247
 MORTALITY 1214
 MOSAIC VIRUS 1299
 MOTHERS 1323
 MOULDING 1450
 MOULDS 758
 MOVEMENT 1223
 MRNA 1186
 MRNA PROCESSING 1119
 MUGINEIC ACID 1057, 1060, 1091, 1118
 MULTIGENE FAMILIES 1040
 MULTIPLE CROPPING 877
 MULTIPLE SEQUENCE ALIGNMENT 898
 MULTIPLICATIVE INTERACTIONS 1066
 MULTISPECTRAL RADIOMETER 1276
 MULTIVARIATE ANALYSES 1322
 MUTAGENS 931, 964, 1004
 MUTANT LINE 1043
 MUTANT LINES 726
 MUTANTS 907, 986, 1015, 1026
 MUTATION 986, 995, 1015
 MYCOTOXINS 1252, 1341, 1463, 1467, 1492, 1498
 N 15 1054
 N 15 FERTILIZER 848
 N DEMAND 1053
 N ECONOMY 868
 N FERTILIZATION 868
 N GLYCOSYLATION 1087
 N MINERALIZATION 1054
 N NUTRITION 1206
 N RATES 813
 N S RATIO 837
 N SYNTHASE] 1077
 N TRANSFORMATIONS 848
 N UPTAKE 848, 1001
 N2 FIXING CYANOBACTERIA 1058
 NA+/H+ ANTIPORT 1208
 NAD(+) KINASE 1190
 NAD+ KINASE 1190
 NAGELE 864
 NATURAL DISTRIBUTION 1303
 NATURE CONSERVATION 716, 862
 NDVI 1191
 NEAR ISOGENIC LINES 917
 NECROSIS 1265
 NEMATODA 1265
 NET CA 45(2+) UPTAKE 875
 NET RETURNS 1327
 NEURAL NETWORK 1405

NEUROSPORA CRASSA MITOCHONDRIA 1124
 NEW RESISTANCE GENE 988
 NEW SOUTH WALES 867
 NEW ZEALAND 846
 NICKEL 1066
 NICKEL TOXICITY 1066
 NICOTIANA TABACUM 690
 NICOTIANAMINE AMINOTRANSFERASE 1091
 NICOTIANAMINE SYNTHASE 1060
 NITRATE ASSIMILATION 1112
 NITRATE REDUCTASE 713, 1105, 1112, 1184
 NITRATES 792, 1085, 1104
 NITRIFICATION INHIBITORS 737
 NITROGEN 738, 769, 779, 780, 784, 789, 792, 793, 800, 809, 814, 819, 822, 851, 1001, 1075, 1105, 1109, 1113, 1135, 1140, 1151, 1198, 1311, 1317, 1365, 1469, 1473, 1499
 NITROGEN ACCUMULATION 726
 NITROGEN CONTENT 1096, 1390
 NITROGEN FERTILISER 774
 NITROGEN FERTILIZER 799
 NITROGEN FERTILIZERS 692, 708, 713, 714, 723, 724, 725, 737, 784, 787, 852, 853, 856, 1096, 1126, 1140, 1383, 1384, 1470
 NITROGEN LOSSES 765
 NITROGEN METABOLISM 1126, 1380
 NITROGEN MINERALIZATION 1054
 NITROGEN RETENTION 1375
 NITROGEN SOURCE 781
 NITROGEN SOURCES 754
 NITROUS OXIDE 767
 NO TILL 844
 NO TILLAGE CORN 863
 NO3 EFFLUX 1117
 NOAA AVHRR 1191
 NOCARDIA 1385
 NODORUM 1283
 NON LINEAR MODEL 1254
 NONPHOTOSYNTHETIC MUTANTS 1119
 NORFLURAZON 1332
 NORMALIZED DIFFERENCE VEGETATION INDEX 1191
 NORTH AMERICAN GRASSLAND 1351
 NORTH CAROLINA PHOSPHATE ROCK 838
 NOSTOC 1058
 NPK FERTILIZERS 768, 783
 NUCLEAR 1161
 NUCLEAR MUTANTS 1119
 NUCLEI 1192
 NUCLEOTIDE SEQUENCE 1209
 NURSE CROPS 869
 NUTRIENT AVAILABILITY 779, 1104, 1373, 1390
 NUTRIENT STORAGE 827
 NUTRIENT TRANSPORT 1103, 1268
 NUTRIENT UPTAKE 749, 784, 786, 789, 791, 794, 805, 809, 814, 822, 851, 1072, 1104, 1105, 1108, 1113, 1260, 1317
 NUTRIENTS 1067, 1090, 1377
 NUTRITION 1155
 NUTRITION PHYSIOLOGY 1378
 NUTRITIONAL DISORDERS 1361
 NUTRITIONAL REQUIREMENTS 801, 880, 1106, 1345
 NUTRITIONAL STATUS 1504
 NUTRITIVE VALUE 702, 703, 745, 1342, 1359, 1371, 1377, 1378, 1403, 1477
 OATS 1462, 1491, 1496

OBTUSIFOLIOL 14 ALPHA METHYL DEMETHYLASE 1160
 OCCURRENCE 1213
 OCEANIA 684
 OCHRATOXIN 1462, 1492
 OIDIUM 966
 OIL BINDING ABILITY 1428
 OILSEED 804
 OILSEED RAPE 1160, 1322
 OLD 1001
 OLIGOMYCIN 1146
 OLIGOSACCHARIDE 1178
 ONE LAYER 1056
 OPTICAL PROPERTIES 693, 1096, 1312, 1479
 OPTIMIZATION METHODS 1037
 ORANGE JUICE 1493
 ORGANIC ACIDS 1121
 ORGANIC AMENDMENTS 1137
 ORGANIC ANIONS 1121
 ORGANIC CARBON 844, 1055
 ORGANIC FARMING 792, 865, 948
 ORGANIC FERTILIZER 1064, 1065
 ORGANIC FERTILIZERS 814, 856, 1389
 ORGANIC MATTER 861, 1374, 1390, 1501
 ORGANIC PHOSPHORUS 845
 ORGANIZATION 898, 914, 989, 1134
 ORGANOLEPTIC PROPERTIES 1458
 ORGANOSULPHUR COMPOUNDS 1385
 ORYZA SATIVA 734, 796, 1103, 1106, 1292, 1306, 1436
 ORYZA SATIVA L 973
 ORYZAE L 1224
 OSMOTIC POTENTIAL 818
 OSMOTIC POTENTIAL, MATRIC POTENTIAL 1211
 OSMOTIC STRESS 1102
 OVA 1210
 OVARIOL NUMBER 1214
 OVERPRODUCTION 1503
 OXIDATION 1318, 1385
 OXIDATIVE PHOSPHORYLATION 1146
 OXIDOREDUCTASES 895, 1149, 1197
 OXYGEN EVOLUTION 1134
 OXYGEN EVOLVING COMPLEX 1209
 P 32 770
 P ACCUMULATION 773
 P MOVEMENT 773
 P USE 698
 PACIFIC NORTHWEST 1245
 PACLOBUTRAZOL 747, 749, 1159, 1160
 PAECILOMYCES 1385
 PAKISTAN 673, 951, 1382
 PANCREAS 1376
 PAPILLA FORMATION 1153, 1204
 PARAGUAY 777, 839
 PARENTAGE 940, 1033
 PARTIAL AMPHIPLOID 969
 PARTIAL RESISTANCE 892, 1266, 1276, 1283
 PARTICLE BOMBARDMENT 1028
 PARTICLE SIZE 1443, 1496, 1497
 PARTICLE SIZE FRACTIONS 827
 PARTITIONING 1141
 PASSAGE 1297
 PASTA DOUGH RHEOLOGY 970
 PASTES 1412
 PASTURE 709
 PATH ANALYSIS 736, 992
 PATHOGENIC FUNGI 1204, 1249
 PATHOGENICITY 916, 1236, 1247, 1263, 1273, 1303
 PATHOGENS 1277

PATHOTYPES 1241
 PATTERNS 1033, 1178
 PEA 1201
 PEA LEAVES 1155
 PEARL MILLET 874, 1115, 1194
 PEAS 865
 PECTIN 1366
 PEDIGREE 977
 PEEL 1375
 PENETRATION 1407
 PENETROMETER RESISTANCE 826
 PENICILLIUM 1385, 1462
 PENICILLIUM BILAJI 1143
 PENTOSANASE 1368
 PENTOSANS 1089
 PEPTIDE HYDROLASES 1067
 PERFORMANCE 821, 1342, 1347, 1351, 1360
 PERFORMANCE LIQUID
 CHROMATOGRAPHY 962, 970, 1063, 1245,
 1393, 1438
 PERFORMANCE TESTING 1356
 PERMEABILITY 790, 1103, 1318
 PEROXIDASE ACTIVITY 1153, 1185
 PEROXIDASES 713, 747
 PERSISTENCE 1329
 PERSONAL COMPUTER 1266
 PEST CONTROL 699, 1212, 1226
 PEST INSECTS 1220, 1265
 PEST RESISTANCE 1215
 PESTICIDE ACTIONS 1324
 PESTICIDE PERSISTENCE 1279
 PESTICIDES 862, 1282
 PESTS OF PLANTS 865
 PGEN 1136
 PH 1092, 1144, 1374, 1377, 1471
 PHAEOSPHAERIA NODORUM 1297
 PHASE PROPERTIES 1076
 PHASEOLUS 1504
 PHASEOLUS COCCINEUS L 1099
 PHASEOLUS VULGARIS 1272, 1413
 PHENOLIC ACIDS 1061
 PHENOLIC COMPOUNDS 1061, 1193, 1482
 PHENOLOGY 1507
 PHENOTYPES 708, 1035
 PHENOTYPIC CHARACTERISTICS 829
 PHENOTYPIC PLASTICITY 1214
 PHLOROGLUCINOL 1078
 PHOSPHATE 1430
 PHOSPHATE FERTILIZERS 692, 724, 778, 794,
 856
 PHOSPHATE SOLUBILIZING BACTERIA 830
 PHOSPHATES 790, 803, 1491
 PHOSPHOLIPASE C 1127
 PHOSPHOLIPID TRANSFER PROTEIN 1040
 PHOSPHORUS 723, 766, 775, 778, 779, 785, 846,
 1290, 1311, 1317, 1344, 1367, 1373, 1494, 1495
 PHOSPHORUS AVAILABILITY 770
 PHOSPHORUS FERTILIZATION 1143
 PHOSPHORUS TRANSLOCATION
 EFFICIENCY 799
 PHOSPHORUS UPTAKE 773, 782, 799
 PHOSPHORYLATION 1161, 1193
 PHOTOGRAPHY 693
 PHOTOINHIBITION 1134, 1146
 PHOTOINTERPRETATION 693
 PHOTOPERIOD 997
 PHOTOPERIODICITY 1045, 1168, 1169, 1199
 PHOTORESPIRATION 1206
 PHOTOSENSITIVITY 1111
 PHOTOSYNTHESIS 713, 714, 749, 1071, 1073,
 1109, 1110, 1125, 1126, 1136, 1141, 1174, 1181,

1184, 1187, 1193, 1206, 1268, 1291, 1304, 1312,
 1332
 PHOTOSYNTHETIC RATE 1162
 PHOTOSYSTEM I 1209
 PHOTOSYSTEM I SUBUNIT PSI F 1209
 PHOTOSYSTEM II HETEROGENEITY 1134
 PHOTOTROPISM 1059
 PHYLLCHRON 1150
 PHYLLCHRON DURATION 802
 PHYLOGENETIC ANALYSIS 898
 PHYLOGENY 1027
 PHYSICAL PROPERTIES 841, 843
 PHYSICOCHEMICAL PROPERTIES 1434
 PHYSIOGRAPHIC FEATURES 999
 PHYSIOLOGICAL CRITERIA 1131
 PHYSIOLOGICAL FUNCTIONS 1139
 PHYSIOLOGY 1151, 1198
 PHYTASE 1358
 PHYTATES 1491
 PHYTIC ACID 1441, 1491
 PHYTOPHTHORA INFESTANS 1237
 PHYTOSIDEROPHORE 1091
 PHYTOSIDEROPHORES 1057, 1118
 PHYTOTOXICITY 991, 1061, 1323, 1332
 PIG SLURRY 1064
 PIG SLURRY, 1065
 PIGMENTS 1464, 1465
 PIGS 1360
 PIRIMPHOS METHYL 1336
 PISUM SATIVUM 852, 853, 865, 912, 948, 1268,
 1287
 PLACEMENT METHOD 838
 PLAINS 730
 PLANT 1068, 1092
 PLANT AGE 846
 PLANT ANATOMY 1025, 1164
 PLANT BIOTECHNOLOGY 1039
 PLANT BREEDERS 912
 PLANT BREEDING 718, 737, 893, 900, 905, 909,
 912, 919, 929, 932, 948, 961, 993, 999, 1029, 1109,
 1285, 1466, 1468
 PLANT CERTIFICATION 960
 PLANT CHITINASES 1272
 PLANT COVER 693, 857
 PLANT DEHYDRINS 1128
 PLANT DEVELOPMENT 698
 PLANT DEVELOPMENTAL STAGES 800, 1098,
 1108, 1110, 1125, 1139, 1145, 1163, 1164, 1199,
 1274, 1377
 PLANT DISEASES 854, 865, 1235, 1278
 PLANT ECOLOGY 694, 798
 PLANT EMBRYOS 1210
 PLANT ESTABLISHMENT 999
 PLANT FATS 1493
 PLANT FIBRES 1474
 PLANT GENES 756
 PLANT GROWTH SUBSTANCES 694, 780, 806,
 1038, 1101
 PLANT MATERIAL 1054, 1144
 PLANT METABOLISM 1200
 PLANT NURSERIES 1215
 PLANT NUTRITION 785, 1104, 1311
 PLANT PHYSIOLOGY 930, 1109, 1139, 1507
 PLANT POPULATION 721, 750, 1109, 1328
 PLANT PRODUCTION 686, 689, 702, 707, 712,
 727, 728, 729, 735, 744, 816, 834, 857, 1086, 1199
 PLANT PROTECTION 738, 1278
 PLANT REGENERATION 753, 973, 980, 1157
 PLANT REQUIREMENTS 786, 880
 PLANT RESIDUES 1061
 PLANT RESISTANCE 1214, 1229, 1272

PLANT RESPONSE 741, 856, 1045, 1104
 PLANT ROOTS 1167
 PLANT SOIL RELATIONS 778
 PLANT STEROL 1160
 PLANT TISSUES 1299
 PLANT TYPE 947
 PLANT VIRUSES 925, 1244, 1265, 1271
 PLANT WATER RELATIONS 880
 PLANTING DATE 819
 PLANTS 753, 755, 765, 782, 1008, 1028, 1040,
 1091, 1114, 1131, 1144, 1148, 1150, 1178, 1181,
 1184, 1201, 1208, 1277
 PLASMA MEMBRANE 755, 875, 1208
 PLASMOLOGY 887
 PLOUGHING 828, 831
 POA PRATENSIS 1287
 POACEAE 1027, 1059
 PODZOLS 812
 POINT INJECTION 810
 POLAND 928, 1476
 POLAR TRANSPORT 1063
 POLCO 1327
 POLLEN 995, 1024
 POLLEN FERTILITY 1007
 POLLEN STORAGE 944
 POLLUTION 1373
 POLLUTION CONTROL 706
 POLY (N ACETYLLACTOSAMINO)GLYCAN
 1411
 POLYAMINES 757
 POLYMERASE CHAIN REACTION 977, 1245
 POLYMERIZATION 1244
 POLYMERS 1422
 POLYMORPHISM 1000
 POLYMORPHISMS 917
 POLYPEPTIDE 875
 POLYPEPTIDES 1161
 POLYPLOIDY 889
 POLYSACCHARIDE 1058, 1178
 POLYSACCHARIDES 1347
 POPULATION DENSITY 862
 POPULATION DYNAMICS 1223, 1234, 1333
 POPULATIONS 1034, 1055, 1158, 1253
 PORCINE ZONA PELLUCIDA 1411
 PORK 1367
 POROSITY 709
 PORTUGAL 795, 796
 POSITION 833
 POSSIBLE PHYTOSIDEROPHORE 1060
 POSTHARVEST CONTROL/ HANDLING 1340
 POSTHARVEST TECHNOLOGY 1340
 POT EXPERIMENTATION 801, 1384
 POTASH FERTILIZERS 723, 856
 POTASSIUM 779, 785, 1085, 1108, 1311
 POTATO MITOCHONDRIA 1124
 POTATO STARCH 1398
 POTATOES 865, 1451
 POTENTIAL BREADMAKING QUALITY 1438
 POTENTIAL WATER USE EFFICIENCY 937
 POTENTIALLY MINERALIZABLE NITROGEN
 827
 POULTRY 1349
 POULTRY MANURE 776
 POVERTY 674
 POWDERY MILDEW 1036, 1204, 1266, 1276
 POWDERY MILDEW RESISTANCE 946, 974,
 1042
 PRE HARVEST SPROUTING 1116
 PRECEDING CROPS 873
 PRECIPITATION 741, 1391
 PRECURSOR 1209

PREDICTION 1499
 PREGERMINATION 1477
 PRESERVATION 1315
 PRESERVATIVES 1359
 PRESSING 1376
 PRESSURE PROBE 1102
 PRICE POLICIES 670
 PRICES 704
 PRIMARY LEAVES 755
 PRIMARY TRITICALES 1007
 PROBES 1299
 PROCESSING 1452, 1466, 1476, 1504
 PRODUCT LABELLING 1505
 PRODUCTION 832
 PRODUCTION COSTS 730, 881
 PRODUCTION DATA 684, 696, 724, 730, 741, 860
 PRODUCTION INCREASE 857
 PRODUCTION POSSIBILITIES 880
 PRODUCTIVITY 698, 717, 796
 PRODUCTS 1397, 1399
 PROEMBRYOS 753
 PROFILE MODIFICATION 826
 PROFITABILITY 739
 PROGENY 896, 928, 929, 1031
 PROLAMINE 1403
 PROLAMINES 896, 920, 983
 PROLINE 749, 1142
 PROLINE ACCUMULATION 1131
 PROMOTER 756, 1028
 PROPICONAZOL 1298
 PROTEASES 943, 1349, 1500
 PROTEIN 731, 781, 1128, 1181, 1351, 1360, 1365, 1400, 1425, 1435
 PROTEIN AGGREGATION 1409
 PROTEIN COMPLEX 1134
 PROTEIN COMPOSITION 962, 1393
 PROTEIN CONCENTRATES 1378
 PROTEIN CONTENT 787, 800, 811, 817, 909, 919, 952, 960, 971, 984, 1374, 1468, 1470, 1476, 1480, 1481, 1487
 PROTEIN IMPORT 1124, 1209
 PROTEIN PLASTOCYANIN 1209
 PROTEIN PRODUCTS 1503
 PROTEIN QUALITY 800, 984, 1376
 PROTEIN REMOBILISATION 1067
 PROTEIN SYNTHESIS 1307, 1316
 PROTEINS 924, 1001, 1009, 1039, 1119, 1157, 1161, 1186, 1304, 1306, 1307, 1316, 1341, 1359, 1499, 1504
 PROTEOLYSIS 943
 PROTEOLYTIC ACTIVITIES 1067
 PROTOCHLOROPHYLLIDE 1185
 PROTON EXTRUSION 1208
 PROTON RELEASE 782
 PROTOPLAST REGENERATION 1157
 PROTOPLASTS 1039, 1146, 1315
 PROXIMATE COMPOSITION 714, 909, 1081, 1377, 1452, 1460
 PS II HETEROGENEITY 1134
 PSAF 1209
 PSBA 1119
 PSEUDOCERCOSPORELLA 828, 1256, 1285
 PSEUDOCERCOSPORELLA HERPOTRICHOIDES 859, 967, 988, 1247, 1248, 1297
 PSEUDOMONADS 867
 PSEUDOMONAS 1385
 PSEUDOMONAS PUTIDA WCS358 1057
 PUCCINIA 1226
 PUCCINIA CORONATA 1285

PUCCINIA GRAMINIS 1272, 1285
 PUCCINIA HORDEI 1241, 1261, 1268, 1285, 1291
 PUCCINIA RECONDITA 897, 903, 1014, 1260, 1269, 1279, 1286
 PUCCINIA SPP 1298
 PUCCINIA STRIIFORMIS 913, 1263, 1285, 1301, 1302
 PULPING 1502
 PULSE LABELLING 1068, 1069, 1167
 PURCHASING 680
 PURE LINES 934
 PURIFICATION 1040, 1124, 1300
 PURITY 1459
 PYRAZOPHOS 1298
 PYRENOPHORA 769, 1248
 PYRENOPHORA TERES 1236
 PYROPHOSPHATASE 1208
 PYRUS 1237
 PYTHIUM 867
 PYTHIUM ROOT ROT 1287
 PYTHIUM ULTIMUM 1300, 1305
 QTLs 997
 QUALITY 680, 706, 715, 722, 724, 740, 751, 752, 758, 798, 817, 906, 912, 920, 922, 956, 960, 976, 985, 1010, 1097, 1223, 1432, 1434, 1437, 1439, 1440, 1445, 1450, 1453, 1454, 1455, 1457, 1461, 1466, 1468, 1473, 1475, 1476, 1480, 1483, 1486, 1487, 1490
 QUALITY CHARACTERISTICS 1430
 QUALITY CONTROLS 1340, 1478
 QUALITY ROUGHAGES 1350
 QUANTITATIVE ANALYSIS 1436
 QUANTITATIVE RESISTANCE 967
 QUANTITATIVE TRAIT LOCI 997
 QUANTITATIVE VARIATION 1393
 QUEENSLAND 767, 824
 R ENZYME 1418
 RADIAL VARIATION 1337
 RADIATION USE EFFICIENCY 1141, 1194
 RADIATIONS 908, 1009, 1096, 1199
 RADIATIVE SURFACE TEMPERATURE 1056
 RADIOACTIVE CONTAMINATION 986, 995
 RADIOISOTOPES 986
 RAIN 682, 1047, 1199
 RAIN FED FARMING 673, 683, 808, 815, 849, 951, 1382, 1391
 RAIN FED WHEAT 1113
 RAINWATER 1140
 RANGELANDS 673
 RAPD 917, 1012
 RAPD MARKERS 917
 RAT LIVER 1124
 RATE OF ACCUMULATION 726
 RATES 1068, 1170, 1179
 RATIONS 1359
 RECIPROCALLS 887
 RECOMBINANTS 923
 RECOMBINATION 957, 976, 1000, 1043
 RECOVERY 1053
 RED SPRING WHEAT 799
 RED WHEAT 1120, 1421
 REDUCTASE ACTIVITY 1112
 REDUCTION 1117, 1441
 REFRIGERATION 1439, 1475
 REGENERATION 980, 1028, 1092
 REGISTRATION 988, 1205, 1264
 REGULATED EXPRESSION 756
 REGULATOR ACTIVITIES 1160
 REGULATORS OF SOIL FERTILITY 883
 RELATIVE EFFECTIVENESS 771

RELATIVE HUMIDITY 1447
 RELATIVE TIME 1333
 RELATIVE WATER CONTENT 1184
 REMOBILIZATION 1177
 REMOTE SENSING 1191
 REPEATED DNA SEQUENCE 923
 REPETITIVE DNA SEQUENCES 1027
 REPRODUCTION 1214
 REQUIREMENTS 1160
 RESEARCH 674, 686, 689, 697, 703, 707, 712, 718, 727, 728, 729, 735, 743, 744, 1466
 RESEARCH NETWORKS 958
 RESEARCH PROJECTS 673, 1381
 RESIDUAL EFFECTIVENESS 774
 RESIDUAL SOIL N 813
 RESIDUE 1156
 RESIDUE MANAGEMENT 841
 RESIDUES 1460
 RESISTANCE 924, 997, 1036, 1131, 1227, 1236, 1239, 1241, 1247, 1293, 1297, 1336
 RESISTANCE GENES 1242
 RESISTANCE TO INJURIOUS FACTORS 732, 888, 893, 905, 930, 948, 985, 1075
 RESORPTION 1214
 RESOURCE CONSERVATION 958
 RESPIRATION 1146, 1205, 1206
 RESPIRATORY CHAIN 1124
 RESPONSE CURVE 1134
 RESPONSES 875, 1123, 1136, 1207
 RESTRICTED FEEDING 1343
 RESTRICTION ENDONUCLEASES 1012
 RESTRICTION FRAGMENT LENGTH 1000
 RESTRICTION FRAGMENT LENGTH POLYMORPHISM 1042
 RFLP 914, 987, 990, 1000, 1027, 1043
 RFLP ANALYSIS 980, 1027
 RFLP DATA 1033
 RFLP MARKERS 923
 RHEOLOGICAL PROPERTIES 1412, 1439, 1475, 1476, 1487, 1489
 RHINELAND PALATINATE 1445
 RHIZOCTONIA 867, 1278, 1285, 1303
 RHIZOCTONIA CEREALIS 859
 RHIZOCTONIA ROOT ROT 1287
 RHIZODEPOSITION 1068
 RHIZOSPHERE 830, 848, 1068, 1118, 1148, 1167, 1176, 1255, 1385, 1386, 1387
 RHIZOSPHERE MICROORGANISMS 845
 RHOPALOSIPHUM PADI L 1214
 RHYNCHOSPORIUM 769
 RHYNCHOSPORIUM SECALIS 1248, 1285
 RHYZOPERTHA DOMINICA 1336
 RIBOFLAVIN 1477
 RIBONUCLEASE 1142
 RIBONUCLEASES 1009
 RIBOSOMAL RNA GENES 898
 RIBOSOMES 1307
 RICE 846, 868, 926, 1028, 1058
 RICE STARCH 1430
 RICE STRAW 1350
 RIPENING 1081, 1238
 RISC 864
 RNA 1009
 ROASTED BARLEY 1365
 ROASTING 1395
 ROCK 720
 ROCK PHOSPHATE 770, 771
 ROOT 826, 1123
 ROOT ASSOCIATION 1058
 ROOT DEPTH INDEX (RDI) 1175
 ROOT DERIVED C 848

ROOT DERIVED MATERIAL 1167
 ROOT EXUDATES 1118
 ROOT EXUDATION 1121
 ROOT GROWTH 847, 867, 910, 1113, 1155
 ROOT GROWTH ANGLE 1175
 ROOT LENGTH 846
 ROOT LENGTH DENSITY 1196
 ROOT MEDIUM PH 782
 ROOT RESPIRATION 1068
 ROOT ROT 1245
 ROOT ROTS 1264
 ROOT SIGNAL 867
 ROOT SYSTEMS 700, 938, 1062, 1072
 ROOT TIPS 1190
 ROOT VERTICAL DISTRIBUTION 1175
 ROOT WIDTH 846
 ROOTING 747
 ROOTS 709, 747, 791, 845, 848, 867, 875, 999,
 1046, 1048, 1057, 1067, 1069, 1090, 1099, 1103,
 1104, 1107, 1108, 1163, 1167, 1182, 1290, 1305,
 1306, 1386, 1387, 1388
 ROT 1258
 ROT FUNGI 1211
 ROTARY CULTIVATORS 828
 ROTATION 844, 1052
 ROTATIONAL CROPPING 690, 700, 717, 730,
 794, 839, 854, 856, 857, 860, 861, 862, 866, 881,
 1388
 ROW CROP 1195
 RP HPLC 1393
 RUBPC ACTIVITY 1206
 RUMEN 1078, 1374
 RUMEN FERMENTATION 1365
 RUMINAL FERMENTATION 1355, 1365
 RUMINANTS 1350
 RURAL AREAS 674
 RUSSIAN FEDERATION 758, 794, 812, 1016
 RUSSIAN WHEAT APHID (DIURAPHIS
 NOXIA) 1216
 RUST 1262
 RUST RESISTANCE 917, 946, 1283
 RUST RESISTANCE GENES 1241
 RUSTS 950, 1006, 1243, 1248, 1264, 1269, 1279,
 1281
 RWANDA 686, 768
 RYE 736, 851, 975, 1043, 1162, 1190, 1247, 1347,
 1353, 1356, 1368, 1379, 1451, 1471, 1472, 1476,
 1482, 1491, 1501
 RYE FLOUR 1441, 1489
 RYE GRASS 1182
 RYEGRASS SILAGE 1348
 S TRANSFERASE 1201
 SACCHAROMYCES CEREVISIAE 1441
 SALES PROMOTION 679
 SALINE SOILS 999
 SALINE WATER 999
 SALINITY 1114, 1172, 1313
 SALINITY MANAGEMENT 818
 SALT TOLERANCE 818, 889, 899, 907, 998, 999,
 1041, 1114, 1313, 1314
 SANDY SOILS 746, 789, 822, 922, 1075
 SARDINIA 998, 999, 1215
 SAXONY 752
 SAXONY ANHALT 676
 SBPASE 756
 SCABS 1026, 1259
 SCARAB 864
 SCLEROTIUM ROLFII 1300
 SCREENING 910
 SCREENING STANDARDS 1295
 SDS PAGE 969

SDS SEDIMENTATION TEST 970
 SEASONS 1047
 SECALE 1379
 SECALE CEREALE 696, 717, 801, 851, 861, 895,
 957, 974, 975, 980, 1022, 1074, 1094, 1285, 1304,
 1307, 1386, 1501, 1506
 SECALE CEREALE L 914
 SEDOHEPTULOSE 1, 7 BISPHOSPHATASE 756
 SEED 680, 758, 892, 1015, 1083, 1115, 1249, 1282,
 1323
 SEED BANKS 1322
 SEED CALCIUM 910
 SEED CLEANERS 763
 SEED DEPTH 1233
 SEED DRESSING 1282
 SEED FILLING 1098, 1101, 1164
 SEED HARVESTERS 1083
 SEED IMBIBITION 843
 SEED PATHOLOGY 1249, 1282
 SEED PRODUCTION 758, 763, 1020
 SEED PROTEINS 1005
 SEED TESTING 1249, 1282
 SEED TREATMENT 1003, 1051
 SEED TREATMENTS 1245
 SEEDBED PREPARATION 701
 SEEDBORNE ORGANISMS 1280
 SEEDING METHOD 705
 SEEDING RATE 731
 SEEDLING EMERGENCE 1333
 SEEDLING RESISTANCE 1014
 SEEDLINGS 790, 939, 1009, 1050, 1114, 1123,
 1138, 1142, 1155, 1211, 1234, 1277, 1283, 1306,
 1307, 1313, 1316, 1318, 1332
 SEEDS 763, 889, 893, 1035, 1050, 1081, 1084,
 1088, 1089, 1197, 1418, 1499
 SEGREGATION RATIO 1014
 SELECTION 912, 925, 933, 934, 954, 1006, 1020,
 1044
 SELECTION ADVANTAGE 891
 SELECTION CRITERIA 677, 888, 893, 919, 925,
 948, 955, 991, 1029
 SELECTIVE MEDIUM 1297
 SELECTIVITY 1228
 SELENIUM DETERMINATION 1144
 SELF COMPATIBILITY 896
 SEMI ARID TROPICS 1156
 SEMI TROPICAL 1329
 SEMICHEMICAL PULP 1502
 SEMOLINA 677, 1443, 1464, 1465
 SENESCENCE 1067, 1187, 1211
 SENSITIVE CULTIVARS 1121
 SENSITIVITY 1186, 1288
 SENSORY 1421
 SEPTORIA 769, 1237, 1248, 1278
 SEPTORIA NODEORUM 1295
 SEPTORIA NODORUM 1257, 1297
 SEPTORIA SPP 1298
 SEPTORIA TRITICI 981
 SEQUENCE 923, 989, 1087
 SEQUENCE DIVERSITY 898
 SEQUENCES 990, 1272
 SEQUENTIAL CROPPING 849, 850
 SERUM 1494
 SET ASIDE LAND 882
 SEVERITY 1298
 SEWAGE SLUDGE 785
 SHAANXI 916, 1391
 SHEEP 673, 1348, 1374
 SHEEP, ADULT 1350
 SHOOT 847
 SHOOT GROWTH 1196

SHOOT ROOT RATIO 1206
 SHOOTS 1067, 1114
 SHORT TERM 1117
 SHORT TIME EXTRUSION 1435
 SHORTENING 1493
 SHX MUTANT 1200
 SICILY 1163, 1164, 1199
 SIDE EFFECTS ON PATHOGENS 1298
 SIDES 1367
 SIEVING 1443, 1496
 SILAGE 1346, 1374
 SILICATES 1389
 SIMAZINE 1323
 SIMULATED FOODS 1493
 SIMULATED URINE PATCHES 1351
 SIMULATION 818, 1223, 1254, 1255, 1338
 SIMULATION MODELS 675, 699, 1139, 1169,
 1220
 SINAPIS ALBA 1155
 SINK REMOVAL 1187
 SITE 1348
 SITE FACTORS 688, 738, 746, 758, 786, 803
 SITES 1053, 1204
 SITOBION AVENAE 1214
 SITOPHILUS GRANARIUS 1224
 SITOPHILUS ORYZAE 1336
 SIZE EXCLUSION CHROMATOGRAPHY 1428
 SIZE EXCLUSION HIGH PERFORMANCE
 LIQUIDS CHROMATOGRAPHY 962
 SLENDER 1186
 SLENDER BARLEY 1185
 SLOPE POSITION 698
 SLOVAK REPUBLIC 680
 SLOW RELEASE NITROGEN FERTILIZER 874
 SMALL GRAINS 1225
 SNOW CONTROL 842
 SNOW MANAGEMENT 842
 SNOWFALL 842
 SO42 813
 SODIUM CHLORIDE 889, 1313, 1314, 1318
 SODIUM HYDROXIDE 1350
 SOFT WHEAT 708, 766, 885, 913, 1086, 1243,
 1321, 1406, 1490
 SOIL 691, 767, 803, 811, 813, 823, 830, 873, 1055,
 1063, 1123, 1144, 1148, 1172, 1182, 1211, 1254,
 1287, 1329
 SOIL BACTERIA 829
 SOIL BIOLOGY 828, 867, 1386
 SOIL BIOMASS 848
 SOIL CHEMICAL 841
 SOIL CHEMICOPHYSICAL PROPERTIES 823,
 1383, 1389
 SOIL CONSERVATION 881
 SOIL COVER 767
 SOIL DEGRADATION 841
 SOIL DENSITY 831
 SOIL DETERIORATION 884
 SOIL EVAPORATION 1195
 SOIL FERTILITY 692, 742, 779, 792, 794, 814, 868,
 880, 881, 1390
 SOIL FOLLOWING CEREAL 804
 SOIL MICROBIAL BIOMASS 1167
 SOIL MOISTURE 1189
 SOIL N SUPPLY 1053
 SOIL NITRATE 882
 SOIL ORGANIC MATTER 827, 1064, 1065
 SOIL PH 1155
 SOIL QUALITY 827
 SOIL RESPIRATION 1176
 SOIL SCIENCES 723
 SOIL STRENGTH 867

SOIL STRUCTURE 777, 827, 839
 SOIL TEMPERATURE 877, 1115
 SOIL TESTING 778, 792
 SOIL TOXICITY 991
 SOIL TRANSPORT PROCESSES 779, 789
 SOIL TYPE 802
 SOIL TYPES 717, 785, 851, 1390
 SOIL WATER 821
 SOIL WATER BALANCE 1125, 1199
 SOIL WATER CONTENT 779, 820, 822, 831, 877, 1062, 1105, 1136, 1162
 SOIL WATER REGIMES 1100, 1391
 SOILS 773, 776, 824, 843, 868, 1061
 SOLANI 1300
 SOLANUM TUBEROSUM 796, 854, 865, 912, 1212, 1237
 SOLAR ENERGY 1125
 SOLIDS 1378
 SOLUBILITY 1460
 SOLUTE ACCUMULATION 1114
 SOLUTION CULTURE 846
 SOLUTIONS 889
 SOMACLONAL VARIATION 939
 SOMATIC VARIATION 1035, 1237
 SORGHUM 818, 836, 1115, 1194, 1213, 1414
 SORGHUM GRAIN 889
 SOUTH AMERICA 884, 1270
 SOUTH AUSTRALIA 1273
 SOUTH DAKOTA 718, 719
 SOUTHWESTERN SASKATCHEWAN 1052
 SOWING 682, 738, 745, 879
 SOWING DATE 725, 1101, 1150, 1166, 1168, 1169, 1170, 1199
 SOWING DEPTH 828
 SOWING RATES 750, 852, 857
 SOYBEAN AXES 1076
 SOYBEAN MEAL 1345
 SOYBEANS 1367, 1375, 1376, 1477
 SPACE FLIGHT 1059
 SPACING 721, 852, 853, 1023
 SPAGHETTI 970, 1397
 SPATIAL DISTRIBUTION 1102, 1185, 1186
 SPECIES 862, 1108, 1303
 SPECIES GROUPS 1300
 SPECIFIC VIRULENCE 1253
 SPECIFICITY 1299
 SPECTROMETRY 1096, 1468, 1480
 Sperm Receptor Activity 1411
 SPHAEROTHECA FULIGINEA 1266
 SPIDERS 1232
 SPIKELETS 1074
 SPIKES 893, 896, 1015, 1020, 1035, 1164
 SPINACH 1209
 SPINACH CHLOROPLASTS 1134
 SPLIT APPLICATIONS 813
 SPLIT DRESSINGS 737, 792
 SPONTANEUM 1262
 SPORE GERMINATION 1211
 SPORES 1263
 SPRAYING 862
 SPRING BARLEY 709, 765, 832
 SPRING CROPS 693, 710, 800, 831, 851, 890, 893, 942, 960, 965, 993, 1011, 1020, 1023, 1032, 1045, 1051, 1072, 1079, 1090, 1105, 1107, 1111, 1145, 1149, 1197, 1248, 1249, 1260, 1264, 1274, 1308, 1314, 1323, 1326, 1481, 1506
 SPRING WHEAT 691, 819, 980, 1001, 1135, 1141, 1151, 1166, 1179, 1189, 1191, 1333
 SPRING WHEAT PREDECESSORS 883
 SPRING WHEAT ROTATIONS 827
 SPRINKLER IRRIGATION 713, 714, 779

SPROUTING 675
 SPS 1146
 SR22 1000
 STABILITY 1295
 STABILIZERS 1505
 STAGE 799
 STANDARDIZING 1480
 STANDARDS/ CAROTENOIDS 1464, 1465
 STARCH 1081, 1198, 1374, 1375, 1376, 1423, 1425, 1435, 1451, 1460, 1480, 1481
 STARCH GRANULES 1418
 STARCH PRODUCTS 676
 STARCH SYNTHESIS 1200
 STARTER CULTURES 1441
 STATISTICAL ANALYSIS 708, 795, 965, 971, 1008, 1011, 1031, 1035, 1037, 1038, 1045, 1047, 1051, 1234, 1328, 1378, 1442, 1470, 1472, 1480, 1489, 1490, 1506
 STEAMING 1376
 STEERS 1348, 1355
 STEM ELONGATION 817
 STEM RUST 1153
 STEMS 725, 805, 927, 1035, 1169, 1377, 1386
 STEROL BIOSYNTHESIS 1160
 STEROLS 1160
 STICKINESS 962
 STIMULI 1075
 STOCHASTIC MODEL 1255
 STOMACH 1361
 STOMATA 1123
 STOMATAL CONDUCTANCE 1136, 1172, 1198
 STOMATAL DENSITY 1133
 STORAGE 1069, 1340, 1341, 1439, 1462, 1463
 STORAGE PROTEINS 1431
 STORED PRODUCT PEST 1224
 STRAW 691, 745, 785, 1061, 1371, 1456
 STRAW MULCHES 877
 STREPTOMYCES 1237
 STRESS 691, 698, 843, 875, 999, 1075, 1123, 1128, 1136, 1207
 STRUCTURAL REQUIREMENTS 1411
 STUBBLE MANAGEMENT 842
 SUBSOILING 709
 SUBSTRATE FLOW 1063, 1068, 1167
 SUBTILISIN 1413
 SUBUNIT 914
 SUBUNIT COMPOSITION 1431
 SUBUNITS 1438
 SUCROSE 787, 1178, 1180, 1315
 SUCROSE PHOSPHATE SYNTHASE 1146, 1174
 SUCROSE SYNTHASE 1180
 SUGAR BEET 1451
 SUGARS 1441
 SULFUR 837
 SULPHUR 1385
 SULPHUR DIOXIDE 790
 SULPHUR FERTILIZERS 723
 SUPERPHOSPHATE 770, 771
 SUPPLEMENT FEEDING 1350
 SUPPLEMENTATION 1360, 1365
 SUPPLEMENTS 1356, 1357, 1369, 1379
 SUPPLY BALANCE 675, 778
 SURFACE ENERGY BALANCE 1156
 SURPLUSES 1378
 SURVEY 1288
 SURVEYS 1466, 1472, 1491
 SURVIVAL 1049, 1263
 SUSCEPTIBILITY 1076
 SUSPENSION 754
 SUSTAINABILITY 1086, 1292
 SWEDEN 948, 1082, 1383

SWELLING 1491
 SWINE 1345, 1349, 1354, 1357, 1361, 1367, 1378
 SWITZERLAND 1256
 SYNCHRONIZE 1365
 SYNEXIN 1076
 SYNTHASE 1180
 SYNTHASE] 1077
 SYNTHETIC HEXAPLOID (SH) 1036
 SYRPHIDAE 1221
 SYRPHIDS 1228
 SYSTEM 821, 826, 1091, 1159, 1416
 SYSTEM II 1134
 SYSTEMS 1255, 1409
 T ARARATICUM 987
 T BOEOTICUM 1000
 T TAUSCHII 1036
 T UMBELLULATUM 924
 TACK 1410
 TAKE ALL 1211, 1287
 TAKE ALL FUNGUS 1245
 TAKE ALL FUNGUS (GAEUMANNOMYCES GRAMINIS) 1254
 TALISMAN 864
 TALL FESCUE 1185
 TAN SPOT 1183
 TANNINS 1351
 TANZANIA 729, 834, 1414
 TAPIOCA 1374
 TAXONOMY 1273, 1406
 TEACHERS 718
 TECHNICAL PROPERTIES 1481
 TECHNIQUES 846
 TECHNOLOGICAL PROPERTIES 1403
 TECHNOLOGY 674, 836
 TELEOMORPH 1247
 TEMIK 1287
 TEMPERATURE 821, 1062, 1115, 1135, 1139, 1150, 1151, 1156, 1166, 1168, 1169, 1170, 1179, 1196, 1211, 1231, 1335, 1439, 1471
 TEMPERATURE RESISTANCE 719, 725, 951, 1094, 1304, 1307, 1308, 1309, 1310, 1316
 TENDERNESS 1421
 TERES F TERES 1236
 TERM PHOTOINHIBITION 1146
 TESTING 869, 1324, 1346
 TETRAPLOID WHEAT 972
 TETRAPLOIDY 895, 996
 TEXTURAL PROPERTIES 1435
 TEXTURE PROFILE PARAMETERS 1422
 THAWING 1439
 THERMAL CONDUCTIVITY 1433
 THIAMIN 1477
 THIN LAYER DRYING 1339
 THINOPYRUM 1114
 THIOLS 1149, 1197
 THIONINS 1157
 THIRAM 1274
 THRESHING 710
 THYLAKOID 1119
 THYLAKOID MEMBRANES 1161
 THYMIDINE INCORPORATION 1055
 TILLAGE 691, 730, 823, 828, 839, 854, 867, 1140, 1156
 TILLAGE AND MULCHING 1113
 TILLAGE EQUIPMENT 823
 TILLERING 749, 1143
 TIME 810, 1456
 TIME OF APPLICATION 838
 TIMING 800
 TISSUE 1184
 TISSUE CULTURE 1324

TISSUE CULTURES 1436
 TOBACCO 1272
 TOLERANCE 910, 981, 1295
 TOLERANT 1121
 TOMATO 917, 1042
 TOMATO PLANTS 1067
 TONOPLAST VESICLES 1208
 TOTAL PROTEINASE 1116
 TOXICITY 910, 1061, 1121, 1190, 1324, 1482
 TRACE ELEMENT DEFICIENCIES 1106
 TRACE ELEMENTS 837, 1106, 1474
 TRACER TECHNIQUES 749, 784, 814, 822, 1046, 1072, 1126, 1291, 1317
 TRACTORS 823
 TRADE MODELS 670
 TRADITIONAL FARMING 701, 881
 TRADITIONAL TECHNOLOGY 1381
 TRALKOXYDIM 1329
 TRANSFERS 1148
 TRANSFORMATION 1028
 TRANSGENIC RICE PLANTS 754
 TRANSIENT EXPRESSION 973, 1028
 TRANSIT PEPTIDE 1209
 TRANSLATION 1119
 TRANSLOCATING ATPASES 1208
 TRANSLOCATION 891, 972, 1112, 1141
 TRANSLUCENS 892
 TRANSPIRATION 1123, 1136, 1162, 1205, 1207
 TRANSPIRATION EFFICIENCY 1195
 TRANSPORT 1057, 1060, 1155
 TREATED STRAW 1350
 TRIADIMEFON 1246
 TRIAL METHODS 722, 792, 795, 796, 803, 823, 850, 869, 1238, 1256, 1373
 TRIALS 894
 TRIASULFURON 1327, 1330
 TRICHODERMA 1385
 TRIDEMORPH 1246
 TRIFOLIUM 745, 794
 TRIFOLIUM HYBRIDUM 912
 TRIFOLIUM PRATENSE 869, 912
 TRIFOLIUM REPENS 730
 TRIFOLIUM SUBTERRANEUM 857, 858
 TRIPLE SUPERPHOSPHATE 838
 TRITICALE 705, 736, 972, 1092, 1116, 1122, 1224
 TRITICALE (GRAMINEAE) 682, 696, 713, 714, 732, 738, 900, 928, 929, 1138, 1311
 TRITICALES (PRODUCT) 928, 929, 1343, 1344, 1471, 1472, 1476, 1482
 TRITICEAE 898, 1027
 TRITICUM BOEOTICUM 895
 TRITICUM DICOCCOIDES 895, 919, 987
 TRITICUM DURUM 677, 683, 692, 694, 700, 711, 724, 741, 748, 798, 816, 835, 860, 888, 895, 919, 976, 1010, 1021, 1090, 1100, 1140, 1163, 1164, 1199, 1215, 1222, 1240, 1265, 1335
 TRITICUM DURUM DESF 799
 TRITICUM MONOCOCCUM 757, 895, 1021, 1214, 1285
 TRITICUM TAUSCHII 990
 TRITICUM TURGIDUM 895, 896, 904, 1036
 TRITICUM TURGIDUM CONV DURUM 910
 TRITICUM TURGIDUM L VAR DURUM 1131
 TROPICAL CROPS 1106
 TROPICAL ZONES 1106
 TRYPSIN 1376
 TRYPTOPHAN 1345, 1499
 TURGOR PRESSURE 1102
 TURNOVER 1148
 TUSCANY 1096, 1169
 TYPHA LATIFOLIA L 1076

UDP GLUCOSE, (1, 3) BETA GLUCAN GLUCOSYL TRANSFERASE [(1, 3) BETA GLUCAN SYNTHASE 1077
 UDP GLUCOSE, (1, 3)(1, 4) BETA GLUCAN GLUCOSYL TRANSFERASE [(1, 3)(1, 4) BETA GLUCA 1077
 UGANDA 707, 968
 UKRAINE 986, 995
 ULTRAFILTRATION 792
 ULTRASTRUCTURE 941, 1252, 1260
 ULTRAVIOLET RADIATION 1263
 UMBRIA (ITALY) 1442
 UNDULOSA 892
 UNITED STATES 1262, 1431
 UNIVERSITIES 718
 UPTAKE CARRIER 1099
 UREA 767, 784, 787
 UREA SUPERGRANULES 874
 UREA TREATMENT 1371
 UROMYCES 1305
 USA 684
 USE EFFICIENCY 821, 1141
 USTILAGO 1285
 VACUOLES 1085
 VAM 845
 VAPOR PRESSURE DEFICITS 1136
 VARIABLE CHLOROPHYLL FLUORESCENCE RATIO RFD 690 1198
 VARIABLES 1425
 VARIATION 846
 VARIETIES 688, 694, 708, 711, 722, 732, 737, 738, 741, 748, 769, 808, 865, 889, 890, 912, 915, 916, 922, 928, 929, 942, 943, 955, 960, 966, 968, 976, 983, 984, 986, 1001, 1023, 1037, 1044, 1045, 1046, 1047, 1082, 1088, 1089, 1097, 1109, 1163, 1164, 1169, 1215, 1238, 1250, 1252, 1267, 1274, 1285, 1311, 1409, 1423, 1432, 1450, 1454, 1457, 1458, 1459, 1476, 1479, 1481, 1483, 1487
 VARIETY TRIALS 732, 741, 746, 922, 951
 VARYING RESISTANCE 1208
 VEGETATION 716, 862, 1191
 VEGETATIVE DEVELOPMENT 819
 VEGETATIVE MULCH 1156
 VEGETATIVE PERIOD 1374
 VELOCITY 1302, 1456
 VENETO 1139, 1169
 VENTILATION 1463
 VERNALIZATION 887, 997, 1168, 1169
 VERNALIZATION REQUIREMENT 997
 VERTICILLIUM 1385
 VERTICILLIUM LECANII 1223
 VERTISOL 767
 VERTISOLS 701, 745, 879, 885
 VESICULAR ARBUSCULAR MYCORRHIZAE 791, 1388
 VETERINARY SERVICES 1361
 VIABILITY 944
 VICIA ERVILIA 951
 VICIA FABA 1305
 VICIA SATIVA 849
 VICIA VILLOSA 673
 VIGOR 691
 VIRULENCE 1223, 1277, 1297
 VISCOELASTIC BEHAVIOR 1412
 VISCOSITY 1081, 1089, 1347, 1360, 1368, 1379, 1475
 VOLATILE ANTIBIOTICS 1300
 VOLATILE FATTY ACIDS 1374
 VOLATILE FLAVOR COMPOUNDS 1395
 VOLCANIC ASH SOIL 830
 VOLGA REGION 883

VOLUME 1449, 1470, 1475
 VOLUNTARY INTAKE 1350
 W TYPE 967
 WALL BOUND THIONINS 1157
 WALL EXTENSIBILITY 1102
 WASHING LOSSES 1069
 WATER 698, 826, 1054, 1098, 1113, 1135, 1254, 1410, 1451
 WATER AVAILABILITY 1125, 1391
 WATER BINDING CAPACITY 1081
 WATER EROSION 828
 WATER EXTRACTION FRONT VELOCITY 1196
 WATER EXTRACTION PATTERN 1196
 WATER HARVESTING 673, 1382
 WATER MANAGEMENT 842
 WATER POTENTIAL 1207, 1211
 WATER QUALITY 706
 WATER SOLUBLE PENTOSANS 1423
 WATER STABLE AGGREGATION 827
 WATER STRESS 819, 1102, 1131, 1142, 1162, 1172, 1189, 1194
 WATER TOLERANCE 1046
 WATER UPTAKE 1380
 WATER USE 1141, 1191
 WATER USE EFFICIENCY 1141, 1172, 1195, 1198
 WATERLOGGING 1067
 WEATHER 928
 WEED CONTROL 699, 730, 828, 835, 856, 1139, 1212, 1320, 1321, 1325, 1328, 1331, 1334
 WEEDING 701, 866, 1321
 WEEDS 857, 862, 882, 1322, 1326, 1388
 WEEVIL 1224
 WEIGHT 1049, 1163, 1342, 1481
 WEIGHT GAIN 1349, 1357, 1359, 1367, 1380
 WEIGHT GAINS 1355
 WEIGHT LOSS 1054
 WEIGHTLESSNESS 1059
 WESTERN CANADA 1236
 WESTERN EUROPE 864
 WET PERIOD 1183
 WETHERS 1377
 WHEAT CLASS 1416
 WHEAT CROP 765
 WHEAT CULTIVARS 875
 WHEAT ENDOXYLANASE 1368
 WHEAT FLOUR 906, 1361, 1398, 1399, 1413, 1439, 1441, 1442, 1444, 1464, 1465, 1468, 1475, 1489, 1490
 WHEAT GERM AGGLUTININ 1411
 WHEAT GLUTEN FEED 1352
 WHEAT LEAVES 1186
 WHEAT MEAL 1421
 WHEAT PASTURE 1355
 WHEAT PRESSURES 1337
 WHEAT PROTEIN FRACTIONS 1438
 WHEAT ROOTS 1102, 1255
 WHEAT RYE ADDITION LINES 980
 WHEAT RYE TRANSLOCATIONS 962
 WHEAT SEEDS 1061
 WHEAT SILAGE 1348
 WHEAT STARCH 1408, 1422
 WHEAT STORAGE PROTEINS 1409
 WHEAT STRAW 701, 1052, 1350, 1502
 WHEAT TRITICUM AESTIVUM 836
 WHEAT YIELD 1319
 WHEAT YIELDS 833
 WHITE WHEAT 1421
 WHOLE CROP SILAGE 1377
 WILD PLANTS 919

WILD WHEATS 1005
 WINDS 999, 1302
 WINTER 822, 1129
 WINTER CEREALS 767
 WINTER CROPS 678, 693, 713, 714, 721, 733,
 742, 749, 750, 769, 779, 780, 784, 789, 792, 794,
 801, 812, 831, 851, 852, 853, 854, 861, 866, 928,
 938, 984, 985, 986, 1008, 1015, 1016, 1031, 1037,
 1044, 1094, 1110, 1139, 1235, 1238, 1246, 1248,
 1250, 1256, 1264, 1282, 1304, 1305, 1307, 1309,
 1310, 1316, 1317, 1386, 1390, 1473, 1487, 1501,
 1506
 WINTER HABIT 997
 WINTER LEGUMES 863
 WINTER WHEAT 799, 859, 873, 882, 962, 967,
 1053, 1076, 1135, 1150, 1156, 1166, 1170, 1179,
 1183, 1189, 1191, 1221, 1228, 1245, 1247, 1257,
 1258, 1431
 WINTERHARDINESS 997

WORLD MARKETS 675, 681
 WORT 1082, 1469, 1486
 X TRITICOSECALE 771
 XANTHIUM STRUMARIUM L 1172
 XANTHOMONAS CAMPESTRIS PV HORDEI
 892
 XINJIANG (WEIWUER) 695, 750, 942, 1044
 XYLANS 1379
 XYLEM SAP 1123
 XYLOGLUCAN ENDOTRANSGLYCOSYLASE
 1102
 YEAR 832
 YEAST MITOCHONDRIA 1124
 YEASTS 1442, 1451
 YELLOW RUST RESISTANCE 891
 YELLOW SPOT 1183
 YIELD 691, 709, 781, 811, 844, 894, 1034, 1194,
 1205, 1287, 1298, 1333

YIELD COMPONENTS 682, 708, 721, 731, 736,
 780, 801, 808, 831, 909, 955, 965, 1011, 1025,
 1030, 1036, 1046, 1071, 1131, 1151, 1189, 1384
 YIELD FACTORS 713, 714, 725, 764, 768, 775,
 835, 879, 880
 YIELD FORECASTING 880
 YIELDS 933, 1256, 1268, 1381, 1389, 1390, 1391,
 1490
 YUGOSLAVIA 966, 983, 1097
 ZAMBIA 728
 ZEA MAYS 684, 695, 720, 730, 778, 794, 796, 803,
 807, 828, 856, 866, 877, 881, 944, 1096, 1106,
 1108, 1130, 1285, 1292, 1374, 1390
 ZEA MAYS L 845
 ZEARELENONE 1492
 ZERO TILLAGE 831, 877, 1319
 ZIMBABWE 727
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