

Literature Update on Wheat, Barley, and Triticale



CIMMYT



Literature Update on Wheat, Barley, and Triticale



CIMMYT



Distribution Restricted to Developing Countries Only.

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

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

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

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

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

ISSN 1405-1672

Several CIMMYT staff made important contribution to this document: Dr. Edith Hesse, Leader, Information Technology Unit (editor); Fernando García, Supervisor of Information Services, and Pedro Santamaría, Database Administrator (data processing); Miguel Mellado, Coordinator of Design and Photography Department, and Eliot Sánchez, Design Assistant (design); Laura González, Secretarial Support.

Literature Update on Wheat, Barley, and Triticale

CONTENTS

	Page
Preface	iv
Sample Entries	vi
Notes to Readers	vi
Citations and Abstracts	1
Author Index	91
Keyword Index	97
How to Obtain the Full Text of Documents	111
CIMMYT Addresses	112
ICARDA Addresses	113

Subject Headings and Reference Numbers

	Ref. No.		Ref. No.
History	3310	Weeds	3968-3984
Extension	3311-3312	Handling, Transport, Storage and	
Legislation	3313-3330	Protection of Plant Product	3985-3992
Agricultural Economics and Policies	3331-3334	Animal Husbandry	3993-3994
Investment Finance and Credit	3335	Animal Feeding	3995-4015
Production Economics	3336-3340	Animal Physiology - Nutrition	4016-4018
Organization, Administration and Management		Agricultural Machinery and Equipment	4019
of Agricultural Enterprises or Farms	3341-3344	Nature Conservation and Land Resources	4020
Agro-Industry	3345	Water Resources and Management	4021
Trade, Marketing and Distribution	3346	Soil Chemistry and Physics	4022-4031
Domestic Trade	3347-3348	Soil Biology	4032-4039
Agrarian Structure	3349	Soil Fertility	4040-4049
Crop Husbandry	3350-3427	Soil Erosion, Conservation and Reclamation	4050-4053
Plant Propagation	3428-3438	Meteorology and Climatology	4054-4058
Seed Production	3439-3441	Food Science and Technology	4059-4069
Fertilizing	3342-3494	Food Processing and Preservation	4070-4089
Irrigation	3495-3496	Food Contamination and Toxicology	4090-4095
Soil Cultivation	3497-3508	Food Composition	4096-4143
Cropping Patterns and Systems	3509-3531	Food Additives	4144-4145
Plant Genetics and Breeding	3532-3684	Feed Technology	4146
Plant Ecology	3585-3690	Feed Processing and Preservation	4147
Plant Structure	3691-3692	Feed Contamination and Toxicology	4148-4150
Plant Physiology and Biochemistry	3693-3735	Feed Composition	4151-4155
Plant Physiology - Nutrition	3736-3773	Feed Additives	4156
Plant Physiology - Growth and Development	3774-3829	Processing of Non-Food or Non-Feed Agricultural Products	4157-4159
Plant Physiology-Reproduction	3830-3834	Processing of Agricultural Wastes	4160
Plant Taxonomy and Geography	3835-3836	Packaging	4161
Protection of Plants - General Aspects	3837-3838	Pollution	4162-4166
Pests of Plants	3839-3864	Mathematical and Statistical Methods	4167-4169
Plant Diseases	3865-3947	Research Methods	4170
Miscellaneous Plant Disorders	3948-3967		

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
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
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 —→ 8
 Investigaciones en Granos y Semillas); Sterling, F.; Herrera, J. (1992) —→ 3
 4 —→ [Evaluation of the vigor in maize seeds and its relationship with the —→ 5
 behaviour in the field]. Evaluacion del vigor en semillas de maiz y su —→ 6
 relacion con el comportamiento en el campo. *Agroномia Costarricense*
 (Costa Rica) v. 16(2) p. 203-210. 20 ref.; grafs. 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,
 Chapingo, Mex. 56230 (Mexico)), (1992) [Economic aspects of agricultural —→ 4
 3 —→ research in relation to the production of wheat in Mexico]. Aspectos —→ 5
 economicos de la investigacion agricola en el cultivo del trigo en Mexico.
 Primera conferencia nacional sobre la produccion de trigo en Mexico.
 (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National
 6 —→ 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
 9 —→ 94-114649). —→ 7

- | | | | |
|---|--|---|--|
| 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
for entries retrieved from AGRIS |
| 5 | Original title (only in 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.

B50 HISTORY

3310 Winks, R.G. (Commonwealth Scientific and Industrial Research Organisation, Canberra (Australia). Div. of Entomology); Ryan, R. (Commonwealth Industrial Gases Ltd, Chatswood (Australia)) (1994) **The history of chemical grain protection in Australia [wheat]**. *Chemistry in Australia (Australia)* v. 61(9) p. 515-517. 3 tables, 2 fig., 7 ref. English. (AGRIC 95-073697).

C20 EXTENSION

3311 Anon. (1994) [Poultry advisory experts hold a meeting: where does the consultation go?]. *Geflügelwirtschaft und Schweineproduktion (Germany)* v. 46(47) p. 11-14. 3 ill., 1 table. German. (AGRIC 95-085174).

3312 Plueng, N.S.; Shinawatra, B.; Boonwiroj, S.; Connell, J. (Paholyothin Road, Bang Kaen, Bangkok 10900 (Thailand)) (1994) **Strategy to foster institutionalization of farmers' participation for agricultural change in Thailand**. 3. Asian Farming Systems Symposium; Manila (Philippines); 7-10 Nov 1994. *Abstracts of papers presented at the third Asian farming systems symposium; theme: conservation and equitable growth: the challenge for farming systems*. Department of Agriculture, Diliman, Quezon City (Philippines). Asian Farming Systems Association; Department of Science and Technology, Bicutan, Taguig, Metro Manila (Philippines) p. 71. Received Dec 1994. English. (AGRIC 95-085171).

Despite good intentions, institutional change to accomplish greater farmers' participation is difficult especially in a large organization like the Thai Department of Agriculture Extension (DOAE). The Participatory Extension project, as an action research project, aimed to develop an extension process that actively engaged farmers in a process of evaluating and adapting production technologies appropriate to their local conditions. The standard operating procedures for extension, training and on-farm trials were modified so that greater farmers' participation is assured in an extension activity for a newly introduced crop, wheat. The involvement of a senior staff from both the DOAE and the Department of Agriculture as well as of a social scientist from Chiang Mai University as principal researchers using participatory FSR/E concept is instrumental to the change that may take place. After two years of implementation, the project has succeeded in a) evaluating the potentials and difficulties in the extension process as a result of participatory extension training, b) developing and documenting farmers' role in evaluating and adapting technologies to suit their local conditions, and c) developing a draft participatory extension training program which could be used by DOEA to ensure interaction among officers and farmers. Once improved, this program can supplement the newly introduced participatory planning already initiated by the DOAE.

D50 LEGISLATION

3313 Clarke, J.M.; McCaig, T.N.; Vallega, V.; Depauw, R.M.; McLeod, J.G.; Thiessen, L.L. (1995) **REGISTRATION OF SEVEN PAIRS OF DURUM WHEAT GENETIC STOCKS NEAR-ISOGONIC FOR GLAUCOUSNESS**. *Crop Science*. 35(4):1241. English. [AGR & AGRIFOOD CANADA RES STN SWIFT CURRENT SK S9H 3X2 CANADA].

3314 Friebe, B.; Gill, B.S.; Tuleen, N.A.; Cox, T.S. (1995) **REGISTRATION OF KS93WGRC28 POWDERY MILDEW RESISTANT T6BS-CENTER-DOT-6RL WHEAT GERMPLASM**. *Crop Science*. 35(4):1237. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

3315 Gill, B.S.; Friebe, B.; Wilson, D.L.; Martin, T.J.; Cox, T.S. (1995) **REGISTRATION OF KS93WGRC27 WHEAT STREAK MOSAIC VIRUS RESISTANT T4DL 4AI-NUMBER-2S WHEAT GERMPLASM**. *Crop Science*. 35(4):1236-1237. English. [KANSAS STATE UNIV AGR & APPL SCI CTR WHEAT GENET RESOURCE DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

3316 Hole, D.J.; Dewey, W.; Albrechtsen, R.S. (1995) **REGISTRATION OF PROMONTORY WHEAT**. *Crop Science*. 35(4):1206-1207. English. [UTAH STATE UNIV DEPT PLANTS SOILS & BIOMETEOROL LOGAN, UT 84322 USA].

3317 Ohm, H.W.; Shaner, G.; Buechley, G.; Ratcliffe, R.H.; Patterson, F.L.; Bostwick, D.E.; Aldridge, W.G. (1995) **REGISTRATION OF GRANT WHEAT**. *Crop Science*. 35(4):1220. English. [PURDUE UNIV DEPT AGRON W LAFAYETTE, IN 47907 USA].

3318 Risius, M.L.; Christ, B.J. (1995) **REGISTRATION OF PENNMORE WHEAT**. *Crop Science*. 35(4):1219. English. [PENN STATE UNIV DEPT PLANT PATHOL UNIVERSITY PK, PA 16802 USA].

3319 Sebesta, E.E.; Young, H.C.; Porter, D.R.; Webster, J.A. (1995) **REGISTRATION OF TWO WHEAT STREAK MOSAIC VIRUS-RESISTANT WHEAT GERMPLASMS**. *Crop Science*. 35(4):1238. English. [USDA ARS 1301 N WESTERN ST STILLWATER, OK 74075 USA].

3320 Souza, E.; Windes, J.M.; Sunderman, D.W.; Whitmore, J.; Kruk, M.; Goates, B.J. (1995) **REGISTRATION OF BONNEVILLE HARD RED WINTER WHEAT**. *Crop Science*. 35(4):1218-1219. English. [UNIV IDAHO ABERDEEN RES & EXT CTR POB AA ABERDEEN, ID 83210 USA].

3321 Wesenberg, D.M.; Burrup, D.E.; Whitmore, J.C. (1995) **REGISTRATION OF TARGHEE BARLEY**. *Crop Science*. 35(4):1209-1210. English. [UNIV IDAHO ABERDEEN RES & EXT CTR USDA ARS NATL SMALL GRAINS GERMPLASM RES FACIL POB 307 ABERDEEN, ID 83210 USA].

3322 Windes, J.M.; Souza, E.; Sunderman, D.W.; Goates, B.J. (1995) **REGISTRATION OF FOUR WHEAT GERMPLASMS RESISTANT TO DWARF BUNT - IDAHO 352, IDAHO 364, IDAHO 443, AND IDAHO 444**. *Crop Science*. 35(4):1239-1240. English. [UNIV IDAHO ABERDEEN RES & EXT CTR DEPT PLANT SOIL & ENTOMOL SCI POB AA ABERDEEN, ID 83210 USA].

3323 Wolfe, R.I.; Dofing, S.M.; Davidson, J.G.N.; Clarke, P.J. (1995) **AC ALBRIGHT BARLEY**. *Canadian Journal of Plant Science*. 75(2):457-459. English. [AGR & AGRIFOOD CANADA CTR FIELD CROP DEV 5030-50 ST LACOMBE AB T4L 1W8 CANADA].

AC Albright (*Hordeum vulgare* L.) is an early maturing, six-row feed barley cultivar. It was selected from the cultivar Otal at the Northern Agriculture Research Centre, Agriculture and Agri-Food Canada, Beaverlodge, Alberta Canada. It has demonstrated adaptation to north-central and western Alberta and the Peace River region of British Columbia. [References: 5].

3324 Wolfe, R.I.; Faris, D.G.; Davidson, J.G.N.; Clarke, P.J. (1995) **AC STACEY BARLEY**. *Canadian Journal of Plant Science*. 75(2):461-463. English. [AGR & AGRIFOOD CANADA CTR FIELD CROP DEV 5030-50 ST LACOMBE AB T4L 1W8 CANADA].

AC Stacey is an early maturing, six-row feed barley (*Hordeum vulgare* L.) with excellent barley leaf scald resistance. It was developed at the Northern Agriculture Research Centre, Beaverlodge, Alberta from the cross Otal/Melvin. It is moderately strong strawed, and adapted to barley leaf scald prone areas in Alberta, and the Peace River region of British Columbia. [References: 1].

3325 Worrall, W.D.; Caldwell, S.P.; Marshall, D.S.; McDaniel, M.E.; Sernasaldivar, S.; Lazar, M.D. (1995) **REGISTRATION OF TAM-202 WHEAT**. *Crop Science*. 35(4):1224-1225. English. [POB 1658 VERNON, TX 76385 USA].

3326 Worrall, W.D.; Gilmore, E.C.; Porter, K.B.; McDaniel, M.E.; Rooney, L.W. (1995) **REGISTRATION OF TAM-200 WHEAT**. *Crop Science*. 35(4):1223-1224. English. [TEXAS A&M RES & EXT CTR POB 1658 VERNON, TX 76385 USA].

3327 Worrall, W.D.; Gilmore, E.C.; Porter, K.B.; McDaniel, M.E.; Rooney, L.W. (1995) **REGISTRATION OF TAM-201 WHEAT**. *Crop Science*.

35(4):1224. English. [TEXAS A&M RES & EXT CTR POB 1658 VERNON, TX 76385 USA].

3328 Worrall, WD.; Marshall, DS.; Caldwell, SP.; Peterson, CJ.; Baenziger, PS.; Schmidt, JW. (1995) **REGISTRATION OF SIOUXLAND 89 WHEAT**. *Crop Science*. 35(4):1223. English. [TEXAS A&M RES & EXT CTR POB 1658 VERNON, TX 76385 USA].

3329 Worrall, WD.; Porter, KB.; Lazar, MD.; Gomez, MH.; Marshall, DS.; Nelson, LR.; McDaniel, ME. (1995) **REGISTRATION OF TAM-109 WHEAT**. *Crop Science*. 35(4):1223. English. [TEXAS A&M RES & EXT CTR POB 1658 VERNON, TX 76385 USA].

3330 Zemetra, RS.; Liu, CT.; Kronstad, WE.; Lauver, M.; Haugerud, N. (1995) **REGISTRATION OF LAMBERT WHEAT**. *Crop Science*. 35(4):1222. English. [UNIV IDAHO DEPT PLANT SOIL & ENTOMOL SCI MOSCOW, ID 83844 USA].

E10 AGRICULTURAL ECONOMICS AND POLICIES

3331 Bhattarai, M. (1994) **Wheat supply response in Nepal: econometric and programming approaches**. Philippines Univ., Los Banos, College, Laguna (Philippines). 3 ill.; 1 chart; 19 graphs; 30 tables. Bibliography (74 ref.). Received Feb 1995. 165 leaves. English. (AGRIC 95-085280).

The price response of wheat supply was 0.18 in the short run and 0.25 in the long run, and was statistically significant at the 10 percent level. Similarly, the response of wheat supply to irrigation was relatively higher, which was 0.33 in the short run and 0.45 in the long run (significant at the 1 percent level). The adjustment coefficient was 0.73 in the wheat sector during the period, implying that wheat farmers in Nepal were much responsive to change in supply shifters. Results of the costs and return analysis of major agricultural winter crops grown in the district such as wheat, mustard, lentil, and grass pea, and rice grown in the preceding rainy season showed that wheat production, at least at the current level of prices, was most profitable near the market - accessible locality. Wheat acreage in the optimum farm plan was relatively more in the market accessible irrigated locality (Location A). However, the derived supply response estimated at an increased wheat price was in fact higher in the market-inaccessible irrigated locality (Location C). This may be due to limitation of the farm resources (e.g., land, plow, etc.) in location A. Similarly, the derived supply response at the district level was estimated as 1.11 for the price range of 15 percent above and below the current level wheat price. The farm-level analysis indicates that irrigation and market infrastructures influence the variation of gross margin as well as the farm level supply response. Moreover, the supply analysis at different price levels in this study indicates that wheat farmers in Nepal respond positively to prevailing product prices and marketing situations. Hence, price policy could be used to influence the supply of wheat in Nepal.

3332 Eder, MG.; Ruckebauer, P.; Ehrendorfer, K. (1995) **COMPARISON OF DIFFERENT INPUT-LEVELS IN THE CROPPING OF WINTER WHEAT IN THE REGION PULKAUTAL LOWER AUSTRIA**. *Bodenkultur*. 46(2):141-163. French. [UNIV WIEN INST PFLANZENBAU & PFLANZENZUCHTUNG GREGOR MENDEL STR 33 A-1480 VIENNA AUSTRIA].

Due to economic reasons the necessary reduction of working stocks in agricultural production also forces grain producers to cut input drastically. For this reason a three year trial program was held in a part of the pannonic region of Lower Austria, Pulkautal. Four different input-levels for quality grain production of wheat were tested: These four variants ran as follows: untreated variant (a), reduced input-level (b) in terms of seed density, fertilizer and agrochemicals, standard procedure (c) and intensively treated variant (d) with a high degree of cultivation. The results can be summarized as follows: The level of yield of the five different varieties of quality wheat was highly influenced by the effects of years and locations. The performance in yield of the three treated variants (b, c, d) was very much the same. There was no definite trend of an increase in yield through higher supply with fertilizer and plant protection. Regarding margins variant b) outnumbered the opponents. The amount of gluten was partly influenced by effects of varieties and fertilizer, although there was

no clear dependence from the amount of nitrogen-supply. The level of gluten in the three treated variants was very much alike. A steady increase in gluten through the increasing supply with nitrogen was only found on the light soil throughout three years.

3333 Sawarkar, SD.; Pannase, SK.; Goydani, BM. (1995) **ECONOMIC ANALYSIS OF WHEAT (TRITICUM AESTIVUM) AND CHICKPEA (CICER ARIETINUM)-BASED CROP SEQUENCES**. *Indian Journal of Agronomy*. 40(1):1-3. English. [JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA ZONAL AGR RES STN CHHINDWARA 480001 MADHYA PRADESH INDIA].

A field experiment was conducted during 1988-89 to 1990-91 with different crop sequences, viz. soybean [Glycine max (L.) Merr.]-wheat (Triticum aestivum L. emend. Fiori and Paol.), soybean-chickpea (Cicer arietinum L.), groundnut (Arachis hypogaea L.)-wheat, groundnut-chickpea, sorghum [Sorghum bicolor (L.) Moench]-wheat and sorghum-chickpea, on farmers' fields. These were evaluated for their production potential, stability and economics. Wheat can successfully be grown after soybean, groundnut and sorghum. Groundnut-wheat, groundnut-chickpea and soybean-wheat gave significantly higher total yield of 6, 41, 6, 38 and 5.83 tonnes/ha respectively than sorghum-wheat (4.25 tonnes/ha); and higher si net returns of Rs 14, 429, Rs 13, 345 and Rs 13, 125/ha. The best crop sequences were found and groundnut-chickpea, followed by soybean-wheat for economic return.

3334 Schneekloth, JP.; Clark, RT.; Coady, SA.; Klocke, NL.; Hergert, GW. (1995) **INFLUENCE OF WHEAT-FEED GRAIN PROGRAMS ON RISKINESS OF CROP ROTATIONS UNDER ALTERNATE IRRIGATION LEVELS**. *Journal of Production Agriculture*. 8(3):415-423. English. [UNIV NEBRASKA DEPT AGRON W CENT RES & EST CTR RT 4 BOX 46A N PLATTE, NE 69101 USA].

Declining groundwater levels in parts of the Great Plains could lead to reduced irrigation and a decline in the economies of those areas. Improved irrigation efficiency has helped slow the rate of decline in aquifer levels but adoption of limited irrigation and water conserving rotations could slow the decline even more. The objective was to estimate the riskiness and profitability of these alternatives with and without farm commodity programs. Three water levels-rainfed, limited irrigation (6 in./yr water allocation) and full irrigation (meet crop evapotranspiration demands) were established for continuous corn (Zea mays L.), winter wheat (Triticum aestivum L.)-corn-soybean [Glycine max (L.) Merr.], and corn-soybean rotations. The profitability of each rotation under each water level was estimated using results of field experiments conducted since 1981 in west central Nebraska and cost estimates based on a typical center pivot irrigation system covering 126 acres. Stochastic dominance techniques were then applied to the data by using combinations of prices for corn, wheat, and soybean to generate cumulative distribution functions. Profitability and riskiness were estimated with and without participation in the wheat and feed grain programs and with alternate acreage conservation reserve (ACR) levels. Results showed that the government program improved income levels and reduced income variation for each water level and all rotations. Program participation did encourage monoculture corn under full irrigation and under limited irrigation with low ACR requirements. Under rainfed conditions the relative ranking of the three rotations was not changed by program participation.

E13 INVESTMENT, FINANCE AND CREDIT

3335 Azzam, A.M.; Britel, A. (University of Nebraska Lincoln, Lincoln, Nebraska (USA)) (1992) **An economic analysis of a cross-market subsidy scheme for Morocco's food grain sector**. *Journal of Economic Studies (Bradford) (United Kingdom)* v. 19(5) p. 55-72. 8 ref., 5 fig., 4 tab. English. (AGRIC 95-074127).

E16 PRODUCTION ECONOMICS

3336 Abd El Zaher, M.T. (Cairo Univ., Fayoum (Egypt). Faculty of Agriculture); Ashry, A.M.; Fahmy, F.A. (1994) **[Economics of production and marketing for wheat in Fayoum Governorate [Egypt]]**. *Journal of Agricultural Sciences, Mansoura Univ. (Egypt)* v. 19(2) p. 681-694. 1 ill. 3 tables; 6 ref. Arabic. (AGRIC 95-085494).

3337 Chaillet, I. (Institut Technique des Cereales et des Fourrages, Paris (France)); Remuau, M.; Longchamps, J.Y.; Carrouee, B. (1994) [Comparison of crop rotations in Eure-et-Loir area: peas increase margins]. *Comparaison des rotations en Eure-et-Loir: le pois augmente la marge. Perspectives Agricoles (France) (no 194) p. 26-29. French. (AGRI 95-074310).*

3338 Hacquet, J. (Federation Nationale des Agriculteurs Multiplicateurs de Semences, Lusignan (France)) (1994) [Centre-Ouest (France). What future for durum wheat?]. *Centre-Ouest. Quel avenir pour les bles durs? Bulletin de la Federation Nationale des Agriculteurs Multiplicateurs de Semences (France) (no 129) p. 59-60. French. (AGRI 95-085515).*

3339 Martig, J.M. (Institut Technique des Cereales et des Fourrages, Paris (France)); Hussons, G. (1994) [Wheat crops in Lorraine area (France)]. *Produire du ble en Lorraine (France). Perspectives Agricoles (France) (no 191) p. 14-25. 9 graph. French. (AGRI 95-074311).*

3340 Mehier, C. (Institut Technique des Cereales et des Fourrages, Paris (France)) (1995) [Evolution of wheat production costs in USA (cash cost, economic cost)]. *L'evolution des couts de production du ble aux USA. Perspectives Agricoles (France) (no 199) p. 12-14. 8 graph. French. (AGRI 95-074285).*

E20 ORGANIZATION, ADMINISTRATION AND MANAGEMENT OF AGRICULTURAL ENTERPRISES OR FARMS

3341 [Survey among wheat farmers in North Kivu]. *Enquete aupres des exploitants de ble dans le Nord Kivu (1992) FAO, Rome (Italy). Div. des Operations Agricoles; Ministere de l'Agriculture et du Developpement Rural, Kinshasa (Zaire). Secretariat General a l'Agriculture. Fig. 78 p. FAO-AGO-ZAI/88/004. French. (AGRI 95-074397).*

3342 [The profitability of the agricultural farms (in Belgium) in 1993 (financial year 1993 - 1994)]. *La rentabilite de l'exploitation agricole en 1993 (94) (1995) Institut Economique Agricole, Bruxelles (Belgium). Publications de l'IEA (Belgium); Institut Economique Agricole Rapports; no. 573 65 p. 2 ill.; 36 tables. IEA-2-35. French. (AGRI 95-085636).*

3343 Cowles, S.; Hicks, S. (1994) *An analysis of the sampling frame for the Chemical Use and Farm Finance survey. SRB research report (USA); no. 94-05 21 p. English. (AGRI 95-074395).*

3344 Myers, M.D.M. (1994) *A quality assessment of near real-time precipitation data used to make crop yield forecasts. SRB research report (USA); no. 94-03 26 p. references. English. (AGRI 95-074441).*

E21 AGRO-INDUSTRY

3345 Ermont, J. (ed.) (1994) [Prices and wheat flour quality]. *Grands moulins de Paris: les producteurs payes a la qualite ? Perspectives Agricoles (France) (no 197) p. 24-25. French. (AGRI 95-074580).*

E70 TRADE, MARKETING AND DISTRIBUTION

3346 Thow, D. (London Commodity Exchange (United Kingdom)) (1994) *Agricultural futures and options - the way ahead. Kraftfutter (Germany) (no.11) p. 431-434. 4 ill. English. (AGRI 95-085820).*

E72 DOMESTIC TRADE

3347 Fritzer, H. (1994) [The German malteries at the moment of decision]. *Die deutschen Maelzereien am Scheideweg. Brauwelt (Germany) v. 134(48) p. 2602-2603. 11 ill. German. (AGRI 95-086002).*

3348 Pescio, F. (1994) [Production of wheat flour and wheat byproducts]. *Produccion de harinas y subproductos de trigo. Secretaria de Agricultura,*

Ganaderia y Pesca, Buenos Aires (Argentina). Direccion Nacional de Produccion Agropecuaria. *Integracion Vertical (Argentina) 38 p. Spanish. (AGRI 95-085993).*

E90 AGRARIAN STRUCTURE

3349 Tyagunenko, A.V. (Centre for Economic Reform, Government of the Russian Federation, Il'inka 10, entrance 9, 103132 Moscow (Russian Federation)) (1993) *Agrarian reform in Russia. Communist Economies and Economic Transformation (United Kingdom) v. 5(4) p. 461-471. English. (AGRI 95-086026).*

F01 CROP HUSBANDRY

3350 *Eighty-sixth Annual Report, 1993-1994 [arable crops, straw disposal and habitat management] (1994) Morley Research Centre, Wymondham (United Kingdom). Morley Research Centre. 113 p. English. (AGRI 95-086165).*

3351 *Nile valley regional program barley annual report, 1991/92 (1992) Annual Coordination Meeting; Cairo (Egypt); 13-17 Sep 1992. ARC. Tables. 130 p. English. (AGRI 95-075187).*

3352 [Sowing date and sowing rate in wheat crops]. *Comment determiner la date et la dose de semis (1994) Institut Technique des Cereales et des Fourrages, Paris (France). Perspectives Agricoles (France) (no 195) p. 34-35. French. (AGRI 95-075244).*

3353 Aly, R.M.; El Bana, A.Y.A. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) *Grain yield analysis for nine wheat cultivars grown in newly cultivated sandy soil under different N-fertilization levels. Zagazig Journal of Agricultural Research (Egypt) v. 21(1) p. 67-77. 7 tables; 13 ref. English. (AGRI 95-086090).*

3354 Amatya, R.K.; Jaiswal, J.P. (Lumle Agricultural Research Centre, P.O.Box No.1, Pokhara, Kaski (Nepal)) (1995) *Findings of winter crops (wheat, barley, lentil, tori and potato) trials and minikit/demonstrations conducted in LARC's extension command area during 1992/93. LARC Working Paper (Nepal); no. 95/7 28 p. Lumle Agricultural Research Centre. English. (AGRI 95-086121).*

A total of 19 verification trials and minikits/demonstrations were conducted on various winter crops (wheat, barley, lentils and potato) in farmers field of the extension command area (ECA) of Lumle Agricultural Research Centre (LARC) during 1992.

3355 Anon. (1994) *Contract growing of malting barley as seen by a maltster. Brauwelt international (Germany) (no.3) p. 222-223. English. (AGRI 95-075191).*

3356 Anon. (1994) [Contract growing of malting barley as seen by a maltster]. *Vertragsanbau von Braugerste aus der Sicht eines Maelzers. Brauwelt (Germany) v. 134(35) p. 1709-1710. German. (AGRI 95-075196).*

3357 Anon. (1994) [Independent breweries back supervised integrated cultivation. Demand still lacking]. *Mittelstandsbrauereien setzen auf kontrolliert-integrierten Anbau. Nachfrage fehlt noch. Brauindustrie (Germany) v. 79(7) p. 582-583. German. (AGRI 95-075193).*

3358 Baumer, M.; Pichlmaier, K.; Lenz, W. (1994) [Bavarian barley crop 1994. Yield and quality of summer barley]. *Bayerische Gerstenenernte 1994. Kornertrag und Kornqualitaet der Sommergerste. Brauwelt (Germany) v. 134(48) p. 2572-2580. 7 ill., 7 tables; 3 ref. German. (AGRI 95-075192).*

3359 Baumer, M.; Pichlmaier, K.; Lenz, W. (1994) [Bavarian barley crop 1994. Yield and quality of winter barley]. *Bayerische Gerstenenernte 1994. Kornertrag und Kornqualitaet der Wintergerste. Brauwelt (Germany) v. 134(37) p. 1816, 1818-1820, 1822. 1 ill., 6 tables. German. (AGRI 95-075198).*

3360 Bavec, M. (Kmetijski zavod, Maribor (Slovenia)) (1994) [Seeding rate for wheat and nitrogen fertilization as two factors forming the yield and its components]. *Gostota setve pšenice in gnojenje z dušikom kot dejavnika oblikovanja pridelka in njegovih komponent*. Simpozij Novi izzivi v poljedelstvu (Symposium on New Challenges in Field Crop Production); Kocevje (Slovenia); 7-8 Sep 1994. [Proceedings of the Symposium on New Challenges in Field Crop Production]. Kotnik, T. (ed.). Ljubljana Univ. (Slovenia). Biotechnical Fac., Agronomy Dept. p. 13-17. 9 ref. Slovenian. (AGRIS 95-086091).

The influence of plant density and nitrogen fertilising on yield, yield components and grain quality (protein content, sedimentation value) have been investigated in several experiments in Podravje area (E Slovenia) since 1987. The soil N-min and the N content in the plants have been analysed. For the cultivars marija, zitarka, zelengora, lonja and pinka 350-500 grains per square m are sufficient in the optimal sowing time. Higher sowing rate (650 grains/square m) are necessary in the late sowing period (marija, julius and olga). General recommendations can not be given. Higher N-rates increased grain protein content and sedimentation value.

3361 Bebeli, P.J.; Kaltsikes, P.J. (1995) MULTIVARIATE STATISTICAL ANALYSIS OF THE EFFECTS OF RYE TELOMERIC HETEROCHROMATIN ON THE AGRONOMIC TRAITS OF HEXAPLOID TRITICALE. *Breeding Science*. 45(2):151-156. English. [AGR UNIV ATHENS DEPT PLANT BREEDING & BIOMETRY ATHENS GREECE].

Two pairs of sister lines of hexaploid triticale (X Triticosecale Wittmack) differing by the presence (++) or absence (-) of telomeric heterochromatin on chromosome arms 7 RL (cv. Drira) and 6 RS (cv. Rosner) were used in order to study the effects of telomeric heterochromatin loss on twelve agronomic traits. The following multivariate statistical techniques were used: multivariate analysis of variance, partial correlation, multiple regression analysis and canonical correlation. The loss of telomeric heterochromatin was accompanied by significant changes in the means of the twelve traits as a whole as evidenced by the results of the multivariate analysis of variance and in the regression of yield on the other traits. Many more partial correlation coefficients were changed in the Drira lines than in the Rosner lines; most coefficients became larger in the Rosner line lacking heterochromatin while the opposite was true in the corresponding Drira line. The traits most affected differed from cultivar to cultivar. There were also changes in the regression of seed yield on the other traits with number of spikes contributing significantly only in the lines lacking telomeric heterochromatin with a concomitant loss of the significant contributions in these lines of spike length, number of spikelets per spike and the derived variable spike density. It is concluded that the loss of telomeric heterochromatin has significant effects on the expression and the relationships between agronomic traits and groups of traits in hexaploid triticale and that for some traits these effects can be cultivar and chromosome specific.

3362 Bordes, J.P. (Institut Technique des Cereales et des Fourrages, Paris (France)); Martin, G.; Gate, P.; Gouet, J.P. (1994) [Wheat: how to forecast yield or quality before harvest]. *Ble: comment prévoir le rendement ou la qualité avant la récolte. Perspectives Agricoles (France) (no 197)* p. 70-72. French. (AGRIS 95-075245).

3363 Brown, B.D. (1993) Rotation and field selection. *Bulletin - Idaho Agricultural Experiment Station (USA) (no. 742)* p. 7. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRIS 95-086114).

3364 Cachola, F.B. (Mariano Marcos State Univ., Batac, Ilocos Norte (Philippines)) (1992) Role of commitments of MMSU to the development of wheat in the Philippines. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop*. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). *Regional Wheat Program for Southeast Asia* p. 156-159. Received Nov 1994. English. (AGRIS 95-075164).

3365 Chastain, T.G.; Ward, K.J.; Wysocki, D.J. (1995) SEEDBED RESIDUE AND SEED SIZE RELATIONSHIPS IN WINTER BARLEY. *Agronomy Journal*. 87(3):517-520. English. [OREGON STATE UNIV DEPT CROP & SOIL SCI CROP SCI BLDG 107 CORVALLIS, OR 97331 USA].

Understanding how winter barley (*Hordeum vulgare* L.) seeds and seedling plants interact with crop residue in the seedbed is essential for development of planting recommendations for dryland conservation tillage systems. Field trials were conducted in 1990-1991 (Trial 1) and 1991-1992 (Trial 2) near Pendleton, OR, to determine the effects of seedbed crop residue, seed size, and cultivar on emergence, growth, and yield of winter barley. Seedbed residue cover (32-45%) did not affect seedling emergence rate in Trial 1. Seed-soil contact was apparently reduced in high-residue seedbeds, but emergence was reduced only when seed-zone water content was <120 g kg⁻¹ in Trial 2. More water was present in the seedbed at the time of seeding in Trial 1 than in Trial 2. Low-residue seedbeds were drier than moderate- or high-residue seedbeds at the time of seeding in both trials. Final stand density and subsequent plant growth were not influenced by seedbed residue (up to 49% residue) in either trial. Spike production was reduced by high residue and test weight was reduced by moderate and high residue in Trial 1. Grain yield and plumpness were lowest when barley was sown in low residue in Trial 2. Seedlings produced from large seeds emerged more rapidly and produced higher density stands than small seeds in Trial 1 but not Trial 2. Plants grown from large seed were somewhat larger in spring, but seed size had no other effect on growth or yield. Grain plumpness was greater in plants grown from large seed in Trial 1 but not Trial 2. No differences in stand establishment were detected among the cultivars tested. Higher seedbed residues should not be viewed as detrimental to achieving good winter barley performance in conservation tillage systems. [References: 14].

3366 Conry, M.J. (1995) A NOTE ON THE EFFECT OF SOWING DATE AND FERTILISER NITROGEN ON THE YIELD, GRAIN NITROGEN AND SCREENINGS CONTENT OF SPRING-SOWN MALTING BARLEY. *Irish Journal of Agricultural & Food Research*. 34(1):69-73. English. [TEAGASC OAK PARK RES CTR CARLOW IRELAND].

Malting barley (cv. Blenheim) was sown on three sowing dates (March, early April, late April) at three rates of N (100, 125 and 150 kg/ha) on three different soil types (light, medium and heavy) in the south-east of Ireland in 1990 and 1991, to test the effect of these factors on yield and quality. The earliest-sown spring barley generally gave the greatest yield and the best quality grain (lowest grain nitrogen and smallest amount of screenings). Increasing increments of N always reduced the quality of the grain but did not always increase the grain yield. The higher rates of N (125 and 150 kg/ha) increased yields on the light soil in 1991 and on the medium soil in 1990 and 1991. There was no response on the heavy soil.

3367 Dar, W.D.; Labios, R.V. (Department of Agriculture, Diliman, Quezon City (Philippines). Bureau of Agricultural Research) (1992) Role and commitments of DA-BAR to the development of wheat in the Philippines. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop*. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). *Regional Wheat Program for Southeast Asia* p. 133-136. Received Nov 1994. English. (AGRIS 95-075161).

3368 De Pous, M. (Institut Technique des Cereales et des Fourrages, Paris (France)); Gillet, J.P.; Girard, C. (1994) [Wheat crops in Pays de la Loire area (France)]. *Ble en Pays de la Loire: maîtriser l'itinéraire technique pour valoriser le potentiel. Perspectives Agricoles (France) (no 195)* p. 20-31. 10 ref. French. (AGRIS 95-075180).

3369 Dong Yanqing; Zhang Jitao; Wang Weiling (Shaanxi Provincial Academy of Agricultural Sciences, Yangling (China). Inst. of Grain Crops) (1994) A study on the pattern of high-yielding cultivation of wheat cultivar "Shaan-229" in Weiwei Rainfed Highland, Shaanxi (China). *Acta Universitatis Agriculturae Boreali-Occidentalis (China)* v. 22(2) p. 86-91. 2 tables; 2 ill., 5 ref. Chinese. (AGRIS 95-086170).

3370 Eissa, M.M.; Awaad, H.A. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) Path coefficient analysis for some yield attributes in ten wheat crosses (*Triticum aestivum* L.). *Zagazig Journal of Agricultural Research (Egypt)* v. 21(3A) p. 617-629. 7 tables; 9 ref. English. (AGRS 95-086173).

3371 El Bana, A.Y.A.; Basha, H.A. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) Response of yield and yield attributes of wheat (*Triticum aestivum* L.) to planting density under newly cultivated sandy soil. *Zagazig Journal of Agricultural Research (Egypt)* v. 21(3A) p. 671-681. 6 tables; 20 ref. English. (AGRS 95-086174).

3372 Fiez, TE.; Miller, BC. (1995) VARYING WINTER WHEAT SEEDING RATES AMONG LANDSCAPE POSITIONS. *Journal of Production Agriculture*. 8(3):346-350. English. [WASHINGTON STATE UNIV DEPT CROP & SOIL SCI PULLMAN, WA 99164 USA].

Recent research in the Palouse region of eastern Washington has suggested that traditional seeding rates may not be adequate to maximize winter wheat (*Triticum aestivum* L.) yield on all landscape positions. Low spike densities due to reduced light intensities, longer snow cover, and cool temperatures result in lower than expected yields on north-backslope (N-backslope) landscape positions. The objective of this experiment was to determine if higher seeding rates could increase spike density and yield. Three seeding rates, 1.0X standard grower rate (1.0X), 1.5X standard rate (1.5X), and 2.0X standard rate (2.0X), were tested on toeslope, south-backslope (S-backslope), shoulder, and N-backslopes at two locations, Farmington and Pullman, WA, in 1992 and 1993. The 1.5X and 2.0X treatments were established with an additional seeding operation perpendicular to the 1.0X drill passes. Increasing seeding rates resulted in greater spike density on all landscape positions. Spike density of wheat seeded at the 2.0X rate was from 11% greater on the S-backslope to 24% greater on the N-backslope in comparison with the 1.0X rate. Yield, however, only increased on the N-backslope with wheat seeded at the 2.0X rate yielding 10.3% more than wheat seeded at the 1.0X rate. On the three other landscape positions, a reduction in kernel number per spike resulted in no yield increase. Based on expected costs, the 2.0X seeding rate would increase net return on the N-backslope by \$2.35/acre given \$3.55/bu wheat. Research is needed to determine if similar yield increases could be achieved without making a perpendicular drill pass to double the seeding rate, which would increase net returns by \$13.23/acre.

3373 Frederick, JR.; Camberato, JJ. (1995) WATER AND NITROGEN EFFECTS ON WINTER WHEAT IN THE SOUTHEASTERN COASTAL PLAIN. 1. GRAIN YIELD AND KERNEL TRAITS. *Agronomy Journal*. 87(3):521-526. English. [CLEMSON UNIV DEPT AGRON & SOILS PEE DEE RES & EDUC CTR ROUTE 1 BOX 531 FLORENCE, SC 29501 USA].

Understanding how environmental factors affect winter wheat (*Triticum aestivum* L. emend. Thell.) responses to spring N application is an important component of economically and environmentally sound winter wheat production on the southeastern Coastal Plain of the USA. Increasing the amount of N applied to winter wheat grown in this region has been shown to result in a greater severity of drought stress during grain fill and lower individual kernel weights. This 2-yr field study was conducted to determine whether drought-induced reductions in kernel weight with high spring N rates are the result of decreases in the rate or the duration of kernel growth. Winter wheat was grown with different rates of spring-applied N (0, 45, 90 and 135 kg N ha⁻¹) under both irrigated and nonirrigated conditions. Increases in the rate of spring-applied N resulted in a greater severity of soil water deficits under nonirrigated conditions. Quadratic increases in grain yield and kernel number per square meter occurred in response to increased spring N under both levels of soil water treatment. Grain yield and individual kernel weight responses to irrigation were greater at the higher N rates than at the lower N rates. Over both years, the average increase in individual kernel weight due to irrigation was 3.9 and 13.3% at the 0 and 135 kg N ha⁻¹ rates, respectively. Similar responses were found for the effective filling period (EFP), where irrigation increased the EFP an average of 3.2 and 14.5% at the lowest and highest spring N rates, respectively. Soil water treatment had no effect on kernel growth rate. Results indicate that high rates of spring-applied N increase the severity of drought stress in nonirrigated winter wheat grown

on the Coastal Plain, resulting in reductions in the EFP and, consequently, kernel weight. [References: 17].

3374 Gouda, M.A.; El Shami, M.M.; Sharshar, M.S. (Ministry of Agriculture, Kafr El Sheikh (Egypt). Sakha Agricultural Research station) (1994) Effect of planting methods, seeding rates and use of herbicides on yield and its components of wheat. *Journal of Agricultural Sciences, Mansoura Univ. (Egypt)* v. 19(1) p. 39-47. 5 tables; 16 ref. English. (AGRS 95-086175).

3375 Guy, S.O.; Tindall, T.A. (1993) Lodging management. *Bulletin / (USA)* (no. 742) p. 16-17. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRS 95-086115).

3376 Hadjichristodoulou, A. (1995) SELF-RESEEDING PASTURE BARLEY FOR MEDITERRANEAN DRYLANDS. *Experimental Agriculture*. 31(3):361-370. English. [AGR RES INST POB 2016 NICOSIA CYPRUS].

Permanent pastures were successfully established with mixtures of bulks of crosses of *Hordeum vulgare* ssp. *vulgare* with ssp. *spontaneum* (given the name Mia Milia) and with mixtures of natural crosses involving *H. vulgare* ssp. *agriocrithon* (given the name Akhera). These crosses were made to exploit the brittle-rachis gene of wild barley in order to develop self-reseeding pasture barley. No re-seeding of the pasture was necessary but a light cultivation to cover the seed in the first year of solving improved plant establishment. No cultivation was necessary in the following years. Genotypes with a tough rachis were rapidly eliminated from the Milia pastures (F-2 bulks) because of their poor seed dispersal. Nitrogen and phosphorus fertilizer increased dry matter yield. Levels of seed dormancy in the wild barley were adequate to provide a safeguard against extreme dry weather conditions and other natural hazards. Forage quality was very high, with a crude protein content of 18% and digestible organic matter of 80% in harvested dry matter. Permanent barley pastures that exploit the brittle-rachis gene of indigenous genetic material have considerable potential for increasing the animal-carrying capacity of permanent pastures and marginal cropped lands. [References: 15].

3377 Hansen, P.F. (1994) [Sowing time and rate: spring barley and oats]. *Saatid og saamaengde: vaerbyg og havre. Statens Planteavlssforsoeg, Soenderborg (Denmark). Groen Viden. Landbrug (Denmark)*; no. 142 6 p. SP. 5 ill., 4 tables. Danish. (AGRS 95-086107).

3378 Hertel, K.A. (New South Wales Agriculture, Nyngan (Australia)) (1994) Nyngan agronomy district 1993 trial results [New South Wales]. *Nyngan Agronomy District Trial Results (Australia)*; no. 1994 11 p. New South Wales Agriculture. Tables. English. (AGRS 95-075181).

3379 Hoepfner, P. (1994) [To do without plant growth regulators in cereals]. *Auf Wachstumsregler in Getreide verzichten? Lohnt das Kurzspritzen noch? dz. Die landwirtschaftliche Zeitschrift fuer Produktion - Technik - Management (Germany)* v. 45(4) p. 28-31. 1 ill., 2 tables. German. (AGRS 95-086089).

3380 Huebner, G. (1994) [Malting barley 1994 in Rhineland-Palatinate: Having a narrow escape once again]. *Braugerste 1994 in Rheinland-Pfalz: Noch einmal davongekommen. Brauwell (Germany)* v. 134(37) p. 1823. German. (AGRS 95-075197).

3381 Hussain, G.; Aljaloud, AA. (1995) EFFECT OF IRRIGATION AND NITROGEN ON WATER USE EFFICIENCY OF WHEAT IN SAUDI ARABIA. *Agricultural Water Management*. 27(2):143-153. English. [KING ABDULAZIZ CITY SCI & TECHNOL NAT RESOURCES & ENVIRONM RES INST POB 6086 RIYADH 11442 SAUDI ARABIA].

Water use efficiency (WUE) and yield of wheat were determined in a field experiment using different irrigation waters, with and without nitrogen fertilizer on a sandy to loamy sand soil during 1991-1992 and 1992-1993. Depending upon different fertilizer treatments, the mean crop yield ranges in 1992-1993 were: biomass 4290-13 960 kg ha⁻¹ (well water) and 6460-14 870 kg ha⁻¹ (aquaculture effluent) and grain yield 770-5010 kg ha⁻¹ (well water) and 2140-5790 kg ha⁻¹ (aquaculture effluent). The

WUE for grain yield in 1991-1992 was 2.67-12.24 kg ha⁻¹ mm⁻¹ (well water) and 4.29-12.67 kg ha⁻¹ mm⁻¹ (aquaculture effluent). The WUE for grain yield in 1992-1993 was 1.22-7.97 kg ha⁻¹ mm⁻¹ (well water) and 3.40-9.21 kg ha⁻¹ mm⁻¹ (aquaculture effluent). The WUE for biomass in 1991-1992 ranged between 8.74-29.16 kg ha⁻¹ mm⁻¹ (well water) and 11.34-30.02 kg ha⁻¹ mm⁻¹ (aquaculture effluent). Whereas in 1992-1993, the WUE for biomass was 6.82-22.19 kg ha⁻¹ mm⁻¹ (well water) and 8.68-23.64 kg ha⁻¹ mm⁻¹ (aquaculture effluent). The grain yield and WUE obtained in T4 and T5 irrigated with well water and receiving 75 and 100% nitrogen requirements, were comparable with T4 and T5 irrigated with aquaculture effluent and receiving 25 and 50% nitrogen requirements. It is, therefore, concluded that application of 150-225 kg N ha⁻¹ for well water irrigation and 75-150 kg N ha⁻¹ for aquaculture effluent irrigation containing 40 mg N l⁻¹ would be sufficient to obtain optimum grain yield and higher WUE of wheat in Saudi Arabia. [References: 26].

3382 Huvet, D. (Malteurop, Reims (France)) (1994) [Malting barley]. L'orge de brasserie. *Perspectives Agricoles (France) (no 195)* p. 3-48. French. (AGRIS 95-075185).

3383 Jedel, PE.; Helm, JH. (1995) AGRONOMIC RESPONSE TO SEEDING RATE OF TWO- AND SIX-ROWED BARLEY CULTIVARS IN CENTRAL ALBERTA. *Canadian Journal of Plant Science*. 75(2):315-320. English. [ALBERTA AGR CROP RES CTR FIELD CROP DEV BAG 47 LACOMBE AB TOC 150 CANADA].

Little information is available on the response of two-rowed barley (*Hordeum vulgare* L.) cultivars to seeding rate in central Alberta. The objective of this research was to compare the effects of seeding rates of 129-344 seeds m⁻² (50-140 kg ha⁻¹) on the agronomic response of two- and six-rowed barley grown in central Alberta. Grain yields of 5.8-6.1 t ha⁻¹ were not affected by seeding rates in 1990 and 1991 at Lacombe. As seeding rates increased in 1992, grain yields at Lacombe increased from 6.4 to 7.8 t ha⁻¹; at Olds, from 3.5 to 4.0 t ha⁻¹; and at Botha for the 129 seeds m⁻² treatment, yields were only 5.5 t ha⁻¹, compared with 5.8 to 6.0 t ha⁻¹ for the other treatments. Effects of seeding rate on test and kernel weights varied between location-years. Tiller numbers m⁻² were found to increase at higher seeding rates for the two-rowed cultivars, Abee and Harrington, while for the six-rowed cultivars, Noble and Virden, these numbers remained constant. Node numbers spike⁻¹ decreased with higher seeding rates for both two- and six-rowed cultivars. There was little effect of seeding rate on kernel number spike⁻¹ for the two-rowed cultivars, while for the six-rowed cultivars this number decreased. Although the two- and six-rowed cultivars differed in their partitioning of yield and the effects of seeding rates on these components, their yield responses to seeding rate did not differ. Recommended seeding rates for barley in central Alberta should be above 129 seeds m⁻² (50 kg ha⁻¹). To maintain high kernel and test weights, seeding rates for barley grown in central Alberta for malt quality should range from 172 to 258 seeds m⁻². When conditions warrant accelerated development, seeding rates of 300 or more seeds m⁻² should be used. [References: 15].

3384 Jing Xiangtian (Baiying Municipal Agricultural Administration Office, Shaanxi (China)) (1994) Analysis on optimal decision-making of cultivated technique scheme of spring wheat in irrigated field. *Journal of Gansu Agricultural University (China)* v. 29(1) p. 61-67. 7 tables; 4 ref. Chinese. (AGRIS 95-086087).

3385 Kadayat, K.B.; Dhital, B.K. (Lumle Agricultural Research Centre Pokhara, Kaski (Nepal)) (1995) Research Outreach Report on Barley, 1993/94. *LARC Working Paper (Nepal); no. 95/15* 9 p. Lumle Agricultural Research Centre, Pokhara (Nepal). 4 tables. English. (AGRIS 95-086112).

Under the outreach research programme, a farmers' field varietal trial (FFVT) and an informal research and development (IRD) programme on barley were conducted in the winter season of 1993 at various off-station research (OSR) sites and outreach research (OR) sites of Lumle Agricultural Research Centre (LARC) in the Western Hills of Nepal. The sites were located across varied agro-ecological zones of the research command Area (RCA) was ranging from 350 to 2200m.

3386 Kashta, F.; Peculi, V. (Universiteti Bujqesor, Tirane (Albania)) (1994) (Increase indices and production of hard wheat). *Treguesit e rritjes dhe prodhimi i grurit te forte. Bujqesia Shqiptare (Albania) (no.2)* p. 12-14. 4 tables; 2 ill.; 9 ref. Albanian. (AGRIS 95-086176).

The hard wheat varieties created during those last years, have a large productivity comparable with the existing one. To fix the capacity of this genotype to the reaction against the stresses, through the increase analysis methods were studied four genotypes increase for a two year period. According to the results achieved for LAI, LAD, NAR, G/LAD and production, it is shown that the physiological indices which have a great influence in the plant productivity are LAD and photosynthetic fruitfulness after spiking (G/LAD).

3387 Kim, H.B. (Dongguk University, Seoul (Korea Republic). Department of Agronomy) (1994) Effect of sowing depth on coleoptile length and plant height of barley, wheat, rye and corn. *Korean Journal of Crop Science (Korea Republic)* v. 39(3) p. 232-236. 2 illus.; 4 tables; 9 ref. Korean. (AGRIS 95-086111).

3388 Kristensen, K.; Rasmussen, I. (Department of Biometry and Informatics, Danish Institute of Plant and Soil Science, Thorvaldsensvej 40, Frederiksberg 1871 (Denmark)) (1993) Models to assist the choice of strategies for growing malting barley without the use of pesticides. *SP Rapport (United Kingdom) (no.)* p. 39-46. 9 ref., a workshop on computer-based DSS on crop protection held in Palma, Italy, on 23-26 November 1993. English. (AGRIS 95-086109).

3389 Kumar, A.; Sharma, DK.; Sharma, HC. (1995) RESPONSE OF WHEAT (TRITICUM AESTIVUM) TO IRRIGATION AND NITROGEN IN SODIC SOILS. *Indian Journal of Agronomy*. 40(1):38-42. English. [INDIAN AGR RES INST DIV AGRON NEW DELHI 110012 INDIA].

An experiment was carried out with wheat (*Triticum aestivum* L. emend. Fiori & Paol.) during 1990-91 and 1991-92 at Karnal, to find out the irrigation and nitrogen requirement in sodic soil (pH 9.2 and ESP 29.8). Crop-growth rate, yield attributes, yield and water use by wheat increased significantly with an increase in irrigation water depth: cumulative pan evaporation (IW : CPE) ratio from 0.6 to 1.2 in both years. Application of 180 kg N/ha gave significantly higher yield attributes and yield of wheat. Interaction effect between irrigation and N on wheat was significant during both the years. Significantly higher grain yield was recorded at 1.2 IW : CPE ratio with the application of 180 kg N/ha to wheat in sodic soils.

3390 Layaoen, H.L. (National Tobacco Administration, Panay Ave., Quezon City (Philippines). Deputy Administrator for Research) (1992) Status of wheat R and D [research and development] in Region 1 (Ilocos, Philippines). Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 20-28. 4 tables. Received Nov 1994. English. (AGRIS 95-075158).

3391 Lei Yongchang (Hanzhong Prefectural Extension Centre of Agrotechnique, Shaanxi (China)) (1994) Preliminary study on the pattern of population grain yield structure of wheat. *Shaanxi Journal of Agricultural Sciences (China)* (no. 2) p. 1-3. 1 table. Chinese. (AGRIS 95-086167).

3392 Li Fujiang; Wang Xianying; Shi Xiaoyang (Ankang Prefectural Inst. of Agricultural Sciences, Shaanxi (China)) (1994) Zero tillage or fewer-tillages used in rice and wheat field with 100 kg yield per mu. *Shaanxi Journal of Agricultural Sciences (China)* (no. 6) p. 39. Chinese. (AGRIS 95-086169).

3393 Liu Mandao; Yuan Baoxiang (Shaanxi Provincial Inst. of Cotton, Sanyuan County (China)) (1994) Study on changes of ecologic factors and growth of cotton during restoring period after wheat harvested in the field of undersowing of wheat and cotton. *Shaanxi Journal of Agricultural Sciences (China)* (no. 5) p. 1-3. 5 tables. Chinese. (AGRIS 95-086221).

3394 Mann, C.E. (Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Asian Regional Program) (1992) Role and commitments of CIMMYT to the development of wheat in the Philippines. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop*. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). *Regional Wheat Program for Southeast Asia* p. 127-128. Received Nov 1994. English. (AGRI 95-075160).

3395 Mautner, J. (1994) Spring barley 1994 - Europe. *Brauwelt international (Germany)* (no.3) p. 224-225. 1 table. English. (AGRI 95-075190).

3396 Mautner, J. (1994) [Spring barley in Europe 1994]. *Sommergerste 1994 in Europa. Brauwelt (Germany)* v. 134(37) p. 1826-1827. German. (AGRI 95-075194).

3397 Mautner, J. (1994) [Spring barley in Germany 1994]. *Sommergerste 1994 in Deutschland. Brauwelt (Germany)* v. 134(37) p. 1828-1829. German. (AGRI 95-075195).

3398 Miguel, V. (Agricultural Pilot Center, Iguig, Cagayan (Philippines)) (1992) Role and commitments of DA-Region 2 [Cagayan Valley] to the development of wheat in the Philippines. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop*. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). *Regional Wheat Program for Southeast Asia* p. 143-145. Received Nov 1994. English. (AGRI 95-075163).

3399 Mitchell, RAC.; Lawlor, DW.; Mitchell, VJ.; Gibbard, CL.; White, EM.; Porter, JR. (1995) EFFECTS OF ELEVATED CO₂ CONCENTRATION AND INCREASED TEMPERATURE ON WINTER WHEAT - TEST OF ARCWHEAT1 SIMULATION MODEL. *Plant Cell & Environment*. 18(7):736-748. English. [AFRC INST ARABLE CROPS RES ROTHAMSTED DEPT BIOCHEM & PHYSIOL HARPENDEN AL5 2] QHERTS ENGLAND].

Winter wheat (*Triticum aestivum* L., cv, Mercia) was grown in a controlled-environment facility at two CO₂ concentrations (targets 350 and 700 $\mu\text{mol mol}^{-1}$), and two temperature regimes (tracking ambient and ambient + 4 degrees C). Observations of phenology, canopy growth, dry matter production and grain yield were used to test the ARCWHEAT1 simulation model. Dry-matter production and grain yield were increased at elevated CO₂ concentration (27 and 39%, respectively) and reduced at increased temperature (-16 and -35%, respectively). ARCWHEAT1 substantially underestimated canopy growth for all treatments. However, differences in the facility environment from field conditions over the winter, indicated by the unusually rapid canopy growth observed in this period, meant that empirical model relationships were being used outside the conditions for which they were developed. The ARCWHEAT1 productivity submodel, given observed green area indices as inputs, overestimated the effect of CO₂ on productivity. An alternative, more mechanistic submodel of productivity, based on the SUCROS87 and Farquhar and von Caemmerer models, simulated observed crop biomass very closely. When these productivity simulations were inputted into the ARCWHEAT1 partitioning and grain-fill submodels, grain yield was predicted poorly, mainly as a result of the assumption that the number of grains is proportional to total growth during a short preanthesis phase. While yield was not correlated with growth in this phase, it was correlated with growth in longer preanthesis phases, indicating that ARCWHEAT1 could be improved by taking into account the contribution of earlier growth in determining yield. [References: 27].

3400 Murphy, D.P.L. (Newcastle upon Tyne Univ. (United Kingdom). Dept. of Agriculture); Dahab, M.H.; Wyseure, G.C.L.; O'Callaghan, J.R. (1994) The simulation of the effects of shading on the growth and yield of winter barley (*Hordeum distichum*). *Computers and Electronics in*

Agriculture (Netherlands) v. 11(4) p. 347-350. 16 ref. English. (AGRI 95-075202).

3401 Murray, G.A. (1993) Spring barley growth and development. *Bulletin - Idaho Agricultural Experiment Station (USA)* (no. 742) p. 6-7. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRI 95-086113).

3402 O'Callaghan, J.R. (Newcastle upon Tyne Univ. (United Kingdom). Dept. of Agricultural and Environmental Science); Hossain, A.H.M.S.; Wyseure, G.C.L. (1994) Some factors limiting the yield of wheat in Bangladesh. *Computers and Electronics in Agriculture (Netherlands)* v. 11(4) p. 337-345. 12 ref. English. (AGRI 95-075157).

3403 Obien, S.R. (Philippine Rice Research Inst., Maligaya, Munoz, Nueva Ecija (Philippines)) (1992) PhilRice commitment to wheat research. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop*. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). *Regional Wheat Program for Southeast Asia* p. 137-142. Received Nov 1994. English. (AGRI 95-075162).

3404 Parihar, GN.; Singh, R. (1995) RESPONSE OF WHEAT (*TRITICUM AESTIVUM*) GENOTYPES TO SEED RATE AND SOWING METHOD UNDER WESTERN RAJASTHAN CONDITION. *Indian Journal of Agronomy*. 40(1):97-98. English. [RAJASTHAN AGR UNIV AGR RES STN MANDOR 342304 INDIA].

3405 Powell, C. (New South Wales Agriculture, Wagga Wagga (Australia)) (comp.) (1994) Regional on farm experiments: eastern Riverina 1993 [New South Wales]. *Regional On-Farm Experiments - Eastern Riverina (Australia)* 68 p. New South Wales Agriculture. 40 fig. English. (AGRI 95-075203).

Reports on the results of variety trials conducted on district properties in the eastern Riverina district in 1993. Trials for wheat, barley, oats, lupins, field peas, lupins and pasture crops are included as well as fertiliser and herbicide demonstration plots.

3406 Puyaoan, M. (Batac, Ilocos Norte (Philippines)) (1992) Wheat production in Ilocos Norte [Philippines] a farmer's experience. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop*. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). *Regional Wheat Program for Southeast Asia* p. 44-46. Received Nov 1994. English. (AGRI 95-075159).

3407 Qafoku, N. (Universiteti Bujqesor, Tirane (Albania)) (1994) [Wheat yield depending on the content of the nutritive elements in plant. I. Nitrogen]. *Rendimenti i grurit ne varesi te permbajtjes se elementeve ushqyes ne bime. I. Azoti. Bujqesia Shqiptare (Albania)* (no.1) p. 14-16. 1 table; 11 ill.; 8 ref. Albanian. (AGRI 95-086166).

The dependence, yields, nitrate percentage in wheat plant is studied at 5 phenophases, at Tirana district. There exists a correlative dependence between yields and nitrogen percentage in wheat plant. At the first phenophase the interval of nitrogen concentration for the maximal yield achieved at experiment was found. At the second growing phenophase and spiking, a critical interval of nitrogen concentration was found. Regression equation taken by this study may be used for nutritive modes at wheat plant with nitrogen.

3408 Robertson, L.D. (ed.); Stark, J.C. (ed.) (1993) Idaho spring barley production guide. *Bulletin - Idaho Agricultural Experiment Station (USA)*; no. 742 47 p. English. (AGRI 95-086118).

3409 Robertson, L.D.; Wesenberg, D.M. (1993) Major uses of barley. *Bulletin - Idaho Agricultural Experiment Station (USA)* (no. 742) p. 5. In the

series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRIS 95-086119).

3410 Rossberg, R. (1994) [Many ways - one goal. Comparison of European wheat cultivation methods. International DLG exhibition]. *Viele Wege - ein Ziel. Vergleich europäischer Weizen-Anbauverfahren. (Internationale DLG-Feldtage). dlz. Die landwirtschaftliche Zeitschrift fuer Produktion - Technik - Management (Germany) v. 45(6) p. 20-25. 6 ill., 2 tables. German. (AGRIS 95-086088).*

3411 Ruetter, A. (Landwirtschaftskammer Muenster, Muenster (Germany)); Ruland, W. (1994) [Varieties for bio-farming]. *Sorten fuer den Oeko-Landbau. Landwirtschaftliches Wochenblatt Westfalen-Lippe, Ausgabe A (Germany) v. 151(38) p. 28-30. 2 ill., 5 tables. German. (AGRIS 95-075090).*

3412 Ryu, Y.H. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station); Lee, C.D. (Kangwon National University, Chunchon (Korea Republic). College of Agriculture) (1994) *Role of awns and leaves during grain filling period in barley. Korean Journal of Crop Science (Korea Republic) v. 39(3) p. 216-222. 3 illus.; 6 tables; 14 ref. Korean. (AGRIS 95-086110).*

3413 Schildbach, R. (1994) [Malting barley worldwide]. *Braugerste weltweit. Brauwelt (Germany) v. 134(45) p. 2436-2438, 2440, 2442-2446, 2448-2454, 2456. 14 ill., 20 tablesBibliography 53 ref. German. (AGRIS 95-075188).*

3414 Schildbach, R. (1994) *Malting barley worldwide. Brauwelt international (Germany) (no.4) p. 292-294, 296-308, 310. 14 ill., 20 tablesBibliography 53 ref. English. (AGRIS 95-075189).*

3415 Schwappach, P. (1994) [Crop 1994 of malting barley in Frankonia]. *Braugerstenerte 1994 in Unterfranken. Brauwelt (Germany) v. 134(37) p. 1825. German. (AGRIS 95-075200).*

3416 Shehab El Din, T.M. (King Saud Univ., Al Qassim Branch (Saudi Arabia). College of Agriculture and Veterinary Medicine) (1993) *Response of two spring wheat cultivars, Aestivum L. Thell. to ten seeding rates in sandy soils. Journal of Agricultural Sciences, Mansoura (Egypt) v. 18(8) p. 2235-2240. 3 tables; 11 ref. English. (AGRIS 95-086172).*

3417 Smathers, R.L.; Patterson, P.E. (1993) *Production costs and budgeting. Bulletin - Idaho Agricultural Experiment Station (USA) (no. 742) p. 42-46. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRIS 95-086120).*

3418 Song Jiabao; Wang Youliang; Wu Shenglong (Baiying Municipal Agricultural Technique Center, Gansu (China)) (1994) *Integrated agricultural measures with high yield and high benefit for intercropping of wheat and corn in Baiying District, Gansu [China]. Journal of Gansu Agricultural University (China) v. 29(1) p. 43-48. 5 tables; 2 ref. Chinese. (AGRIS 95-086171).*

3419 Tanner, Douglas G. (CIMMYT, Addis Abeba (Ethiopia)); Amanuel Gofru; Maina, M.P.; Negusie Tadese (1994) *A Collaborative Research Agenda to Develop Sustainable Wheat Production Technologies for East Africa. Regional Travelling Workshop on Long-term Wheat-based Sustainability Trials in East Africa; Addis Abeba (Ethiopia); 7-18 Feb 1994. A Regional Travelling Workshop on Long-term Wheat Based Sustainability Trials in East Africa. Tanner, Douglas G. (CIMMYT, Addis Abeba (Ethiopia)) (ed.) p. 23-34. CIMMYT. 9 tables; 22 ref. English. (AGRIS 95-075156).*

3420 Tausch, H. (1994) [Cultivation of malting barley in Baden-Wuerttemberg: a stabile area]. *Braugerstenanbau Baden-Wuerttemberg: eine feste Groesse. Brauwelt (Germany) v. 134(37) p. 1824. German. (AGRIS 95-075199).*

3421 Veseth, R.J.; Brown, B.D.; Tindall, T.A. (1993) *Crop residue management. Bulletin - Idaho Agricultural Experiment Station (USA) (no. 742)*

p. 38-41. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRIS 95-086117).

3422 Veseth, R.J.; Robertson, L.D. (1993) *Harvest and storage. Bulletin - Idaho Agricultural Experiment Station (USA) (no. 742) p. 36-37. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRIS 95-086116).*

3423 Viadya, A.K.; Gurung, H.B. (Lumle Agricultural Research Centre, Kaski, Pokhara (Nepal)) (1995) *Yield estimation and farm management study of wheat in the extension command area (1991/92-1992/93). LARC Working Paper (Nepal); no. 95/23 43 p. Lumle Agricultural Research Centre, Pokhara (Nepal). 19 tables. English. (AGRIS 95-086096).*

A crop-out survey was undertaken in 1991/93 to assess the biological yield of wheat in the extension command area of Lumle Agricultural Research Centre which includes 24 village development committee of Parbat, Kaski and Myaggi districts. The second year survey was conducted with the help of extension field staff. Biological yields of the year 1991/92 and 1992/93 are estimated to be 1.42+0.07 and 1.49+0.07 ton/ha which is higher than average by the Government estimates of those districts. Farmers' yield estimates agreed with that in bari and was less than khet. Despite efforts to achieves varietal diversity RR-21 is still the common variety grown, input level in the study area is poor and gross margin per hectare was NCR6552 and 7803 in the year and spike sterility as major problems does not incur serious economic losses.

3424 Wang Caibin (Shandong Research Inst. of Peanut, Laixi (China)); Sun Yanhao (1994) *Analysis of yielding components under different planting modes in two-crop system of wheat and peanut and the pathway of high-yielding cultivation. Peanut Science and Technology (China) (no. 3) p. 24-27. 1 table; 2 ref. Chinese. (AGRIS 95-075275).*

3425 Yagbasanlar, T.; Ozkan, H.; Genc, I. (1995) *RELATIONSHIPS OF GROWTH PERIODS, HARVEST INDEX AND GRAIN YIELD IN COMMON WHEAT UNDER MEDITERRANEAN CLIMATIC CONDITIONS. Cereal Research Communications. 23(1-2):59-62. English. [UNIV CUKUROVA FAC AGR DEPT FIELD CROPS ADANA TURKEY].*

This study was conducted to determine the effect of growth periods, harvest index, and biomass on grain yield of wheat and to estimate the inheritance of these characters. In this research, the highest value of heritability was found for plant height, while the lowest value of heritability was found for grain yield. The coefficient of variability for biomass and grain yield was higher than other traits. Grain yield was positively correlated with grain Filling period, plant height, biomass, harvest index, while it was negatively correlated with days to heading. As the results of this study it was concluded that the selection criterion for improving the grain yield of common wheat under Mediterranean climatic conditions should include high biomass yield with high harvest index.

3426 Yan Zhen De (Xu Zhou Prefecture Agricultural Inst., Jiangsu Province 221000 (China)) (1994) *Extending cultivation of medium-maturing hybrid indica rice northward through management of cultural practices. International Rice Research Conference; Los Banos, Laguna (Philippines); [nd]. Hybrid rice technology: new developments and future prospects. Virmani, S.S. (ed.). International Rice Research Inst., Los Banos, Laguna (Philippines) p. 284. IRRI. English. (AGRIS 95-086156).*

Using traditional cultural practices, medium-maturing hybrid indica rices, such as Shan You 63 and Nan You 3, are best suited for central Jiangsu Province (south of 33 deg N), where the rice-wheat rotation system is practiced. In the mid-1970s, similar hybrids were extended to Xuzhou (34-35 deg N) and the production area has increased year by year since then. If the cultural practices used in the south were applied to growing hybrids in Xuzhou, low temperatures would allow only a single-cropped rice system. Local agricultural production is dominated by a double-cropped rice-wheat system. Early and sparse sowing of old hybrid seedlings (with 8-9 leaves) must be adopted to ensure that the heading stage comes before 20 Aug. Grain yield have reached 8.25 t/ha in large areas and 12.75 t/ha in small areas. Medium-maturing hybrids have been introduced further north, in the Laizhou Bay Region in northern Shandong (37.56 deg N) following a series of experiments. Local conditions favor a single-cropped rice system. To ensure early heading (mid-August)

and harvest before 1 Oct, sowing is done in greenhouses in mid-late April to produce stronger seedlings. Transplanting is done in early May. The rice yield in commercial production was 9.4 t/ha in 1991; yield potential was 14.25 t/ha. This yield level was higher than that in the south due to simultaneous increases in number of panicles, number of grains per panicle, grain weight, and the rate of filled spikelets resulting from longer growth duration, sufficient sunshine, fewer pests, and a large difference between day and night temperature.

3427 Zeidan, E.M.; Ghanem, S.A.I.; Aly, R.M.; Gomaa, A.F.A. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) **Effect of seeding rate, row spacing and nitrogenous fertilization level on yield and yield attributes of barley**. *Zagazig Journal of Agricultural Research (Egypt)* v. 21(1) p. 57-65. 2 tables; 17 ref. English. (AGRIS 95-086108).

F02 PLANT PROPAGATION

3428 Balyan, R.S.; Malik, R.K. (Haryana Agricultural University, Hisar (India). Department of Agronomy) (1993) **Interaction effect of seed rate and weed control practices on wild oat (*Avena ludoviciana* Durieu) and wheat (*Triticum aestivum* L.)**. *Haryana Agricultural University Journal of Research (India)* v. 23(4) p. 225-229. 7 tables; 7 ref. English. (AGRIS 95-075670).

3429 DeLeon, J.L.D.; Garibaldimeza, C. (1995) **POTENTIAL PRACTICAL APPLICATIONS OF IN VITRO CULTURE OF MATURE WHEAT EMBRYOS**. *Cereal Research Communications*. 23(1-2):19-25. English. [UNIV AUTONOMA BAJA CALIFORNIA DEPT AGRON CULTIVOS LAB APARTADO POSTAL 19-B LA PAZ BAJA CALIF SUR MEXICO].

Plantlets of *Triticum aestivum* cv. Opat. were established by the in vitro culture of mature embryos. Differences in growth and development were dependent upon excision procedures and the chemical constitution of culture medium. Dry seeds-excised embryos (DSEE), either imbibed or not, did not develop into normal seedlings. Embryo excised from imbibed seeds (ISEE) yielded normal embryos seedlings growth and development when in vitro cultured. Murashige and Skoog (MS) medium was optimum for mature embryo culture. One-half or one-quarter of strength of MS medium inhibited growth by 40% and 53% respectively. Both Gamborg and Eveleigh, and White media inhibited height, root and leaf number by 23% and 46% respectively. Ammonium (< than 1650 mg/L) and calcium (< than 440 mg/L) ion concentrations were limiting factors for normal growth and development of mature embryo-derived wheat seedlings. However, the sugar source (sucrose, maltose and glucose) did not have a significant effect on embryo performance.

3430 Ganeva, G.; Karadimova, M.; Djambova, G. (1995) **EFFECTS OF 4H HORDEUM VULGARE L. 4A AND 4D TRITICUM AESTIVUM L. CHROMOSOMES ON THE GENETIC CONTROL OF IN VITRO AND IN VIVO PLANT RESPONSE TO EXOGENOUS AUXINS**. *Cereal Research Communications*. 23(1-2):27-33. English. [BULGARIAN ACAD SCI INST GENET BU-1113 SOFIA BULGARIA].

The behaviour of immature embryos derived from a wheat line (*T. aestivum* cv. Chinese Spring) with disomic addition of 4H chromosome (from *Hordeum vulgare* L. cv. Betzes) and tetrasomic 4A and 4D lines in callus initiation medium culture was studied, with respect to factors: alien chromosome, chromosome dose and 2, 4D content in the medium. The alien chromosome 4H and the overdose of 4A and 4D chromosomes changed considerably embryo and callus culture reaction to exogenous auxins. The chromosomes and 2, 4-D concentration effects on the germination of mature seeds from these lines were analysed too. Chromosome 4H stimulated root formation and coleoptile growth in vivo.

3431 Gold, C.M.; Duffus, C.M. (1995) **THE USE OF EAR CULTURE TO STUDY THE EFFECT OF DRYING RATE ON ALPHA-AMYLASE ACTIVITY IN NEAR ISOGENIC LINES OF WHEAT CV. HUNTSMAN, MARIS**. *Cereal Research Communications*. 23(1-2):79-85. English. [SCOTTISH AGR COLL DEPT CROP SCI & TECHNOL W MAINS RD EDINBURGH EH9 3JG MIDLOTHIAN SCOTLAND].

A method for culturing detached wheat ears in liquid media has been developed in order to examine the effect of grain drying rate on alpha-amylase activity in near-isogenic lines of wheat which contain the

gibberellic acid-insensitive dwarfing (Rht) genes. The results show that the incorporation of polyethylene glycol (PEG) in the culture medium can be successfully used to alter grain drying rates. Overall, alpha-amylase activity was significantly lower ($p < 0.001$) in caryopses cultured on PEG. However, despite the range of drying rates achieved, there was no correlation between alpha-amylase activity and drying rate.

3432 Jahne, A.; Lorz, H. (1995) **CEREAL MICROSPORE CULTURE [Review]**. *Plant Science*. 109(1):1-12. English. [UNIV HAMBURG INST ALLGEMEINE BOT AMP 2 OHNHORSTSTR 18 D-22609 HAMBURG GERMANY].

The present review will examine some of the recent developments in cereal microspore culture. Experimental procedures as well as applied purposes will be considered. This article will mainly concentrate on the culture of isolated microspores, but due to the close relationship some aspects of anther culture will be discussed also. [References: 86].

3433 Jia Xu (Academia Sinica, Beijing (China). Inst. of Genetics) (1994) **Establishment and application of the medium of anther culture of intergeneric hybrids of *Triticum aestivum* X *Agropyron***. *Scientia Agricultura Sinica (China)* v. 27(4) p. 83-87. 2 tables; 10 ref. Chinese. (AGRIS 95-086497).

3434 Rikiishi, K.; Takeda, K.; Yasuda, S. (1995) **GEOGRAPHICAL DIFFERENTIATION AND VARIETAL VARIATION IN ROOT DIFFERENTIATION ABILITY OF CALLI DERIVED FROM MATURE EMBRYOS IN LOCAL BARLEY VARIETIES [Japanese]**. *Breeding Science*. 45(2):211-215. Japanese. [OKAYAMA UNIV BIORESOURCES RES INST KURASHIKI OKAYAMA 710 JAPAN].

Differentiation ability of calli derived from mature embryos was surveyed using a total of 269 local barley varieties collected from various countries or regions of the world. Eighty five varieties differentiated roots, though they did not regenerate shoots. The percentages of root differentiation in all tested varieties ranged from 0 to 100 %, and their average was 10.2 %. Varieties collected from Japan, Korea, China, Nepal, Turkey and North Africa showed a low differentiation ability (1-5 %), while those from South-West Asia, Europe and Ethiopia showed a high differentiation ability (13-19 %). Two kinds of non-brittle rachis type, Bt bt(2) and btBt(2), which are one of the key characters for distinguishing the oriental and occidental types of cultivated barley varieties, showed an average percentage of 3.3 % and 15.7 % for root differentiation, respectively. In each of two non-brittle rachis genotypes, no differences in the average percentage of root differentiation was detected between two-rowed and six-rowed varieties, and also between covered and naked varieties. There were no differences among esterase isozyme genotypes within each non-brittle rachis genotype. These findings suggest that the high root differentiation ability of barley varieties is characterized by geographical differentiations and is related to the Bt Bt(2) genotype for non-brittle rachis.

3435 Sesek, S. (Faculty of Agriculture, Novi Sad (Yugoslavia). Institute of Field and Vegetable Crops) (1993) **The influence of cytokinin concentration on callus induction and plant regeneration in wheat embryo culture**. *Zastita bilja (Yugoslavia)* v. 42(2) p. 133-139. 2 graphs; 2 tables; 21 ref. English. (AGRIS 95-075680).

The effect of a cytokinin concentration on the success of callus induction, callus proliferation and plant regeneration from wheat embryos was studied; in vitro regeneration. The spring wheat cultivar (*Triticum aestivum* L.) was used. The results obtained indicated that the different 2iP concentrations did not bear a significant effect on callus induction which ranged, in dependence of concentration, from 92 to 94 in relation to the total number of isolated embryos. The largest callus diameter was obtained in the 2iP - free variant (control), but the highest frequency of regenerated plants was obtained on the medium containing the highest 2iP concentration which was 0.5 mg/l** (-1).

3436 Simmen, U.; Gisi, U. (1995) **EFFECTS OF SEED TREATMENT WITH SAN 789 F, A HOMOPROPARGYLAMINE FUNGICIDE, ON GERMINATION AND CONTENTS OF SQUALENE AND STEROLS OF WHEAT SEEDLINGS**. *Pesticide Biochemistry & Physiology*. 52(1):25-32.

Wheat seedlings (*Triticum aestivum* L. cv. Arina) contained mainly sitosterol and campesterol as the principal sterol compounds (71 and 21% of the total amount of free sterols, respectively), whereas stigmasterol (3%) and other unidentified sterols (together 5%) were much less abundant. Squalene, an important intermediate of sterol biosynthesis, was only found in traces. Seed treatment with SAN 789 F (N-(5, 5-dimethyl-3-hexynyl)-N-ethyl-1-naphthalenemethanamine), a homopropargylamine fungicide, induced two primary effects on sterol biosynthesis: First, squalene accumulated temporarily in large amounts within 48 hr after treatment, indicating an inhibition of squalene epoxidase; second, the content of free sterols slightly decreased within 14 days after treatment, probably as a consequence of squalene epoxidase inhibition. An additional effect of the seed treatment was an inhibition of growth occurring immediately after germination, whereas later, seedlings started to regrow. In contrast to a seed treatment with a wettable powder formulation (10 WP), seeds treated with an encapsulated "slow-release" formulation (CS 250) accumulated much less squalene. In addition, the growth of seedlings was only slightly inhibited by treatment with the CS 250 formulation. A reduced growth inhibition was also achieved when seedlings were treated between 3 and 7 days after germination. These results suggest that accumulation of squalene rather than a deficiency of free sterols is responsible for the inhibition of germination induced by the treatment with SAN 789 F. The inhibitory effects of the fungicide on growth and on squalene epoxidase were drastically reduced, when the homopropargylamine delivery to the seed was delayed by either a late application or the use of an encapsulated formulation. (C) 1995 Academic Press, Inc. [References: 25].

3437 Turkina, MV.; Kulikova, AL.; Koppel, LA.; Akatova, LZ.; Butenko, RG. (1995) **ACTIN AND HEAT-STABLE ACTIN-BINDING PROTEINS IN WHEAT CALLUS CULTURE**. *Russian Journal of Plant Physiology*. 42(3):303-309. English. [RUSSIAN ACAD SCI KA TIMIRYAZEV PLANT PHYSIOL INST UL BOTANICHESKAYA 35 MOSCOW 127276 RUSSIA].

Total actin and its filamentous (F) and globular (G) forms were quantified in the wheat (*Triticum aestivum* L.) callus culture. The total amount of actin remained essentially constant (ca. 9 μ g/mg of extracted protein) during the long-term callus culturing, and did not differ in the morphogenic and nonmorphogenic callus zones. The amount of F-actin correlated with the proportion of morphogenic callus tissue, where it comprised up to 50% of total actin. In the soft, hydrated callus, the content of F-actin decreased to nearly zero. A fraction of heat-stable actin-binding proteins was isolated from the wheat callus. The polypeptides with mol wts of 30 (a major polypeptide), 35.5, and 38 kD were identified as tropomyosin isoforms on the basis of their thermostability, isoelectric point (4.5), and ability for a Mg²⁺-dependent actin binding. The heat-stable F-actin-binding polypeptides with apparent mol wts of 86 and 83 kD appear to be the light caldesmon isoforms. The suggestion was made that the cell potential for differentiation was related to the state of the actin cytoskeleton. Further methods for tropomyosin and caldesmon identification in plant tissues as well as the occurrence of specific isoforms of these proteins in callus cultures are discussed. [References: 25].

3438 Zamecnik, J. (Research Inst. of Crop Production, Prague (CZECH REPUBLIC). Dept. of Plant Physiology); Bieblova, J.; Grospletsch, M. (1994) **Safety zone as a barrier to root-shoot ice propagation**. *Plant and Soil (Netherlands)* v. 167(1) p. 149-155. 14 ref. English. (AGRIS 95-075677).

F03 SEED PRODUCTION

3439 Kim, J.K. (Chonbuk National University, Chonju (Korea Republic). College of Agriculture) (1994) **Studies on practical methods to control seed vigor in several food crops**. *Korean Journal of Crop Science (Korea Republic)* v. 39(2) p. 128-138. 6 tables; 48 ref. Korean. (AGRIS 95-086586).

3440 Klein, JD.; Hebbe, Y. (1995) **EFFECT OF THE TREATMENT OF WHEAT SEEDS WITH VEGETABLE OILS ON GERMINATION AND EMERGENCE**. *Experimental Agriculture*. 31(3):291-298. English. [AGR RES ORG VOLCANI CTR INST FIELD & GARDEN CROPS DEPT AGRON & NAT RESOURCES IL-50250 BET DAGAN ISRAEL].

Seeds of wheat (*Triticum aestivum* L.) were coated with a range of vegetable oils before sowing, in an effort to provide a hydrophobic coating that would only dissolve or wash away in the presence of sufficient water to maintain continued seedling growth. Germination of oil-treated seeds was reduced by 20-50% and time to 50% emergence was increased by two to five days. Treating pesticide-coated seeds with vegetable oil further decreased germination and extended time to emergence. Oil treatment did not decrease water uptake or affect seed respiration. Degree of saturation and linoleic acid:oleic acid ratio were not correlated with the effects of the various oils. The decreased germination and delayed emergence associated with the oil treatment were probably due to physiological rather than physical factors. [References: 17].

3441 Shi Sixin (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Crop Germplasm Resources) (1994) **Study on vigor of wheat seeds after storage in LN2 (-196 deg C.) for 11 years**. *Chinese Agricultural Science Bulletin (China)* v. 10(5) p. 12-15. 3 tables; 4 ref. Chinese. (AGRIS 95-086588).

F04 FERTILIZING

3442 [Nitrogen fertilization of wheat]. **Une fertilisation azotée toujours plus précise** (1994) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 197) p. 32-34. French. (AGRIS 95-075962).

3443 [The advices about the nitrogen fertilization [in Belgium]]. **Les conseils de fumure azotée** (1994) Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium); Faculte des Sciences Agronomiques de Gembloux (Belgium). [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. *Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993*. Seutin, E.; Falisse, A. (eds) (Fumure) 26 p. 28 tables. French. (AGRIS 95-075913).

3444 [Varieties trials [Winter wheat, Barley, Triticale, Rye, Triticum spelta, Oats]]. **Varietes** (1994) Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium); Faculte des Sciences Agronomiques de Gembloux (Belgium). [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. *Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993*. Seutin, E.; Falisse, A. (eds) (Varietes) 21 p. 11 tables. French. (AGRIS 95-075914).

3445 Almstafa, WA.; Elshall, AA.; Abdallah, AE.; Modaihsh, AS. (1995) **RESPONSE OF WHEAT TO SEWAGE SLUDGE APPLIED UNDER TWO DIFFERENT MOISTURE REGIMES**. *Experimental Agriculture*. 31(3):355-359. English. [KING SAUD UNIV COLL AGR DEPT SOIL SCI POB 2460 RIYADH 11451 SAUDI ARABIA].

A field experiment was conducted from 1989 to 1992 to investigate the effect of sewage sludge applications on wheat yield under different irrigation regimes. The sewage sludge was applied at rates equivalent to 0, 20 or 60 t ha⁻¹ whenever the available soil moisture reached 30 or 70%. The results showed a significant response in grain yield and its nutrient content with no significant differences between rates of sewage sludge applied. Much higher responses were obtained under the wet than under the dry regime. [References: 16].

3446 Baenziger, M. (Eidgenossische Technische Hochschule Zuerich (Suisse). Institute of Plant Sciences); Feil, B.; Schmid, J.E.; Stamp, P. (1994) **Utilization of late-applied fertilizer nitrogen by spring wheat genotypes**. [Utilisation d'un engrais azote applique tardivement par des genotypes de ble de printemps]. *European Journal of Agronomy (France)* v. 3(1) p. 63-69. 34 ref., 5 tableaux. English. (AGRIS 95-086714).

3447 Basha, H.A.; EL Bana, A.Y.A. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) **Effect of nitrogen fertilization on barley in newly cultivated sandy soil**. *Zagazig Journal of Agricultural Research (Egypt)* v. 21(4) p. 1053-1066. 6 tables; 28 ref. English. (AGRIS 95-086672).

3448 Berecz, K.; Kissimon, J.; Ragasits, I. (1995) **CHANGES IN PROTEIN COMPOSITION DURING THE GRAIN FILLING OF WHEAT AS A FUNCTION OF NITROGEN FERTILISATION USING CLASSICAL**

FRACTIONATION AND SDS-PAGE METHODS. *Novenytermeles.* 44(1):19-32. Hungarian. [PANNON AGRARTUDOMANYI EGYETEM DEAK F U16 H-8360 KESZTHELY HUNGARY].

The effect of different levels of N supply on the development, accumulation and composition of wheat grain proteins was studied during grain filling using classical fractionation and gel electrophoresis. The field N fertilisation experiment was carried out on Ramann's brown forest soil in Keszthely. Grains for analysis were removed by hand from 100 ears every 7 days on a total of 6 occasions after the grains had reached 70% moisture content. The dynamics with which various protein fractions accumulated, their proportions within the total protein content and the gliadin:glutenin ratio was similar in samples from plots given only basis fertiliser (80 kg N/ha) and in those topdressed in spring with 60 or 120 (in one or more doses) kg/ha N too. As in the classical fractionation, the results of gel electrophoresis also demonstrated only a proportional increase in quantity for all subunits as the result of differing N rates. The gliadin composition characteristic of the mature grain was reached at a grain moisture content of 56-59%, and the typical glutenin subunit composition at 46-47%. Compared with basic fertilisation in autumn, even a single dose of 120 kg/ha N in spring, which resulted in the highest grain protein content, did not increase the non-protein nitrogen content, which made up 29% of the total protein content at a grain moisture content of 70% and decreased to 5.5% by full maturity. Reserve proteins made up a decisive (75%) proportion of the increase in total N content caused by N fertilisation.

3449 Bezzola, L. (UCA, Buenos Aires (Argentina)); Barbaro, N.O.; Lopez, S. (CNEA, Buenos Aires (Argentina)) (1993) [Phosphoric fertilizers: response of a wheat yield and changes of soil phosphorus availability]. *Fertilización fosfatada: respuesta de un cultivo de trigo y variación del fósforo disponible en el suelo. Revista Ciencias Agrarias y Tecnología de los Alimentos (Argentina)* v. 11-12 p. 55-58. 2 tablas; 8 ref. Spanish. (AGRI 95-086713).

The effect of different phosphoric fertilizers on wheat yield was evaluated. Changes on soil phosphorous availability were determined in greenhouse conditions. Phosphorus uptake in field conditions and phosphorus remaining available after the harvest were related. Commercial diammonium phosphate and compost (Eisenia californiana compost) produced larger increases on yield and on phosphorus availability than triple superphosphate and rock phosphate (hyperphosphate).

3450 Claupein, W. (Goettingen Univ. (Germany). Inst. fuer Pflanzenbau und Pflanzenzüchtung); Baumer, K. (1992) [Short-term and long-term effects of reduced nitrogen fertilization in the arable cropping-system experiment Goettingen (Germany)]. *Kurzfristige und langfristige Auswirkungen reduzierter Stickstoffdüngung im Ackerbau-Systemversuch Goettingen. Symposium "Dauerfeldversuche und Naehrstoffdynamik"*; Bad Lauchstaedt (Germany); 9-12 Jun 1992. (Proceedings of the symposium "Continuous field experiments and nutrient dynamics"). *Umweltforschungszentrum Leipzig-Halle GmbH, Bad Lauchstaedt (Germany). Sektion Bodenforschung* p. 219-223. Druck-Strom GmbH. 4 ill., 1 table; 2 ref. German. (AGRI 95-075909).

3451 Conry, M.J. (1995) **EFFECT OF TIMING OF N APPLICATION ON THE GRAIN YIELD AND GRAIN QUALITY OF SPRING-SOWN MALTING BARLEY.** *Irish Journal of Agricultural & Food Research.* 34(1):25-31. English. [TEAGASC OAK PARK RES CTR CARLOW IRELAND].

Malting barley (cv. Blenheim) was sown on two dates (March and April) and given 100 kg N/ha in three different proportions, 100%, 67% and 33% at sowing time and the remainder as a top-dressing at an early tillering stage, growth stage (g.s.) 21-22, on three different soils over a 3-year period (1989-91). The early-sown barley (March) gave significantly greater grain yields in seven experiments, lower grain nitrogen in eight experiments and lower screenings in all nine experiments. Applying all the N at sowing consistently produced the best quality grain. The greater the proportion of N applied at sowing time the lower the grain nitrogen and the lower the screenings for both sowing dates. Timing of N application generally did not affect grain yield when the barley was sown in April but it gave variable results with the early-sown barley. Over the 3-year period timing of N application did not give a significant difference in mean yield for either of the sowing dates on the heavier textured soils. On the light

gravelly soil, applying all the N at sowing time significantly reduced yield on the March-sown crop in 1 of the 3 years.

3452 Djokic, D.; Kostic, M.A. (Institute for Small Grains, Kragujevac (Yugoslavia)) (1992) **Effect of mineral nutrition on physiological efficiency of wheat nitrogen.** *Journal of Scientific Agricultural Research (Yugoslavia)* v. 53(189-192) p. 13-21. 3 tables; 12 ref. English. (AGRI 95-075900).

The effect of fertilization on nitrogen physiological efficiency in wheat was investigated over a 10-year period in a stationary field experiment. The nitrogen efficiency decreased under influence of nitrogen nutrition, increased under influence of phosphorus nutrition, and potassium did not make any changes. The changes of nitrogen physiological efficiency caused by nitrogen nutrition were in negative and those caused by phosphorus nutrition in passive correlation with grain yield. The nitrogen physiological efficiency showed dependence on the amount of rainfall in May and June.

3453 Fayed, M.N. (Monoufeya Univ., Shebin El Kom (Egypt). Faculty of Agriculture) (1994) **The combined effect of some organic residues and N, P fertilization on wheat grown in recently reclaimed sandy soil.** *Zagazig Journal of Agricultural Research (Egypt)* v. 21(3B) p. 999-1013. 5 tables; 21 ref. English. (AGRI 95-086662).

3454 Genaidy, S. (Ministry of Agriculture, Sakha (Egypt). Soils and Water Research Inst.) (1994) **Evaluation of organic manure and phosphorus fertilization for wheat crop in salt-affected soils.** *Zagazig Journal of Agricultural Research (Egypt)* v. 21(2) p. 573-582. 4 tables; 14 ref. English. (AGRI 95-086723).

3455 Genaidy, S.; Abd El Maged, A.A.; Hegazy, M.H. (Ministry of Agriculture, Sakha (Egypt). Soils and Water Research Inst.) (1994) **Comparative study on some mineral fertilizers for two different crops [barley and cotton].** *Zagazig Journal of Agricultural Research (Egypt)* v. 21(2) p. 583-591. English. (AGRI 95-086671).

3456 Goswami, J.; Barrova, S.R.; Thakuria, K. (Assam Agricultural Univ., Jorhat 785013 (India). Agronomy Dept.) (1994) **Residual effects of P on wheat in a rice-wheat sequence.** *International Rice Research Notes (Philippines)* v. 19(3) p. 25. English. (AGRI 95-075966).

Residual effects of fertilizer P sources applied to rice on subsequent wheat growth were assessed. The soil was a loamy sand with pH 5.1, 0.59 percent organic C, 90.96 mg available N/kg (extracted in 0.32 percent KMnO₄), 3.39 mg available P/kg (Bray I), and 20.45 mg available K/kg (extracted in neutral IN NH₄OAc). P was applied to the rice as either single superphosphate (SSP) or diammonium phosphate (DAP) at transplanting, or mussoorie rock phosphate (MRP) or purulin rock phosphate (PRP) 15 d before transplanting at a rate of 13.1, 26.2, and 39.3 kg/ha; 175 kg P/ha was applied as SSP to the wheat at sowing. Both rice and wheat also received 40 kg N/ha and 16.6 K/ha. Treatments were replicated three times in a randomized block design. Rice variety Culture 1 and wheat variety Sonalika were used. Wheat was sown at 120 kg seed/ha at a planting depth of 5 cm in rows 20 cm apart. Significant differences were observed among both sources and levels of P in their residual effects on P uptake and to a lesser extent on grain yield. Differences among sources were greater than those among levels, with the rock phosphates having the greatest residual effect. In no case did the residual effects match the benefit of directly applying P to the wheat.

3457 Guiot, J.; Rouxhet, F.; Goffart, J.P.; Couvreur, L. (Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium). Station de Phytotechnique) (1994) **Evolution of the mineral nitrogen in the cultural profile in 1993-94 [in Belgium, arable soils]. Evolution de l'azote mineral dans le profil cultural en 1993-94. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993. Seutin, E.; Falisse, A. (eds) (Azote mineral) 10 p. 14 tables. French. (AGRI 95-076002).**

3458 Hanus, H. (Kiel Univ. (Germany). Inst. fuer Pflanzenbau und Pflanzenzüchtung); Finck, M. (1994) **[No slurry for winter wheat sown late in autumn]. Keine Herbstguelle zu spaetem Weizen. DLG-**

Mitteilungen (Germany) v. 109(10) p. 18-20. 1 ill., 3 tables. German. (AGRS 95-075896).

3459 He Yizhe; Li Zhang (Academia Sinica, Yangling, Shaanxi (China). Northwestern Inst. of Botany) (1994) Efficacy analysis of ammonium bicarbonate application with long-term effectiveness to wheat and maize. *Shaanxi Journal of Agricultural Sciences (China)* (no. 6) p. 23-24. 3 tables. Chinese. (AGRS 95-086718).

3460 Hebrard, J.P. (1995) [Jubil: a kit for monitoring nitrogen fertilization in soft wheat crops]. Fertilisation azotee: tout ce qu'il faut savoir sur Jubil. *Perspectives Agricoles (France)* (no 198) p. 88-93. French. (AGRS 95-075963).

3461 Hou Gaoli (Fufeng County Centre of Agricultural Technology, Shaanxi (China)) (1994) Effect of potash fertilizer application on wheat yield in high yield areas. *Shaanxi Journal of Agricultural Sciences (China)* (no. 4) p. 23. 1 table. Chinese. (AGRS 95-086717).

3462 Hua Tianmao; Li Changwei; Zhao Boshan (Northwestern Agricultural Univ., Yangling, Shaanxi (China). Dept. of Soil Science and Agrochemistry) (1994) Determining the application rate of phosphorus to wheat on cultivated loessal soil using fertilizer as a target. *Shaanxi Journal of Agricultural Sciences (China)* (no. 3) p. 1-3. 1 table; 4 ref. Chinese. (AGRS 95-086716).

3463 Ignacio, D.D. (Mariano Marcos State Univ., Batang, Ilocos Norte (Philippines)) (1992) Wheat R and D [research and development] at MMSU; study title: effect of different rates of NPK fertilizers on wheat in the Ilocos (Philippines). Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 29-31. 2 tables. Received Nov 1994. English. (AGRS 95-075897).

3464 Ignacio, D.D. (Mariano Marcos State Univ., Batang, Ilocos Norte (Philippines)) (1992) Wheat R and D [research and development] at MMSU; study title: response of wheat to different rates and schedule of nitrogen fertilizer application in the Ilocos (Philippines). Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 33. Received Nov 1994. English. (AGRS 95-075898).

3465 Ignacio, D.D. (Mariano Marcos State Univ., Batang, Ilocos Norte (Philippines)) (1992) Wheat R and D [research and development] at MMSU; study title: response of wheat to different NPK rates and schedule of N-fertilizer application in the Ilocos (Philippines). Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 33-37. 4 tables. Received Nov 1994. English. (AGRS 95-075899).

3466 Kaetterer, T. (1995) Nitrogen dynamics in soil and winter wheat subjected to daily fertilization and irrigation - measurements and simulations. Sveriges Lantbruksuniversitet, Uppsala (Sweden). *Rapport - Sveriges Lantbruksuniversitet, Institutionen for Ekologi och Miljovard* (Sweden); no. 81 32 p. Bibliography p.: 27-32. A dissertation bound with a collection of 4 reprints. SLU-EKOMIL-R-81-SE. English. (AGRS 95-086724).

3467 Kastori, R.; Petrovic, M.; Starcevic, Lj.; Kota, E. (Faculty of Agriculture, Novi Sad (Yugoslavia). Institute of Field and Vegetable

Crops) (1992) Effect of different nitrogen doses and harvest residues on amino acid content in wheat and maize grain. *Journal of Scientific Agricultural Research (Yugoslavia)* v. 53(189-192) p. 3-12. 5 tables; 17 ref. English. (AGRS 95-075923).

A stationary field trial was conducted on a calcareous chernozem soil for three years to investigate the effect of increasing nitrogen doses applied with and without incorporation of straw on the content of amino acids in wheat and maize grains. The application of nitrogen and incorporation of harvest residues (straw) increased the total content of essential and non-essential amino acids in wheat and maize grains. At that, the contents of different amino acids did not increase proportionally. The partial correlation coefficient showed that in the total effect of the treatment applied, the straw incorporation contributed with 1.74 to 5.76 percent and nitrogen application with 94.04 to 97.81 percent.

3468 Kelley, KW. (1995) RATE AND TIME OF NITROGEN APPLICATION FOR WHEAT FOLLOWING DIFFERENT CROPS. *Journal of Production Agriculture*. 8(3):339-345. English. [KANSAS STATE UNIV AGR & APPL SCI AGR RES CTR PARSONS, KS 67357 USA].

Winter wheat (*Triticum aestivum* L.) is often rotated with other crops in the eastern Great Plains to diversify cropping systems. Optimum management of N fertilizer is important for maximum profit potential and for avoiding environmental concerns. This study was conducted from 1986 through 1991 in southeastern Kansas to determine the influence of previous crop (grain sorghum [*Sorghum bicolor* (L.) Moench], soybean [*Glycine max* (L.) Merr.], and spring oat [*Avena sativa* L.]) on the N requirement for hard red winter wheat and to determine the optimum time of N application (fall, late winter, or fall + late winter and fall + late winter + early spring). Doublecrop soybean followed wheat in a 2-yr cropping rotation. Soil type was a Parsons silt loam soil (fine, mixed, thermic, Mollic Albaqualf) with 2.8% O.M. Influence of previous crop on wheat yield, grain protein, and plant N increased with time in the rotation sequence. Differences between previous crops were small after the first cropping cycle; however, after the third cycle, all values were significantly highest following spring oat and lowest following grain sorghum. Grain yield response to applied N was highest following grain sorghum, intermediate following soybean, and lowest following spring oat. Nitrogen response differences probably are due to a larger net mineralization of soil-N and crop residue N following spring oat than soybean or grain sorghum and to immobilization of applied N following grain sorghum. Number of heads per sq ft was highly correlated ($R^2 = 0.85$) with grain yield response. Split N (fall + late winter) and split-spring N (fall + late winter + early spring) applications generally showed no consistent yield advantage over single N treatments (fall preplant or late winter topdress). Grain protein, however, was often higher when N was delayed until late winter or early spring. Results indicate that fertilizer N requirements for hard winter wheat are likely to be low following another small grain crop, intermediate following soybean, and high following a high residue crop, such as grain sorghum. For the climatic and soil conditions in this study, applying N fertilizer at the proper rate was more important than timing of application. Applying up to 1/4 of the total N in early spring, however, could be beneficial for increasing grain protein content in hard winter wheat areas.

3469 Kumpawat, BS.; Rathore, SS. (1995) RESPONSE OF MAIZE (ZEA MAYS) WHEAT (TRITICUM AESTIVUM) CROPPING SEQUENCE TO FERTILIZER APPLICATION. *Indian Journal of Agronomy*. 40(1):26-29. English. [RAJASTHAN AGR UNIV AGR RES STN ARJA 311001 INDIA].

A field experiment was conducted during the rainy (Kharif) and winter (rabi) seasons 1989-90 and 1990-91 on sandy-loam soil to evaluate the effect of continuous maize (*Zea mays* L.)-wheat (*Triticum aestivum* L. emend. Fiori and Paol.) cropping system on yield stability. N 120 kg/ha and P₂O₅ 60 kg/ha to each crop was effective for cereal-cereal cropping sequence under semi-humid southern plains region of Rajasthan.

3470 Lezovic, P. (Halle Wittenberg Univ., Halle (Germany). Inst. fuer Biometrie); Koerschens, M. (1992) [Yield development in the static fertilization experiment Bad Lauchstaedt (Germany) in the course of 90 years]. Die Ertragsentwicklung im Statischen Duengungsversuch Bad Lauchstaedt im Verlaufe von 90 Jahren. Symposium "Dauerfeldversuche und Naehrstoffdynamik"; Bad Lauchstaedt (Germany); 9-12 Jun 1992.

(Proceedings of the symposium "Continuous field experiments and nutrient dynamics"). Umweltforschungszentrum Leipzig-Halle GmbH, Bad Lauchstaedt (Germany). Sektion Bodenforschung p. 224-230. Druck-Strom GmbH. 5 ill., 1 table. German. (AGRIS 95-075910).

3471 Loewy, T.; Ron, M.M. (1995) NITROGEN FERTILIZATION RECOMMENDATIONS FOR WHEAT IN SOUTHWESTERN BUENOS AIRES, ARGENTINA. *Communications in Soil Science & Plant Analysis*. 26(13-14):2041-2049. English. [EEA BORDENAVE INTA RA-8187 BORDENAVE ARGENTINA].

The objective of this research was to develop a general soil fertility model for nitrogen (N) in the south west of Buenos Aires Province (Argentina) which i) explained the regional variations in soil fertility and response of wheat (*Triticum aestivum* L.) to N fertilizer, and ii) predicted the most profitable N rates. Between 1980 and 1986, 28 fertilization experiments in wheat were established on N-deficient farmers' fields in the area. Dependent variables were Y (mean yield), AI (overall efficiency of fertilizer), and B2 (curvature adjustment). Independent variables included site, crop, and climate factors. For the two times of fertilization (sowing and tillering), Y was found to be strongly related to organic matter content (OM) for a given climatic year and AI was mainly determined by September rainfall (S). B2 depended on OM and was affected by the time of fertilization for the selection of other variables. A recommendation chart for farmers was derived for a relevant price ratio of 8. [References: 13].

3472 Mahapatra, B.S.; Sharma, G.L. (G.B. Pant Univ. of Agriculture and Technology, Pantnagar 263145, Nainital, Uttar Pradesh (India). Agronomy Dept.) (1994) Evaluating Sesbania and urea supergranules vs prilled urea in rice and their residual effect on the succeeding wheat crop. *International Rice Research Notes (Philippines)* v. 19(3) p. 21-22. 2 tables. English. (AGRIS 95-075956).

Integrated management of Sesbania GM + 29 kg N/ha as USG [urea supergranules] applied 2-5 wk after transplanting (WT) gave about the same yield as that of 120 kg N/ha applied as PU [prilled urea]. Yields obtained with 120 kg N/ha as PU and Sesbania + USG 2-5 WT were significantly more than those with 80 kg N/ha as PU. Yield obtained with Sesbania + USG at 1 WT was equal to that with 80 kg N/ha with panicle number and with soil ammonium N measured during 1988-89 and 1989-90 at different rice growth stages. N uptake by rice showed a trend similar to that of yield obtained. Integrated management of Sesbania + USG 1-5 WT in lowland rice resulted in a significant increase in residual wheat yields compared with the control and with PU applied to rice at 40, 80, or 120 kg N/ha. Increase in yield was greater in the second year and N uptake by the residual wheat crop was greater in the third year, and were significantly correlated with soil nitrate at wheat planting. Integrated GM + USG in rice-wheat rotation helped to maintain higher available soil N after 3 yr compared with the control and with PU application to the rice crop. Integrated N management with Sesbania GM and USG 2-4 WT can be used instead of PU at the recommended dose in a rice-wheat rotation where there is only time enough to grow a Sesbania crop for 50-60 d before transplanting rice. Using a renewable N source in lowland rice also benefits the succeeding wheat crop in a rice-wheat rotation, is equivalent to 20-30 kg N/ha, and will help to sustain soil N fertility.

3473 Metwally, I.O.E.; Gaber, E.M.A.; Abd El Aal, A.M. (Ministry of Agriculture, Cairo (Egypt). Field Crops Research Inst.) (1994) Effect of maize and rice as preceding summer crops on growth and yield of two wheat cultivars under nitrogen fertilizer levels. *Journal of Agricultural Sciences, Mansoura Univ. (Egypt)* v. 19(2) p. 473-482. 7 tables; 10 ref. English. (AGRIS 95-086710).

3474 Miguel, V. (Agricultural Pilot Center, Iguig, Cagayan (Philippines)) (1992) Wheat R and D [research and development] at APC, DA [Department of Agriculture - Region 2, Cagayan Valley, Philippines]. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop*. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia p. 47-62. 3 tables. Received Nov 1994. English. (AGRIS 95-075960).

3475 Milosev, D.; Molnar, I.; Bicanin, V.; Govedarica, M.; Jarak, M. (Faculty of Agriculture, Novi Sad (Yugoslavia). Institute of Field and Vegetable Crops) (1993) [Wheat yield depending on saturation mud and nitrogen application]. *Zastita bilja (Yugoslavia)* v. 42(2) p. 149-157. 8 tables; 7 ref. English. (AGRIS 95-075901).

The adsorptive complex of many local soil types is saturated with hydrogen ions. Because of their acid reaction, hydrogen ions are destructive for these soils. To be improved these soils should be calcified using saturation mud from sugarbeet refineries. This would solve two problems in one swath: refineries would be relieved of useless by-products and soil quality would be improved. The objective of this investigation, carried out in Mitscherlich pots, was to examine the effect of saturation mud and nitrogen added to the heavy limeless soil on the yield and yield components of winter wheat in order to determine their optimum doses for maximum yield.

3476 Mouchova, H. (Research Inst. of Crop Production, Praha (Czech Republic)); Lippold, H. (1994) [Environmental balance of (15)N-labelled fertilizer nitrogen applied to winter wheat in spring]. *Umweltbilanz von (15)N-markiertem Mineralduengerstickstoff, angewendet zu Winterweizen im Fruhjahr*. *Archives of agronomy and soil science (Germany)* v. 38(2) p. 83-88. 1 ill., 3 tables; 6 ref. English. (AGRIS 95-075895).

3477 Nemeth, I. (Pannon Agrarwissenschaftliche Univ., Keszthely (Hungary)); Bory, E. (1992) [The humus content of soil and the dry matter production of plants in dependence on farmyard fertilization researched in continuous experiments]. *Der Humusgehalt des Bodens und die Trockensubstanzproduktion der Pflanzen in Abhaengigkeit von der Stallmistduengung in Dauerversuchen*. Symposium "Dauerfeldversuche und Naehrstoffdynamik"; Bad Lauchstaedt (Germany); 9-12 Jun 1992. (Proceedings of the symposium "Continuous field experiments and nutrient dynamics"). Umweltforschungszentrum Leipzig-Halle GmbH, Bad Lauchstaedt (Germany). Sektion Bodenforschung p. 198-201. Druck-Strom GmbH. 2 ill., 1 table. German. (AGRIS 95-075836).

3478 Panse, A.; Maidl, F.X.; Dennert, J.; Muller, R.; Fischbeck, G. (1995) EFFECT OF COMBINED SLURRY AND MINERAL FERTILIZATION ON YIELD FORMATION, YIELD COMPONENTS AND NITROGEN EFFICIENCY OF WINTER WHEAT. *Zeitschrift fur Pflanzenernahrung und Bodenkunde*. 158(3):221-229. German. [TECH UNIV MUNICH LEHRSTUHL PFLANZENBAU & PFLANZENZUCHTUNG D-85350 FREISING GERMANY].

From 1984/85 to 1987/88 field trials were conducted on the experimental farm Roggenstein in order to examine the efficiency of pig slurry applied at different developmental stages of winter wheat combined with different dosage and distributions of mineral N-fertilizer. On the average over 4 years maximum grain yield by applying exclusively mineral N-fertilizer has been achieved with 120 kg N/ha, with the optimal amount of N-fertilizer at the 3 developmental stages being 40 kg N/ha, respectively. Decreased yields induced by a reduced mineral N-fertilization could be compensated by application of 20 m(3)/ha or 40 m(3)/ha slurry either at the beginning of the growing period. EC 30-31 or EC 33-35 developmental stages. However, mineral fertilizer equivalents calculated on the basis of the NH₄-N-content of slurries for each year ranged from 25 to 79 in dependence of application date and prevailing, weather conditions. Regarding the effect on yield components, no difference between slurry and mineral N-fertilizer were observed. The mediocre and very variable efficiency of slurry-N leads to the conclusion, that the use of slurry in cereal production may be of limited value for agronomic as well as for ecological reasons, as long as no efficient and cost-effective application techniques are available. [References: 17].

3479 Petersen, J. (1995) [Pig slurry and commercial fertilizers for spring barley]. *Svinegylle og handelsgoedning til vaarbyg*. Statens Planteavlfsforsoeg, Lyngby (Denmark). *Groen Viden (Denmark)*; no. 151 6 p. SP. 3 ill., 4 tables. Danish. (AGRIS 95-086669).

3480 Rathore, A.L.; Chipde, S.J.; Pal, A.R. (1995) DIRECT AND RESIDUAL EFFECTS OF BIO-ORGANIC AND INORGANIC FERTILIZERS IN RICE (ORYZA SATIVA) WHEAT (TRITICUM

AESTIVUM) CROPPING SYSTEM. *Indian Journal of Agronomy*. 40(1):14-19. English. [INDIRA GANDHI KRISHI VISHWA VIDYALAYA BILASPUR 495001 MADHYA PRADESH INDIA].

A field experiment was carried out for 2 years to find out the optimum combination of chemical fertilizers with blue-green algae and farmyard manure in rice (*Oryza sativa* L.)-wheat (*Triticum aestivum* L. emend. Fiori and Paol.) cropping system. Rice-grain yield was statistically similar under treatments of blue green algae 10 kg culture/ha and farmyard manure 5 tonnes/ha, but was significantly higher (16-17%) than the unfertilized control. Organic manure and blue green algae combined with 60 kg N + 37.5 kg P₂O₅ + 22.5 kg K₂O/ha as inorganic fertilizers proved superior to other treatments and showed significantly higher yield and crop nutrient uptake than other treatments. The residual effect of blue green algae and organic manure with inorganic fertilizer was significant on grain yield of wheat and on N, P and K uptake by the crop. Residual fertility in terms of organic carbon and available P increased under blue green algae and farmyard manure with and without inorganic fertilizers, whereas these sources had no impact on build-up of N and K in the soil.

3481 Robert, D. (Institut Technique des Cereales et des Fourrages, Paris (France)); Masse, J.; Poitrat, E.; Theobald, O. (1995) [Nitrogen fertilization in wheat crops for biofuel production]. Production de ble pour le bioethanol. Il convient de bien maitriser le facteur azote. *Perspectives Agricoles (France) (no 198) p. 83-87*. French. (AGRIS 95-075903).

3482 Russow, R. (Umweltforschungszentrum Leipzig Halle GmbH, Bad Lauchstaedt (Germany). Sektion Bodenforschung); Faust, H.; Knappe, S.; Foerstel, H. (1992) [(15)N tracer research on N uptake and N metabolism by winter barley (*Hordeum vulgare*) under conditions of foliar fertilization with ammonium nitrate urea solution]. (15)N-Tracer-Untersuchungen zur N-Aufnahme und zum N-Metabolismus bei der Blattapplikation von Ammonitrat-Harnstoff-Loesung (AHL) bei Wintergerste (*Hordeum vulgare*). Symposium "Dauerfeldversuche und Naehrstoffdynamik"; Bad Lauchstaedt (Germany); 9-12 Jun 1992. (Proceedings of the symposium "Continuous field experiments and nutrient dynamics"). Umweltforschungszentrum Leipzig-Halle GmbH, Bad Lauchstaedt (Germany). Sektion Bodenforschung p. 246-253. Druck-Strom GmbH. 5 ill., 2 tables; 6 ref. German. (AGRIS 95-075912).

3483 Shangguan Zhouping; Chen Peiyuan; Li Ying (Academia Sinica, Yangling, Shaanxi (China). Northwestern Inst. of Soil and Water Conservation) (1994) Analysis of effects of nitrogen and soil moisture before planting on grain filling in wheat. *Acta Botanica Boreali-Occidentalia Sinica (China) v. 14(2) p. 107-116*. 6 tables; 8 ill., 7 ref. Chinese. (AGRIS 95-086719).

3484 Sharma, CM.; Kaul, S.; Bhardwaj, SK. (1995) AGRONOMIC EFFECTIVENESS OF UDAIPUR ROCK PHOSPHATE AS INFLUENCED BY ORGANICS IN WHEAT (*TRITICUM AESTIVUM*) MAIZE (*ZEA MAYS*) CROPPING-SEQUENCE. *Indian Journal of Agronomy*. 40(1):93-95. English. [HIMACHAL PRADESH AGR UNIV DEPT SOIL SCI PALAMPUR 176062 HIMACHAL PRADESH INDIA].

3485 Sharma, KN.; Singh, H.; Vig, AC. (1995) INFLUENCE OF CONTINUOUS CROPPING AND FERTILIZATION ON ADSORPTION AND DESORPTION OF SOIL PHOSPHORUS. *Fertilizer Research*. 40(2):121-128. English. [PUNJAB AGR UNIV DEPT SOILS LUDHIANA 141004 PUNJAB INDIA].

Surface soil samples (0-15 cm) from six differentially fertilized plots (N0P0K0, N120P0K0, N120P17.5K0, N120P35K0, N120P17.5K33.2 and N120P35K33.2) of a long-term experiment on maize-wheat annual sequence at Ludhiana (India) were collected after 11 years of continuous cropping and fertilization, to study soil phosphorus (P) adsorption-desorption. These soils differed widely with respect to their P adsorption and desorption properties. Phosphate adsorption increased with increasing levels of added P in all soils. The extent of P adsorption was comparatively lower in the plots receiving P. Phosphorus adsorption data was found to fit best both to Langmuir and Freundlich isotherms for each of the six soil samples. Soil P adsorption maxima obtained from Langmuir isotherm varied from 123 to 498 $\mu\text{g g}^{-1}$ soil in the six differentially fertilized plots. The bonding energy values obtained from Langmuir isotherm plot

were the lowest in control and N120P0K0 treatments whereas these values tended to increase with P addition. Freundlich constants 'a' and 'n' (extent and rate of adsorption) calculated from the regression lines also showed similar trend for the six soil samples. The plot of desorbed P versus desorbed P/adsorbed P was linearly correlated for each of the six soil samples. Computation of desorbable P capacity (or desorption maxima, D-m) and desorption rate constant (K-d) from this relationship indicated higher D-m values in soil samples collected from check (N0P0K0) and N fertilized (N120P0K0) plots. This value tended to decrease in plots which received P during cropping. The K-d values were more in soil samples which were fertilized with P during cropping and lower in check and N120P0K0 treated plots.

3486 Shehab El Din, T.M. (King Saud Univ., Al Qassim Branch (Saudi Arabia). College of Agriculture and Veterinary Medicine) (1993) Effects of twenty nitrogen fertilization levels on spring wheat, *T. aestivum* L., em. Thell. in sandy soil. *Journal of Agricultural Sciences, Mansoura (Egypt) v. 18(8) p.2241-2245*. 2 tables; 13 ref. English. (AGRIS 95-086721).

3487 Singh, T.; Singh, KN.; Bali, AS.; Bhatt, GN. (1995) RESPONSE OF WHEAT (*TRITICUM AESTIVUM*) GENOTYPES TO NITROGEN AND PHOSPHORUS. *Indian Journal of Agronomy*. 40(1):99-101. English. [SHER & KASHMIR UNIV AGR SCI & TECHNOL SHALIMUR 191121 JAMMU & KASHMIR INDIA].

3488 Sitohy, M.Z.; Al Gaby, A.M.; El Attar, W.M.; Abd El Magid, A.A. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1992) Changes in pigments and carbohydrate contents of wheat plants in response to single or combined foliar spray of kinetin, magnesium and molybdenum. *Zagazig Journal of Agricultural Research (Egypt) v. 19(5A) p. 2101-2116*. 7 ill. 2 tables; 18 ref. English. (AGRIS 95-086722).

3489 Swarup, A.; Singh, K.N. (Central Soil Salinity Research Inst., Karnal 132001 (India)) (1994) Effects of gypsum, farmyard manure, and N on ameliorating highly sodic soil and on yields of rice and wheat. *International Rice Research Notes (Philippines) v. 19(3) p. 22-23*. 1 graph; 1 table. English. (AGRIS 95-075955).

Results showed that gypsum and FYM (farmyard manure) improved significantly the grain yield of rice and wheat and substantially decreased pH and ESP [exchangeable sodium percentage] of the soil profile compared with the control. When gypsum dose was reduced from 50 to 25 percent of GR [gypsum requirement], with or without FYM, there was not significant decrease in the yield of either crop except rice during 1989. Gypsum 25 percent GR + FYM was significantly better than gypsum 50 percent GR and at par with gypsum 50 percent GR + FYM in decreasing soil pH and ESP and improving crop yields. Increasing N dose from 100 to 150 kg/ha significantly improved the yield of both crops. Interaction between N and other treatments, however, was not significant. Based on pooled analysis of the data, it is suggested that gypsum 25 percent GR with FYM 20 t/ha could be recommended to successfully ameliorate sodic soils and to maximize rice and wheat production.

3490 Thakur, RC.; Bindra, AD.; Sood, RD.; Bhargava, M. (1995) EFFECT OF FERTILIZER APPLICATION AND GREEN-MANURING ON PHYSICO-CHEMICAL PROPERTIES OF SOIL AND GRAIN YIELD IN RICE (*ORYZA SATIVA*) WHEAT (*TRITICUM AESTIVUM*) CROP SEQUENCE. *Indian Journal of Agronomy*. 40(1):4-13. English. [HIMACHAL PRADESH AGR UNIV DEPT AGRON PALAMPUR 176062 HIMACHAL PRADESH INDIA].

A field experiment was carried out during 1989-90, 1990-91 and 1991-92 to evaluate the effectiveness of prickly sesban or dhaincha [*Sesbania cannabina* (Retz.) Pers.] and Frenchbean (*Phaseolus vulgaris* L.) green-manures grown in rice (*Oryza sativa* L.)-wheat (*Triticum aestivum* L. emend. Fiori and Paol.) crop sequence under irrigated conditions. Direct, and carry-over effects on crop yield, rice-blast incidence, physical and chemical properties of soil were also studied under double-cropping system. Seed and straw yields of rice increased significantly due to green-manuring, and prickly sesban proved better green-manure crop. Fertilizer dose to rice could be saved up to 50% of the recommended dose. Neck-blast incidence increased with increasing fertilizer dose to rice in the presence of higher green-matter addition. No residual effect on wheat yield

could be obtained. Bulk density after rainy season (kharif), i.e. rice harvest, was more whereas cumulative infiltration, available N, P and K were low compared with that after winter season (rabi) (wheat harvest), but the relative values due to green-manuring with dhaincha were higher than those under green-manuring with Frenchbean. However, the treatment differences were not significant after the wheat harvest.

3491 Tindall, T.A.; Stark, J.C.; Brown, B.D. (1993) **Nutrient management.** *Bulletin - Idaho Agricultural Experiment Station (USA)* (no. 742) p. 21-23. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRIS 95-086673).

3492 Vach, M.; Vrkoc, F. (1995) **ANALYSIS OF THE EFFECT OF DIFFERENT FORECROPS, INCREASED N-FERTILIZATION, WEATHER IN THE YEARS AND SITES ON WINTER WHEAT YIELDS.** *Rostlinna Vyroba.* 41(6):263-267. Czech. [RES INST CROP PROD DRNOVSKA 507 CR-16106 PRAGUE 6 CZECH REPUBLIC].

The results of two series of polyfactorial field trials in Praha-Ruzyně: (soil type: luvisol) and in Lukavec u Pacova (soil type: dystric cambisol) obtained in the years 1985 to 1991 were evaluated from the point of view of the effects of sites, weather conditions in the years, different forecrops and three levels of N-fertilization (including mutual interactions of these factors) on the winter wheat yields. The yield variability was affected by studied factors in this order: weather conditions, forecrops, sites, N-fertilization. Significant effect of convenient forecrop was not compensated by high doses of N-fertilization to unsuitable forecrop oats. In the mean of experimental years the yields of winter wheat grain without N-fertilization after leguminous fodder lay, clover and peas on luvisol were higher by 0.08 to 1.20 t.ha⁻¹, on cambisol by as much as 0.72 t.ha⁻¹ in comparison with oats as forecrop with the application of 100 kg N.ha⁻¹. Highest increments of winter wheat grain yields obtained by 1 kg N in mineral fertilizers were gained on less fertile cambisol in Lukavec u Pacova after the forecrop oats (+13, 9 kg). As the result of more suitable moisture conditions and high efficiency of N-fertilization on this site, the significance of lower grain yields in comparison with more fertile luvisol in Praha-Ruzyně: was not confirmed. On the basis of regression analysis and model economic calculations the most effective doses of N for winter wheat following different forecrops were determined.

3493 Wang Chengshe; Wang Yaru; Liu Shengfang (Shaanxi Provincial Inst. of Grain Crops, Yangling (China)) (1994) **Analysis on the effect of a compound fertilizer "Fei Bao" on seed germination of wheat.** *Shaanxi Journal of Agricultural Sciences (China)* (no. 1) p. 28-29. 3 tables. Chinese. (AGRIS 95-086715).

3494 Wang, X.B.; Xin, J.F.; Grant, C.A.; Bailey, L.D. (1995) **EFFECTS OF PLACEMENT OF UREA WITH A UREASE INHIBITOR ON SEEDLING EMERGENCE, N UPTAKE AND DRY MATTER YIELD OF WHEAT.** *Canadian Journal of Plant Science.* 75(2):449-452. English. [CHINESE ACAD AGR SCI INST SOILS & FERTILIZERS BEIJING PEOPLES REPUBLIC OF CHINA].

Growth chamber studies were conducted to determine the effect of seed-placed and surface dribble-banded urea fertilizer, with and without the addition of two levels of the urease inhibitor N-(n-butyl) thiophosphoric triamide (nBTPT) on seedling emergence, vegetative yield and nitrogen accumulation of hard red spring wheat. Seedling emergence was reduced with increasing applications of seed-placed urea, but nBTPT reduced the damage from seed-placed urea. The 0.15% inhibitor level was as effective as the 0.25% level in reducing seedling damage. Vegetative yield increased with application of urea fertilizer but no difference in vegetative yield resulted from varying fertilizer placement or additions of nBTPT. Nitrogen accumulation increased with increasing N application and with the use of the urease inhibitor, indicating an increase in N availability due to slowing of urea hydrolysis. Use of the urease inhibitor nBTPT shows promise in reducing seedling damage from seed-placed urea fertilizer and increasing the utilization of seed-placed and surface-applied urea fertilizer on a black Chernozemic soil. Further studies are in progress to assess the performance of nBTPT under field conditions. [References: 10].

F06 IRRIGATION

3495 Aragues, R. (Consejo Superior de Investigaciones Científicas, Zaragoza (España). Servicio Investigación Agraria, Laboratorio de Agronomía y Medio Ambiente, Unidad Suelos y Riegos); Royo, A.; Grattan, S.R. (1994) **[Foliar uptake of sodium and chloride in barley sprinkler-irrigated with saline water: effect of pre-irrigation with fresh water]. [Absorption foliaire de sodium et de chlorure par de l'orge irriguée par aspersion avec de l'eau saline: effet d'une pré-irrigation à l'eau douce].** *European Journal of Agronomy (France)* v. 3(1) p. 9-16. 14 ref., 6 graph. English. (AGRIS 95-086888).

3496 Stark, J.C. (1993) **Irrigation.** *Bulletin - Idaho Agricultural Experiment Station (USA)* (no. 742) p. 18-20. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRIS 95-086889).

F07 SOIL CULTIVATION

3497 [Winter barley (in Belgium)]. Escourgeon et orge d'hiver (1994) Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium); Faculté des Sciences Agronomiques de Gembloux (Belgium). [Cereal crops manure and protection. Conclusions of the research performed in 1993 (in Belgium)]. *Fumure et protection phytosanitaire des céréales. Conclusions des recherches effectuées en 1993.* Seutin, E.; Falisse, A. (eds) (Escourgeon) 26 p. 14 tables. French. (AGRIS 95-076173).

3498 [Winter wheat (in Belgium)]. Froment d'hiver (1994) Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium); Faculté des Sciences Agronomiques de Gembloux (Belgium). [Cereal crops manure and protection. Conclusions of the research performed in 1993 (in Belgium)]. *Fumure et protection phytosanitaire des céréales. Conclusions des recherches effectuées en 1993.* Seutin, E.; Falisse, A. (eds) (Froment) 47 p. 24 tables. French. (AGRIS 95-076170).

3499 Amato, M.; Pardo, A.; Landi, G. (Basilicata Univ., Potenza (Italy)) (1994) **[Effects of tillage methods of a sloping soil on root growth of horsebean (Vicia faba minor, Beck) and wheat (Triticum durum, Desf.) in rotation]. Effetti delle modalità di lavorazione di un terreno declive sull'accrescimento radicale del favino (Vicia faba minor Beck) e del frumento (Triticum durum Desf.) in rotazione.** Società Italiana di Agronomia. 28. Annual meeting on agronomic aspects of soil conservation on slopes and the safeguard of the environment; Potenza (Italy); 6-9 Jul 1993. *Rivista di Agronomia (Italy)* v. 28(4) p. 407-412. 2 tables; 6 graphs; 5 ref. Italian. (AGRIS 95-086949).

Data are reported on root length density (RLD), and shoot to root ratio in weight (A/R) and surface area (LAI/RAI) measured in 1990-92 on horsebean and wheat in rotation, with four tillage methods: harrowing at 20 cm (E), ploughing at 40 cm + harrowing (A+E), scarifying at 50 cm + ploughing at 20 cm + harrowing (D+A+E), scarifying at 50 cm + harrowing (D+E). With the exception of horsebean in the first year, ploughed plots showed a lower RLD and a higher A/R and LAI/RAI. Maximum RLD values were found at flowering for wheat, and at pod filling for horsebean, and decreased at harvest, especially at the soil surface.

3500 Craig, J.P.; Weil, R.R. (Department of Agronomy, University of Maryland, College Park, MD 20742 (USA)) (1993) **Nitrate leaching to a shallow mid-Atlantic coastal plain aquifer as influenced by conventional no-till and low-input sustainable grain production systems.** *Water Science and Technology (United Kingdom)* v. 28(3-5) p. 691-700. 23 ref. English. (AGRIS 95-086934).

3501 Donald, W.W. (1995) **WHEAT YIELD AND WEED POPULATION AS INFLUENCED BY THREE TILLAGE SYSTEMS ON A CLAY SOIL IN A TEMPERATE CONTINENTAL CLIMATE - COMMENTS.** *Soil & Tillage Research.* 34(2):141-142. English. [USDA ARS CROPPING SYST & WATER QUAL RES UNIT WASHINGTON, DC 20250 USA].

3502 El Banna, E.B.; El Saadany, M.A. (Mansoura Univ. (Egypt). Faculty of Agriculture); Abd El Rahman, M.M. (1994) Precision of land levelling affecting water amount and efficiency of water use for wheat and maize crops. *Journal of Agricultural Science, Mansoura Univ. (Egypt)* v. 19(7) p. 2345-2360. 4 ill. 3 tables; 25 ref. English. (AGRIS 95-086935).

3503 Falco, E. de; Franchi, A.S. de; Basso, F. (Basilicata Univ., Potenza (Italy)); Postiglione, L. (Naples Univ., Portici (Italy). Dipartimento Scienze Agronomiche e Genetica Vegetale) (1994) [Soil erosion and runoff quality in a sloping soil under different tillage methods and wheat (*Triticum durum* Desf.) horsebean (*Vicia faba* Minor Beck) rotation [Basilicata]]. Effetti delle modalita' di lavorazione di un terreno declive a rotazione favino (*Vicia faba* minor Beck) frumento (*Triticum durum* Desf.) sull'erosione e sulla qualita' dei deflussi [Basilicata]. Societa Italiana di Agronomia. 28. Annual meeting on agronomic aspects of soil conservation on slopes and the safeguard of the environment; Potenza (Italy); 6-9 Jul 1993. *Rivista di Agronomia (Italy)* v. 28(4) p. 348-355. 7 tables; 4 graphs; 18 ref. Italian. (AGRIS 95-086948).

3504 Montfort, B.; Falisse, A. (1994) [The brewery barley [in Belgium]]. Les orges brassicoles. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993. Seutin, E.; Falisse, A. (eds) (*Orge brassicole*) 6 p. 3 tables. French. (AGRIS 95-076174).

3505 Quaglietta Chiaranda, F.; Falco, E. de; Graziano, F.S. (Basilicata Univ., Potenza (Italy)) (1994) [Effects of tillage of a sloping soil on growth and yield of horsebean (*Vicia faba* Minor, beck) and wheat (*Triticum durum*, Desf.) in rotation]. Effetto delle modalita' di lavorazione di un terreno declive sull'accrescimento e sulla produzione di favino (*Vicia faba* minor Beck) e di frumento (*Triticum durum* Desf.) in rotazione. Societa Italiana di Agronomia. 28. Annual meeting on agronomic aspects of soil conservation on slopes and the safeguard of the environment; Potenza (Italy); 6-9 Jul 1993. *Rivista di Agronomia (Italy)* v. 28(4) p. 438-447. 4 tables; 7 graphs; 10 ref. Italian. (AGRIS 95-086950).

3506 Roisin, C. (Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium). Station de Phytotechnie); Falisse, A.; Poelaert, J.; Monfort, B.; Bodson, B. (1994) [Some recent developments of soil preparation in cereal crops]. Quelques developpements recents du travail du sol en cereales. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993. Seutin, E.; Falisse, A. (eds) (*Travail du sol*) 11 p. 7 tables. French. (AGRIS 95-076169).

3507 Sharma, VK.; Acharya, CL.; Kapur, OC. (1995) UTILIZATION OF RESIDUAL MOISTURE AFTER MAIZE (ZEA MAYS) HARVEST IN MAIZE-WHEAT (TRITICUM AESTIVUM) SEQUENCE IN MID-HILLS OF NORTH INDIA. *Indian Journal of Agricultural Sciences*. 65(6):425-427. English. [HIMACHAL PRADESH KRISHI VISHVAVIDYALAYA DEPT AGRON PALAMPUR 176062 HIMACHAL PRADESH INDIA].

3508 Trochard, R. (Institut Technique des Cereales et des Fourrages, Paris (France)); Lajoux, P. (1994) [Crops behaviour under minimum tillage conditions]. Les cultures qui acceptent les techniques simplifiees. *Perspectives Agricoles (France)* (no 194) p. 12-15. French. (AGRIS 95-076188).

F08 CROPPING PATTERNS AND SYSTEMS

3509 Arshad, MA.; Gill, KS.; Coy, GR. (1995) WHEAT YIELD AND WEED POPULATION AS INFLUENCED BY THREE TILLAGE SYSTEMS ON A CLAY SOIL IN A TEMPERATE CONTINENTAL CLIMATE - REPLY. *Soil & Tillage Research*. 34(2):142-143. English. [AGR & AGRI FOOD CANADA NO AGR RES CTR BEAVERLODGE AB CANADA].

3510 Asakawa, S.; Hayano, K. (1995) POPULATIONS OF METHANOGENIC BACTERIA IN PADDY FIELD SOIL UNDER DOUBLE CROPPING CONDITIONS (RICE-WHEAT). *Biology & Fertility of Soils*. 20(2):113-117. English. [KYUSHU NATL AGR EXPT STN SOIL MICROBIOL LAB KUMAMOTO 86111 JAPAN].

The methanogenic populations able to use H₂-CO₂, methanol, and acetate were investigated in paddy dy field soil in situ under double cropping conditions [rice (*Oryza sativa* L.) as a summer crop under flooded conditions and wheat (*Triticum aestivum* L.) as an upland winter crop] over 2 years approximately bimonthly by the most probable number method. Three fields, one without fertilizer, one treated with inorganic fertilizer (mixed fertilizer including urea, ammonium phosphate, and potassium sulfate), and one treated with wheat straw plus inorganic fertilizer, were examined. The population of H₂-CO₂, methanol, and acetate utilizers in the paddy field soil at a depth of 1-6 cm was 10(3)-10(4), 10(4)-10(5), and 10(4)-10(5) g(-1) dry soil, respectively. These values were almost constant during the 2 years irrespective of moisture regime (flooded or nonflooded), crop (rice or wheat), fertilizer treatment, and soil depth (0-1, 1-10, and 10-20 cm). [References: 22].

3511 Bonafaccia, G.; Caproni, E. (Istituto Nazionale della Nutrizione, Rome (Italy)); Olimpieri, G. (Consiglio Nazionale delle Ricerche, Porano, Terni (Italy). Istituto per l'Agricoltura) (1994) [Biological and traditional agriculture. The possible influences of nitrogen and phosphorus fertilization on certain constituents and on the technology properties of wheat]. Agricoltura biologica e tradizionale. Possibile influenza della concimazione con azoto e fosforo su alcuni costituenti e sulle proprieta' tecnologiche del frumento. *Rivista di Scienza dell'Alimentazione (Italy)* v. 23(4) p. 461-465. 4 tables; 1 graph. Italian. (AGRIS 95-087018).

In this experiment, wheat was grown with increasing amounts of nitrogen and phosphorus fertilization to see whether the various final products presented qualitative or functional differences or not. The analyses showed that the protein component increased as increasing amounts of nitrogen were given, whereas no variations were found in all the other indexes taken into consideration. Therefore, as regards the rheological properties, no differences were found between wheat cultivated with or without chemical fertilizers. The soil type used for cultivation is of particular importance.

3512 Canteromartinez, C.; Oleary, GJ.; Connor, DJ. (1995) STUBBLE RETENTION AND NITROGEN FERTILISATION IN A FALLOW-WHEAT RAINFED CROPPING SYSTEM. 1. SOIL WATER AND NITROGEN CONSERVATION, CROP GROWTH AND YIELD. *Soil & Tillage Research*. 34(2):79-94. English. [UNIV MELBOURNE CTR CROP IMPROVEMENT DEPT AGR PARKVILLE VIC 3052 AUSTRALIA].

In semi-arid environments where water supply is the factor usually limiting grain yield, fallowing provides a way to increase water and nitrogen supply. An experiment was maintained from 1980 to 1990 at the Wimmera Research Station, Dooen, Australia. In each year, water use, growth and yield of wheat (*Triticum aestivum* L.) were measured following three tillage methods of year-long fallow. The three methods were: chemical (no tillage), blade plough (sub-surface tillage) and a fully tilled fallow following burning of stubble residues (conventional method). From 1984, the comparison was extended to include two levels of applied nitrogen (zero and from 20 to 60 kg N ha(-1)). Over the decade of the experiment, annual rainfall varied from 190 to 586 mm and yield from 1.03 to 5.72 Mg ha(-1). There were small but significant differences in water conservation and resultant wheat yield by the three fallow methods. The differences were not consistent from year to year but a pattern was evident. In years of low yield (less than 3.7 t ha(-1), 5 years in ten), chemical fallow had a yield advantage over both tillage methods, fully tilled fallow (up to 0.8 Mg ha(-1)) and blade plough (up to 0.6 Mg ha(-1)). In seasons with yield greater than 3.7 Mg ha(-1) (4 years in ten), yield following the fully tilled fallow exceeded that of the other methods (up to 0.75 Mg ha(-1)). In the driest year (1982), there was no difference between methods. During the 7 year sequence when nitrogen was applied, yield of the unfertilised treatments exceeded 3.5 Mg ha(-1) in 5 years. Under those conditions, the addition of nitrogen increased yield by a maximum of 0.6 Mg ha(-1). The advantage of chemical fallow in years of low rainfall and yield potential was shown to result from greater water conservation (average of 53 mm year(-1)). It is proposed that the advantage of the fully tilled fallow in years of greater yield potential can be attributed to better N supply. [References: 27].

3513 Carr, PM.; Gardner, JC.; Schatz, BG.; Zwinger, SW.; Guldán, SJ. (1995) **GRAIN YIELD AND WEED BIOMASS OF A WHEAT-LENTIL INTERCROP.** *Agronomy Journal*. 87(3):574-579. English. [N DAKOTA STATE UNIV DICKINSON RES EXT CTR 470 STATE AVE SUITE 101 DICKINSON, ND 58601 USA].

Intercropping cereal with pulse crops often increases total grain production in subtropical regions. Our objective was to determine if a yield advantage resulted when lentil (*Lens culinaris* Medik.) was intercropped with wheat (*Triticum aestivum* L. emend. Thell.) in a cool semiarid region. A held experiment was conducted during 1989, 1990 and 1991 under dryland management in south central North Dakota. Lentil and hard red spring wheat were each sown alone and intercropped in different planting patterns and populations. Plants were hand clipped at the soil surface and threshed to provide grain yield estimates in an 3 yr. In 1991, grain was also harvested with a research combine to assess if intercrops could be harvested mechanically. Grain yield of wheat was unaffected by intercropping ($P < 0.05$). Intercropping reduced grain yield of lentil by 87 to 95% when yield estimates were based on samples harvested manually, and by 70 to 85% when samples were harvested mechanically. The increased height at which pods formed on intercropped compared with sole-cropped lentil plants and subsequent enhancement in mechanical harvestability of grain in intercrops partially explains this difference in yield estimates between harvesting methods. The land equivalent ratio was 1.15 for grain yield across intercrop treatments with mechanical harvest, and 1.03 for the intercrop treatments when grain was harvested manually. While harvestability of the short-statured lentil was enhanced in this investigation by intercropping, the low lentil yield under intercropping suggests that wheat-lentil mixtures are probably not adapted to cool semiarid regions. [References: 20].

3514 Hershman, DE.; Bachi, PR. (1995) **EFFECT OF WHEAT RESIDUE AND TILLAGE ON HETERODERA GLYCINES AND YIELD OF DOUBLECROP SOYBEAN IN KENTUCKY.** *Plant Disease*. 79(6):631-633. English. [UNIV KENTUCKY DEPT PLANT PATHOL PRINCETON, KY 42445 USA].

A study (1990 to 1992) was conducted in western Kentucky to determine the effects of wheat (*Triticum aestivum* 'Clark') residue and minimal- (two disking) or no-tillage on soybean cyst nematode (*Heterodera glycines*) cyst and egg population densities and yield of the H. glycines-susceptible soybean (*Glycine max*) cultivar Pennyrite. In each year, cyst densities at soybean planting were unaffected by the presence of residue from a prior winter wheat crop; however, harvest population densities were lower in plots with wheat residue compared with those without residue. Across residue treatments, tillage had no effect on harvest densities of cysts in any year. Differences in egg densities, determined only in 1992, were similar to differences detected in cyst densities for both residue and tillage. Minimum-tillage of wheat residue significantly reduced the "residue effect" in 1990 and 1991; however, plots with wheat residue had fewer cysts at harvest than plots without residue in both years regardless of tillage method. Neither residue nor tillage affected soybean yields. Results indicate that producers who have the option to no-till doublecrop soybean following wheat may have an advantage in long-term management of H. glycines. [References: 18].

3515 Ignacio, D.D. (Mariano Marcos State Univ., Batac, Ilocos Norte (Philippines)) (1992) **Wheat R and D [research and development] at MMSU; study title: effect of time of planting, row spacing and seeding rate of wheat grown in the Ilocos (Philippines).** Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maíz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia p. 31-32. 1 table. Received Nov 1994.* English. (AGRIS 95-076253).

3516 Jacobsen, O.H.; Melander, B. (1994) **[Natural regeneration in rotational set-aside fields and its influence on nitrate leaching and weed problems: Investigations performed in the winter 1992-93].** Selvetableret plantedaekke i enaarige brakmarker i relation til kvaelfstudvaskning og ukrudt: Undersoegelser fra vinteren 1992-93. Statens

Planteavlssorog, Lyngby (Denmark). *SP-Rapport (Denmark); no. 48 46 p. SP. 20 ill., 3 tables; 28 ref. Legends in En. Danish. (AGRIS 95-087017).*

3517 Johnston, AM.; Janzen, HH.; Smith, EG. (1995) **LONG-TERM SPRING WHEAT RESPONSE TO SUMMERFALLOW FREQUENCY AND ORGANIC AMENDMENT IN SOUTHERN ALBERTA.** *Canadian Journal of Plant Science*. 75(2):347-354. English. [AGRI FOOD CANADA RES STN BOX 1240 MELFORT SK S0E 1A0 CANADA].

A long-term rotation experiment was established in 1951 to determine the influence of summerfallow frequency and organic amendment on the yield and quality of unfertilized spring wheat (*Triticum aestivum* L.) on a Dark Brown Chernozem (Typic Haploboroll) at Lethbridge, Alberta. Wheat was grown either continuously (W), in a 2-yr summerfallow-wheat rotation (FW), or in a 3-yr fallow-wheat-wheat rotation (FWW). No fertilizer N was applied and P, at 22 kg ha⁻¹, was applied to all wheat crops starting in 1985. The 3-yr rotation was also amended with livestock manure (FmWW) and modified to include a hay mixture of alfalfa (*Medicago sativa* L.) and crested wheatgrass (*Agropyron cristatum* L.) (FWWHH). Annual grain production was affected by summerfallow frequency and organic amendment, with the lowest grain production obtained in the FW rotation. Amendment with livestock manure resulted in the highest grain yields for wheat grown on summerfallow, while 3 yr of hay in the rotation produced the highest stubble wheat yields. These higher grain yields were accompanied by a 12-31% increase in grain N uptake. Decomposing hay roots increased plant available N as reflected in the highest grain N concentration and grain N yield in the FWWHHH rotation. Evaluation of grain yields under a range of moisture deficit conditions revealed that a year of summerfallow was often insufficient to recharge soil water depleted by 3 yr of hay in the FWWHHH rotation. Both summerfallow and stubble wheat yields were positively influenced by May rainfall. Overwinter precipitation contributed significantly to the variability observed in stubble wheat and hay yields. In the absence of fertilizer N additions, organic amendments such as animal manures and hay residues are effective means of increasing crop productivity and grain quality in semiarid regions. [References: 26].

3518 Jones, MJ.; Singh, M. (1995) **YIELDS OF CROP DRY MATTER AND NITROGEN IN LONG-TERM BARLEY ROTATION TRIALS AT TWO SITES IN NORTHERN SYRIA.** *Journal of Agricultural Science*. 124(Part 3):389-402. English. [INT CTR AGR RES DRY AREAS POB 5466 ALEPPO SYRIA].

Trials were established at two sites in 1982 to compare six 2-course rotations, in which barley alternated with feed legumes (pure or mixed with barley), fallow or barley, in partial factorial combination with different N and P fertilizer regimes. This paper summarizes data from the second to the seventh cropping seasons. Barley yielded most after fallow and more after legumes than after barley; but, on the basis of total dry matter production over both courses, barley-legume rotations outyielded barley-fallow and barley-barley rotations. In terms of net nitrogen offtake, which may be taken as a rough measure of feed value, barley-legumes surpassed the other rotations by c. 100% at both sites, whether the comparison was made on values obtained from plots with or without added fertilizer. Of the legumes, *Lathyrus sativus* was slightly more productive than *Vicia sativa*, and this carried over into the rotational yield of both dry matter and nitrogen. Rotations involving pure legumes were slightly more productive than those involving legume/barley mixtures. Yields of all crops and rotations varied greatly from year to year depending on rainfall. Those of the barley-fallow rotation were much less variable than those of the barley-barley rotation at the wetter site (323 +/- 103 mm), with the barley-legume rotation intermediate; but variability was much greater at the drier site (250 +/- 79 mm), with much less difference between rotations. Nevertheless, fertilizer use and rotations including legumes gave a significant yield advantage under the driest conditions. [References: 14].

3519 Kandil, A.A.; Abou Deya, I.B. (King Saud Univ., Al Qassim Branch (Saudi Arabia). College of Agriculture and Veterinary Medicine) (1993) **Response of barley to N. P-fertilizers in soil cropping and intercropping with berseem clover in sandy soil. 1.-forage yield and growth traits.** *Journal of Agricultural Sciences, Mansoura (Egypt) v. 18(8) p. 2253-2261. 4 tables; 10 ref. English. (AGRIS 95-086989).*

3520 Liboon, S.P. (International Rice Research Inst., Los Banos, Laguna (Philippines). Multiple Cropping Dept.) (1992) Summary of wheat research at IRRI (Philippines) (1987 DS [dry season] - 1988 DS). Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 103-120. 9 tables. Received Nov 1994. English. (AGRI 95-076266).

3521 Modak, S.B.; Rai, R.K.; Sinha, M.N. (Indian Agricultural Research Institute, New Delhi. Division of Agronomy) (1993) Tracer studies on phosphorus utilization in pigeonpea wheat sequence. *Journal of Nuclear Agriculture and Biology (India)*. v. 22(3-4) p. 150-154. 4 tables; 8 ref. English. (AGRI 95-076284).

3522 Pankhurst, CE.; McDonald, H.J.; Hawke, BG. (1995) INFLUENCE OF TILLAGE AND CROP ROTATION ON THE EPIDEMIOLOGY OF PYTHIUM INFECTIONS OF WHEAT IN A RED-BROWN EARTH OF SOUTH AUSTRALIA. *Soil Biology & Biochemistry*. 27(8):1065-1073. English. [CSIRO DIV SOILS PRIVATE BAG 2 GLEN OSMOND SA 5064 AUSTRALIA].

Propagules of *Pythium* spp were concentrated in the top 10 cm and associated with soil aggregates > 250 μ m and < 500 μ m in a typical wheat-growing soil (red-brown earth) in South Australia. Propagule numbers were significantly affected by tillage and crop rotation. Over a 4-yr sampling period (1987-1990) propagule numbers were significantly higher in soil subjected to direct-drilling (no cultivation before crops were sown) than in soil subjected to conventional cultivation (2-3 cultivations before sowing). This effect was most consistent with a continuous-wheat rotation but was present in the wheat phase of a pasture-wheat and lupins-wheat rotation following a wet autumn in 1988. In 1988, *Pythium* propagule numbers were higher in soil that had been under pasture the previous year than in soil previously under wheat or lupins. This build up of *Pythium* inoculum was related to a significantly larger amount of particulate organic material (mostly fine roots from regenerating pasture plants) in this soil during the autumn before wheat was sown. The roots of these pasture plants were heavily infested with *Pythium* spp. The amount of wheat seed and wheat root that became infected with *Pythium* was related to the numbers of *Pythium* propagules in the soil and thus was highest in direct-drilled soil and in soil previously under pasture. *Pythium* spp could be isolated from different parts of the wheat root system throughout the entire growing cycle of the wheat plant. Two *Pythium* spp, *P. irregulare* and *P. echinulatum* were identified. *P. irregulare* was dominant and accounted for > 80% of isolates recovered from wheat seed and wheat roots. [References: 41].

3523 Poelaert, J.; Monfort, B.; Falisse, A.; Bodson, B. (1994) [The fallow at lower cost: criteria of choice selected after some experimental results]. La jachere au moindre cout: criteres de choix a la lumiere de quelques resultats d'essais. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. *Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993*. Seutin, E.; Falisse, A. (eds) (Jachere) p. 1-20. French. (AGRI 95-076263).

3524 Rudnicki, F.; Kotwica, K. (Akademia Techniczna Rolnicza, Bydgoszcz (Poland)) (1994) [Forecrop value of spring triticale, yellow lupine and their mixture for winter wheat]. *Wartosc przedplonowa pszenzyta jarego, lubinu zoltego i ich mieszanek dla pszenicy ozimej. Fragmenta Agronomica (Poland)* v. 11(2) p. 19-24. 2 fig., 2 tables; 11 ref. Polish. (AGRI 95-087031).

In three field experiments the influence of various sowing density of spring triticale and yellow lupine in pure sowing and in the mixture of these species on the yields of winter wheat was examined. Thick set yellow lupine was a better forecrop for wheat than spring triticale. The cultivation of spring triticale with yellow lupine softened the results of cultivating grains one after the other. The forecrop value of the mixtures for winter wheat was the same or greater than that of lupine in pure sowing.

3525 Sharma, S.N.; Prasad, R.; Singh, S. (1995) THE ROLE OF MUNGBEAN RESIDUES AND SESBANIA ACULEATA GREEN MANURE IN THE NITROGEN ECONOMY OF RICE-WHEAT CROPPING SYSTEM. *Plant & Soil*. 172(1):123-129. English. [INDIAN AGR RES INST DIV AGRON NEW DELHI 110012 INDIA].

Field experiments were carried out to determine the effect of *Sesbania aculeata* L. green manuring and mungbean, *Vigna radiata* (L.) residue incorporation on the response of rice to urea-N and their residual effects on a subsequent spring wheat. Compared with a pre-rice fallow, *Sesbania* green manuring and mungbean residue increased grain yield of rice by 0.4 and 0.3 t ha⁻¹, respectively and of spring wheat by 0.6 and 0.7 t ha⁻¹, respectively when no urea-N was applied to rice and 40 kg urea-N ha⁻¹ as a basal starter dose was applied to wheat. *Sesbania* green manure and mungbean residue substituted for 43 and 30 kg urea-N ha⁻¹ in rice and subsequently gave a beneficial effect in spring wheat equal to the residual effect of 89 and 112 kg urea-N ha⁻¹ applied to rice, respectively. Mungbean residue remaining after the picking of pods, was found to be at par with *Sesbania* green manuring towards N contribution to "rice-wheat" cropping system but had an additional advantage of 0.5 to 1.3 t ha⁻¹ seed yield of protein rich mungbeans. [References: 13].

3526 Singh, S.S.; Ehsanullah, M.D.; Singh, A.K.; Singh, B.K. (1995) SPATIAL ARRANGEMENT IN WHEAT (TRITICUM AESTIVUM) INDIAN MUSTARD (BRASSICA JUNCEA) INTERCROPPING. *Indian Journal of Agronomy*. 40(1):91-93. English. [RAJENDRA AGR UNIV REG RES STN W CHAMPARAN BIHAR INDIA].

3527 Sparrow, S.D.; Cochran, V.L.; Sparrow, E.B. (1995) RESIDUAL EFFECTS OF HARVESTED AND GREEN-MANURED LEGUMES ON A SUBSEQUENT BARLEY CROP IN A SUBARCTIC ENVIRONMENT. *Canadian Journal of Plant Science*. 75(2):453-456. English. [UNIV ALASKA FAIRBANKS AGR & FORESTRY EXPT STN FAIRBANKS, AK 99775 USA].

Experiments were conducted at two locations in Alaska to determine effects of incorporating and harvesting forage legumes on subsequent barley crops. Barley (*Hordeum vulgare* L.) following forage legume crops and fallow had higher yields and plant N than barley following non-N-2-fixing crops. Incorporating, as opposed to harvesting, legume crops sometimes resulted in positive response of barley. [References: 9].

3528 Taguam, F.C.; Bucag, M.T.; Daoang, E.U. (Isabela State Univ., Cagayan, Isabela (Philippines)) (1992) Performance of wheat grown as intercrop in Cagayan Valley (Philippines). Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 63-83. 6 tables. Received Nov 1994. English. (AGRI 95-076265).

3529 Thomas, E.C.; Gardner, E.A.; Littleboy, M.; Shields, P. (1995) THE CROPPING SYSTEMS MODEL PERFECT AS A QUANTITATIVE TOOL IN LAND EVALUATION - AN EXAMPLE FOR WHEAT CROPPING IN THE MARANO AREA OF QUEENSLAND. *Australian Journal of Soil Research*. 33(3):535-554. English. [QUEENSLAND DEPT PRIMARY IND LOCKED MAILBAG EMERALD QLD 4720 AUSTRALIA].

The mechanistic cropping systems model PERFECT was validated for six different soils and used as a tool to evaluate land suitability of wheat cropping in the Maranoa, a marginal cropping area of Queensland. Using 100 years of historic climate data from the area, and crop, soil and management parameters, simulations provided an objective insight into the key interactions of the cropping system. Current methods of land suitability evaluation are qualitative and rely on the experience of the land resource surveyor and local precedent. Consequently, where local precedent is lacking, as in marginal areas, current methods are considered less reliable and quantitative data from simulation studies will be useful. Using this process, the significance of key components of the systems (climate, plant available water capacity, soil nitrate and soil loss hazard) were quantified. These quantitative data were used to establish critical values for diagnostic attributes for land suitability evaluation in the

Maranoa. The role for this approach as a tool in quantitative land evaluation is discussed. [References: 28].

3530 Wang Jufang; Cao Weixian (Shaanxi Provincial School of Agricultural Sciences, Yangling (China)) (1994) **Experiment of underplanting watermelon on late sowing wheat field covered with plastic film in dryland**. *Shaanxi Journal of Agricultural Sciences (China)* (no. 2) p. 22-24. 3 tables. Chinese. (AGRI 95-087016).

3531 Yuan Baoxiang; Liu Mandao (Shaanxi Provincial Inst. of Cotton, Sanyuan County (China)) (1994) **Change of ecologic factors and its effect on the growth and development of cotton seedlings during symbiotic period in field of interplanting wheat and cotton**. *Shaanxi Journal of Agricultural Sciences (China)* (no. 1) p. 13-14. 32. 5 tables; 1 ill., Chinese. (AGRI 95-087015).

F30 PLANT GENETICS AND BREEDING

3532 **Varieties for the future - Quality grains to improve market opportunities**. [Field day proceedings] (1993) 61. *Annual Field Day*. Mallee Research Station; Walpeup, Vic. (Australia); 7 Oct 1993. Victorian Dept. of Agriculture, Walpeup (Australia). Mallee Research Station. Department of Agriculture. 39 p. English. (AGRI 95-076529).

Major topics covered are: breeding wheat for cereal cyst nematode resistance; new wheat varieties for western Victoria; barley classification and protein testing; new barley crossbred for medium rainfall areas; seed certification and seed-borne diseases; control of mouse plagues.

3533 [Hard wheat varieties [lessons of 1993, sheets of varieties]]. **Ble dur: les enseignements de 1993 [fiches des variétés]** (1994) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 192) p. 67-79. French. (AGRI 95-076668).

3534 [Small grain cereals: varieties]. **Cereales a paille: variétés 1994** (1994) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 192) p. 101-110. French. (AGRI 95-076669).

3535 [Soft wheat varieties [lessons of 1993, sheets of new varieties]]. **Ble tendre: les nouveautes [les enseignements de 1993, fiches des nouvelles variétés]** (1994) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 192) p. 35-66. 15 tableaux, 6 graph. French. (AGRI 95-076667).

3536 [Triticale varieties]. **Triticale: variétés** (1994) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 192) p. 100. French. (AGRI 95-076486).

3537 [Winter and spring barley varieties [lessons of 1993]]. **Orge d'hiver et de printemps: les nouveautes [les enseignements de 1993]** (1994) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 192) p. 93-96. French. (AGRI 95-076497).

3538 Al Muslum, I.S. (King Faisal Univ., Al Hassa (Egypt). College of Agriculture and Food Sciences) (1994) **Comparative study of growth and yield in barley (*Hordeum vulgare* L.) genotypes as affected by saline water**. *Journal of Agricultural Sciences, Mansoura Univ. (Egypt)* v. 19(3) p. 1245-1253. 4 tables; 8 ref. English. (AGRI 95-087182).

3539 Aledo, R.; Raz, R.; Monfort, A.; Vicient, CM.; Puigdomenech, P.; Martinezizquierdo, JA. (1995) **CHROMOSOME LOCALIZATION AND CHARACTERIZATION OF A FAMILY OF LONG INTERSPERSED REPETITIVE DNA ELEMENTS FROM THE GENUS ZEA**. *Theoretical & Applied Genetics*. 90(7-8):1094-1100. English. [CSIC CID DEPT MOLEC GENET JORDI GIRONA SALGADO 18-26 E-08034 BARCELONA SPAIN].

This paper describes the characterization and chromosomal distribution of new long repetitive sequences present in all species of the genus *Zea*. These sequences constitute a family of moderately repetitive elements ranging approximately from 1350 to 1700 copies per haploid genome in modern maize (*Zea mays* ssp. *mays*) and teosinte (*Zea diploperennis*), respectively. The elements are long, probably larger than 9 kb, and they

show a highly conserved internal organization among *Zea* subspecies and species. The elements are present in all maize chromosomes in an interspersed pattern of distribution, are absent from centromeric and pericentric heterochromatin, and with some clustering in the distal regions of chromosome arms. [References: 32].

3540 Ali, NM. (1995) **PERFORMANCE OF HIGH-PROTEIN MUTANT LINES OF TRITICUM-AESTIVUM (L) UNDER SEMI-ARID CONDITIONS OF SYRIA**. *Field Crops Research*. 41(2):101-108. English. [ATOM ENERGY COMMISS SYRIA DEPT RADIAT AGR POB 6091 DAMASCUS SYRIA].

The agronomical characters of nine high-protein mutant lines of *T. aestivum* produced by the IAEA were studied along with their mother line Mex22A and four local cultivars. The experiments were carried out under rainfed conditions in 1990 and 1991 in southern Syria. Statistical analysis revealed significant differences among the lines in all characters. Genotype by environment interaction was significant for all characters except for N yield. There was a negative correlation between grain nitrogen concentration (GNC) and yield. However, two of the check cultivars and seven mutant lines had similar yield to Mex22A with greater GNC. The other two mutant lines, 5074M and E296, were very late in heading and were characterized by low yield with extremely high GNC. Spikes per square meter contributed most to grain yield followed by number of seeds per spike and lastly seed weight. SDS sedimentation test values were negatively correlated with GNC. Polyacrylamide gel electrophoresis in the presence of sodium dodecyl sulphate (SDS-PAGE) was used to assay for high molecular weight (HMW) glutenin protein subunits of the grain endosperm. The results showed the presence of HMW glutenin GluD1 subunits 2 + 12 in Mex22A and all IAEA genotypes. Check varieties L92-6, Buhuth 4 and Cham 2 contain the good quality allelic GluD1 subunits 5 + 10. Nevertheless, 4 of 9, IAEA mutant lines were characterized by having higher SDS sedimentation values due to the presence of Glu-B1 subunits 17 + 18 when compared to those that had subunits 7 + 8. [References: 20].

3541 Alkaddoussi, A.R.; Eissa, M.M.; Salama, S.M. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) **Estimates of genetic variance for yield and its components in wheat (*Triticum aestivum* L.)**. *Zagazig Journal of Agricultural Research (Egypt)*. v. 21(2) p. 355-366. 4 ill. 4 tables; 15 ref. English. (AGRI 95-087334).

3542 Begum, S. (1995) **GENETIC VARIABILITY AND CORRELATION STUDY IN EXOTIC GENOTYPES OF HULL-LESS BARLEY (*HORDEUM VULGARE* L.)**. *Bangladesh Journal of Botany*. 24(1):61-66. English. [BANGLADESH AGR RES INST CTR GENET RESOURCE GAZIPUR 1700 BANGLADESH].

Seven exotic hull-less genotypes of barley showed significant differences in respect of yield and other yield contributing characters. Highest phenotypic and genotypic coefficient of variations were observed in case of grain yield/plant and lowest values were observed in case of 1000 grain weight in both cases. Heritability estimate was found to be high in case of number of days to heading and this was followed by plant height and 1000 grain weight. Maximum genetic advance was found in grain yield/plant which followed by number of fertile tillers/plant. Significant positive correlation was found in grain yield/plant with number of fertile tillers/plant, between plant height and spike length, spike length and 1000 grain weight, number of days to heading and number of fertile tillers/plant. Significant negative correlation was found in number of days to heading with plant height. Negative association was also found between number of days to heading and spike length, fertile tillers with plant height, spike length with fertile tillers. Number of fertile tillers, plant height, spike length and grain weight appeared to be the effective criteria for improvement of yield.

3543 Benamer, IM.; Worland, AJ.; Borner, A. (1995) **CHROMOSOMAL LOCATION OF GENES AFFECTING TISSUE-CULTURE RESPONSE IN WHEAT**. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(1):84-85. English. [INST PFLANZENGENET & KULTURPFLANZENFORSCH CORRENS STR 3 D-06466 GATERSLEBEN GERMANY].

Six 'Chinese Spring/*Triticum spelta*' substitution lines for chromosomes 1A, 1D (duplicates), 3D (duplicates), 6D, and one 'Chinese Spring/Marquis' substitution line for chromosome 2B were studied for

tissue-culture response (TCR). The results reported here indicate that chromosomes 2B and 6D are critical for TCR, whereas chromosome 1D affects callus weight only. Chromosomes 1A and 3D were not found to be critical, however, these chromosomes may carry genes with minor effects. [References: 8].

3544 Bernicot, M.H. (Institut Technique des Cereales et des Fourrages, Paris (France)) (1994) [Spring barley: 1994 results by variety]. *Orges de printemps: les resultats varietaux 1994. Perspectives Agricoles (France)* (no 197) p. 61-68. 7 graph. French. (AGRI 95-076498).

3545 Bi Yunqing; Rao Weiwei; Ran Yun (Yunnan Provincial Inst. of Plant Protection, Kunming (China)) (1993) Exploitation of minor effect genes resistant to wheat stripe rust (*Puccinia striiformis* West). *Journal of Yunnan Agricultural University (China)* v. 8(3) p. 162-166. 4 tables, 4 ref. Chinese. (AGRI 95-076676).

3546 Bonhomme, A.; Gale, MD.; Koebner, RMD.; Nicolas, P.; Jahier, J.; Bernard, M. (1995) RFLP ANALYSIS OF AN AEGILOPS VENTRICOSA CHROMOSOME THAT CARRIES A GENE CONFERRING RESISTANCE TO LEAF RUST (*PUCCINIA RECONDITA*) WHEN TRANSFERRED TO HEXAPLOID WHEAT. *Theoretical & Applied Genetics*. 90(7-8):1042-1048. English. [INRA AMELIORAT PLANTES STN DOMAINE CROUELLE F-63039 CLERMONT FERRAND FRANCE].

RFLP analysis has been used to characterise XM(v), a chromosome of *Aegilops ventricosa* present in a disomic addition line of wheat. This chromosome is known to carry a major gene conferring resistance to leaf rust (Lr). The analysis demonstrated that XM(v) is translocated with respect to the standard wheat genome, and consists of a segment of the short arm of homoeologous group 2 attached to a group 6 chromosome lacking a distal part of the short arm. Lr was located to the region of XM(v) with homoeology to 2S by analysis of a leaf rust-susceptible deletion line that was found to lack the entire 2S segment. Confirmation and refinement of the location of Lr was obtained by analysis of a spontaneous resistant translocation in which a small part of XM(v) had been transferred to wheat chromosome 2A. [References: 23].

3547 Boskovic, J.; Boskovic, M. (Faculty of Agriculture, Novi Sad (Yugoslavia)) (1994) International testing of genetically different sources of resistance to *Puccinia recondita* tritici and other wheat pathogens. *Zastita bilja (Yugoslavia)* v. 45(208) p. 99-106. 2 tables; 29 ref. English. (AGRI 95-076480).

European Leaf Rust of Wheat Nurseries (ELRWN 1989/1990) have been composed of 20 genetically different resistant spring wheat lines and five isogenic Lr lines. This cooperative investigations are refer to interactions between genetically different sources of resistance of wheat to the wide spectrum of virulence of *Puccinia recondita* tritici. ELRWN have been tested in the seedling stage to different international pathogen cultures and in the adult stage on the large European-Mediterranean epidemiological territory. Cooperative seedling testings of this nursery have been realized in eight countries. The field reactions of ELRWN 1989/90 to pathogens of leaf rust, stem rust, yellow rust, powdery mildew and *Septoria* sp. have been evaluated in thirteen countries.

3548 Bouzerzour, H.; Dekhili, M. (1995) HERITABILITIES, GAINS FROM SELECTION AND GENETIC CORRELATIONS FOR GRAIN YIELD OF BARLEY GROWN IN TWO CONTRASTING ENVIRONMENTS. *Field Crops Research*. 41(3):173-178. English. [CTR UNIV OUM EL BOUAGHI ECOLE NORMALE SUPER DEPT AGRON OUM EL BOUAGHI 4000 ALGERIA].

Heritabilities and variance component estimates were, obtained from a set of 15 barley lines and cultivars grown for three consecutive years in two contrasting environments in the high plateaux of Eastern Algeria. Genotype X environment interactions, particularly related to seasonal effects, seriously limited selection for increased barley grain yield. Their effect was to reduce the genetic variance component, heritability estimates and genetic correlation coefficients. The results indicated that selection in a high-yielding location does not identify genotypes suitable for low-yielding environments, which are more representative of the production conditions of a low-input agriculture. Selection in low-yielding environments appears more efficient. [References: 19].

3549 Cai Shibin; Cao Yang; Zhu Wei (Jiangsu Provincial Academy of Agricultural Sciences, Nanjing (China). Inst. of Grain Crops) (1994) Identification of preharvest field sprouting resistance in dwarf wheat lines carrying Rht 3 gene and their corresponding parents. *Crop Genetic Resources (China)* (no. 4) p. 10-12. 2 tables, 6 ref. Chinese. (AGRI 95-087329).

3550 Calderini, DF.; Dreccer, MF.; Slafer, GA. (1995) GENETIC IMPROVEMENT IN WHEAT YIELD AND ASSOCIATED TRAITS - A RE-EXAMINATION OF PREVIOUS RESULTS AND THE LATEST TRENDS. *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 114(2):108-112. English. [UNIV BUENOS AIRES FAC AGRON DEPT PROD VEGETAL CATEDRA CEREALICULTURA AV SAN MARTIN 4453 RA-1417 BUENOS AIRES DF ARGENTINA].

Two field experiments were carried out with seven wheat cultivars (three of them, including a commercial hybrid, released during the last 10 years) representing different eras of plant breeding, to evaluate genetic improvement over the last century in grain yield, height, biomass, harvest index and grain yield components. Plots were fertilized and irrigated, and lodging and diseases were prevented. Main culm height was negatively correlated with the year of release of the cultivars; probably as a consequence of selection for increased lodging resistance. There was no significant association between total above-ground biomass and year of release of the cultivars. On the other hand, grain yield increased as newer cultivars were released. Results indicate that during recent years harvest index has been kept as the main attribute responsible for increases in grain yield. In general, number of grains/m² was associated with increases in grain yield during the century. However, the newest cultivars showed an increased grain weight. In both growing seasons, cultivars released before 1980 showed a trend towards reduced grain weight, but cultivars released after 1987 had a similar number of grains per m² with a higher grain weight than their predecessors. This was probably because the most modern cultivars have a longer grain-filling duration with a similar length of growth cycle. [References: 20].

3551 Cao Yang (Jiangsu Academy of Agricultural Science, Nanjiang (China). Inst. of Food Crops) (1994) Combining ability analysis of waterlogging tolerance and main agronomic traits in common wheat. *Scientia Agricultura Sinica (China)* v. 27(6) p. 50-55. 6 tables; 4 ref. Chinese. (AGRI 95-087319).

3552 Chaudhary, HK.; Kapoor, AS. (1995) INHERITANCE OF WAXY BLOOM IN SPRING X WINTER WHEAT (*TRITICUM AESTIVUM* L) CROSSES. *Cereal Research Communications*. 23(1-2):49-52. English. [HIMACHAL PRADESH AGR UNIV KUKUMSRI LAHAUL & SPITI REG RES STN PALAMPUR 176062 HIMACHAL PRADESH INDIA].

Six spring x winter wheat (*Triticum aestivum* L.) crosses were investigated in the Dry Temperate Region of North Western Himalayas to find out the mode of inheritance of the waxy bloom character. Waxiness imparts drought tolerance and also helps the host plant in avoiding the pathogen through its physiological or biochemical properties. The F₁ generation of all the crosses indicated waxy bloom to be controlled by dominant gene. A monohybrid ratio of 3 waxy : 1 non-waxy was observed in the F₂ generations of all the six crosses. This ratio was further confirmed by the analysis of F₃ breeding behaviour. Hence, the waxy bloom of winter wheat varieties viz., J.O.3057, Bounty, Funddin, Flenders and Atou is monogenically dominant to the bloomlessness of spring wheat varieties viz., HPW 47, PEW 65, and HD 2380.

3553 Chaudhuri, P.; Sengupta, RK.; Ghosh, PD. (1995) AN INVESTIGATION OF GAMMA-RADIATION SENSITIVITY ON IN VITRO STUDY OF *HORDEUM VULGARE* L. *Acta Societatis Botanicorum Poloniae*. 64(2):163-164. English. [UNIV KALYANI DEPT BOT CYTOGENET & TISSUE CULTURE LAB KALYAN 741235 W BENGAL INDIA].

Gamma-radiation sensitivity was studied on in vitro condition in *Hordeum vulgare* L. The variation of callusing response assessed with the increasing level of gamma-radiation treatment and regeneration delayed at higher dose level.

3554 Chen Jixian; Zhao Xulan (Academia Sinica, Xining, Qinghai (China). Northwest Plateau Inst. of Biology) (1994) A discussion on spring wheat breeding for high yields on the Qinghai Plateau, China. *Scientia Agricultura Sinica (China)* v. 27(3) p. 12-18. 3 tables; 27 ref. Chinese. (AGRIC 95-087138).

3555 Devos, K.M.; Dubcovsky, J.; Dvorak, J.; Chinoy, C.N.; Gale, M.D. (1995) STRUCTURAL EVOLUTION OF WHEAT CHROMOSOMES 4A, 5A, AND 7B AND ITS IMPACT ON RECOMBINATION. *Theoretical & Applied Genetics*. 91(2):282-288. English. [JOHN INNES INST NORWICH RES PK NORWICH NR4 7UH NORFOLK ENGLAND].

The construction of comparative genetic maps of chromosomes 4A(m) and 5A(m) of *Triticum monococcum* and chromosomes of homoeologous groups 4, 5 and 7 of *T. aestivum* has provided insight into the evolution of these chromosomes. The structures of chromosomes 4A, 5A and 7B of modern-day hexaploid bread wheat can be explained by a 4AL/5AL translocation that occurred at the diploid level and is present both in *T. monococcum* and *T. aestivum*. Three further rearrangements, a 4AL/7BS translocation, a pericentric inversion and a paracentric inversion, have taken place in the tetraploid progenitor of hexaploid wheat. These structural rearrangements and the evolution of chromosomes 4A, 5A and 7B of bread wheat are discussed. The presence of the 4AL/5AL translocation in several Triticeae genomes raises two questions - which state is the more primitive, and is the translocation of mono- or poly-phylogenetic origin? The rearrangements that have occurred in chromosome 4A resulted in segments of both arms having different positions relative to the telomere, compared to 4A(m) and to 4B and 4D. Comparisons of map length in these regions indicate that genetic length is a function of distance from the telomere, with the distal regions showing the highest recombination. [References: 43].

3556 Ding Hongjian; Ni Hanxiang; Su Jingrui (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Plant Protection) (1994) A study on the technique for evaluation of resistance of wheat varieties to wheat midge (*Sitodiplosis mosellana*). *Crop Genetic Resources (China)* (no. 4) p. 34-36. 3 tables; 5 ref. Chinese. (AGRIC 95-087330).

3557 Djokic, D.; Knezevic, D.; Kostic, M. (Institute for Small Grains "Kragujevac", Kragujevac (Yugoslavia)) (1992) Parameters of accumulation and distribution of dry matter and nitrogen in F1 and F2 generations of wheat. *Journal of Scientific Agricultural Research (Yugoslavia)* v. 53(189-192) p. 75-85. 3 tables; 16 ref. English. (AGRIC 95-076481).

Winter wheat varieties Jugoslavija, Zitnica, Novosadska Rana 2 and Osjecanka and progenies of F1 and F2 developed from diallel crosses were investigated in order to determine a mode of inheritance of parameters of accumulation and distribution of dry matter and nitrogen in plant as genotypic index of grain yield and grain protein content. Nitrogen accumulation in plant of F2 generation was decreased in relation to parents and caused decrease of dry matter yield, grain yield, grain and nitrogen harvest indexes, physiological efficiency of nitrogen and vegetative nitrogen re-utilization by grain. Relative decrease of grain harvest index was higher than decrease of nitrogen harvest index what resulted in nitrogen concentration increase and nitrogen accumulation decrease in grain.

3558 Dovidio, R.; Masci, S.; Porceddu, E. (1995) DEVELOPMENT OF A SET OF OLIGONUCLEOTIDE PRIMERS SPECIFIC FOR GENES AT THE GLU-1 COMPLEX LOCI OF WHEAT. *Theoretical & Applied Genetics*. 91(2):189-194. English. [UNIV TUSCIA DIPARTIMENTO AGROBIOL & AGROCHIM VIA S CAMILLO LELLIS I-01100 VITERBO ITALY].

Specific amplification of the complete coding region of all six high-molecular-weight (HMW) glutenin genes present in hexaploid wheat was obtained by the polymerase chain reaction (PCR). Primers specific for the N-terminal region of the 1Dx gene and for the repetitive domain of the y-type HMW glutenin genes were also developed. Although the primers were constructed on the basis of the nucleotide sequences of HMW glutenin genes present in *T. aestivum* L. cv 'Cheyenne', they were very efficient in amplifying HMW glutenin genes of diploid and tetraploid wheat species. PCR analysis of HMW glutenin genes of *T. urartu* Tuman., *T. longissimum* (Schweinf. & Muschl.) Bowden and *T. speltoides* (Tausch) Gren. ex Richt. showed a high degree of length polymorphism, whereas a

low degree of length variation was found in accessions of *T. tauschii* (Coss.) Schmal. Furthermore, using primers specific for the repetitive regions of HMW genes, we could demonstrate that the size variation observed was due to a different length of the central repetitive domain. The usefulness of the PCR-based approach to analyze the genetic polymorphism of HMW glutenin genes, to isolate new allelic variants, to estimate their molecular size and to verify the number of cysteine residues is discussed. [References: 31].

3559 Eissa, M.M. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) Detecting epistasis for yield and its components in wheat using triple test cross analysis (*Triticum aestivum* L.). *Zagazig Journal of Agricultural Research (Egypt)* v. 21(1) p. 11-20. 4 tables; 11 ref. English. (AGRIC 95-087336).

3560 Eissa, M.M. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) Genetic correlation and predicting new recombinant lines in bread wheat using triple test cross analysis (*Triticum aestivum* L.). *Zagazig Journal of Agricultural Research (Egypt)* v. 21(1) p. 21-31. 4 tables; 11 ref. English. (AGRIC 95-087337).

3561 Eissa, M.M. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) Triple test cross analysis in bread wheat (*Triticum aestivum* L.). *Zagazig Journal of Agricultural Research (Egypt)* v. 21(1) p. 1-10. 4 tables; 12 ref. English. (AGRIC 95-087335).

3562 Eissa, M.M.; Alkaddoussi, A.R.; Salama, S.M. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) General and specific combining ability and its interactions with sowing dates for yield and its components in wheat. *Zagazig Journal of Agricultural Research (Egypt)* v. 21(2) p. 245-354. 4 tables; 12 ref. English. (AGRIC 95-087159).

3563 Elings, A. (International Center for Agricultural Research in the Dry Areas, Aleppo (Syrie). Genetic Resources Unit); Van Keulen, H. (1994) [Durum wheat landraces from Syria. 4. Simulation of growth and development]. [Races de ble dur de Syrie. 4. Simulation de croissance et de developpement]. *European Journal of Agronomy (France)* v. 3(1) p. 71-83. 40 ref., 5 tableaux. English. (AGRIC 95-087305).

3564 Ellis, R.P.; Thomas, W.T.B.; Swanston, J.S. (Scottish Crop Research Institute, Invergowrie, Dundee (United Kingdom)) (1992) Research on barley genetics at SCRI. *Bulletin - Scottish Crop Research Institute (United Kingdom)* p. 22-25. Prospects for cereals. Proceedings of a meeting organised by the Scottish Crop Research Institute, Dundee, 20 November 1991. English. (AGRIC 95-076500).

3565 Engels, J.M.M. (Plant Genetic Resources Centre/Ethiopia (PGRC/E), PO Box 30726, Addis Ababa (Ethiopia)) (1994) Genetic diversity in Ethiopian barley in relation to altitude. *Genetic Resources and Crop Evolution (United Kingdom)* v. 41(2) p. 67-73. 20 ref. English. (AGRIC 95-087195).

3566 Escano, C.R. (Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines)) (1992) Role and commitments of PCARRD to the development of wheat in the Philippines. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop*. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). *Regional Wheat Program for Southeast Asia* p. 160-163. Received Nov 1994. English. (AGRIC 95-076479).

3567 Fajersson, F. (Inst. fuer Pflanzenzuechtung Weibullsholm, Landskrona (Sweden)) (1994) [Transgression breeding for good quality and agronomic properties. A Northeuropean plant breeding programme in winter wheat]. *Transgressionszuechtung fuer gute Qualitaets- und Anbaueigenschaften. Ein nordeuropaeisches Winterweizen-Zuechtungsprogramm*. *Muehle + Mischfuttertechnik (Germany)* v. 131(38) p. 515-516. 4 tables; 16 ref. German. (AGRIC 95-076471).

3568 Felix, I. (Institut Technique des Cereales et des Fourrages, Paris (France)); Briffaux, G.; Prevot, J.P. (1994) [Cereal varieties according to agroclimatic zones in France]. Les varietes de cereales (choix, region: Champagne Berrichonne, Champagne, Nord Picardie). *Perspectives Agricoles (France)* (no 192) p. 22-28. French. (AGRIS 95-076485).

3569 Fenwick, R. (National Institute of Agricultural Botany (NIAB), Huntingdon Road, Cambridge CB3 0LE (United Kingdom)) (1993) Cereal variety quality evaluation in a changing agricultural environment. *Aspects of Applied Biology (United Kingdom)* (no.36) p. 169-178. English. (AGRIS 95-087306).

3570 Flintham, J.E.; Humphray, S.J. (Cambridge Laboratory, John Innes Centre for Plant Science Research, Norwich NR4 7UJ (United Kingdom)) (1993) Red coat genes and wheat dormancy. *Aspects of Applied Biology (United Kingdom)* (no.36) p. 135-141. 3 ref. English. (AGRIS 95-087312).

3571 Forster, B.P. (Cell and Molecular Genetics Department, Scottish Crop Research Institute, Invergowrie, Dundee DD2 5DA (United Kingdom)) (1993) Water-soluble proteins (WSPs) of barley: genetics and characterisation. *Aspects of Applied Biology (United Kingdom)* (no.36) p. 121-124. 12 ref. English. (AGRIS 95-087171).

3572 Friebe, B.; Tuleen, N.A.; Gill, B.S. (1995) STANDARD KARYOTYPE OF TRITICUM SEARSII AND ITS RELATIONSHIP WITH OTHER S-GENOME SPECIES AND COMMON WHEAT. *Theoretical & Applied Genetics*. 91(2):248-254. English. [KANSAS STATE UNIV AGR & APPL SCI CTR WHEAT GENET RESOURCE DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

C-banding polymorphism was analyzed in 14 accessions of *Triticum searsii* from Israel, and a generalized idiogram of the species was established. One accession was homozygous for whole arm translocations T1S(s)S . 4S(s)S and T1S(s)L . 4S(s)L. C-banding analysis was also used to identify 7 *T. aestivum* cv 'Chinese Spring'-*T. searsii* disomic chromosome addition lines, 14 ditelosomic chromosome addition lines, 21 disomic whole chromosome, and 31 ditelosomic chromosome substitution lines. The identity of these lines was further confirmed by meiotic pairing analysis. Sporophytic and gametophytic compensation tests were used to determine the homoeologous relationships of the *T. searsii* chromosomes. The results show that the *T. searsii* chromosomes do not compensate well for their wheat homoeologues. The C-banding patterns of *T. searsii* chromosomes are distinct from those of other S-genome species and from the B-genome chromosomes of wheat, indicating that *T. searsii* is not a direct B-genome donor species of *T. turgidum* and *T. aestivum*. [References: 35].

3573 Galiba, G.; Quarrie, S.A.; Sutka, J.; Morgounov, A.; Snape, J.W. (1995) RFLP MAPPING OF THE VERNALIZATION (VRN1) AND FROST RESISTANCE (FR1) GENES ON CHROMOSOME 5A OF WHEAT. *Theoretical & Applied Genetics*. 90(7-8):1174-1179. English. [HUNGARIAN ACAD SCI AGR RES INST H-2462 MARTONVASAR HUNGARY].

A population of single chromosome recombinant lines was developed from the cross between a frost-sensitive, vernalization-insensitive substitution line, 'Chinese Spring' (*Triticum spelta* 5A) and a frost-tolerant, vernalization-sensitive line, 'Chinese Spring' ('Cheyenne' 5A), and used to map the genes *Vrn1* and *Fr1* controlling vernalization requirement and frost tolerance, respectively, relative to RFLP markers located on this chromosome. The *Vrn1* and *Fr1* loci were located closely linked on the distal portion of the long arm of 5AL, but contrary to previous observations, recombination between them was found. Three RFLP markers, *Xpsr426*, *Xcdo504* and *Xwg644* were tightly linked to both. The location of *Vrn1* suggests that it is homoeologous to other spring habit genes in related species, particularly the *Sh2* locus on chromosome 7 (5H) of barley and the *Sp1* locus on chromosome 5R of rye. [References: 40].

3574 Galterio, G.; Desiderio, E. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)); Cappelloni, M.; Pogna, N.E. (Istituto Nazionale della Nutrizione, Rome (Italy)) (1994) Genetic - technological and nutritional characteristics of three Italian populations of "farro"

(*Triticum turgidum* ssp. *dicoccum*). Caratteristiche genetiche - tecnologiche e nutrizionali di tre popolazioni italiane di "farro" (*Triticum turgidum* ssp. *dicoccum*). *Journal of Genetics and Breeding (Italy)* v. 48(4) p. 391-397. 4 tables; 39 ref. English. (AGRIS 95-087559).

3575 Ghaemi, M.; Sarrafi, A. (Ecole Nationale Supérieure Agronomique de Toulouse, Toulouse (France)) (1994) [Pollen-derived plants from F1 hexaploid x tetraploid wheats]. Plante derivate da polline di F1 esaploidi x tetraploidi di frumenti. *Journal of Genetics and Breeding (Italy)* v. 48(4) p. 367-370. 2 tables; 22 ref. English. (AGRIS 95-087339).

Crosses were performed between two hexaploid and four tetraploid wheat genotypes. Five F1 hybrids and their respective parents were grown under greenhouse conditions. The anthers of F1 hybrids and their parents were cultured on potato -2 medium modified by adding 0.5 g/l of glutamin and gellified with 4 g/l of gelrite. Approximately 1600 anthers per genotype were plated. An important genetic variability was observed for all androgenetic parameters studied. From approximately 8000 F1 anthers cultured 226 embryoids, 15 green and 30 albinos plantlets were obtained. Thirteen green and 24 albino plants had 21 chromosomes, whereas only two green and six albinos had 14 chromosomes. Plants with a chromosome number between 14 and 21 were not observed. The results suggest that embryoids with 21 chromosomes had better regeneration ability than embryoids with 14 chromosomes, the D genome improving total and especially green plant regeneration. Tetraploid and hexaploid doubled haploids obtained from interspecific crosses, which have genes of both species, could be valuable genetic material for breeding purposes.

3576 Gupta, S.; Saini, R.G.; Gupta, A.K. (1995) GENETIC ANALYSIS OF RESISTANCE TO LEAF-RUST (PUCCINIA RECONDITA F SP TRITICI) PATHOTYPES IN THE DURUM WHEATS PBW 34 AND DWL 5023. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(2):176-178. English. [DEPT AGR 3 BARON HAY COURT S PERTH WA 6151 AUSTRALIA].

Genetic analysis of leaf-rust resistance was conducted on two durum wheats. *Triticum durum* cvs. 'PBW-34' and 'DWL 5023' were crossed with the leaf-rust-susceptible durum wheat 'Malvi Local'. The F-1, F-2 and F-3 generations were tested against leaf-rust pathotypes 1, 77A and 108. In 'PBW 34', a single dominant gene was effective against each of the pathotypes 1 and 108, whereas two independently inherited dominant genes were effective against pathotype 77A. In 'DWL 5023', two independently inherited dominant genes were operative against pathotypes 1 and 77A, whereas a single dominant gene was identified as being operative against pathotype 108. Allelic tests on F-2 generation and joint segregation analysis on F-3 generation seedlings, suggested that two different genes in each cultivar are effective against these three leaf-rust pathotypes. Cultivar 'PBW 34' has *Lrd1* and *Lrd2* genes whereas *Lrd1* and *Lrd3* genes are present in 'DWL 5023'. [References: 13].

3577 Han Jinghua; Fan Lu (Chinese Academy of Agricultural Science, Beijing (China). Inst. of Crop Breeding and Cultivation) (1994) The effect of *ph1b*, *ph2a* and *ph2b* genes on the hybrids between common wheat and *Triticum timopheevii*. *Scientia Agricultura Sinica (China)* v. 27(5) p. 22-26. 2 tables; 20 ref. Chinese. (AGRIS 95-087157).

3578 Hannappel, U.; Vicentecarajosa, J.; Barker, J.H.A.; Shewry, P.R.; Halford, N.G. (1995) DIFFERENTIAL EXPRESSION OF TWO BARLEY SNF1-RELATED PROTEIN KINASE GENES. *Plant Molecular Biology*. 27(6):1235-1240. English. [UNIV BRISTOL LONG ASHTON RES STN DEPT AGR SCI INST ARABLE CROPS RES BRISTOL BS18 9AF AVON ENGLAND].

We have amplified and cloned DNA sequences derived from a gene encoding a SNF1 (sucrose-nonfermenting 1)-related protein kinase which differs from that previously reported from barley. Northern blot and polymerase chain reaction (PCR) analysis of RNA populations, using specific probes and oligonucleotide primers, indicated that the two SNF1-related genes are differentially regulated. One is expressed in all tissues, whereas the other is expressed at high levels in the seed endosperm and aleurone, but at levels undetectable by northern blot analysis in other tissues. Comparisons with other plant SNF1-related protein kinase genes suggest that the form which is expressed at greatly enhanced levels in the

seed is less similar to the other plant homologues which have been reported and may be unique to cereals. [References: 28].

3579 He Congfen (Hebei Normal Univ., Shijiazhuang (China). Dept. of Biology) (1994) Study on utilization of allogen cytoplasmic wheat. *Chinese Agricultural Science Bulletin (China)* v. 10(5) p. 31-33. 5 ref. Chinese. (AGRI 95-087332).

3580 Hernandez, J.E.; Ona, B.D. (Philippines Univ., Los Banos, College, Laguna (Philippines). Dept. of Agronomy) (1992) Wheat R and D [research and development] at UPLB [College, Laguna, Philippines]. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 84-94. 7 tables. Received Nov 1994. English. (AGRI 95-076476).

3581 Hetrick, B.A.D.; Wilson, G.W.T.; Gill, B.S.; Cox, T.S. (1995) CHROMOSOME LOCATION OF MYCORRHIZAL RESPONSIVE GENES IN WHEAT. *Canadian Journal of Botany-Revue Canadienne de Botanique* 73(6):891-897. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

Symbiotic relationships between wheat plants and mycorrhizal fungi may play an important role in the growth and productivity of wheat as a crop. Wheat cultivars differ in their ability to form such relationships, but little is known concerning the genetic basis of such differences. A set of intervarietal substitution lines having individual chromosomes from 'Cheyenne' (nonresponsive to mycorrhizae) substituted into 'Chinese Spring' (nonresponsive to mycorrhizae) were tested for mycorrhizal response in greenhouse experiments. Chromosomes 1A, 5B, 6B, 7B, 5D, and 7D of 'Cheyenne' had positive effects on the trait, with homologous groups 5 and 7 in the B and D genomes having the largest effects. Chromosome 5B of 'Hope', a nonresponsive cultivar, also had a positive effect in a 'Chinese Spring' background. In addition, the mycorrhizal responsiveness of a range of other cultivars and ancestors was tested to expand information on the trait in wheat and its relatives. Data on chromosome location of mycorrhizal-response genes and genotypic responsiveness will permit more effective genetic manipulation of this trait. [References: 16].

3582 Holubova, K.; Hradecka, D.; Bekele, N.A. (Vysoka Skola Zemedelska, Prague Suchdol (Czech Republic)) (1994) Assessment of some valuable parameters of selected varieties of *Triticum durum*. *Agricultura Tropica et Subtropica (Czech Republic)* v. 27 p. 10-19. 5 tables, 8 ref. English. (AGRI 95-087343).

In a field test, five wheat cultivars, including common wheat and four durum wheat varieties were studied for some characteristics important for the assessment of the production processes and formation of the yield. The characteristics under study included leaf area index, dry matter formation, tillering potential, potential and actual productivity, grain yield obtained, and thousand seed weight. In the majority of comparisons, the durum wheat cultivars showed better results in leaf area index, dry matter production, stalk length and thousand seed weight. However, they had a poorer tillering potential and a lower grain yield.

3583 Huang Henglu; Lu Ping; Xiu Yian (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Crop Germplasm Resources) (1994) Adaptability and utilization prospect of Tibetan wheat [China]. *Crop Genetic Resources (China)* (no. 2) p. 5-7. 18. 4 tables; 4 ref. Chinese. (AGRI 95-087328).

3584 Ibrahim, K.I.M. (Ain Shams Univ., Cairo (Egypt). Faculty of Agriculture) (1994) Estimation of the relative importance of plant characters contributing to yield of a factorial cross of barley. *Journal of Agricultural Sciences, Mansoura Univ. (Egypt)* v. 19(1) p. 15-21. 3 tables; 13 ref. English. (AGRI 95-087183).

3585 Ignacio, D.D. (Mariano Marcos State Univ., Batac, Ilocos Norte (Philippines)) (1992) Wheat R and D [research and development] at MMSU; study title: performance of wheat varieties in the Ilocos [Philippines]. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 38-41. 2 tables. Received Nov 1994. English. (AGRI 95-076475).

3586 Inagaki, M.; Mujeeb-kazi, A. (1995) COMPARISON OF POLYHAPLOID PRODUCTION FREQUENCIES IN CROSSES OF HEXAPLOID WHEAT WITH MAIZE, PEARL MILLET AND SORGHUM. *Breeding Science* 45(2):157-161. English. [CIMMYT INT MAIZE & WHEAT IMPROVEMENT CTR APARTADO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Frequencies of polyhaploid production were compared among three hexaploid wheat varieties ($2n = 6x = 42$, Chinese Spring, Norin 61 and Siete Cerros) pollinated with maize, pearl millet and sorghum lines. All wheat varieties produced embryos in crosses with maize lines at frequencies ranging from 12.6 to 26.8 %. In crosses with pearl millet lines, the embryo formation frequencies were affected by both the wheat varieties and pearl millet lines. In crosses with sorghum lines, the frequencies were highly dependent on the wheat varieties and Siete Cerros produced no embryos. Embryos were obtained from Chinese Spring and Norin 61 in crosses with all lines of maize, pearl millet and sorghum. The embryos from crosses with maize were larger, but developed into plants at lower frequencies than those from crosses with pearl millet and sorghum. Most of the 377 plants cytologically examined were wheat polyhaploids that carried a complement of $3x = 21$ chromosomes. It is inferred that maize-mediated polyhaploid production is more stable than those mediated by pearl millet and sorghum because of less genotypic effects on embryo formation.

3587 Iyamabo, O.E.; Hayes, P.M. (1995) EFFECTS OF PLOT TYPE ON DETECTION OF QUANTITATIVE-TRAIT-LOCUS EFFECTS IN BARLEY (*Hordeum vulgare* L.). *Plant Breeding-Zeitschrift für Pflanzenzüchtung* 114(1):55-60. English. [OREGON STATE UNIV DEPT CROP & SOIL SCI CORVALLIS, OR 97331 USA].

Hill plots offer advantages in testing large germplasm arrays with limited area and seed. However, the relationship of trait expression between hill vs. row plots remains in question. The development of quantitative-trait-locus (QTL) analysis offers alternative methods of testing hypotheses regarding levels of coincident gene effects in divergent plots. The objective of this study was to compare hill and row plots in terms of QTL detection, number of common QTLs and plot-type-specific QTLs for various characters in barley. Assessments were based on sets of 100 F-1-derived doubled haploid progeny from two environments of hill-plot data and two sets of multiple-environment row-plot data. Common large-effect QTLs for height, heading date, and 1000-kernel weight were detected in both plot types. Fewer QTLs were detected in the hill-plot data, with only one QTL detected for grain yield. There were no hill-plot-specific QTL effects. Hill plots appear to be best suited to highly heritable characters such as height, heading date, and 1000-kernel weight. Evaluation of grain yield is best deferred until larger experimental units can be employed. [References: 17].

3588 Iyamabo, O.E.; Hayes, P.M. (1995) EFFECTS OF SELECTION AND OPPORTUNITIES FOR RECOMBINATION IN DOUBLED-HAPLOID POPULATIONS OF BARLEY (*Hordeum vulgare* L.). *Plant Breeding-Zeitschrift für Pflanzenzüchtung* 114(2):131-136. English. [OREGON STATE UNIV DEPT CROP & SOIL SCI CORVALLIS, OR 97331 USA].

Doubled-haploid breeding systems are typically based on sampling gametes from F-1 plants. However, in the case of repulsion linkages, additional recombination could be advantageous. Pre-selection of gamete donors might also shift progeny performance in a desired direction. The objectives of this study were to quantify the effects of an additional round of recombination and assess the effectiveness of preanthesis selection in the production of barley doubled haploids. Assessments were conducted on: 1. 100 F-1-derived lines representing a subset of lines used in previous

genome-mapping studies; 2. 100 random F-2-derived lines; and 3. 50 F-2-derived lines from gamete donors selected for early heading. An additional round of recombination had only a modest effect on generating more favourable genotypes. Pre-anthesis selection was ineffective in generating an earlier heading population. According to published quantitative-trait locus (QTL) analyses based on the F-1-derived population, there are few repulsion linkages between QTL determining the traits measured in this experiment. Any advantages to be gained from postponing the generation of derivation of doubled haploids must be weighed against the delay and additional cost. [References: 23].

3589 Jauhar, PP. (1995) MEIOSIS AND FERTILITY OF F-1 HYBRIDS BETWEEN HEXAPLOID BREAD WHEAT AND DECAPLOID TALL WHEATGRASS (THINOPYRUM PONTICUM). *Theoretical & Applied Genetics*. 90(6):865-871. English. [USDA ARS NO CROP SCI LAB STATE UNIV STN FARGO, ND 58105 USA].

As the first step in the transfer of barely yellow dwarf virus resistance and salt tolerance from decaploid tall wheatgrass (*Thinopyrum ponticum*) into hexaploid bread wheat (*Triticum aestivum* L.), octoploid intergeneric hybrids ($2n = 8x = 56$) were synthesized by crossing the tall wheatgrass cultivar 'Alkar' with wheat cvs. 'Fukuhokomugi' ('Fuko') and 'Chinese Spring'. ('Fuko' x 'Alkar') F-1 hybrids were studied in detail. The F-1 hybrids were perennial and generally resembled the male wheatgrass parent with regard to morphological features and gliadin profile. Most hybrids were euploid with 56 chromosomes and showed high chromosome pairing. On an average, in 6 hybrids 83.6% of the complement showed chiasmatic association, some between wheat and wheatgrass chromosomes. Such a high homoeologous pairing would be obtained if Ph1, the major homoeologous pairing suppressor in wheat, was somehow inactivated. Some of the 'Fuko' x 'Alkar' hybrids had high pollen fertility (18.5-42.0% with a mean of 31.5%) and high seed fertility (3-29 seeds with a mean of 12.3 seeds per spike), offering excellent opportunities for their direct backcrossing onto the wheat parent. [References: 23].

3590 Jauhar, PP. (1995) MORPHOLOGICAL AND CYTOLOGICAL CHARACTERISTICS OF SOME WHEAT X BARLEY HYBRIDS. *Theoretical & Applied Genetics*. 90(6):872-877. English. [USDA ARS NO CROP SCI LAB STATE UNIV STN FARGO, ND 58105 USA].

As initial step in the transfer of dwarf bunt resistance from barley into wheat, the two cereal crops were hybridized. Using the wheat cultivars 'Fukuhokomugi' and 'Chinese Spring' (AABBDD genomes) as female parents and barley cultivar 'Luther' (II genome) as male, we synthesized 9 euploid hybrids ($2n = 4x = 28$; ABDI genomes). The hybrids were vigorous, but highly sterile. Meiotic analyses of seven hybrids showed considerable variation in chromosome pairing. Of the hybrids involving 'Fukuhokomugi' 3 had high pairing with a mean of 5.08-6.72 chiasmata per cell, while others had 2.16-3.52 chiasmata per cell. As many as 12 bivalents in some pollen mother cells would suggest at least some pairing between wheat and barley chromosomes. This level of homoeologous pairing, coupled with some, albeit low, female fertility of the F-1 hybrids, could offer an opportunity for intergeneric gene transfers from barley into wheat and vice versa. [References: 22].

3591 Joshi, K.D.; Budhathoki, C.B.; Gurung, G.B.; Subedi, K.D. (Lumle Agricultural Research Centre, Kaski, Pokhara (Nepal)) (1995) Barley variety improvement research report, 1993/94. *LARC Working paper (Nepal)*; no. 95/24 20 p. Lumle Agricultural Research Centre, Kaski, Pokhara (Nepal). 11 tables. English. (AGRI 95-087185).

Results of barley varietal improvement research conducted at Lumle Centre (1675m) and Out Station Research site Iopre (2150m) in the winter season of 1993/94 are summarized.

3592 Kaminskaya, L.M.; Koran, L.V. (Akadehmiya Navuk Belarusi, Minsk (Belarus). Instytut Genetyki i Tsytalogii) (1994) [Analysis of type of triticale development]. *Analiz typu razvitiya trytsikale. Vestsi Akadehmii Navuk Belarusi. Seryya Biyalagichnykh Navuk (Belarus) (no.2) p. 38-43. 2 tables, 10 ref. Byelo Russian. (AGRI 95-087297).*

3593 Karsai, I.; Bedoe, Z.; Kovacs, G.; Barnabas, B. (Hungarian Academy of Science, Martonvasar. Agricultural Research Inst.) (1994) [The effect of in vivo and in vitro aluminium treatment on anther culture response of

triticale x wheat hybrids (Hungary, Poland)]. *L'effetto del trattamento con alluminio in vivo e in vitro sulla risposta delle colture di antere di ibridi di triticale x grano (Ungheria, Polonia). Journal of Genetics and Breeding (Italy) v. 48(4) p. 353-357. 3 tables; 27 ref. English. (AGRI 95-087313).*

The effects of aluminium on the androgenic response of three F2 population of different wheat x triticale crosses were tested in anther culture. Part of each population was used as a control without in vivo aluminium pretreatment and the other part was selected in hematocytin based seedling test for aluminium tolerance and only plants showing satisfactory rate of root regrowth were retained for anther culture. Androgenic response of each population was tested on liquid MN6 media supplemented with 0.26 M maltose at pH 5.8, while for in vitro aluminium treatment 400 micronM Al was added to the medium with a pH of 4.2. Based on the results, both in vivo and in vitro treatment significantly influenced the anther culture response of the three F2 populations. In vivo Al treatment in the seedling stage resulted in significantly higher embryo induction and to a slightly higher green plant regeneration compared to all the control population studied. On aluminium containing induction media the embryoid induction dropped significantly but led to an increase in green plant regeneration frequency. The vast majority of embryos obtained from aluminium containing induction media regenerated green plants, not albinos.

3594 Khalil, IH.; Carver, BF.; Smith, EL. (1995) GENETIC GAINS IN TWO SELECTION PHASES OF A WHEAT-BREEDING PROGRAMME. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(2):117-120. English. [OKLAHOMA STATE UNIV DEPT AGRON STILLWATER, OK 74078 USA].

Genetic gain in held crops is usually estimated as the collective contribution of several breeding programmes. Critical to an individual breeder, however, is the genetic gain realized within a single programme. Our objective was to quantify per-annum genetic gains from 1969 to 1993 within two successive phases of experimental line testing in the wheat (*Triticum aestivum* L.) breeding programme of the Oklahoma Agricultural Experiment Station. Data for grain yield (Phases I and II), volume weight and heading date (Phase II) were analysed according to the procedure developed by St. Martin and McBlain (1991). Genetic gains for grain yield were indistinguishable between phases, averaging 4.6 +/- 1.1 and 4.2 +/- 1.3% of the control mean across the 24-year period. Genetic gain for volume weight averaged only 0.2% of the check mean, reflecting lower selection pressure for that trait compared to grain yield. Inconsistent genetic gains in heading date reflect a preference for a window of desirable heading dates rather than difficulties in selecting uni-directionally for maturity. The absence of a decline in genetic gain in recent years indicates that future improvement in grain yield is likely; however, increased attention must be given to volume weight to maintain US domestic and export standards for hard winter wheat. The statistical procedure was useful in monitoring long-term trends in genetic gains and identifying gaps in programme efficiency. [References: 8].

3595 Kjaer, B.J. (1994) Use of molecular markers to identify quantitative trait loci in barley (linkage maps, RFLP, RAPD, QTL, earing). Kongelige Veterinaer- og Landbohøjskole, Copenhagen (Denmark); Risø National Lab., Roskilde (Denmark). KVL. 11 ill., 16 tables; 81 ref. 114 p. English. (AGRI 95-087180).

3596 Kolmer, JA. (1995) SELECTION OF PUCCINIA RECONDITA F SP TRITICI VIRULENCE PHENOTYPES IN THREE MULTILINES OF THATCHER WHEAT LINES NEAR ISOGENIC FOR LEAF RUST RESISTANCE GENES. *Canadian Journal of Botany-Revue Canadienne de Botanique*. 73(7):1081-1088. English. [AGR & AGRIFOOD CANADA 195 DAF0E RD WINNIPEG MB R3T 2M9 CANADA].

A heterogeneous population of *Puccinia recondita* f.sp. tritici developed from randomly mated pycnial infections on *Thalictrum speciosissimum* was selected for 12 generations on three multilines composed of Thatcher wheat lines near-isogenic for leaf rust resistance genes. Multiline 1 was composed of 20% each of lines near-isogenic for resistance genes Lr2a, Lr3ka, Lr11, Lr17, and Lr24. Multiline 2 was composed of equal proportions each of Thatcher and the five near-isogenic lines in multiline 1. Multiline 3 was composed of 50% Thatcher and 10% each of the five near-

isogenic lines. Diversity of virulence phenotypes as measured by the Shannon index declined most in the population selected on multiline 1. Phenotypes of *P. r. tritici* with virulence to three of the five resistance genes in the multilines were the predominant isolates in all three populations after 12 generations of selection. Frequency of phenotypes with virulence to resistance genes Lr2a and Lr11 significantly increased in all three populations. Virulence to Lr17 significantly increased in the multiline 3 population, and virulence to Lr24 increased in populations from multilines 2 and 3. Frequency of phenotypes with virulence to Lr3ka did not significantly change in any of the populations. Virulence phenotypes with an intermediate number of virulences appeared to have fitness advantage relative to other isolates on the three host multilines. These results indicate that use of wheat multilines may not necessarily stabilize selection for virulence complexity in *P. r. tritici* populations. [References: 33].

3597 Kumar, J.; Luthra, O.P.; Nirmal, S.C. (Haryana Agricultural University, Hisar (India). Department of Genetics) (1994) Genetic analysis of components of yield in wheat. *Haryana Agricultural University Journal of Research (India)* v. 24(1) p. 1-4. 2 tables; 7 ref. English. (AGRIS 95-076718).

3598 Kutcher, H.R.; Bailey, K.L.; Rossmagel, B.G.; Legge, W.G. (1994) HERITABILITY OF COMMON ROOT ROT AND SPOT BLOTCH RESISTANCE IN BARLEY. *Canadian Journal of Plant Pathology-Revue Canadienne de Phytopathologie*. 16(4):287-294. English. [UNIV SASKATCHEWAN DEPT CROP SCI & PLANT ECOL SASKATOON SK S7N 0W0 CANADA].

Heritability of resistance to common root rot and spot blotch [*Cochliobolus sativus*] was investigated in two resistant-by-susceptible barley crosses. Parental cultivars, F(1)s and progeny lines were evaluated for common root rot reaction in a field disease nursery in four experiments and for spot blotch reaction in two growth chamber experiments. The heritability of common root rot resistance of cross Fr926-77 x Deuce ranged from 56 to 85%. Heritability for spot blotch resistance in this cross was 43 and 61%. For the cross Virden x Ellice, heritability for common root rot resistance ranged from 53 to 78%, and heritability for spot blotch resistance was 73 and 78%. Common root rot resistance appeared to be conditioned by dominant genes in Virden X Ellice, but the genetic basis of the resistance could not be determined for Fr926-77 x Deuce. The continuous nature of the distributions of mean disease reactions of progeny lines and estimation of the number of genes conditioning resistance indicated that inheritance of resistance for both diseases was quantitative in nature. No association between common root rot reaction and spot blotch reaction was detected.

3599 Lamadji, S.; Fautrier, A.G.; Mcneil, D.L.; Sedcole, J.R. (1995) PROPOSED BREEDING STRATEGY FOR YIELD IMPROVEMENT OF HEXAPLOID TRITICALE (X TRITICOSECALE WITTMACK) 1. GENETIC VARIABILITY AND PHENOTYPIC STABILITY. *New Zealand Journal of Crop & Horticultural Science*. 23(1):1-11. English. [INDONESIAN SUGAR RES INST DEPT SUGARCANE BREEDING JALAN PAHLAWAN 25 PASURUAN 67126 INDONESIA].

An experiment to partition the components of variation in selected lines of triticale was conducted at Lincoln, Canterbury, New Zealand. Genetic variation, genotype x environment interaction, and phenotypic stability of 20 quantitative characters, as well as biochemical variation were studied in 11 hexaploid triticale lines. For the quantitative study, the lines were grown in four environments. The randomised complete block design was used in each environment. Data were collected on an individual plant basis except for five characters, measured on a plot basis. The results showed that genetic variation for most of the characters was high as expressed by the high broad sense heritability (>50%). Biochemical variation showed major differences between lines, though each line, except 'Till' and 'Salvo', was relatively homogenous. Genotype x environment interaction was strong for 16 characters. Lines such as 'Lasko', 'Salvo', 'Presto', 'Juanillo', 'Aranui', and 'Swans' have great potential for triticale yield improvements as they had average stability and were well adapted to all environments. Of the early maturing lines-'Fulls', 'Juanillo', 'Swans', and 'Till' are likely to be the best for incorporation in the breeding programme as they had average stability and could be harvested earlier than other lines. [References: 43].

3600 Layaoen, H.L. (National Tobacco Administration, Batac, Ilocos Norte (Philippines)) (1992) Role of commitments of NTA to the development of wheat in the Philippines. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 154-155. Received Nov 1994. English. (AGRIS 95-077355).

3601 Leconte, C. (Institut National de la Recherche Agronomique, Bretenieres (France). Centre de Dijon, Genetique et Amelioration des Plantes) (1994) [Cereal breeding aims]. Orientation de la selection [des cereales]: toujours de nouveaux défis. *Perspectives Agricoles (France)* (no 192) p. 111-117. 5 graph. French. (AGRIS 95-076487).

3602 Lecorre, V.; Bernard, M. (1995) ASSESSMENT OF THE TYPE AND DEGREE OF RESTRICTION FRAGMENT LENGTH POLYMORPHISM (RFLP) IN DIPLOID SPECIES OF THE GENUS TRITICUM. *Theoretical & Applied Genetics*. 90(7-8):1063-1067. English. [INRA AMELIORAT PLANTES STN F-63039 CLERMONT FERRAND FRANCE].

The A genome of the Triticeae is carried by three diploid species and subspecies of the genus *Triticum*: *T. monococcum* ssp. *monococcum*, *T. monococcum* ssp. *boeoticum*, and *T. urartu*, the A-genome donor of bread wheat. These species carry many genes of agronomic interest, including disease resistances, and may also be used for the genetic mapping of the A genome. The aim of this study was to evaluate the variability present in a sample of 25 accessions representative of this group using RFLP markers. Twenty probes, consisting of genomic DNA or cDNA from wheat, were used in combination with four restriction enzymes. A high level of polymorphism was found, especially at the interspecific level. Selecting the most informative enzymes appeared to be of great importance in order to obtain a stable structure for the diversity observed with only 20 probes. The results are largely consistent with taxonomy and data relating to geographical origins. The probes were also tested on 14 wheat cultivars. A good correlation coefficient was found for their informative values on wheat cultivars and diploid lines. Whether the group of species studied here would be useful for genetic mapping remains to be determined. Nevertheless, RFLP markers will be useful to follow genes that can possibly be introgressed from these species into cultivated wheat. [References: 27].

3603 Ledent, J.F. (Universite Catholique de Louvain, Louvain la Neuve (Belgium). Faculte des Sciences Agronomiques. Lab. des Plantes de Grandes Cultures) (1994) [Crops: fascinating, unshaping, disturbing [history of domestication of potato, wheat and maize]]. Les plantes de grandes cultures: fascinantes, incontournables, derangeantes. *Bulletin de la Classe des Sciences - Academie Royale de Belgique (Belgium)* ISSN 0001-4141 v. 5(1-6) p. 95-112. 18 ref. French. (AGRIS 95-076535).

Crops (cultivated plants: potato, wheat, maize, being taken as example) present remarkable features. Some appear clearly as increasing the probability of election by man for domestication (abundance, nutritive value, ease of harvest, productivity, etc.) whereas others are just characters observed more frequently in crops. Chance and interactive feedbacks played an important role in the process of election for gathering and domestication. During history, crops were sometimes considered as nuisance.

3604 Li Weiping; Sun Zheming (Northwestern Agricultural Univ., Yangling, Shaanxi (China)) (1994) A new way of increasing grain yield superiority of wheat hybrids. *Shaanxi Journal of Agricultural Sciences (China)* (no. 5) p. 7-9. 3 tables; 5 ref. Chinese. (AGRIS 95-087315).

3605 Li Yiping (Sichuan Agricultural Univ., Dujiangyan, Sichuan (China). Inst. of Wheats) (1994) Morphological and genetic analysis of natural multi-noded, branched mutant from barley cultivar. *Scientia Agricultura Sinica (China)* v. 27(4) p. 1-9. 4 tables; 9 ref. Chinese. (AGRIS 95-087179).

3606 Liu Binghua; Yang Li (Chinese Academy of Agricultural Science, Beijing (China). Inst. of crop Breeding and Cultivation) (1994) Dwarfing-

sterile wheat and its use in breeding for dwarfness. *Scientia Agricultura Sinica (China)* v. 27(5) p. 17-21. 11 ref. Chinese. (AGRIS 95-087320).

Dwarfing-sterile wheat is a dominant genic male sterile material with dwarfing marker. The dominant gene *Ms2* for male sterility and the dominant gene *Rht10* for dwarfness are closely linked on the short arm of chromosome 4D. Dwarfing-sterile wheat is pollinated by non-dwarfing variety. Of progenies from the cross, dwarf plants will be male sterile type, while non-dwarf plants will be male fertile type. Dwarfing-sterile wheat had potential value in recurrent selection and conventional breeding. The objective, strategy and some important aspects in wheat breeding for dwarfness are discussed in the paper.

3607 Liu, CY.; Rathjen, AJ.; Shepherd, KW.; Gras, PW.; Giles, LC. (1995) GRAIN QUALITY AND YIELD CHARACTERISTICS OF D-GENOME DISOMIC SUBSTITUTION LINES IN LANGDON (TRITICUM TURGIDUM VAR DURUM). *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(1):34-39. English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

Sets of D-genome disomic substitution lines of 'Langdon' (*Triticum turgidum* var. durum) were used to study the effect of chromosome substitutions on grain yield and hour technological properties. In general, the substitution of any D-genome chromosome had a detrimental effect on grain yield and growth vigour (some lines were sterile). SDS-sedimentation, SE-HPLC and two-gram mixograph procedures were used to measure dough strength of the lines studied. Significant correlations were observed between protein concentration and grain yield and other quality parameters such as SDS-sedimentation value, the proportion of glutenin, dough mix time and peak resistance. Most of the quality characters were highly correlated with each other. Substitution of chromosomes 1D, 5D, 2D and 7D resulted in positive responses to SDS-sedimentation values, but only chromosome 1D had positive effects on the proportion of peak 1 (P-1%), measured by SE-HPLC. Besides the major influence of chromosome 1D on three major mixograph parameters (mixing time, peak resistance and resistance breakdown), chromosome 5D also exhibited significant effects on these mixing parameters. Principal-component analysis showed that the predominant effect on durum-wheat technological properties was from chromosome 1D, whereas chromosome 5D had a major effect on grain hardness (50%) and increased the whiteness of the flour. [References: 33].

3608 Liu, CY.; Shepherd, KW. (1995) INHERITANCE OF B SUBUNITS OF GLUTENIN AND OMEGA- AND GAMMA-GLIADINS IN TETRAPLOID WHEATS. *Theoretical & Applied Genetics*. 90(7-8):1149-1157. English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

A double-1RS wheat-rye translocation line lacking all B subunits of glutenin was produced in durum wheat cv 'Langdon' for use in backcrosses and testcrosses in the study of the inheritance of low-molecular-weight (LMW) glutenin subunits in tetraploid wheats. The B subunits of glutenin and gamma- and omega-gliadin bands present in parents derived from *Triticum durum* and *T. dicoccoides*, encoded by *Glu-3* and *Gli-1* loci, respectively, were found to be inherited mainly as units (blocks), as reported previously. Two rare recombination events between the *Glu-A3* and *Gli-A1* loci were detected in testcross progeny from 'Edmore' x *T. dicoccoides* landrace 19-27. Several rare recombinants were also detected within the 1BS-controlled B subunits of glutenin blocks, suggesting that there are two separate tightly linked loci (3.07+/-1.35 cM) within the *Glu-B3* 'locus'. Evidence was also obtained for the presence of an additional locus coding for a B subunit of glutenin in 'Edmore' that is loosely linked (20.9+/-3.18%) with the main *Glu-B3* 'locus'. [References: 29].

3609 Lukaszewski, AJ. (1995) CHROMATID AND CHROMOSOME TYPE BREAKAGE-FUSION-BRIDGE CYCLES IN WHEAT (TRITICUM AESTIVUM L.). *Genetics*. 140(3):1069-1085. English. [UNIV CALIF RIVERSIDE DEPT BOT & PLANT SCI RIVERSIDE, CA 92521 USA].

During the development of disomic additions of rye (*Secale cereale* L.) chromosomes to wheat (*Triticum aestivum* L.), two reverse tandem duplications on wheat chromosomes 3D and 4A were isolated. By virtue of their meiotic pairing, the reverse tandem duplications initiated the chromatid type of the breakage-fusion-bridge (BFB) cycle. This BFB cycle

continued through pollen mitoses and in the early endosperm divisions, but no clear evidence of its presence in embryo mitoses was found. The chromosome type of BFB cycle was initiated by fusion of two broken chromosome ends resulting in a dicentric or a ring chromosome. Chromosome type BFB cycles were detected in embryo mitoses and in root tips, but they did not persist until the next meiosis and were not transmitted to the progeny. Active BFB cycles induced breakage of other wheat chromosomes that resulted in additional reverse tandem duplications and dicentric and ring chromosomes. Four loci, on chromosome arms 2BS, 3DS, 4AL, and most likely on 7DL, were particularly susceptible to breakage. The BFB cycles produced high frequency of variegation for pigmentation of the aleurone layer of kernels and somatic chimeras for a morphological marker. With the exception of low mutation rate, the observed phenomena are consistent with the activity of a Ds-like element. However, it is not clear whether such an element, if indeed present, was of wheat or rye origin. [References: 25].

3610 Lukaszewski, AJ.; Xu, XT. (1995) SCREENING LARGE POPULATIONS OF WHEAT HYBRIDS BY C-BANDING. *Cereal Research Communications*. 23(1-2):9-13. English. [UNIV CALIF RIVERSIDE DEPT BOT & PLANT SCI RIVERSIDE, CA 92521 USA].

The requirements of some experiments in wheat cytogenetics dictate screening of large populations of hybrids. Because cytogenetics is perceived as tedious, such experiments may not be undertaken, or be limited in scale. This note describes a simplified C-banding procedure and the organization of work in a cytogenetic laboratory which permit screening of 240-960 wheat plants per day. Depending on the level of motivation and experience in cytology, this pace can be sustained over a period of several days to several weeks. However, at this pace of cytology, the development of populations for screening quickly becomes a new bottleneck.

3611 Luthra, O.P.; Chawla, V.; Yadav, B.; Saharan, R.P. (Haryana Agricultural University, Hisar (India). Department of Genetics) (1994) Genetic architecture of some physiological characters in wheat. *Haryana Agricultural University Journal of Research (India)* v. 24(2-3) p. 79-83. 4 tables; 5 ref. English. (AGRIS 95-076721).

3612 Lutz, J.; Katzhammer, M.; Stephan, U.; Felsenstein, FG.; Oppitz, K.; Zeller, FJ. (1995) IDENTIFICATION OF POWDERY-MILDEW-RESISTANCE GENES IN COMMON WHEAT (TRITICUM AESTIVUM L. EM THELL) 5. OLD GERMAN CULTIVARS AND CULTIVARS RELEASED IN THE FORMER GDR. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(1):29-33. English. [TECH UNIV MUNICH INST PFLANZENBAU & PFLANZENZÜCHTUNG D-85350 FREISING GERMANY].

A total of 59 old wheat cultivars grown in Germany prior to 1960 were tested for mildew response using a collection of 12 differential isolates of *Erysiphe graminis* DC f. sp. *tritici* Marchal (*Blumeria graminis* (DC) Speer f. sp. *tritici*). Nineteen cultivars did not possess any major resistance gene and 25 were characterized by susceptible or intermediate responses. Fifteen cultivars revealed isolate-specific response patterns that could not be attributed to known major resistance genes or gene combinations. Many of the old German cultivars inherited a mildew-resistance gene from the Canadian cultivar 'Garnet', which is tentatively designated MI-Ga. Cultivars 'Bretonischer Bartweizen' (designated MI-Br) and 'Adlungs Alemannen' (designated MI-Ad) appeared to carry unknown resistance genes. Among 18 winter wheat cultivars released in the former GDR, eight showed susceptibility to all isolates used. Cv. 'Borenos' carries resistance gene *Pm3c*. Five cultivars possess gene *Pm4b*, two cultivars gene *pm5* and one cultivar a combination of genes *Pm2* and *Pm4b*. Cultivar 'Zentos' was resistant to almost all isolates used. Its resistance might be conditioned by different unknown major resistance genes. [References: 17].

3613 Ma Jnhu; Huang Peizhong (Shanghai Municipal Academy of Agricultural Science (China). Inst. of Crop Breeding and Cultivation) (1994) A study on screening of resistant resource and its geographical distribution of BaYMV in China. *Scientia Agricultura Sinica (China)* v. 27(5) p. 39-44. 3 tables; 12 ref. Chinese. (AGRIS 95-087178).

3614 Ma, H.; Singh, R.P.; Mujeeb-kazi, A. (1995) RESISTANCE TO STRIPE RUST IN TRITICUM TURGIDUM, T-TAUSCHII AND THEIR SYNTHETIC HEXAPLOIDS. *Euphytica*. 82(2):117-124. English. [CIMMYT INT MAIZE & WHEAT IMPROVEMENT CTR LISBOA 27 APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Resistance to stripe rust (caused by *Puccinia striiformis* Westend.) of 34 *Triticum turgidum* L. var. durum, 278 *T. tauschii*, and 267 synthetic hexaploid wheats (*T. turgidum* x *T. tauschii*) was evaluated at the seedling stage in the greenhouse and at the adult-plant stage at two field locations. Mexican pathotype 14E14 was used in all studies. Seedling resistance, expressed as low infection type, was present in all three species. One hundred and twenty-eight (46%) accessions of *T. tauschii*, 8 (23%) of *T. turgidum* and 31 (12%) of synthetic hexaploid wheats were highly resistant as seedlings. In the field tests, resistance was evaluated by estimating area under disease progress curve (AUDPC). Synthetic hexaploid wheats showed a wide range of variability for disease responses in both greenhouse and field tests, indicating the presence of a number of genes for resistance. In general, genotypes with seedling resistance were also found to be resistant as adult plants. Genotypes, which were susceptible or intermediate as seedlings but resistant as adult plants, were present in both *T. turgidum* and the synthetic hexaploids. Resistances from either *T. turgidum* or *T. tauschii* or both were identified in the synthetic hexaploids in this study. These new sources of resistance could be incorporated into cultivated hexaploid wheats to increase the existing gene pool of resistance to stripe rust. [References: 29].

3615 Ma, ZQ.; Sorrells, ME. (1995) GENETIC ANALYSIS OF FERTILITY RESTORATION IN WHEAT USING RESTRICTION FRAGMENT LENGTH POLYMORPHISMS. *Crop Science*. 35(4):1137-1143. English. [CORNELL UNIV DEPT PLANT BREEDING & BIOMETRY 252 EMERSON HALL ITHACA, NY 14853 USA].

Fertility restoration for *Triticum timopheevi* Zhuk. cytoplasmic male sterility in wheat (*Triticum aestivum* L.) is controlled by both major fertility restorer (Rf) genes and modifier genes together with environment effects. Therefore, the breeding of efficient and stable male-fertility restorer lines (R-lines) should be facilitated by marker-assisted selection. This study was conducted to identify restriction fragment length polymorphism (RFLP) markers for the Rf genes, Rf1 and Rf4 in restorer line R113, and Rf3 and a Rf gene on 5D in cultivar Primepi. Polymorphic markers were mapped in testcross F-1 populations and their association with fertility restoration was analyzed by analysis of variance. The results indicated that Rf4 was linked to Xksug48 located on 6BS in R113, Rf3 was linked to Xbcd249 and Xcdo442 on 1BS, and Xcdo786 may be associated with the 5D Rf gene in Primepi. In addition, in R113 two other chromosome regions with fertility restoration-associated loci were detected by CD0786 and H1 on 5AL and CDO1189 on 7BS. A locus on 5DS, detected by BCD1871, showed significant epistatic effect on the expression of Rf genes. In Primepi, a locus on 5AL, detected by Xbcd183 and Xbcd876, had effects similar to Xcdo786. Two loci in 'Qu Xian Early A', identified by Xbcd871 and Xwg1026, may be associated with genes controlling ease of restoration in this male-sterile line (A-line). Except for Xbcd1871 and Xwg1026, the effects of other significant RFLP loci were additive in both populations. [References: 42].

3616 Mamluk, OF.; Nachit, MM. (1994) SOURCES OF RESISTANCE TO COMMON BUNT (TILLETIA FOETIDA AND T-CARIES) IN DURUM WHEAT. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 142(2):122-130. English. [INT CTR AGR RES DRY AREAS POB 5466 ALEPPO SYRIA].

Screening of durum wheat germplasm for resistance to common bunt (*Tilletia foetida* and *T. caries*) resulted in the identification of 26 resistant genotypes. The screening was made using nine common bunt isolates from the West Asia and North Africa (WANA) region. In one isolate the two pathogens were represented in ratio of 1:1, whereas eight isolates contained only *T. foetida*. The correlation, principal components and clustering analyses grouped the genotypes into three clusters. Cluster one comprised genotypes with genetic interrelationship with Jennah Khetifa, a Maghrebian landrace. Cluster two comprised genotypes close to Senatore (S.) Cappelli and Haurani, the latter is a landrace from Syria. Cluster three comprised advanced genotypes containing resistance genes from Mindum, a Turkish landrace. Results indicated that donor sources of resistance

appear to be related to the three major sources mentioned. Cultivar S. Cappelli is considered resistant since it has been grown by farmers on a large scale for many years and remained resistant to common bunt throughout 7 years of testing. This resistance is assumed to be of a durable type. The isolates were also grouped into three clusters representing different ecological areas and the wheat types from which the isolates originated. We infer that the different clusters reflect the presence of three pathotype groups of the pathogens. [References: 27].

3617 Mangat, GS.; Dhindsa, GS. (1995) COMBINING ABILITY STUDIES IN SPRING X WINTER TRITICALE CROSSES FOR YIELD AND ITS COMPONENTS OVER ENVIRONMENTS. *Cereal Research Communications*. 23(1-2):73-78. English. [PUNJAB AGR UNIV DEPT PLANT BREEDING LUDHIANA 141004 PUNJAB INDIA].

Eight parent half diallel set involving four spring and four winter triticale lines was studied over three unilocation environments. The three environments under study were observed to be divergent. The mean squares due to genotypes were highly significant for all the characters evaluated. Both general combining ability (GCA) and specific combining ability (SCA) variances were influenced by environmental conditions, thereby suggesting that to have unbiased estimates of GCA and SCA, such studies be made over a range of environments. The non-additive gene effects were more pronounced in the inheritance of characters under study. On the basis of per se performance and GCA effects, winter parent WTCB 29 was adjudged as being the best overall combiner for grain yield, number of grains per spike and second best combiner for 1000 grain weight while TL 1210 emerged as the best combiner for 1000-grain weight and harvest index. The desirable crosses on the basis of SCA effects were: WTCB 29 x JNIT 108 (winter x spring), WTCB 29 x WTCB 21 and WTCB 22 x WTCB 119 both involving winter x winter parents.

3618 Maramba, F.K. Jr. (Philippine Association of Flour Millers, Inc., Pasay Road, Makati, Metro Manila (Philippines)) (1992) Role and commitments of PAFMIL to the development of wheat in the Philippines. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia p. 129-132. Received Nov 1994. English. (AGRI 95-076477).*

3619 Martin, G. (Institut Technique des Cereales et des Fourrages, Paris (France)) (1994) [Soft wheat varieties and quality]. Comment mieux apprehender la qualite des varietes [de ble tendre]. *Perspectives Agricoles (France) (no 192) p. 29-34. French. (AGRI 95-076666).*

3620 Mastebroek, HD.; Balkemaboomstra, AG.; Gaj, M. (1995) GENETIC ANALYSIS OF POWDERY-MILDEW (ERYSIPHE GRAMINIS F SP HORDEI) RESISTANCE DERIVED FROM WILD BARLEY (HORDEUM VULGARE SSP SPONTANEUM). *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 114(2):121-125. English. [CTR PLANT BREEDING & REPROD RES DLO POB 16 6700 AA WAGENINGEN NETHERLANDS].

The inheritance of resistance to powdery mildew was investigated in 20 accessions of *Hordeum spontaneum* and in 20 F-4 lines derived from crosses between the variety 'Aramir' and 13 accessions of *H. spontaneum*. Two resistance genes were detected in 17 accessions, and three resistance genes in one accession. In two accessions, only one resistance gene was present. The 20 breeding lines showed a large variation in infection type and infection level. The genetic relationship between the resistance genes detected was investigated in the seven most resistant F-4 lines. These F-4 lines were divided into three groups which carried different resistance genes. In two lines, the detected resistance gene was shown to be race-specific. [References: 18].

3621 Mayer, M.; Gland, A.; Ceccarelli, S.; Geiger, HH. (1995) COMPARISON OF DOUBLED HAPLOID LINES AND F-2 BULKS FOR THE IMPROVEMENT OF BARLEY IN THE DRY AREAS OF NORTH SYRIA. *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 114(1):45-49. English. [UNIV HOHENHEIM INST PFLANZENZUCHTUNG

Drought stress is the main factor limiting barley yields in West Asia and North Africa. This study compares the utility of doubled haploid lines (DHLs) and conventional F-2 plant-derived bulks (F(2)Bs) in improving barley in stress environments. Double crosses were made, DHLs were developed by anther culture from double-cross F-1 plants, and F(2)Bs were produced by bulking the offspring of F-2 plants. Field tests were conducted in three drought-stressed environments. No major differences were observed in the mean performance of DHLs and F(2)Bs. For most traits, both the genotypic and the genotype x location interaction Variances were higher in the DHL group, whereas heritabilities were similar. Higher gains from selection were predicted for the DHL group. Regression analysis of yield stability indicated a lower predictability of the DHL performance. The haploid technique can improve breeding populations from which Varieties with stable yields can be developed. The costs involved are determined by the DHL production rate, which needs to be improved in many developing countries. [References: 23].

3622 Mazzola, M.; Fujimoto, DK.; Thomashow, LS.; Cook, RJ. (1995) VARIATION IN SENSITIVITY OF GAEUMANNOMYCES GRAMINIS TO ANTIBIOTICS PRODUCED BY FLUORESCENT PSEUDOMONAS SPP AND EFFECT ON BIOLOGICAL CONTROL OF TAKE-ALL OF WHEAT. *Applied & Environmental Microbiology*. 61(7):2554-2559. English. [WASHINGTON STATE UNIV USDA ARS ROOT DIS & BIOL CONTROL RES UNIT 365 JOHNSON HALL PULLMAN, WA 99164 USA].

Isolates of *Gaeumannomyces graminis* var. *tritici*, the causal agent of take all of wheat, varied in sensitivity in vitro to the antibiotics phenazine-1-carboxylic acid (PCA) and 2, 4-diacetylphloroglucinol (Phl) produced by fluorescent *Pseudomonas* spp. shown previously to have potential for biological control of this pathogen. None of the four isolates of *G. graminis* var. *avenae* examined were sensitive to either of the antibiotics in vitro at the concentrations tested. The single isolate of *G. graminis* var. *graminis* tested was insensitive to PCA at 1.0 µg/ml. *Pseudomonas fluorescens* 2-79 and *Pseudomonas chlororaphis* 30-84, both of which produce PCA, effectively suppressed take-all caused by each of two PCA-sensitive isolates of *G. graminis* var. *tritici*. PCA-producing strains exhibited a reduced ability or complete inability to suppress take-all caused by two of three isolates of *G. graminis* var. *tritici* that were insensitive to PCA at 1.0 µg/ml. *P. fluorescens* Q2-87, which produces Phl, suppressed take-all caused by three Phl-sensitive isolates but failed to provide significant suppression of take-all caused by two isolates of *G. graminis* var. *tritici* that were insensitive to Phl at 3.0 µg/ml. These findings affirm the role of the antibiotics PCA and Phl in the biocontrol activity of these fluorescent *Pseudomonas* spp. and support earlier evidence that mechanisms in addition to PCA are responsible for suppression of take all by strain 2-79. The results show further that isolates of *G. graminis* var. *tritici* insensitive to PCA and Phl are present in the pathogen population and provide additional justification for the use of mixtures of *Pseudomonas* spp. that employ different mechanisms of pathogen suppression to manage this disease. [References: 32].

3623 Mccaig, TN.; Depauw, RM. (1995) BREEDING HARD RED SPRING WHEAT IN WESTERN CANADA - HISTORICAL TRENDS IN YIELD AND RELATED VARIABLES. *Canadian Journal of Plant Science*. 75(2):387-393. English. [AGR CANADA RES STN RES BRANCH SWIFT CURRENT SK S9H 3X2 CANADA].

The Western Bread Wheat Cooperative test and Central Bread Wheat Cooperative test are the bases of evaluation for cultivar registration in the Canada Western Red Spring (CWRS) wheat class. Historical data from these tests were analyzed with the objectives of comparing grain-yield-related variables of recently registered cultivars with those of earlier cultivars and determining the yield advances made within the CWRS wheat class. Canadian cultivars increased maximum yield potential approximately 6-9 kg ha⁻¹ yr⁻¹ during a 90-yr period. Yield potential of sawfly-resistant cultivars has been increasing at a rate of 11 kg ha⁻¹ yr⁻¹, although they consistently yielded less than the highest yielding hollow-stem cultivars. In general, the genetic yield increases resulted from an increase in the number of kernels produced rather than an increase in kernel size. This suggests that bread wheat grown on the prairies has been sink limited during grain filling. Breeding efforts focused on increasing Canadian production through the development of numerous CWRS

cultivars with specific traits (e.g., early maturity, disease resistance) to allow hard red spring wheat to be grown over a broad geographical range. Plant height, time to maturity, and hectolitre weight did not change significantly during the 1947-1992 period. [References: 17].

3624 McIntosh, RA.; Friebe, B.; Jiang, J.; The, D.; Gill, BS. (1995) CYTOGENETICAL STUDIES IN WHEAT .16. CHROMOSOME LOCATION OF A NEW GENE FOR RESISTANCE TO LEAF RUST IN A JAPANESE WHEAT-RYE TRANSLOCATION LINE. *Euphytica*. 82(2):141-147. English. [UNIV SYDNEY INST PLANT BREEDING PRIVATE BAG 11 CAMDEN NSW 2570 AUSTRALIA].

A leaf rust resistant wheat-rye translocation stock, ST-1, introduced from Japan, comprised distinct morphological types. One type possessed a T1BL-1RS chromosome with genes Lr26, Yr9 and Sr31. A second type carried a new gene, Lr45, located in a large segment of rye chromosome translocated to wheat chromosome 2A. Its structure was identified as T2AS-2RS2RL. Despite the homoeology of the 2A and 2R chromosomes and the high level of compensation provided by the translocation, Lr45 was not normally inherited and is probably associated with agronomic deficiencies that will prevent its exploitation in agriculture. [References: 23].

3625 Mickelsonyoung, L.; Endo, TR.; Gill, BS. (1995) A CYTOGENETIC LADDER-MAP OF THE WHEAT HOMEOLOGOUS GROUP-4 CHROMOSOMES. *Theoretical & Applied Genetics*. 90(7-8):1007-1011. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

We report the results of chromosome maps of wheat homoeologous chromosomes 4A, 4B, and 4D using 40 RFLP markers and 39 homozygous deletion lines. Deletion breakpoints divide the chromosomes into 45 sub-arm intervals with 32 intervals distinguished by molecular markers. The chromosome maps confirm the homoeology of arms 4AS to 4BL and 4DL, and 4AL to 4BS and 4DS. The chromosome map of 4A reveals novel information concerning the 4AL-5AL-7BS cyclical translocation. The presence of homoeologous group-4 long-arm markers, Xksu C10 and Xpsr 1051, intervening between the translocated 5AL and 7BS chromosome segments in 4AL suggests that the translocation events are more complex than was earlier believed. Chromosome maps confirm a pericentric inversion in Chinese Spring chromosome 4B. The consensus chromosome map is compared to the genetic map of wheat to construct a cytogenetic ladder-map (CLM). The CLM reveals an unequal distribution of recombination along the length of the chromosome arms. Recombination is highest in the distal half, and low in the proximal half, of the chromosome arms. [References: 22].

3626 Miedaner, T.; Ziegler, DE.; Geiger, HH. (1995) VARIATION AND COVARIATION FOR QUANTITATIVE RESISTANCE TO HEAD BLIGHT (FUSARIUM CULMORUM) IN TWO TESTCROSS SERIES OF S-2 LINES IN WINTER RYE. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(2):155-159. English. [UNIV HOHENHEIM LANDESSAATZUCHTANSTALT 720 D-70593 STUTTGART GERMANY].

The amount of genetic variation among inbred lines and testcrosses, and covariation between both genetic materials, are of crucial importance for selection efficiency in hybrid breeding. To estimate these quantitative genetic parameters for resistance of winter rye (*Secale cereale*) to head blight caused by *Fusarium culmorum*, 88 three-way cross hybrids, produced by crossing each of 44 S-2 Carsten inbred lines with two unrelated Petkus single-cross testers, were evaluated along with the parental lines over 2 years. Resistance traits were head-blight rating and grain weight per spike relative to the non-inoculated control. Significant genotypic variation occurred among lines and in both testcross series. S-2 lines displayed considerably more variation than testcross series. Genotype x environment interaction was more marked among the inbred lines, while estimates of heritability were similar for both genetic materials. Testcrosses showed heterosis for head-blight resistance. No relationship existed between S-2 lines and the two testcross series for any resistance trait. This might be caused by an association between inbreeding and *Fusarium*-head-blight susceptibility and different inbreeding depression among the S-2 population. The phenotypic correlations between the testcross series were moderate for both traits ($r = 0.58$, $P < 0.01$). In conclusion, *Fusarium*-head-blight resistance has to be selected at the respective heterozygosity levels. [References: 29].

3627 Milovanovic, M.; Kuburovic, M. (Centar za strna zita, Kragujevac (Yugoslavia)) (1993) [Yield and trade quality of Kragujevac (Yugoslav) triticale cultivars]. *Rodnost i prometni kvalitet kragujevackih [jugoslovenskih] sorti tritikalea. Zito hleb (Yugoslavia) v. 20(1-2) p. 25-31. 5 tables; 16 ref. Serbian. (AGRI 95-076489).*

Two spring triticale cultivars Zlatar and Soko and winter triticale Kg-20, created in Institute for Small Grains, Kragujevac (Yugoslavia), were recognized by Yugoslav Commission for Cultivars Approval between 1980 and 1990. These cultivars achieved higher grain yield and quality than standard varieties. Crude protein content in spring triticale cultivars was especially high. Mentioned cultivars had high yields in micro trials in Kragujevac too. They had large kernels, with satisfying plumpness and high protein content. Grain filling and protein content were considerably influenced by year conditions.

3628 Monte, J.V.; Flavell, R.B.; Gustafson, J.P. (1995) WIS 2-1A - AN ANCIENT RETROTRANSPOSON IN THE TRITICEAE TRIBE. *Theoretical & Applied Genetics. 91(2):367-373. English. [USDA ARS PLANT GENET RES UNIT COLUMBIA, MO 65211 USA].*

WIS 2-1A, the first retrotransposon found in wheat, has been recently studied and characterized. Southern hybridization experiments utilizing several species from the Triticeae revealed the presence of homologous sequences in all the taxa tested, showing high levels of interspecific variability and almost no intraspecific differentiation. Further experiments using in situ hybridization in several species showed that the retrotransposon was almost completely dispersed throughout the genomes tested. These results suggested that WIS 2-1A is an ancient element that probably was present in the unknown common ancestor of the Triticeae and that only under rare circumstances does it become active. DNA fragments homologous to the WIS 2-1A reverse transcriptase gene were isolated from most of the Triticeae species using PCR. The fragments obtained were sequenced and analyzed. Even though the sequence alignment was consistent with the phylogenetic studies made in the past, the genus *Thinopyrum* showed new evidence for a possible horizontal propagation of the retroelement. [References: 36].

3629 Morenosevilla, B.; Baenziger, P.S.; Peterson, C.J.; Graybosch, R.A.; Mcvey, D.V. (1995) THE 1BL/1RS TRANSLOCATION - AGRONOMIC PERFORMANCE OF F-3-DERIVED LINES FROM A WINTER WHEAT CROSS. *Crop Science. 35(4):1051-1055. English. [UNIV NEBRASKA DEPT AGRON LINCOLN, NE 68583 USA].*

Cultivar comparisons have suggested that the 1BL/1RS wheat (*Triticum aestivum* L.)-rye (*Secale cereale* L.) chromosomal translocation enhances agronomic performance and environmental stability of wheat. This advantage has been attributed either to disease resistance genes or to improved adaptation genes on the 1RS segment. The objective of this study was to determine the effect of 1BL/1RS without the confounding effect of cultivar background by evaluating 17 homogeneous 1B, 20 heterogeneous 1B:1BL/1RS, and 22 homogeneous 1BL/1RS lines. The lines were randomly selected from the cross 'Siouxland'/'Ram'. The 59 progeny lines and the two parents were tested in seven Nebraska held environments with a randomized complete-block design. Data were obtained for grain yield, components of yield, grain volume weight, anthesis date, plant height, and leaf rust infection. The 1BL/1RS class was 9% higher yielding than 1B and heterogeneous classes. This yield advantage was attributed to increased kernel weight, which was generally expressed in lower yielding environments. Differential response to disease pressure did not explain yield differences. Within chromosome classes, differences in grain yield were attributed more to variation in number of spikes per square meter not kernel weight. The grain yield advantage of the 1BL/1RS appeared to be associated with a postanthesis stress tolerance, which resulted in increased kernel weight of the 1BL/1RS genotypes. [References: 25].

3630 Murai, K.; Tsunewaki, K. (1995) PHOTOPERIOD-SENSITIVE CYTOPLASMIC MALE STERILITY INDUCED IN JAPANESE WHEAT CULTIVARS BY TRANSFERRING AEGILOPS CRASSA CYTOPLASM. *Breeding Science. 45(2):199-203. English. [SUMITOMO CHEM CO LTD TAKARAZUKA RES CTR TAKARAZUKA HYOGO 665 JAPAN].*

Triticum aestivum cv. Norin 26 with *Aegilops crassa* cytoplasm shows photoperiod-sensitive cytoplasmic male sterility (PCMS). The alloplasmic

line is almost completely male sterile under long-day conditions (greater than or equal to 15 h light period), but highly male fertile under short-day conditions (less than or equal to 14.5 h). To examine the effects of the Ae. crassa cytoplasm on other wheat cultivars, this cytoplasm was introduced into 17 Japanese wheat cultivars by repeated backcrosses. Among their alloplasmic lines which reached B-5 (11 lines) or B-4 (six lines) generation, those of nine cultivars showed PCMS caused by the Ae. crassa cytoplasm, while those of other eight cultivars did not. Thus, the former nine cultivars are converted to the PCMS lines by transfer of the Ae. crassa cytoplasm, and the latter eight cultivars have demonstrated to carry fertility-restoring (Rf) gene(s) against PCMS. Pedigrees of the Japanese wheat cultivars suggest monophyletic origin of the Rf gene(s).

3631 Naranjo, T. (1995) CHROMOSOME STRUCTURE OF TRITICUM LONGISSIMUM RELATIVE TO WHEAT. *Theoretical & Applied Genetics. 91(1):105-109. English. [UNIV COMPLUTENSE MADRID FAC BIOL DEPT GENET E-28040 MADRID SPAIN].*

Homoeologous pairing at meiotic metaphase I was analyzed in *T. longissimum* x *T. aestivum* hybrids in order to reconfirm the homoeologous relationships of *T. longissimum* chromosomes to wheat. Hybrids between *T. longissimum* and 'Chinese Spring' carrying the Ph1 gene or the ph1b mutation, which showed low and high pairing levels, respectively, were used. Chromosome arms associated at metaphase I were identified by C-banding. The homoeology of chromosomes 1S(I), 2S(I), 3S(I), 5S(I) and 6S(I) to wheat group 1, 2, 3, 5, and 6 chromosomes, respectively, was confirmed. Chromosome arms 4S(I)S and 7S(I)S showed normal homoeologous relationships to wheat. The 4S(I)L arm carries a translocated segment from 7S(I)L relative to wheat. The 7S(I)L arm seldom paired, likely because this arm lost a relatively long segment and received a very short segment in the interchange with 4S(I)L. Available data suggest that translocation 4S(I)L/7S(I)L arose in the evolution of *T. longissimum*, which implies that this species was not the donor of the B genome of wheat. [References: 27].

3632 Okada, Y.; Yoshigi, N.; Sahara, H.; Koshino, S. (1995) INCREASE IN THERMOSTABILITY OF RECOMBINANT BARLEY BETA-AMYLASE BY RANDOM MUTAGENESIS. *Bioscience Biotechnology & Biochemistry. 59(6):1152-1153. English. [SAPPORO BREWERIES LTD BREWING RES LABS 10 OKATOHME YAIZU SHIZUOKA 425 JAPAN].*

Random mutations were introduced into recombinant barley beta-amylase by modified PCR to increase its thermostability. Two clones were obtained. One was found to have a change of Ser-351 to Pro and another, a change of Ala-376 to Ser, and 2.3 degrees C and 1.0 degrees C increases, respectively, in the thermostabilities compared with that of native recombinant beta-amylase. [References: 14].

3633 Pang Chunming (Hebei Provincial Academy of Agricultural Sciences, Shijiazhuang (China). Inst. of Grain and Oil Crops) (1994) The analysis of Hebei winter wheat variety developing by grey correlative degree [China]. *Crop Genetic Resources (China) (no. 3) p. 4-7. 3 tables; 2 ref. Chinese. (AGRI 95-087158).*

3634 Pannu, R.K.; Singh, D.P.; Chaudhary, B.D.; Singh, P.; Sangwan, V.P. (Haryana Agricultural University, Hisar (India). Directorate of Research) (1994) Use of potassium iodide a desiccant as technique for screening drought tolerant genotypes in wheat. *Haryana Agricultural University Journal of Research (India) v. 24(1) p. 43-48. 4 tables; 6 ref. English. (AGRI 95-076720).*

3635 Pecetti, L.; Annicchiarico, P. (1995) EFFICACY OF A VISUAL ASSESSMENT FOR DROUGHT TOLERANCE IN DURUM WHEAT IMPROVEMENT UNDER DRYLAND CONDITIONS. *Cereal Research Communications. 23(1-2):95-101. English. [IST SPERIMENTALE CULTURE FORAGGERE VIALE PIACENZA 29 LODI 20075 ITALY].*

Twenty-five durum wheat accessions, preliminarily selected for drought tolerance from a large germplasm collection on the basis of a visual score particularly devised for this purpose, were further evaluated in two subsequent very dry seasons. Grain yield and other important morpho-agronomic characters were recorded. Significant variation for yield was found among the visually selected entries. Some of them performed consistently well in the two seasons. Differences of performance

were associated to differences for key traits, such as earliness, plant height and frost tolerance. When empirically compared to advanced breeding materials grown under the same conditions, the 25 selected accessions appeared, on average, a valuable germplasm set for drought tolerance. The drought tolerance score confirmed to be a good predictor of yield performance under stressful conditions other than those of the visual evaluation.

3636 Pecetti, L.; Annicchiarico, P.; Gorham, J. (1995) FIELD HETEROGENEITY OF THE STRESS AFFECTS GENOTYPIC RESPONSE TO SALINITY IN DURUM WHEAT. *Cereal Research Communications*. 23(1-2):173-177. English. [ISCF VIALE PIACENZA 29 I-20075 LODI ITALY].

A large durum wheat germplasm collection was evaluated for salinity tolerance at a naturally salt-affected site in northern Syria. Given the unreplicated experimental design (modified augmented design) adopted to cope with the size of the trial and limited seed available, a study was conducted on several replications of the control cultivar 'Haurani' used throughout the field, to assess the effects of soil heterogeneity on the genotypic response to the stress. The results confirmed previous observations on the great variation of salt content in naturally salinized field sites, and indicated that the variation of response to the stress was largely due to such soil variation. Implications of use of naturally saline sites on screening germplasm for stress tolerance are discussed.

3637 Plaschke, J.; Korzun, V.; Koebner, RMD.; Börner, A. (1995) MAPPING THE GA(3)-INSENSITIVE DWARFING GENE CT1 ON CHROMOSOME 7 IN RYE. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(2):113-116. English. [INST PFLANZENGENET & KULTURPFLANZENFORSCH CORRENSSTR 3 D-06466 GATERSLEBEN GERMANY].

A gibberellic acid-insensitive dwarfing gene in rye (ct1) was mapped in an F-2 population on chromosome 7R close to the centromere. Two RFLP markers were found, which flank the gene at distances of 1 and 3 cM, respectively. A total of 11 markers were mapped on 7R of which six cluster around the centromere and show segregation distortion in the case of the codominant markers. The ct1 gene is closely linked to copies of both alpha-amylase and EmBP, as is the ct2 gene on chromosome 5R. Because of the different chromosomal locations of the GA(3)-insensitive dwarfing genes in rye and wheat it is concluded that these genes are not homoeologous. This is supported by further differences in their phenotypic and genotypic expressions. [References: 25].

3638 Poulsen, DME.; Henry, RJ.; Johnston, RP.; Irwin, JAG.; Rees, RG. (1995) THE USE OF BULK SEGREGANT ANALYSIS TO IDENTIFY A RAPD MARKER LINKED TO LEAF RUST RESISTANCE IN BARLEY. *Theoretical & Applied Genetics*. 91(2):270-273. English. [QUEENSLAND DEPT PRIMARY IND HERMITAGE RES STN WARWICK 4370 AUSTRALIA].

An F-2 population from a cross between barley accession Q21861 and the Australian barley variety 'Galleon' was used to develop RAPD markers for resistance to barley leaf rust (*Puccinia hordei*). Resistant and susceptible DNA bulks were constructed following the classification of F-2 plants by leaf rust infection type. Bulk segregant analysis was then used to identify a 2.7-kb marker, designated OU02(2700) and located approximately 12cM from RphQ, a leaf rust resistance gene in Q21861. The marker was generated by PCR with the oligonucleotide primer OPU-02 (Operon). Infection types of F-3 progeny were used to confirm assignment of F-2 genotypes. OU02(2700) was shown, retrospectively, to be useful in the identification of individual F-2 plants that had been originally misclassified as having susceptible infection types. Both the RAPD marker and RphQ will be potentially useful in the development of new barley cultivars. [References: 24].

3639 Rahman, S. (Commonwealth Scientific and Industrial Research Organisation, Canberra (Australia). Div. of Plant Industry) (1994) Genetic manipulation of starch properties in wheat. *Chemistry in Australia (Australia)* v. 61(9) p. 517-518. 1 fig., 13 ref. English. (AGRIS 95-076469).

Although the pathway for starch synthesis in the endosperm is understood in broad outline many of the details are still lacking. The ability to transform wheat and other species has opened the way to manipulating

the properties of starch by targeting not only the enzymes whose functions are known, but also others whose role is uncertain but whose absence could make a significant difference to starch properties.

3640 Ran Yun; Bi Yunqing; Yan Changshou (Yunnan Provincial Inst. of Plant Protection, Kunming (China)) (1993) Quantitative study on host population resistance in diversity of wheat cultivars. *Journal of Yunnan Agricultural University (China)* v. 8(3) p. 158-161. 2 tables, 2 ref. Chinese. (AGRIS 95-076675).

3641 Rasco, E.T. Jr. (Philippines Univ., Los Banos, College, Laguna (Philippines). Inst. of Plant Breeding) (1992) Commitment of IPB [College, Laguna, Philippines] to wheat research. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia* p. 146-153. Received Nov 1994. English. (AGRIS 95-076478).

3642 Reddy, VRK.; Asir, R.; Viswanathan, P. (1995) DEVELOPMENT OF DISEASE RUST RESISTANCE IN WHEAT VARIETY HW 741. *Cereal Research Communications*. 23(1-2):147-152. English. [BHARATHIAR UNIV DEPT BOT CYTOGENET LAB COIMBATORE 641046 TAMIL NADU INDIA].

The popular Indian bread wheat cultivar HW 741 was improved for rust resistance by incorporating various leaf, stem and stripe rusts resistance alien genes through simple back cross method. In BC2S4 generation, the genotypes with good resistance coupled with desirable agronomic characters were constituted. An increase in grain yield/plant and 1000-grain weight in the resistant genotypes was observed.

3643 Riede, CR.; Williams, ND.; Miller, JD. (1995) WHEAT LINES MONOGENIC FOR RESISTANCE TO STEM RUST FROM THE WHEAT CULTIVAR WALDRON. *Theoretical & Applied Genetics*. 90(7-8):1164-1168. English. [CNPQ INST AGRON PARANA IAPAR CX POSTAL 1331 BR-86001 LONDRINA PARANA BRAZIL].

The *Triticum aestivum* L. cultivar 'Waldron' has long lasting resistance to most North American stem rust (*Puccinia graminis* Pers.:Pers. f. sp. tritici Eriks. and E. Henn.) isolates. The objective of this research was to develop wheat lines monogenic for resistance to stem rust from 'Waldron' using allelism tests and tests for reaction to a series of ten stem rust cultures having a range of virulences. Twelve lines homozygous for single resistance genes were selected as parents of a diallel cross to test for allelism among genes for resistance. We identified 6 lines or groups of lines (WDR-A1, the WDR-B1 and WDR-B2 group, the WDR-C1 and WDR-C2 group, WDR-D1, the WDR-E1, WDR-E2, WDR-E3, and WDR-E4 group, and WDR-F1) that carried different single genes for resistance from 'Waldron'. A seventh line (WDR-G1) probably has two genes for resistance, one in common with WDR-C1 and WDR-C2. The gene in the WDR-E group is probably the same as SrWld1, and the one in WDR-F1 the same as Sr11. 'Waldron' probably has two or more genes for resistance to stem rust that previous genetic studies did not detect. [References: 22].

3644 Riede, CR.; Williams, ND.; Miller, JD.; Joppa, LR. (1995) CHROMOSOMAL LOCATION OF GENES FOR STEM RUST RESISTANCE DERIVED FROM WALDRON WHEAT. *Theoretical & Applied Genetics*. 90(7-8):1158-1163. English. [CNPQ INST AGRON PARANA IAPAR CX POSTAL 1331 BR-86001 LONDRINA PARANA BRAZIL].

The chromosomal locations of genes for resistance to stem rust (*Puccinia graminis* Pers.:Pers. f. sp. tritici Eriks. and E. Henn.) in the wheat (*Triticum aestivum* L.) cultivar 'Waldron' (WDR) were determined by monosomic analyses. Wheat lines WDR-B1, -C2, -E4, and -F1, which have single genes for resistance to stem rust derived previously from WDR sel. 'Little Club', were crossed onto a complete set of 21 'Chinese Spring' monosomics. The F-2 and backcross-F-1 (BC1F1) seedlings from each of the 84 crosses were tested for reaction to culture 111-SS2 (CRL-LCBB) of stem rust, and a few selected segregants were analyzed cytologically for chromosome number. The F-2 from 2 crosses of WDR-C2, -E4 and -F1 and

the BC1F1 from 2 crosses of WDR-F1 were tested also with culture Or11c (CRL-QBCN). Significant deviations from disomic ratios towards monosomic ratios in the F-2 and BC1F1 were used to determine which chromosomes carried the genes for resistance. Cytological analyses of certain BC1F1 and susceptible F-2 plants were used to help identify the location of the genes for rust resistance. WDR-B1 has a gene, herein designated Sr41, for resistance on chromosome 4D. WDR-C2 has a gene on chromosome 7A that may be the same as one previously designated SrWld2. WDR-E4 has a gene on chromosome 2A, possibly SrWld1, which is effective against most or all North American stem rust cultures. WDR-F1 has a gene on chromosome 6B that is the same as or similar to Sr11. [References: 21].

3645 Robertson, L.D.; Wesenberg, D.M.; Brown, B.D.; Burrup, D.E.; Whitmore, J.C. (1993) Variety selection. *Bulletin - Idaho Agricultural Experiment Station (USA)* (no. 742) p. 8-13. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRIS 95-087192).

3646 Ruiz, M.; Carrillo, J.M. (1995) RELATIONSHIPS BETWEEN DIFFERENT PROLAMIN PROTEINS AND SOME QUALITY PROPERTIES IN DURUM WHEAT. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(1):40-44. English. [UNIV POLITECN MADRID ESCUELA TECN SUPER INGN AGRON DEPT GENET CUIDAD UNIV E-28040 MADRID SPAIN].

The objective of this paper was to study the differences between some prolamins variants coded at the loci Glu-3/Gli-1, Glu-1 and Gli-A2 and their relative roles in durum-wheat quality. F-3 lines from four durum wheat crosses ('Abadia' x 'Mexicali', 'Oscar' x 'Ardente', 'Oscar x Mexicali' and 'Alaga' x 'C. of Balazote') were analysed for gliadin and glutenin composition by electrophoresis. Whole-grain-derived samples were analysed for SDS sedimentation (SDSS) value, mixing properties, and contents of protein and vitreousness. The glutenin patterns LMW-2, LMW-2(-) and LMW-2 (CB) at Glu-B3/Gli-B1 were associated with better gluten quality than were LMW-1 and LMW-2*. The glutenin subunits LMW4 and LMW3 + 15 at Glu-A3/Gli-A1 and HMW-1 showed better mixing properties than LMW7 + 12, LMW5 and the null phenotype, respectively. The HMW glutenin subunits 20 + 8 at Glu-B1 showed a negative association with gluten quality, but the rest of the HMW glutenin subunits and alpha-gliadins did not show any influence on gluten quality. Correlations between the results of the SDSS test and the mixograph were highly significant, but no correlation was found between these results and protein and vitreousness contents. The results are discussed in relation to the development of durum wheat varieties with improved qualities. [References: 25].

3647 Saadalla, M.M. (Alexandria Univ. (Egypt). Faculty of Agriculture); Hamada, A.A. (1994) Inheritance of yield and yield components in spring wheat under heat stress. *Journal of Agricultural Science, Mansoura Univ. (Egypt)* v. 19(7) p. 2151-2160. 4 ill. 4 tables; 10 ref. English. (AGRIS 95-087139).

3648 Sacco, F.; Favret, E.A.; Suarez, E.Y.; Solari, R.M.; Saione, H.A. (1995) SPONTANEOUS GENETIC VARIATION FOR LEAF RUST REACTION IN SINVALOCHO MA WHEAT. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 143(4):251-255. English. [INST NACL TECNOL AGROPECUARIA CICA INST GENET EWALD A FAVRET CC 25 RA-1712 CASTELAR ARGENTINA].

Spontaneous off-type plants for leaf rust reaction to Argentine races 66 and 77 of *Puccinia recondita tritici* were found at rates of 3.4 per 1000 and 0.44 per 1000, respectively, in the progeny of self-pollinated (bagged) spikes of Sinvalcho MA wheat. Leaf rust reaction changes were associated to aneuploidy in most cases. The variation to race 66 was associated to monosomy of chromosome 6B or probably deletions on chromosome arm 6BL. Some off-type plants however showed, in subsequent generations, changes for reaction to race 77 or simultaneous changes to races 66 and 77 as well as changes in leucine aminopeptidase isozyme expression, which cannot be explained on grounds of allelic dosage. The origin of these genetic and chromosomal changes is not clear in some cases, however, a common origin could be suggested by the presence of transposonlike elements. [References: 31].

3649 Schachermayr, G.M.; Messmer, M.M.; Feuillet, C.; Winzeler, H.; Winzeler, M.; Keller, B. (1995) IDENTIFICATION OF MOLECULAR MARKERS LINKED TO THE AGROPYRON ELONGATUM-DERIVED LEAF RUST RESISTANCE GENE LR24 IN WHEAT. *Theoretical & Applied Genetics*. 90(7-8):982-990. English. [SWISS FED RES STN AGRON DEPT PLANT BREEDING RECKENHOLZSTR 191 CH-8046 ZÜRICH SWITZERLAND].

The objective of this study was to identify molecular markers linked to the wheat leaf rust resistance gene Lr24 derived from *Agropyron elongatum* (3DL/3 Ag translocation). Two near isogenic lines (NILs), 'Arina' and Lr24/7* 'Arina', were screened for polymorphism at the DNA level with 115 RFLP probes. Twenty-one of these probes map to the homoeologous group 3. In addition, 360 RAPD primers were tested on the NILs. Six RFLP probes showed polymorphism between the NILs, and 11 RAPD primers detected one additional band in the resistant NIL. The genetic linkage of the polymorphic markers with Lr24 was tested on a segregating F-2 population (150 plants) derived from a cross between the leaf rust resistant Lr24/7* 'Arina' and the susceptible spelt (*Triticum spelta*) variety 'Oberkulmer'. All 6 RFLP markers were completely linked to Lr24: one was inherited as a codominant marker (PSR1205), one was in coupling phase (PSR1203) and 4 were in repulsion phase (PSR388, PSR904, PSR931, PSR1067) with Lr24. The localization of these probes on chromosome 3D was confirmed by nulli-tetrasomic analysis. Distorted, genotypic segregation was found for the codominant RFLP marker PSR1205. This distortion can be explained by the occurrence of hemizygous plants. One of the 11 RAPD markers (OPJ-09) also showed complete linkage to the Lr24 resistance gene. The polymorphic RAPD fragment was cloned and sequenced. Specific primers were synthesized, and they produced an amplification product only in the resistant plants. This specific marker allows a reliable and rapid screening of a large number of genotypes in practical breeding. Analysis of 6 additional lines containing Lr24 revealed that 3 lines have a smaller chromosomal segment of *A. elongatum* than lines derived from 'Agent', a commonly used gene donor for the Lr24 resistance gene. [References: 30].

3650 Schweizer, G.F.; Baumer, M.; Daniel, G.; Rugel, H.; Roder, M.S. (1995) RFLP MARKERS LINKED TO SCALD (RHYNCHOSPORIUM SECALIS) RESISTANCE GENE RH2 IN BARLEY. *Theoretical & Applied Genetics*. 90(7-8):920-924. English. [BAYER LANDESANSTALT BODENKULTUR & PFLANZENBAU BIOTECHNOL VOTTINGERSTR 38 D-85354 FREISING GERMANY].

Rhynchosporium secalis is the causal organism of barley scald disease. A number of resistance genes against the fungus are well known; one of them, the single dominant Rh2 resistance gene, has been mapped on the linkage map of barley using RFLP (restriction fragment length polymorphism) markers. The Rh2 gene was located on the distal part of chromosome arm 1S co-segregating with the RFLP marker CDO545 in 85 doubled-haploid progeny plants. The spring barley test population used was a cross between the 6-rowed American spring barley cv Atlas, C.I. 4118, carrying the Rh2 resistance gene, and a Bavarian 2-rowed malting barley cv Steffi, susceptible for *R. secalis*. The assessment of resistance versus susceptibility was based on artificial infections with a one-spore inoculum in greenhouse tests and with pathotype mixtures in field tests. By testing a pathotype mixture of German origin good resistance was found for the Rh2 gene in the field. [References: 41].

3651 Seo, Y.W.; Graybosch, R.A.; Peterson, C.J.; Shelton, D.R. (1995) ASSESSMENT OF ENZYME-LINKED IMMUNOASSAY ON RYE SECALINS AS A TOOL IN THE PREDICTION OF 1RS WHEAT QUALITY. *Cereal Chemistry*. 72(3):252-254. English. [UNIV NEBRASKA DEPT AGRON USDA ARS LINCOLN, NE 68588 USA].

Incorporation of rye chromatin into the wheat genome often has resulted in a subsequent loss of dough quality. A monoclonal antibody, specific for secalins (rye endosperm storage proteins) was tested as a means of consistently identifying wheats carrying rye chromosome arm 1RS and predicting their end-use quality. Mean absorbances (A) in enzyme-linked immunosorbent assays (ELISA) of 1AL/1RS or 1BL/1RS wheats from 16 production environments were significantly higher than those observed with non-1RS wheats. Significantly higher absorbances also were observed in 1AL/1RS wheats as compared to 1BL/1RS wheats.

Among 1AL/1RS wheats, however, ELISA absorbances were associated with increased total flour protein content, a factor contributing to higher wheat quality scores. Among 1BL/1RS wheats, where absorbances were independent of total protein content, significant negative correlations with quality were detected. ELISA using this antiseccalin monoclonal antibody has more utility as a means of identifying 1RS wheats in breeding programs than as a tool for predicting flour quality in the grain trade. [References: 14].

3652 Singh, I.; Sharma, S.K. (Haryana Agricultural University, Hisar (India). Department of Plant Breeding) (1994) **Inter-relationship of harvest index and other traits in wheat. Haryana Agricultural University Journal of Research (India) v. 24(1) p. 33-38. 6 tables; 8 ref. English. (AGRIS 95-076719).**

3653 Singh, I.; Singh, Y.P. (Haryana Agricultural University, Hisar (India). Department of Plant Breeding) (1993) **Harvest index as a criterion for selection in wheat. Haryana Agricultural University Journal of Research (India) v. 23(4) p. 254-257. 2 tables; 14 ref. English. (AGRIS 95-076717).**

3654 Song Ziren; Zhang Aiguo; Jing Penyan (Zhangye Prefecture Agricultural Inst., Gansu (China)) (1994) **Comparative study on cytoplasmic effects of wheat male sterility. Journal of Gansu Agricultural University (China) v. 29(3) p. 255-261. 4 tables; 12 ref. Chinese. (AGRIS 95-087316).**

3655 South, J.B.; Ross, A.R.J. (Research and Development Laboratory, Carlsberg Tetley Brewing Ltd., 107 Station Street, Burton on Trent, Staffs DE14 1BZ (United Kingdom)) (1993) **Evaluation of cereal quality for micronising. Aspects of Applied Biology (United Kingdom) (no.36) p. 433-442. 12 ref. English. (AGRIS 95-087309).**

3656 Steffenson, B.J.; Jin, Y.; Rossmagel, B.G.; Rasmussen, J.B.; Kao, K. (1995) **GENETICS OF MULTIPLE DISEASE RESISTANCE IN A DOUBLED-HAPLOID POPULATION OF BARLEY. Plant Breeding-Zeitschrift für Pflanzenzüchtung. 114(1):50-54. English. [N DAKOTA STATE UNIV DEPT PLANT PATHOL FARGO, ND 58105 USA].**

The barley accession Q21861 possesses resistance to the stem-rust (*Puccinia graminis* f.sp. *tritici*), leaf-rust (*P. hordei*), and powdery-mildew (*Blumeria graminis* f.sp. *hordei*) pathogens. An anther-culture-derived doubled-haploid population was produced from F-1 plants from a cross of this accession and the susceptible breeding line SM89010 as a means of rapidly and efficiently determining the genetics of multiple disease resistance. The doubled-haploid population segregated 1:1 (resistant:susceptible) for resistance to the stem rust pathotype QCC indicating the involvement of a single resistance gene, *rpg4*. Two-gene (3:1) and one-gene (1:1) segregation ratios were observed for resistance to the stem-rust pathotype MCC at low (23-25 degrees C) and high (27-29 degrees C) temperature, respectively. These different segregation patterns were due to a pathotype x temperature interaction exhibited by *rpg4* and *Rpg1*, another stem-rust-resistance gene present in Q21861. One-gene and two-gene segregation ratios were observed in reaction to the leaf rust and powdery mildew pathogens. These data demonstrate the utility of doubled haploid populations for determining the genetics of multiple disease resistance in barley. [References: 29].

3657 Stoilova, T.; Mladenova, V.; Ganeva, G. (1995) **POSSIBILITIES OF INSERTION OF GLUTENIN SUBUNITS AND GLIADIN COMPONENTS OF GIN B1, GLU B3 AND GLI B1 LOCI FROM TRITICUM TURGIDUM INTO TRITICUM AESTIVUM. Biologia Plantarum. 37(2):177-183. English. [BULGARIAN ACAD SCI INST GENET ACAD D KOSTOFF BU-1113 SOFIA BULGARIA].**

An electrophoretic investigation of the glutenin subunits and gliadin components in F-4 progenies between the hexaploid wheat (*Triticum aestivum* L. cv. Bezostaya 1) and the wild tetraploid wheat (*Triticum turgidum* var. *dicoccoides* Korn) is carried out. The possibility of inserting subunits and components of Glu B1, Glu B3 and Gli B1 loci from *T. dicoccoides* in F-4 progenies of *T. aestivum* is investigated. For this purpose parental forms with different allelic variants in these loci are chosen. It is established cytologically that the chromosomal number of progenies is 42. Genotype classes and the frequency of progenies are

analyzed for which we judge by the phenotype manifestation of the allelic variants of the loci investigated. Different frequency of the transfer of subunits and components of Glu B1, Glu B3 and Gli B1 loci from *T. dicoccoides* in the hexaploid wheat genome is established and it is connected with the disposition of the loci on chromosomes arms.

3658 Sun Qixin (Beijing Agricultural Univ. (China). Dept. of Agronomy) (1994) **Genetic effects of alien cytoplasm on heat tolerance in wheat. Acta Agriculturae Universitatis Pekinensis (China) v. 20(4) p. 361-367. 5 ill., 15 ref. Chinese. (AGRIS 95-087321).**

3659 Swanston, J.S.; Ellis, R.P.; Rubio, A.; Ramo, T.; Uribe, T.; Molina Cano, J.L. (Scottish Crop Research Institute, Mynfield, Invergowrie, Dundee DD2 5DA (United Kingdom)) (1993) **Grain quality of a barley mutant and its parent cultivar in Spain and Scotland. Aspects of Applied Biology (United Kingdom) (no.36) p. 143-151. 15 ref. English. (AGRIS 95-087194).**

3660 Takeda, K.; Kanatani, R. (1995) **DIALLEL ANALYSIS FOR THE FREQUENCY OF HULL-CRACKED GRAINS IN TWO-ROWED BARLEY [Japanese]. Breeding Science. 45(2):217-221. Japanese. [OKAYAMA UNIV BIORESOURCES RES INST KURASHIKI OKAYAMA 710 JAPAN].**

Recently grains with cracked hull which results in low germinability and low malt extract have been observed in malting barley varieties in Japan. A large varietal variation in the frequency of hull-cracked grains and the mechanism of hull-cracking have been reported so far. In this study the mode of inheritance of the frequency of hull-cracked grains was analyzed using a reciprocal diallel cross among eight two-rowed malting barley varieties. Among the parents the frequency of hull-cracked grains was low in Amagi Nijo, Kinuyutaka, Misato Golden and Haruna Nijo, but it was high in Yoshikei 16 and Nittakei 22 (Table 2). Parents and F(1)s were grown under five different ripening conditions i.e., (I) Control, (II) Leaf cutting; all leaves were cut at heading time, (III) Spikelet thinning; 25 % of the total number of spikelets were thinned at heading time, (IV) Dry; plants were grown in a vinyl-film house without irrigation, and (V) Wet; plants were mist-sprayed every two hours in the daytime from heading to harvest. The experiment was replicated twice. The frequency of hull-cracked grains was high in the plots III and IV where the grain weight was large, and was low in the plots II and V where the grain weight was small, indicating the presence of a positive environmental correlation between the frequency of hull-cracked grains and the grain weight (Tables 1 and 2). Character expression for the percentage of hull-cracked grains was parallel among the different ripening conditions (Table 3). The diallel analysis revealed the followings: The frequency of hull-cracked grains is predominantly controlled by additive genes and the dominance effect is also significant (Tables 4 and 6). Low frequency of hull-cracked grains is partially dominant over the high frequency (Fig. 1). Epistasis among the genes controlling the frequency of hull-cracked grains is not significant (Table 4). Maternal effect is absent (Table 5). Heritability is about 0.9 and 0.8 in a broad and a narrow sense, respectively (Table 6). Selection for the frequency of hull-cracked grains may be effective under the ripening condition where the frequency is high. However, because the lower frequency is controlled by dominant gene(s), early generation selection for low frequency may not be easy.

3661 Thomas, W.T.B.; Powell, W.; Chalmers, K.J.; Barua, U.M.; Swanston, J.S.; Waugh, R.; Forster, B.P.; Ellis, R.P.; Jack, P.; Lea, V. (Scottish Crop Research Institute, Invergowrie, Dundee DD2 5DA (United Kingdom)) (1993) **Quantitative trait loci for yield and quality components in spring barley. Aspects of Applied Biology (United Kingdom) (no.36) p. 125-134. 21 ref. English. (AGRIS 95-087184).**

3662 Tuomi, T.; Tanskanen, J.; Tyynela, J.; Teeri, T.H.; Schulman, A.H. (Institute of Biotechnology, University of Helsinki, PO Box 45, Karvaamokuja 3a, 00014 Helsinki (Finland)) (1993) **Towards in planta modification of starch synthesis. Aspects of Applied Biology (United Kingdom) (no.36) p. 93-101. 29 ref. Proceedings of the third Association of Applied Biologists conference on cereal quality, Cambridge, UK, 13-15 December 1993. English. (AGRIS 95-087193).**

3663 Vancampenhout, S.; Vanderstappen, J.; Sagi, L.; Volckaert, G. (1995) LOCUS-SPECIFIC PRIMERS FOR LMW GLUTENIN GENES ON EACH OF THE GROUP 1 CHROMOSOMES OF HEXAPLOID WHEAT. *Theoretical & Applied Genetics*. 91(2):313-319. English. [CATHOLIC UNIV LEUVEN GENE TECHNOL LAB WILLEM DE CROYLAAN 42 B-3001 LOUVAIN BELGIUM].

To reveal the chromosomal location of three known low-molecular-weight (LMW) glutenin genes in wheat, we designed and used three sets of sequence-specific primers in polymerase chain reactions (PCR) on 'Chinese Spring' and its derived group 1 aneuploid nullisomic-tetrasomic stocks. Two sets proved to be chromosome specific and amplified sequences from the Glu-A3 and Glu-D3 loci, respectively. The third set was apparently composed of conserved sequences as it produced PCR products in each of the aneuploids. Two of these products were cloned, and their sequences differed from the known LMW glutenin genes at several positions. Again, primer sets specific for these sequences were designed. One set was directed to the Glu-A3 locus, the second set resulted in two PCR products differing in length, one of which was located on chromosome 1B and the other on 1D. Primer sets constructed for the latter two sequences were specific for the Glu-B3 and Glu-D3 loci, respectively. Hence, primer sets specific for each of the three homoeologous chromosomes of the group 1 (1A, 1B, 1D) are available. In addition, these locus-specific primers were assayed for their ability to distinguish among wheat cultivars. PCR products amplified with one of the Glu-A3-specific primer sets showed length polymorphisms in various wheat varieties. Varieties carrying the 1RS.1BL translocated chromosomes could be recognized by the absence of a PCR product when the Glu-B3 primer set was used. These results suggest that PCR with locus-specific primers can be useful in the molecular genetic analysis of hexaploid wheat. [References: 26].

3664 Vanzee, K.; Chen, FQ.; Hayes, PM.; Close, TJ.; Chen, THH. (1995) COLD-SPECIFIC INDUCTION OF A DEHYDRIN GENE FAMILY MEMBER IN BARLEY. *Plant Physiology*. 108(3):1233-1239. English. [OREGON STATE UNIV DEPT HORT CORVALLIS, OR 97331 USA].

An interval on barley (*Hordeum vulgare* L.) chromosome 7 accounting for significant quantitative trait locus effects for winter hardiness were detected in a winter (Dicktoo) x spring (Morex) barley population (P.M. Hayes, T. Blake, T.H.H. Chen, S. Tragoonrung, F. Chen, A. Pan, and B. Liu [1993] *Genome* 36: 66-71). Two members of the barley dehydrin gene family, Dhn1 and Dhn2, were located within the region defining the winter hardiness quantitative trait locus effect (A. Pan, P.M. Hayes, F. Chen, T. Blake, T.H.H. Chen, T.T.S. Wright, I. Karsai, Z. Bedo [1994] *Theor Appl Genet* 89: 900-910). To investigate the possible role of Dhn1 and Dhn2 in winter hardiness, we examined the expression pattern of six barley dehydrin gene family members in shoot tissue in response to cold temperature. Incubation of 3-week-old barley plants at 2 degrees C resulted in a rapid induction of a single 86-kD polypeptide that was recognized by an antiserum against a peptide conserved in the dehydrin gene family. Northern blot analysis confirmed the induction of an mRNA corresponding to Dhn5. The expression patterns of cold-induced dehydrins in shoot tissue for Dicktoo and Morex were identical under the conditions studied, in spite of the known phenotypic differences in their winter hardiness. These results, together with the allelic structure of selected high- and low-survival lines, suggest that the Dicktoo alleles at the Dhn1 and Dhn2 may not be the primary determinants of winter hardiness in barley. [References: 38].

3665 Vapa, L.; Dencic, S.; Soltesrak, E.; Kevresan, S. (1995) GENETIC VARIATION IN GLU-1 LOCI AND BREAD-MAKING QUALITY IN WHEAT. *Cereal Research Communications*. 23(1-2):161-166. English. [FAC SCI NOVI SAD YU-21000 NOVI SAD YUGOSLAVIA].

It is now well recognized that the HMW glutenin subunits, coded by the genes at the Glu-1 loci, are related to significant differences in bread making quality. The aim of this paper was to relate the RFLP pattern at the Glu-1 loci to the bread-making quality of different wheat cultivars, and also to the allelic variability of the HMW glutenin subunits obtained by SDS-PAGE. Significant differences in sedimentation value, yield of flour, loaf volume and loaf quality, were found between cultivars possessing 2.3 kb fragment when compared with those lacking this fragment.

3666 Villareal, RL.; Fuentesdavila, G.; Mujeekbazi, A. (1995) SYNTHETIC HEXAPLOIDS X TRITICUM AESTIVUM ADVANCED DERIVATIVES RESISTANT TO KARNAL BUNT (TILLETIA INDICA MITRA). *Cereal Research Communications*. 23(1-2):127-132. English. [CIMMYT INT MAIZE & WHEAT IMPROVEMENT CTR APARTADO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Eighty-one advanced bread wheat lines derived from 12 crosses involving seven synthetic hexaploids (*Triticum turgidum* x *T. tauschii*) and seven high yielding *T. aestivum* cultivars were evaluated for Karnal bunt (*Tilletia indica* Mitra) resistance during two crop seasons at CIANO, Ciudad Obregon, Sonora, Mexico. Ten random tillers of each test entry at boot stage were injected with a suspension of sporidia in water (10, 000 sporidia/ml of water). At maturity the inoculated spikes were threshed individually and evaluated for percent Karnal bunt infected grains. Based on the mean Karnal bunt score of each entry for two seasons, 17 lines showed less than 3% infection as compared to 82.1% of the susceptible *T. aestivum* check cultivar WL711. Most of the resistant cultivars were derivatives of Chen/*T. tauschii* (205)/Kauz cross. One entry from the cross Chen/*T. tauschii* (205)/Weaver remained immune (0% infection) after two years of test. Finally, these derivatives provide additional source of genetic variability for Karnal bunt resistance in bread wheat improvement.

3667 Wang Jianshe; Liu Guangtian (Beijing Agricultural Univ. (China). Dept. of Agronomy) (1994) Inheritance of grain quality characters in *Triticum aestivum* L. and effect of early generation selection. *Acta Agriculturae Universitatis Pekinensis (China)* v. 20(3) p. 239-245. 2 tables; 7 ref. Chinese. (AGRIS 95-087324).

3668 Wang Xiaoming; Li Yilin; Zhou Ronghua (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Crop Germplasm Resources) (1994) Resistance of wheat wild relatives to powdery mildew (*Erysiphe graminis*) in wheat. *Crop Genetic Resources (China)* (no. 1) p. 13-16. 4 tables; 4 ref. Chinese. (AGRIS 95-087326).

3669 Wang Yueguang (Beijing Agricultural Univ. (China). Dept. of Agronomy) (1994) Inheritance of grain quality characters in *Triticum aestivum* L. and effect of early generation selection. *Acta Agriculturae Universitatis Pekinensis (China)* v. 20(4) p. 355-360. 3 tables; 4 ill., 10 ref. Chinese. (AGRIS 95-087322).

3670 Weller, RF.; Cooper, A.; Dhanoa, MS. (1995) THE SELECTION OF WINTER WHEAT VARIETIES FOR WHOLE-CROP CEREAL CONSERVATION. *Grass & Forage Science*. 50(2):172-177. English. [INST GRASSLAND & ENVIRONM RES ABERYSTWYTH SY23 4LL DYFED WALES].

Ten commercial varieties of winter wheat were sampled at different stages of growth, and dry matter (DM) yields and potential nutritional quality, as determined by modified acid detergent fibre concentration (MADE), were measured. Maximum yields for the different varieties were spread over a four-week period, when the DM content was above 350 g kg⁻¹. When the varieties were harvested for conservation as either fermented (DM 380 g kg⁻¹) or alkaline (DM 580 g kg⁻¹) whole crop, the mean MADE concentration was similar at both harvests, with large differences recorded between varieties. At both harvests the quality of the crops was sharply increased by raising the cutting height from 10 to 40 cm above ground level. [References: 14].

3671 William, MDHM.; Mujeekbazi, A. (1995) BIOCHEMICAL AND MOLECULAR DIAGNOSTICS OF THINOPYRUM BESSARABICUM CHROMOSOMES IN TRITICUM AESTIVUM GERM PLASM. *Theoretical & Applied Genetics*. 90(7-8):952-956. English. [CIMMYT LISBOA 27 APARTADO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Thinopyrum bessarabicum (2n=2x=14, JJ) is a self-fertile salt-tolerant grass species, and its hybridization with *Triticum aestivum* to achieve the transfer of this attributes has been promoted. For the detection of alien introgression, development of diagnostic markers of *Th. bessarabicum* chromosomes in the wheat background has emerged as an important aspect in our intergeneric hybridization program. Six proteins/isozymes-high-molecular-weight glutenins, superoxide dismutase, grain esterase, beta-amylase, glutamate oxaloacetate transaminase and alpha-amylase -

were identified as positive markers for detecting the presence of Th. bessarabicum chromosomes in the advanced backcross derivatives of in aestivum/Th. bessarabicum/n* T. aestivum. Fluorescent in situ hybridization further enabled the detection of complete and translocated arms of Th. bessarabicum chromosomes in the T. aestivum background. These diagnostic markers served for tentatively characterizing a distinct set of Th. bessarabicum disomic additions to wheat (2n=44) and have facilitated establishing the homoeology of these added chromosomes. [References: 26].

3672 Winzeler, M.; Winzeler, H.; Keller, B. (1995) ENDOPEPTIDASE POLYMORPHISM AND LINKAGE OF THE EP-D1c NULL ALLELE WITH THE LR19 LEAF-RUST-RESISTANCE GENE IN HEXAPLOID WHEAT. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(1):24-28. English. [SWISS FED RES STN AGRON DEPT PLANT BREEDING RECKENHOLZ STR 191 CH-8046 ZURICH SWITZERLAND].

The aim of this study was to test whether the null allele Ep-D1c of the endopeptidase Ep-D1 can be used as a marker for the Lr19 leaf rust resistance gene. The frequency of Ep-D1c was determined in 1134 winter wheat, spring wheat and spelt breeding lines and varieties. Only eight lines were found to carry Ep-D1c. Six of these lines originated from crosses with RL6040, the gene donor for Lr19. The other two lines were leaf-rust susceptible in the seedling stage and therefore did not carry Lr19. The genetic distance between Ep-D1c and Lr19 was determined in a reciprocal cross between the lines FAP75184 (Ep-D1c, Lr19) and FAP75106 (Ep-D1a, leaf-rust susceptible in the seedling stage). Out of 840 F-2 seedlings screened, 162 were homozygous for Ep-D1c. From 150 of these F-2 plants, F-3 seedlings were screened for segregation for leaf-rust resistance with isolates avirulent on Lr19. Only one F-2 plant produced susceptible F-3 progeny indicating a recombination event between Ep-D1c and Lr19. From these data, a genetic distance of 0.33 +/- 0.3 cM between Ep-D1c and Lr19 was calculated. The results show that Ep-D1c is a useful marker for a practical breeding programme allowing the rapid identification of plants homozygous for Lr19. [References: 35].

3673 Wu Yaowu; Fu Jie (Academia Sinica, Yangling, Shaanxi (China). Inst. of Northwest Botany) (1994) Establishment of embryonic somaclones in *Hordeum distichus* (2n=24). *Acta Botanica Boreali-occidentalia Sinica (China)* v. 14(1) p. 14-18. 2 tables; 7 ill., 11 ref. Chinese. (AGRI 95-087176).

3674 Wu, J.; Kanatani, R.; Takeda, K. (1995) INHERITANCE OF HULL-CRACKED GRAIN FREQUENCY AND 1,000-GRAIN WEIGHT IN TWO-ROWED BARLEY [Japanese]. *Breeding Science*. 45(2):223-226. Japanese. [YAN BIAN AGR COLL LONGJIN PEOPLES REPUBLIC OF CHINA].

Selection response and correlation response of the frequency of hull-cracked grains and the 1,000-grain weight were investigated for analyzing the mode of inheritance and genetic correlation of the traits. In the first experiment, upper 5% and lower 5% of the four F-2 populations were selected for the frequency of hull-cracked grains and the selection response was examined in F-3 progenies. In the second experiment, the frequency of hull-cracked grains and 1,000-grain weight of 183 F-2 plants from the cross of Nittakei 22 X Yoshikei 16 were recorded and 183 F-3 lines were grown to estimate the parent-offspring correlation and regression. In the third experiment, environmental correlation between the frequency of hull-cracked grains and the 1,000-grain weight was estimated from 50 plants each of Nittakei 22 and Yoshikei 16. The materials were seeded twice in November and December. Broad sense heritability of the frequency of hull-cracked grains estimated in the F-2 populations was in the range of 0.5 similar to 0.6. The realized heritability estimated from the selection response was in the range of 0.4 similar to 0.6. Correlation and regression coefficients between F-2 and F-3 were about 0.5. On the other hand, the realized heritability of the 1,000-grain weight was in the range of 0.1 similar to 0.2. Genetic correlation coefficient between the frequency of hull-cracked grains and the 1,000-grain weight estimated from the correlated response was in the range of -0.1 similar to -0.3, while the environmental correlation coefficient was in the range of 0.4 similar to 0.6 and the phenotypic correlation coefficient in F-2 populations was in the range of 0.1 similar to 0.3. Because of the high heritability of the frequency of hull-cracked grains, selection for decreasing the incidence of hull-cracked grains may be easy, and because the genetic correlation between the frequency of hull-cracked grains and 1,000-grain weight is low,

selection for the frequency of hull-cracked grains may induce little or no change in the 1,000-grain weight.

3675 Xia, X.C.; Hsam, S.L.K.; Stephan, U.; Yang, T.M.; Zeller, F.J. (1995) IDENTIFICATION OF POWDERY-MILDEW-RESISTANCE GENES IN COMMON WHEAT (TRITICUM AESTIVUM L.) 6. WHEAT CULTIVARS GROWN IN CHINA. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(2):174-175. English. [BEIJING AGR UNIV DEPT AGRON BEIJING 100094 PEOPLES REPUBLIC OF CHINA].

A total of 26 common wheat cultivars and advanced breeding lines grown in China were tested with a set of 11 differential powdery-mildew isolates. Seven cultivars were susceptible. Another seven cultivars showed the response pattern of resistance gene Pm2, either individually or in combination with genes Pm3d or Pm4a. Five cultivars expressed the resistance of gene Pm46 singly or in combination with Pm6. Another four cultivars exhibited the response patterns of genes Pm5, Pm6 and Pm8, respectively. Three cultivars, which included one breeding line with a pair of substituted chromosomes from *Haynaldia villosa*, presumably carrying the resistance gene Pm21, showed resistance-response patterns to all the isolates tested. [References: 9].

3676 Xiong Enhui; Cao Yang; Zhu Wei (Jiangsu Provincial Academy of Agricultural Sciences, Nanjing (China). Inst. of Grain) (1994) Resistance changes in the level of powdery mildew, resistance gene to powdery mildew in wheat in the last decade and strategy on the use of resistance germplasm. *Crop Genetic Resources (China)* (no. 2) p. 1-4. 2 tables. Chinese. (AGRI 95-087327).

3677 Yang Yufeng; Cao Xin (Zhejiang Academy of Agricultural Science, Hangzhou (China). Inst. of Crops) (1994) Selection of proanthocyanidin-free barley mutant. *Scientia Agricultura Sinica (China)* v. 27(6) p. 56-60. 1 tables; 14 ref. Chinese. (AGRI 95-087177).

3678 Yildirim, M.B.; Budak, N.; Arshad, Y. (1995) INHERITANCE OF HARVEST INDEX IN A 6X6 DIALLEL CROSS POPULATION OF BREAD WHEAT. *Cereal Research Communications*. 23(1-2):45-48. English. [AEGEAN UNIV FAC AGR DEPT FIELD CROPS IZMIR TURKEY].

The inheritance of harvest index was studied by the Jinks-Hayman type diallel analysis in a 6x6 wheat diallel cross population. The inheritance of harvest index was under the control of additive and partially dominant gene action. The positive and significant associations were found between harvest index and plot yield, thousand kernel weight, spike length and number of tillers.

3679 Zeng Zherong (Chinese Academy of Agricultural Science, Beijing (China). Inst. of Crop Breeding and Cultivation) (1994) Studies on canopy development and structure and physiological basis of high-yielding wheat varieties in Beijing District, China. *Scientia Agricultura Sinica (China)* v. 27(3) p. 30-37. 8 tables; 13 ref. Chinese. (AGRI 95-087325).

3680 Zhang Sui; Liu Weiqun; Chen Ruhai (Henan Agricultural Univ., Zhengzhou (China)) (1994) The preliminary study on the resistant mechanism of wheat varieties to the sheath blight disease. *Chinese Agricultural Science Bulletin (China)* v. 10(6) p. 9-12. 4 tables; 3 ref. Chinese. (AGRI 95-087333).

3681 Zhang Zhongjun (Beijing Agricultural Univ. (China). Dept. of Plant Protection) (1994) Transfer of stripe rust-resistance from *Agropyron intermedium* to *Triticum aestivum* and stability of alien chromosomes. *Acta Agriculturae Universitatis Pekinensis (China)* v. 20(3) p. 293-296. 3 tables; 1 ill., 3 ref. Chinese. (AGRI 95-087323).

3682 Zhu Lieceng; Tang Guoshun (Shaanxi Provincial Inst. of Grain Crops, Yangling (China)) (1994) Study on correlation between early maturity and agronomic characters of wheat varieties. *Shaanxi Journal of Agricultural Sciences (China)* (no. 1) p. 5-6. 12. 2 tables; 2 ref. Chinese. (AGRI 95-087314).

3683 Zhuang Qiaosheng (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Crop Breeding and Cultivation); Dong Yuchen; Zheng Diansheng (1994) Utilization of wheat varieties introduced from

abroad in China. *Chinese Agricultural Science Bulletin (China)* v. 10(1) p. 36-40. 3 ref. Chinese. (AGRI 95-087331).

3684 Zimny, J.; Becker, D.; Bretschneider, R.; Lorz, H. (1995) **FERTILE, TRANSGENIC TRITICALE (x TRITICOSECALE WITTMACK)**. *Molecular Breeding*. 1(2):155-164. English. [UNIV HAMBURG AMP 2 INST ALLGEMEINE BOT OHNHORSTR 18 D-22609 HAMBURG GERMANY].

Fertile transgenic Triticale (x Triticosecale Wittmack) plants expressing the beta-glucuronidase (uidA) and phosphinothricin acetyltransferase (bar) genes were obtained after microprojectile bombardment of scutellar tissue with the plasmid pDB1 containing the uidA gene under the control of the actin-1 promoter (Act1) from rice and the selectable marker gene bar under the control of the CaMV 35S promoter. From 465 bombarded scutella about 4000 plantlets were regenerated; 300 plants survived the selection. These regenerants were screened for enzyme activity by the histological GUS assay and by spraying the plants with a herbicide (Basta). Twenty-five regenerants showed GUS activity and survived repeated Basta spraying. Southern blot analysis showed the presence of both marker genes introduced into the genome of analysed plants. All transgenic plants were fertile. They were grown to maturity and set seed. Pollen and progeny analyses provided evidence for inheritance of the introduced genes to the next generation. [References: 36].

F40 PLANT ECOLOGY

3685 Jovanovic, B. (Faculty of Agriculture, Belgrade (Yugoslavia)); Sobovljevic, R.; Prodanovic, S.; Maletic, R.; Mladenov, N. (1993) **Effect of stem and root characteristics on lodging in wheat**. *Journal of Scientific Agricultural Research (Yugoslavia)* v. 54(193-196) p. 23-28. 2 tables; 10 ref. English. (AGRI 95-077505).

The correlation between lodging and five morphological characteristics of wheat was investigated. The highest simple phenotype correlation coefficients were found for plant height and root mass. Partial correlations showed that the percentage of lodging depended mostly on plant height, number of stems per tiller and phytomass. The most significant changes of partial correlation coefficients in relation to coefficients of simple correlation were established for the number of stems, thickness of first internode and phytomass. The studied characteristics are responsible for 69.4 of lodging.

3686 Ma Qiang; Wang Xiuling; Cui Guangquan (Dezhou Prefectural Inst. of Agricultural Sciences, Shandong (China)) (1994) **A preliminary study on the classification of ecological type of wheat varieties in Shandong Province [China]**. *Chinese Agricultural Science Bulletin (China)* v. 10(3) p. 16-19. 3 tables; 3 ref. Chinese. (AGRI 95-087724).

3687 Panozzo, J.F.; Eagles, H.A. (Victorian Dept. of Agriculture, Horsham (Australia). Victorian Inst. for Dryland Agriculture); Bekes, F. (Commonwealth Scientific and Industrial Research Organisation, North Ryde (Australia). Div. of Plant Industry); Wootton, M. (Austrian Wheat Board, Academy of Grain Technology, Werribee) (1994) **Genotype and environmental interactions on wheat quality**. [Conference abstract]. 44. Royal Chemical Institute Cereal Chemistry Conference; Ballarat, Vic. (Australia); 12 Sep 1994. *Chemistry in Australia (Australia)* v. 61(9) p. 498-499. English. (AGRI 95-077503).

3688 Peterson, C.J.; Graybosch, R.A. (Nebraska Univ., Lincoln (USA). USDA ARS); Shelton, D.R. (Nebraska Univ., Lincoln (USA). Dept. of Agronomy) (1994) **Effects of genotype, environment and G x E interactions on the end-use quality of hard red winter wheat [USA]**. [Conference abstract]. 44. Royal Chemical Institute Cereal Chemistry Conference; Ballarat, Vic. (Australia); 12 Sep 1994. *Chemistry in Australia (Australia)* v. 61(9) p. 498. English. (AGRI 95-077513).

3689 Shaykewich, C.F. (1995) **AN APPRAISAL OF CEREAL CROP PHENOLOGY MODELLING**. *Canadian Journal of Plant Science*. 75(2):329-341. English. [UNIV MANITOBA DEPT SOIL SCI WINNIPEG MB R3T 2N2 CANADA].

A review of responses of phenological development of cereal crops, primarily corn (*Zea mays* L.), wheat (*Triticum aestivum* L.) and barley (*Hordeum vulgare* L.), to environmental conditions was conducted.

Examples of how these studies have been used to model phenological development on the basis of weather data were given. It was concluded that the development rate of most species is a sigmoidal rather than a linear function of temperature. Consequently, phenological models assuming a linear relationship (e.g., degree-days) are inappropriate. Another consequence of the way plants respond to temperature is that the most precise phenological models will require use of temperature data over relatively short periods (e.g., 3 h), rather than just a daily mean temperature. Several suggestions regarding the ways standard climatological station data may be used in such phenological modelling are made. Phenological response to photoperiod was also reviewed, and methods of modelling this response were proposed. [References: 62].

3690 Wrigley, C.W. (Commonwealth Scientific and Industrial Research Organisation, North Ryde (Australia). Div. of Plant Industry); Blumenthal, C. (Western Sydney Univ., Richmond (Australia)); Oliver, J. (New South Wales Agriculture, Wagga Wagga (Australia)) (1994) **Environmental variations in wheat-grain quality: an overview of the problems, the possible causes and potential solutions**. [Conference abstract]. 44. Royal Chemical Institute Cereal Chemistry Conference; Ballarat, Vic. (Australia); 12 Sep 1994. *Chemistry in Australia (Australia)* v. 61(9) p. 499. English. (AGRI 95-077504).

F50 PLANT STRUCTURE

3691 Demchenko, N.P. (Komarov Botanical Institute, Russian Academy of Sciences, 197376 St. Petersburg (Russian Federation)) (1994) **Temporal aspects of protophloem development in roots of Triticum aestivum L**. *Environmental and Experimental Botany (United Kingdom)* v. 34(1) p. 95-106. 64 ref. English. (AGRI 95-087782).

3692 Srecek, S.; Jelenic, S.; Papes, D. (1995) **PHENOTYPIC AND GENOTYPIC ANALYSIS OF SPIKE ABNORMALITY IN WHEAT (TRITICUM AESTIVUM L EM THELL) CV PITOMA**. *Cereal Research Communications*. 23(1-2):63-69. English. [INST AGR M DEMERCA 1 KRIZHEVCI 43260 CROATIA].

In offspring of 4500 selected spikes (breeder's seed) in bread wheat (*Triticum aestivum* L. em Thell) cv. PITOMA, 17 sterile and deformed spikes were found. They were divided into three groups, basically by their phenotypic characteristics. For the purpose of detection causes of such phenomena, the cytogenetic analysis of seedlings obtained from seeds of atypical spikes has been carried out. The cytogenetic analysis showed a decrease of mitotic index (MI) in Group I and Group II of atypical spikes (-17.5% and -61.9%, respectively) and increase of MI (14.5%) in the third group of atypical spikes in comparison with the control. The frequency of chromosomal aberrations ranged from 0.5% (in Group III) to 7.3% (in Group II). The chromosomal bridges were the most represented types of chromosomal aberrations in all three groups. Possible connections between the observed spikes abnormalities and influence of herbicide Dicuran (79.25% chlortoluron) could be predicted in consideration of the type and frequency of chromosomal aberrations.

F60 PLANT PHYSIOLOGY AND BIOCHEMISTRY

3693 Allen, G.J.; Morais, F.; Muir, S.; Jones, R.G.W.; Leigh, R.A. (1995) **CHARACTERISATION OF A CA²⁺-DEPENDENT ATP HYDROLYSIS ASSOCIATED WITH THE VACUOLAR MEMBRANE OF WHEAT ROOTS**. *Physiologia Plantarum*. 94(3):506-514. English. [UNIV YORK DEPT BIOL PLANT LAB POB 373 YORK YO1 5YW N YORKSHIRE ENGLAND].

Microsomal fractions from wheat tissues exhibit a higher level of ATP hydrolytic activity in the presence of Ca²⁺ than Mg²⁺. Here we characterise the Ca²⁺-dependent activity from roots of *Triticum aestivum* (cv. Troy) and investigate its possible function. Ca²⁺-dependent ATP hydrolysis in the microsomal fraction occurs over a wide pH range with two slight optima at pH 5.5 and 7.5. At these pHs the activity co-migrates with the major peak of nitrate-inhibited Mg²⁺, C-1-ATPase on continuous sucrose gradients indicating that it is associated with the vacuolar membrane. Ca²⁺-dependent ATP hydrolysis can be distinguished from an inhibitory effect of Ca²⁺ on the plasma membrane K⁺, Mg²⁺-ATPase following microsomal membrane separation using aqueous polymer two

phase partitioning. The Ca^{2+} -dependent activity is stimulated by free Ca^{2+} with a K_m of 8.1 μM in the absence of Mg^{2+} ($[\text{CaATP}] = 0.8 \text{ mM}$). Vacuolar membrane vesicle preparations contain a higher Ca^{2+} -dependent than Mg^{2+} -dependent ATP hydrolysis, although the two activities are not directly additive. The nucleotide specificity of the divalent ion-dependent activities in vacuolar membrane-enriched fractions was low, hydrolysis of CTP and UTP being greater than ATP hydrolysis with both Ca^{2+} and Mg^{2+} . The Ca^{2+} -dependent activity did discriminate against dinucleotides, and mononucleotides, and failed to hydrolyse phosphatase substrates. Despite low nucleotide specificity the Mg^{2+} -dependent activity functioned as a bafilomycin sensitive H^{+} -pump in vacuolar membrane vesicles. Ca^{2+} -dependent ATP hydrolysis was not inhibited by the V-, P-, or F-type ATPase inhibitors bafilomycin, vanadate and azide, respectively, nor by the phosphatase inhibitor molybdate, but was inhibited 20% at pH 7.5 by K^{+} . Possible functions of Ca^{2+} -dependent hydrolysis as a H^{+} -pump or a Ca^{2+} -pump was investigated using vacuolar membrane vesicles. No H^{+} or Ca^{2+} translocating activity was observed under conditions when the Ca^{2+} -dependent ATP hydrolysis was active. [References: 34].

3694 Benalaya, A. (1995) [Characterization, modelization and forecasting of temporal series of pluviometry, evapotranspiration and irrigation water requirements of wheat in Tunisia]. Carcterisation, modelisation et prevision des series temporelles de pluviometrie, d'evapotranspiration et des besoins en eau d'irrigation du ble en Tunisie. Gent Univ. (Belgium). Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. 85 ill.; 156 tables; bibliography p. 277-286. 372 p. French. (AGRI 95-087884).

3695 Benedek, A.; Gyori, Z. (1995) COMPARISON OF QUALITY PARAMETERS OF WHEAT SPECIES CULTIVATED ON DIFFERENT SITES. *Novenytermeles*. 44(1):11-17. Hungarian. [AGRARTUDOMANYI EGYETEM DEBRECEN BOSZORMENYI U138 H-4032 DEBRECEN HUNGARY].

The introductions of new varieties of wheat might call for study of the relationship between baking quality of wheat and site of cultivation. In this paper the baking quality of the varieties were compared in different sites. Sites of cultivation which have different type of soil were following: Csorvas, Gyulatanya, Karcag. Our study demonstrates that the varieties cultivated in Csorvas have the best quality properties. Especially, the protein %, the gluten expansiveness, valorigraphic value, W and P value show unambiguous change relating to the site of cultivation. In our work was used the alveographic method which is a new measurement for determination of baking quality in our country. Correlations among different quality properties, have also been computed.

3696 Benhammouda, M.; Kremer, R.J.; Minor, H.C.; Sarwar, M. (1995) A CHEMICAL BASIS FOR DIFFERENTIAL ALLELOPATHIC POTENTIAL OF SORGHUM HYBRIDS ON WHEAT. *Journal of Chemical Ecology*. 21(6):775-786. English. [USDA ARS CROPPING SYST & WATER QUAL RES UNIT COLUMBIA, MO 65211 USA].

The basis for differential allelopathic potentials among sorghum (*Sorghum bicolor* L. Moench) hybrids was investigated by conducting quantitative and qualitative studies of their phenolic contents. Total phenolic content in sorghum plant parts varied within hybrids, among hybrids, and between growing seasons. Inhibition of wheat (*Triticum aestivum* L.) radicle growth was positively associated ($r = 0.66$) with concentrations of total phenolics contained in plant parts. Extracts from culms contributed the highest proportion of toxicity from sorghum plants, inhibiting radicle growth up to 74.75%. Concentrations of five phenolic acids, p-hydroxybenzoic (POH), vanillic (VAN), syringic (SYR), p-coumaric (PCO), and ferulic (FER), differed in all plant parts of the three sorghum hybrids. Concentrations of POH, VAN, and SYR were consistently higher than PCO and FER. PCO and FER were absent from some plant parts, with FER being the most frequently missing. Inhibition of wheat radicle growth was found to be positively associated with the concentration of each phenolic acid. Vanillic acid was most highly associated ($r = 0.44$) with inhibition. Thus, above-ground sorghum tissues contained phenolic acids that contributed to allelopathic potential. Additionally, sorghum roots exuded POH, VAN, and SYR that may enhance the overall allelopathic potential of sorghum during growth and

after harvest when residues remain on the soil surface or are incorporated prior to planting a subsequent crop. [References: 23].

3697 Cattivelli, L.; Bartels, D. (Experimental Institute for Cereal Research, 29017 Via S. Protaso 302, Fiorenzuola d'Arda (Italy)) (1992) Biochemistry and molecular biology of cold-inducible enzymes and proteins in higher plants. *Inducible plant proteins: their biochemistry and molecular biology*. Wray, J.L. (ed.) p. 267-288. Cambridge University Press. 71 ref., Society for Experimental Biology Seminar Series 49. English. (AGRI 95-077618).

3698 Claus, S.; Wernicke, P.; Pigla, U.; Dubsy, G. (1995) A DYNAMIC MODEL DESCRIBING LEAF TEMPERATURE AND TRANSPIRATION OF WHEAT PLANTS. *Ecological Modelling*. 81(1-3):31-40. English. [UNIV HALLE WITTENBERG AGRO OKOSYST FORSCH QUEDLINBURG HARZWEG 29 D-06484 QUEDLINBURG GERMANY].

A model of actual wheat canopy transpiration flux is presented as a function of the local transpiration flux at the top of the canopy, of leaf area index and of canopy nitrogen content. Three main assumptions are stated to derive this function. Firstly, with respect to a horizontal area element, the leaf area density and local transpiration flux are independent of their location within a canopy layer (homogeneity in horizontal direction). Secondly, the transpiration activity of plant leaves depends not only on driving environmental forces and available water but on leaf nitrogen content also. Thirdly, the profile of the nitrogen content of leaves within the canopy is divided into a "top" and into a "bottom" region. Both regions are vertically uniform within the canopy (rectangular profile). Based on these assumptions, the canopy transpiration flux of wheat plants grown in north Germany under farmer's usual fertilization (N_4) and zero fertilization (N_0) was investigated with the model. The influence of the normal N fertilization is twofold: transpiration increases because of the higher leaf area index, but also because of the higher nitrogen content of the leaves. A comparison of measured soil water contents under the two N treatment canopies with the modelled canopy evapotranspiration shows that the presented approach is appropriate to capture differences in water budgets due to differences in plant nutrition. The transpiration model is suitable for incorporation into complex models of plant canopies (water transport, growth). [References: 19].

3699 Corcuera, L.J.; Argandona, V.H.; Zuniga, G.E. (Departamento de Biologia, Facultad de Ciencias, Universidad de Chile, Casilla 653, Santiago (Chile)) (1992) Allelochemicals in wheat and barley: role in plant-insect interactions. *Allelopathy: basic and applied aspects*. Rizvi, S.J.H.; Rizvi, V. (eds.) p. 119-127. Chapman and Hall Ltd. 22 ref. English. (AGRI 95-087933).

3700 Coker, S.J.; Gaskin, P.; Beale, M.H.; Lenton, J.R. (1995) ENT-3-BETA-HYDROXYKAUR-16-ENE AND ENT-17-HYDROXYKAUR-15-ENE IN PACLOBUTRAZOL-TREATED WHEAT SEEDLINGS. *Phytochemistry*. 39(1):11-14. English. [UNIV BRISTOL LONG ASHTON RES STN INST ARABLE CROPS RES DEPT AGR SCI BRISTOL BS18 9AF AVON ENGLAND].

Large quantities of ent-kaur-16-ene accumulated in the scutella of wheat and barley seedlings treated with the ent-kaur-ene oxidase inhibitor, (2S, 3S)-paclobutrazol. In addition, ent-3 beta-hydroxykaur-16-ene and ent-17-hydroxykaur-15-ene were identified by full-scan GC mass spectrometric comparison with authentic samples in embryos of paclobutrazol-treated wheat. In four-day-old paclobutrazol-treated wheat, ent-3 beta-hydroxykaur-16-ene occurred in similar amounts to ent-kaur-16-ene in embryonic axes but was about 10-fold less than the quantity of ent-kaur-16-ene in scutella. By comparison, ent-17-hydroxykaur-15-ene was present at very low levels and only in scutella of treated wheat seedlings. Only trace amounts of ent-3 beta-hydroxykaur-16-ene were detected in scutella of paclobutrazol-treated barley. [References: 12].

3701 Deleens, E. (Universite de Paris 11, Orsay (France). Institut de Biotechnologie des Plantes, Groupe Structure et Metabolisme des Plantes); Hannachi, P.; Gate, P.; Bouthier, A.; Casabianca, H. (1995) [Isotopic composition of carbon during development of wheat: water use efficiency of the plant and its different green organs taking part in grain filling]. *Composition isotopique du carbone du ble au cours du developpement: Efficacite d'utilisation de l'eau de la plante et des*

différents organes verts participant au remplissage. Colloques de l'INRA (France); no. 70 p. 65-82. INRA. 17 ref. p. 65-82. French. (AGRS 95-087928).

3702 Delwiche, S.R.; Massie, D.R. (1993) Protein content of intact single wheat kernels by spectrophotometry. *Paper - American Society of Agricultural Engineers (USA)*; no. 936001 20 p. references. Paper presented at the "1993 International Summer Meeting sponsored by the American Society of Agricultural Engineers and The Canadian Society of Agricultural Engineering, " June 20-23, 1993, Spokane, Washington. English. (AGRS 95-077713).

3703 Delwiche, S.R.; Chen, Y.R.; Hruschka, W.R. (1995) DIFFERENTIATION OF HARD RED WHEAT BY NEAR-INFRARED ANALYSIS OF BULK SAMPLES. *Cereal Chemistry*. 72(3):243-247. English. [USDA ARS BELTSVILLE AGR RES CTR INSTRUMENTAT & SENSING LAB BELTSVILLE, MD 20705 USA].

Near-infrared reflectance spectroscopy (1, 100 - 2, 498 nm) has been used to identify hard red winter and hard red spring wheat classes. As a followup to a previous study which involved ground wheat samples, the authors have used the same samples on a whole kernel in-bulk (80 g) basis. Four years of U.S. winter and spring wheats were used. A small number (n = 150 samples per class) from the first three years' samples were used for calibration; the remaining portion (n = 1, 325), plus all of the fourth year's samples (n = 778), were used to verify the models. Four types of classification algorithms were examined: multiple linear regression (MLR), principal component analysis with Mahalanobis distance (PCA/MD), partial least squares (PLS) analysis, and artificial neural networks (ANN). All four models demonstrated classification accuracies (defined as the percentage of correctly classified samples) greater than 88%, and most often, about 95% for samples grown during the same years as used in calibration. These accuracies were significantly better than those associated with discriminant models that were based solely on protein content, NIR-hardness, or a combination of protein and hardness. Spectrally sensed water-matrix interactions were probably beneficial to model accuracy; however, moisture content alone was not deemed necessary to a model's success. When predicting the fourth year, the MLR model needed a bias correction, whereas the other three models performed reasonably well. The ANN model's performance was highest, with accuracies in the range of 95-98%. At little expense to model accuracy, the number of input nodes to the ANN model could be reduced from 223 to 111, provided the full wavelength range was preserved. [References: 20].

3704 Drozdowicz, Y.M.; Jones, R.L. (1995) HORMONAL REGULATION OF ORGANIC AND PHOSPHORIC ACID RELEASE BY BARLEY ALEURONE LAYERS AND SCUTELLA. *Plant Physiology*. 108(2):769-776. English. [UNIV CALIF BERKELEY DEPT PLANT BIOL BERKELEY, CA 94720 USA].

The release of acid from the aleurone layer and scutellum of barley (*Hordeum vulgare* L. cv Himalaya) was investigated. Aleurone layers isolated from mature barley grains acidify the external medium by releasing organic and phosphoric acids. Gibberellic acid and abscisic acid stimulate acid release 2-fold over control tissue incubated in 10 mM CaCl₂. Gibberellic acid causes medium acidification by stimulating the release of phosphoric and citric acids, whereas abscisic acid stimulates the release of malic acid. The accumulation of these acids in the incubation medium buffers the medium against changes in pH, particularly between pH 4 and 5. The amounts of amino acids that accumulate in the medium are low (2-12 nmol/layer) compared to other organic and phosphoric acids (100-500 nmol/layer). The scutellum does not play a major role in medium acidification but participates in the uptake of organic acids. The organic acid composition of the starchy endosperm changes after 3 d of imbibition; malic, succinic, and lactic acids decrease, whereas citric and phosphoric acids remain unchanged or increase. These results indicate that during postgerminative growth, the acidity of the starchy endosperm is maintained by acid production by the aleurone layer. [References: 47].

3705 Fischer, R.A. (Centro Internacional de Mejoramiento de Maiz y Trigo, P.O. Box 6 641, 06600 Mexico D.F. (Mexico)) (1994) Key issues in wheat yield potential. Workshop on Rice Yield Potential in Favorable Environment; Los Banos, Laguna (Philippines); 29 Nov - 4 Dec 1993.

Breaking the yield barrier: proceedings of a Workshop on Rice Yield Potential in Favorable Environments. Casman, K.G. (ed.). International Rice Research Inst., Los Banos, Laguna (Philippines) p. 91-93. IRRI. 2 ref. English. (AGRS 95-077712).

The situation described for determining yield potential in spring wheat has interesting parallels and contrasts with that for irrigated tropical rice. Actual and record grain yields, and P max values, do not differ greatly, whereas the critical role of solar radiation before anthesis in determining the potential number of grains is similar, as is the clear need for greater lodging resistance. In contrast, the high level of stem carbohydrates reserves accumulated before flowering is unique to rice, and investment in inflorescence dry weight relative to total biomass at anthesis is smaller than in wheat. The existence of unfilled spikelets in rice could be likened to failures of grain set in wheat, but the relative loss of potential grains appears greater in rice, and the determination of this yield component seems to extend further into the grain-filling period. Another curious difference is the presumed movement of stem reserves into growing grains early in grain filling in rice and much later in the case of wheat. But the smaller final kernel weight of rice combined with synchrony of flowering means a shorter grain-filling interval and much higher rates of grain weight accumulation (kg/ha per day) this may necessitate the larger investment in pre-anthesis stem carbohydrate reserves.

3706 Frederick, J.R.; Camberato, J.J. (1995) WATER AND NITROGEN EFFECTS ON WINTER WHEAT IN THE SOUTHEASTERN COASTAL PLAIN .2. PHYSIOLOGICAL RESPONSES. *Agronomy Journal*. 87(3):527-533. English. [CLEMSON UNIV DEPT AGRON & SOILS PEE DEE RES & EDUC CTR ROUTE 1 BOX 531 FLORENCE, SC 29501 USA].

The application of N to winter wheat (*Triticum aestivum* L. emend. Thell.) generally increases leaf reduced N concentration (LRN), thereby potentially increasing the rate and duration of leaf photosynthesis during grain fill. For nonirrigated winter wheat grown on the southeastern Coastal Plain of the USA, however, increasing the rate of spring-applied N has been found to result in greater plant water deficits and lower leaf CO₂ exchange rates (CER) during the grain-filling period. This 2-yr study was conducted to determine the effects of spring N rate on the rate and duration of leaf photosynthesis in winter wheat grown with irrigation and to examine the relationship between leaf CER and LRN as affected by spring N rate, soil water treatment, and wheat growth stage. Wheat was grown with different rates of spring-applied N (0, 45, 90 and 135 kg N ha⁻¹) under irrigated and nonirrigated conditions. Leaf CER generally increased with increased spring N under irrigated conditions but decreased under nonirrigated conditions. Higher leaf CER with irrigation, as opposed to without irrigation, resulted in greater vegetative dry weights during the early stages of grain fill. Leaf CER was closely associated with LRN during grain fill under irrigated conditions, but greater stomatal closure with increased spring N resulted in deviations from this relationship under nonirrigated conditions. The dates of initial decline in LRN of the flag leaf and leaf area index (LAI) were similar for all treatments and in both years. Only under irrigated conditions did increases in spring N rate delay the complete loss of leaf area and photosynthetic activity during grain fill. Compared with 1992, the rate of decline in LAI, LRN, and CER during grain fill was more rapid in 1993, when air temperatures were warmer. Results indicate that supplemental water is needed on the southeastern Coastal Plain for high rates of spring-applied N to increase the rate and duration of leaf photosynthesis in winter wheat during the grain-filling period. [References: 12].

3707 Gao Xiang; Ning Kun (Shaanxi Provincial Inst. of Grain Crops, Yangling (China)) (1994) Advance in research on several physiological characteristics of wheat. *Shaanxi Journal of Agricultural Sciences (China)* (no. 5) p. 9-11. Chinese. (AGRS 95-087930).

3708 Han, K.H.; Kim, C.H.; Chung, D.H.; Park, K.H.; Lee, D.S. (Korea Advanced Institute of Science and Technology, Taejeon (Korea Republic). Genetic Engineering Research Institute) (1993) Determination of the composition of a tetrasaccharide isolated from glycosylated barley Beta-amylase isozyme using nuclear magnetic resonance. *Korean Biochemical Journal (Korea Republic)* v. 26(5) p. 440-444. 6 illus.; 16 ref. English. (AGRS 95-077680).

3709 Heathcote, DG.; Chapman, DK.; Brown, AH. (1995) NASTIC CURVATURES OF WHEAT COLEOPTILES THAT DEVELOP IN TRUE MICROGRAVITY. *Plant Cell & Environment*. 18(7):818-822. English. [MARTIN MARIETTA SERV INC AMES RES CTR POB 138 MOFFETT FIELD, CA 94035 USA].

Dark-grown wheat coleoptiles developed strong curvatures within 5 h of being transferred in orbit from a 1 g centrifuge to microgravity during an experiment flown on the IML-1 shuttle mission. The curving tendency was strongest in seedlings that were immature, with coleoptiles shorter than 10 mm at the time of transfer. The curvature direction was non-random, and directed away from the caryopsis (the coleoptile face adjacent to the caryopsis becoming convex). The curvatures were most marked in the basal third of the coleoptiles, contrasting with phototropic responses, which occur in the apical third. We interpret these curvatures as being nastic, and related to the curvatures commonly reported to occur during clinostat rotation treatments. [References: 18].

3710 Howell, TA.; Steiner, JL.; Schneider, AD.; Evett, SR. (1995) EVAPOTRANSPIRATION OF IRRIGATED WINTER WHEAT - SOUTHERN HIGH PLAINS. *Transactions of the ASAE*. 38(3):745-759. English. [USDA ARS CONSERVAT & PROD RES LAB PO DRAWER 10 BUSHLAND, TX 79012 USA].

Models of water use for irrigation scheduling and for crop growth simulation require validation of the evapotranspiration (ET) submodel. In this study ET was measured for irrigated winter wheat (*Triticum aestivum* L.) at Bushland, Texas, in the semi-arid Southern High Plains for the 1989-1990, 1991-1992, and 1992-1993 winter wheat cropping seasons using weighing lysimeters that contained undisturbed monoliths 3 x 3 x 2.3 m deep of Pullman clay loam soil (Torreptic Paleustolls). Weather data from a nearby station were used to compute daily ET values for a reference alfalfa crop (hypothetical) using the ASCE Manual No. 70 equations based on the Penman-Monteith equation and several other widely used "potential" or "maximum" ET models. Linear regressions between ET estimated from widely used equations and the reference alfalfa ET equation indicated that direct comparisons with computed ET values could not be reliably predicted with simple ratios. For the computed reference alfalfa Er base, peak basal crop coefficients (K_{cb}) varied from 0.88 to 1.00 for the three seasons and were lower than those reported from other locations. Peak mean crop coefficients (K_c) varied from 0.83 to 0.94 for the three seasons. Seasonal ET varied from 791 to 957 mm for the three seasons. Evapotranspiration and crop coefficients for winter wheat varied considerably with season. [References: 52].

3711 Ito, T.; Yamai, M.; Nishio, T.; Oku, T. (1994) Carbon-13 NMR spectra of peracetylated derivatives of methyl L-arabinofuranoside and oligosaccharides related to arabinoxylan. *Journal of carbohydrate chemistry (USA)* v. 13(3) p. 491-498. references. English. (AGRIS 95-087899).

The ¹³C NMR signals of methyl tri-O-acetyl-L-arabinofuranosides were assigned on the basis of heteronuclear shift correlated NMR spectra. From the enzymic digest of barley-hull arabinoxylan two oligosaccharides, i.e., alpha-L-Araf-(1 leads to 3)-beta-D-xylp-(1 leads to 4)-D-xylp and alpha-L-Araf-(1 leads to 3)-beta-D-xylp-(1 leads to 4)-beta-D-xylp-(1 leads to 4)-D-xylp were obtained. The NMR spectra of their per-O-acetylated derivatives were assigned, and discussed.

3712 Ivlev, AA.; Pichuzhkin, VI.; Knyazev, DA. (1995) CARBON ISOTOPE DISTRIBUTION IN WHEAT GENOTYPES. *Russian Journal of Plant Physiology*. 42(3):345-349. English. [KA TIMIRYAZEV AGR ACAD UL TIMIRYAZEVA 47 MOSCOW 127550 RUSSIA].

The seeds of spring durum wheat (*Triticum durum* Desf., cv. Khar'kovskaya-46), winter bread wheat (*Triticum aestivum* L., cv. Mironovskaya-808), wheatgrass (*Agropyron glaucum* Desf.), and several cultivars produced by crossing these species were used to determine the carbon isotope discrimination in the total seed biomass and some of its fractions. All the genotypes under study were separated into three groups according to their carbon isotope composition (mainly in starch and protein fractions) as compared to one of the parent forms. Thus, we suggest that the specificity of carbon isotope distribution can be employed as an index of the presence of the parental germplasm in the hybrid. [References: 30].

3713 Jamai, A.; Gaillard, C.; Delrot, S.; Martinoia, E. (1995) DIPEPTIDE TRANSPORT IN BARLEY MESOPHYLL VACUOLES. *Planta*. 196(3):430-433. English. [UNIV POTTERS ECHANGES MEMBRANNAIRES VEGETALES LAB 25 RUE FAUBOURG ST CYPRIEN F-86000 POTTERS FRANCE].

The transport of [C-14]glycyl-glycine (Gly-Gly) across the tonoplast of isolated barley vacuoles has been characterized. Uptake of the dipeptide Gly-Gly into barley mesophyll vacuoles was strongly increased by the addition of ATP, while Mg²⁺ inhibited the ATP-dependent fluxes. Inhibition of the vacuolar proton pump by bafilomycin or dissipation of the Delta pH had no effect on the ATP-dependent Gly-Gly uptake. Only the non-hydrolysable ATP analogue 5'-adenylylimidodiphosphate could partially substitute for ATP; ADP, GTP and UTP had no effect. Transport of Gly-Gly was saturable exhibiting an apparent K_m of 49 +/- 5 mM. Uptake was inhibited by the sulphhydryl reagents N-ethylmaleimide and p-chloromercuribenzenesulphonic acid. When present at 30 mM, various dipeptides as well as tri-glycine inhibited Gly-Gly (10 mM) uptake by 30-50%, whereas 5 mM phenylalanine was able to inhibit Gly-Gly uptake almost completely. Comparison with published data suggests that Gly-Gly is transferred across the tonoplast by the same system as several amino acids and inorganic ions (K.J. Dietz et al., 1994, J. Membr. Biol. 137, 151-158). [References: 21].

3714 Jensen, S.E. (Kgl. Veterinaer og Landbohøjskole, København (Denmark). Dept. of Agricultural Sciences) (1994) Evapotranspiration from agricultural crops. *Avdelningsmeddelande - Sverige* Lantbruksuniversitet, Institutionen för Markvetenskap, Avdelningen för Lantbrukets Hydroteknik (Sweden); no. 5 p. 17-20. 3 ref. p. 17-20. English. (AGRIS 95-077681).

3715 Jorgensen, JA.; Nguyen, HT. (1995) GENETIC ANALYSIS OF HEAT SHOCK PROTEINS IN MAIZE. *Theoretical & Applied Genetics*. 91(1):38-46. English. [TEXAS TECH UNIV DEPT PLANT & SOIL SCI PLANT MOLEC GENET LAB MAIL STOP 2122 LUBBOCK, TX 79409 USA].

A genetic analysis of heat shock protein (HSP) synthesis was performed in seedling leaf tissue of two maize inbred lines, their F-1 hybrid and F-2 progeny. Protein synthesis following a high temperature treatment was visualized by [³⁵S]-methionine in vivo labelling and two-dimensional gel electrophoresis. The parental lines' HSP synthesis patterns revealed both qualitative and quantitative polymorphisms implicative of differences in HSP structural genes and regulatory factors. The F-1 hybrid HSP profile indicated that synthesis of all parental HSPs conformed to dominant inheritance patterns, including complete dominance, over-dominance and co-dominance. Alleles for six low-molecular-weight HSPs in F-2 progeny assorted according to typical 3:1 Mendelian ratios for dominant gene expression. There is evidence for unlinked gene loci of four different HSP gene pairs, but data for three other HSP gene pairs were inconclusive, perhaps reflecting linkage for one pair and complex regulatory factor interactions for the other two pairs of genes. These results clearly indicate the existence of genetic variability in HSP synthesis and emphasize the potential of partitioning their roles in thermal tolerance using genetic and molecular analyses. [References: 33].

3716 Lacerenza, NG.; Cattivelli, L.; Difonzo, N. (1995) EXPRESSION OF DROUGHT INDUCED GENES IN DURUM WHEAT UNDER STRESS IN FIELD CONDITIONS. *Journal of Plant Physiology*. 146(1-2):169-172. English. [EXPTL INST CEREAL RES SECT FOGGIA SS 16KM 675 I-71100 FOGGIA ITALY].

The relationship of the expression levels of drought - (AF93 - Grossi et al., 1992) and ABA-regulated genes (Dhn1 - Close et al., 1989), water potential and ABA content was analyzed in durum wheat at the grain-filling stage. The moisture-stressed plants exhibited a marked reduction of water potential, a rise in ABA content and induction of mRNAs homologous to AF93; no mRNAs homologous to Dhn1 were found. [References: 19].

3717 Liu Xuezu (Beijing Agricultural Univ. (China). Coll. of Agricultural Resources and Environment Science) (1994) Differences of diurnal changes in canopy temperature of winter wheat under the water stress

3718 Lohaus, G.; Winter, H.; Riens, B.; Heldt, H.W. (1995) FURTHER STUDIES OF THE PHLOEM LOADING PROCESS IN LEAVES OF BARLEY AND SPINACH - THE COMPARISON OF METABOLITE CONCENTRATIONS IN THE APOPLASTIC COMPARTMENT WITH THOSE IN THE CYTOSOLIC COMPARTMENT AND IN THE SIEVE TUBES. *Botanica Acta*. 108(3):270-275. English. [UNIV GOTTINGEN INST BIOCHEM PFLANZE UNTERE KARSPULE 2 D-37073 GOTTINGEN GERMANY].

The concentrations of sucrose, amino acids, nitrate and malate in the apoplastic compartment of illuminated leaves of barley and spinach were determined and compared with the corresponding concentrations in the cytosolic compartment of mesophyll cells and in the phloem sap, as measured previously with plants grown under identical conditions. The concentrations of sucrose and amino acids in the apoplast are found to be much lower than in the cytosol and in the phloem sap, indicating that not only the uptake into the phloem of sucrose, but also of amino acids, requires transport against a concentration gradient. The gradient of sucrose and amino acids between the cytosol and the apoplast was maintained when phloem transport had been blocked by cold girdling. Apparently, the efflux of sucrose and amino acids from the source cells to the apoplast is regulated in such a way that it meets the requirements of phloem transport. The percentages of the single amino acids as part of the total amino acids are quite similar in the cytosol, apoplast and phloem sap. The ratio of sucrose to the total amino acids in the cytosol is similar to that in the apoplast but about five times higher in the phloem sap. It appears from these results that the preferential extraction of sucrose over amino acids from the source cells to the phloem is due to the uptake from the apoplast into the phloem. [References: 48].

3719 Narasimhalu, P.; Kong, D.; Choo, T.M.; Ferguson, T.; Therrien, M.C.; Ho, K.M.; May, K.W.; Jui, P. (1995) EFFECTS OF ENVIRONMENT AND CULTIVAR ON TOTAL MIXED-LINKAGE BETA-GLUCAN CONTENT IN EASTERN AND WESTERN CANADIAN BARLEYS (*HORDEUM VULGARE* L.). *Canadian Journal of Plant Science*. 75(2):371-376. English. [AGR & AGRI FOOD CANADA RES STN POB 1210 CHARLOTTETOWN PE C1A 7M8 CANADA].

Two-row and six-row barley (*Hordeum vulgare* L.) cultivars, originating from eastern and western Canada were grown in six environments across Canada. The grain was studied for the effects of environment and cultivar on the total mixed-linkage P-glucan content (TBG, g hg⁻¹ DM). Environment significantly affected TBG content in barley. TBG content differed among the 32 eastern or 43 western Canadian cultivars but the mean TBG for the eastern cultivars was not different from the mean of western cultivars. All eastern cultivars were hulled-feed types, and their TBG ranged from 3.31 in Micmac to 4.09 in Birka for two-row barleys, and from 3.78 in OAC Kippen to 4.41 in Maskot for six-row barleys. Western hulled cultivars which included feed and malt types, contained TBG ranging from 3.37 in Manley to 4.14 in Betzes for two-row barleys, and from 3.71 in Heartland to 4.42 in Tankard for six-row barleys. The two-row hulless cultivar, Condor, contained more TBG (4.69) than the other two hulless cultivars, CDC Richard (3.91) and Scout (3.85). The six-row hulless cultivars, CDC Buck and Tupper, were equal in TBG (4.35). The mean TBG was lower for the two- than six-row barleys (3.7 vs. 4.0), and a broader range for TBG in the two- (3.31-4.55) than six-row barleys (3.71-4.42) suggested the greater possibility of producing low and high TBG barleys from the two-row cultivars. Canadian cultivars contained between 3.31 and 4.55 g TBG hg⁻¹ DM, and there is a need to develop feed-type barleys containing a third less than the minimum TBG, and food-type barleys containing a third more than the maximum TBG. [References: 25].

3720 Novitskaya, G.V.; Karasev, G.S.; Suvorova, T.A.; Trunova, T.I. (1995) THE EFFECT OF CYCLOHEXIMIDE ON THE CONTENT OF LIPIDS AND SOLUBLE PROTEINS IN WINTER WHEAT PLANTS DURING COLD ACCLIMATION. *Russian Journal of Plant Physiology*. 42(3):338-344. English. [RUSSIAN ACAD SCI KA TIMIRYAZEV PLANT PHYSIOL INST UL BOTANICHESKAYA 35 MOSCOW 127276 RUSSIA].

The effect of cycloheximide on the content and composition of proteins and lipids in the leaves and crowns of wheat (*Triticum aestivum* L., cv. Mironovskaya 808) was studied, in relation to the development of cold hardiness during plant acclimation to low temperatures. Plants in the tillering stage were hardened at 2 degrees C for seven days in the light. The content of soluble proteins increased twofold during hardening, which correlated with the increased hardiness of the plant. Four "new" polypeptides appeared during hardening; they comprised about 10% of the total soluble proteins. Cycloheximide retarded the accumulation of soluble proteins, partly inhibited "new" protein biosynthesis, and completely suppressed the development of cold hardiness in plants. Cycloheximide also affected the composition and total content of lipids. The content of the polar lipids of membranes decreased threefold. The relative amounts of linoleic and linolenic acids decreased, while those of lauric, myristic, and palmitic acids increased. These changes were more pronounced in the crowns than in the leaves. The trend toward decreasing the polar lipid unsaturation was quite consistent. Cycloheximide was suggested to decrease the cold hardiness in plants through a direct blocking of protein biosynthesis and an indirect inhibition of lipid biosynthesis due to inactivation of the enzymes of lipid synthesis and dehydrogenation. [References: 27].

3721 Padu, E.K. (1995) PROPERTIES OF PEROXIDASES AND PHENYLALANINE AMMONIA-LYASE IN WHEAT STEMS DURING SECONDARY CELL WALL FORMATION AND LIGNIFICATION. *Russian Journal of Plant Physiology*. 42(3):358-365. English. [TARTU STATE UNIV INST MOLEC & CELLULAR BIOL UL 181 TARTU 2400 ESTONIA].

Differentiation in the conductive tissues and sclerenchyma of wheat (*Triticum aestivum* L.) stems was followed by measuring the cell wall thickening and lignin content. With increasing distance from the intercalary meristem, cell wall thickening in pitted vessels and sclerenchyma, and widening of the layer of the subepidermal sclerenchyma occurred in parallel with lignin accumulation. The activity of phenylalanine ammonia-lyase was greater in the plants with a higher lignin level. The activity of cell wall peroxidase was not a rate-limiting factor in lignin biosynthesis. There was no difference between the soluble and ionically bound peroxidases concerning the Michaelis constants for the substrates guaiacol, syringaldazine, and hydrogen peroxide. One cationic and four anionic peroxidases from the ionically bound fraction are assumed to be involved in lignin biosynthesis. [References: 19].

3722 Panteris, E.; Apostolakis, P.; Galatis, B. (1995) THE EFFECT OF TAXOL ON TRITICUM PREPROPHASE ROOT CELLS - PREPROPHASE MICROTUBULE BAND ORGANIZATION SEEMS TO DEPEND ON NEW MICROTUBULE ASSEMBLY. *Protoplasma*. 186(1-2):72-78. English. [UNIV ATHENS INST GEN BOT GR-15784 ATHENS GREECE].

To examine whether preprophase microtubule band (PPB) organization occurs by rearrangement of pre-existing, or by assembly of new microtubules (MTs), we treated root cells of *Triticum turgidum* with taxol, which stabilizes pre-existing MTs by slowing their depolymerization. With taxol early preprophase cells failed to form a normal PPB and PPB narrowing was prevented in cells that had already formed a wide one. The PPB became persistent in prometaphase cells and the formation of multipolar prophase-prometaphase spindles was induced. These data favour the suggestion that PPB formation and narrowing, as well as prophase spindle development, are dynamic processes depending on continuous MT assembly at the PPB site and in the perinuclear cytoplasm. [References: 46].

3723 Rana, G. (Istituto Sperimentale Agronomico, Bari (Italy)); Cellier, P. (Institut National de Recherches Agronomiques (INRA), Grignon (France). Station de Bioclimatologie) (1994) [Wind and temperature profiles over sloping land. Some experimental data]. I profili di vento e di temperatura su un terreno agrario in pendenza. Alcuni dati sperimentali. *Societa Italiana di Agronomia*. 28. Annual meeting on agronomic aspects of soil conservation on slopes and the safeguard of the environment; Potenza (Italy); 6-9 Jul 1993. *Rivista di Agronomia (Italy)* v. 28(4) p. 448-454. 1 table; 5 graphs; 20 ref. Italian. (AGRIS 95-087886).

To study the hydrological processes in a soil in slope it needs to establish the losses by evapotranspiration (ET). This phenomenon is

difficult to analyse because of the complex dynamic of the air and heat flow over a hill. Major studies are devoted to analyse theoretically and numerically the problem, a little number of works are indeed devoted to experimental trials, due to the complexity of the experimental measurements. The ET flow is linked to vapour, temperature and wind speed profiles and to the soil topography. In the present work wind and temperature profiles experimentally obtained above a wheat canopy on a soil with a slope of 10% are shown. Wind and temperature measurements were automatically executed at five levels in three points on the North versant of a hill. The results show that in ET analysis it is important to take into account both the soil exposure and the wind direction. The profiles, as well as modified, remain logarithmic upwind but are not-logarithmic downwind. Downwind to the atmospheric turbulence is added a turbulence at different scale due to the complex soil geometry.

3724 Robertson, M.; Cuming, AC.; Chandler, PM. (1995) **SEQUENCE ANALYSIS AND HORMONAL REGULATION OF A DEHYDRIN PROMOTER FROM BARLEY, HORDEUM VULGARE**. *Physiologia Plantarum*. 94(3):470-478. English. [UNIV LEEDS DEPT GENET LEEDS LS2 9JT W YORKSHIRE ENGLAND].

A dehydrin gene (*dhn7*) was isolated from a barley (*Hordeum vulgare* L. cv. Himalaya) genomic library. A 2138-bp fragment of the gene was sequenced and the deduced amino acid sequence showed 99% identity with that of a previously identified cDNA, *Dhn1*, which encodes one of a group of closely related proteins induced by dehydration stress. Transient expression assays in barley aleurone protoplasts defined regions of the *dhn7* promoter that mediate abscisic acid (ABA) responsive transcription. A fragment (-935 to +42) of the gene was found to confer concentration-dependent ABA-responsiveness measured by expression of a beta-glucuronidase (GUS) reporter gene. Analysis of a 5' deletion series of the promoter defined a region (-285 to -233) that modulated the amplitude of the ABA-response, whilst ABA-responsiveness, per se, required a region (-233 to -211) that included a conserved motif containing the G-box-like sequence TACGTGG. Gibberellic acid (GA(3)) antagonised ABA-induced accumulation of dehydrin mRNA in aleurone cells, but did not antagonise ABA-induced transcriptional activation as revealed by GUS activity. The antagonistic effect of GA(3) on ABA-induced dehydrin expression might therefore operate post-transcriptionally. [References: 37].

3725 Sapirstein, HD.; Kohler, JM. (1995) **PHYSICAL UNIFORMITY OF GRADED RAILCAR AND VESSEL SHIPMENTS OF CANADA WESTERN RED SPRING WHEAT DETERMINED BY DIGITAL IMAGE ANALYSIS**. *Canadian Journal of Plant Science*. 75(2):363-369. English. [UNIV MANITOBA DEPT FOOD SCI WINNIPEG MB R3T 2N2 CANADA].

The application of digital image analysis for objective measurement of grain uniformity in commercial samples of Canada Western Red Spring (CWRS) wheat was investigated. Official railcar-unloading (carlot) and vessel-loading (cargo) samples of three grades (Nos. 1, 2 and 3) of CWRS wheat were analyzed for 16 kernel-size, shape and brightness features that were automatically computed from digital images acquired in reflected light. Based on a subsample of 400 kernels for each graded sample, coefficient of variation (CV) data were used to evaluate the influence of grading and bulk handling on the uniformity of carlot and cargo shipments. A significant and progressive decrease in sample uniformity for No. 2 and No. 3 carlot samples, compared with No. 1, was observed for all computed kernel features. Averaged over all features, the decreases in uniformity in carlot samples were 13.4 and 13.7% with grade lowering from No. 1 to No. 2 and from No. 2 to No. 3, respectively. For cargo samples, an analogous effect was found as the grade dropped from No. 2 to No. 3 only. There was essentially no measurable difference in the level of uniformity, averaged over all kernel features, between No. 1 and No. 2 cargo samples, which were extremely uniform, as indicated by CV values of 1.27 and 1.25%, respectively. The effect of the bulk handling system was evidenced by a substantial improvement in uniformity of cargo samples compared with carlot samples. Averaged over all features, CV values for cargo samples were lower than CV values for corresponding carlots by 58, 63 and 64% for grade Nos. 1, 2 and 3, respectively. [References: 13].

3726 Schmidt, B.; Rivero, C.; Thiede, B. (1995) **3, 4-DICHLOROANILINE N-GLUCOSYL- AND N-MALONYLTRANSFERASE ACTIVITIES IN CELL CULTURES AND**

PLANTS OF SOYBEAN AND WHEAT. *Phytochemistry*. 39(1):81-84. English. [RHEIN WESTFAL TH AACHEN DEPT BIOL 5 WORRINGER WEG 1 D-52056 AACHEN GERMANY].

The activities of UDP-glucose: 3, 4-dichloroaniline N-glucosyltransferase (N-GT; EC 2.4.1.71) and malonyl-CoA: 3, 4-dichloroaniline, N-malonyltransferase (N-MT) were determined in soybean and wheat cell suspension cultures, and in individual organs of the respective plants. In the soybean suspensions, N-GT and N-MT activities were quite constant over the subculture interval, and ranged from 0.48 to 1.65, and 34.3 to 80.1 pkat . mg(-1) protein, respectively. No N-MT activity was detected in wheat cultures, while the specific N-GT activities were between 1.3 and 4.5 pkat . mg(-1) protein. In soybean plants, N-MT was most active in the roots (9.6 pkat . mg(-1) protein) and N-GT activity was maximal in the cotyledons (1.7 pkat . mg(-1) protein). No N-MT activity was detected in the wheat plants, whereas N-GT activities of the wheat roots and cotyledons amounted to 1.4 and 1.0 pkat . mg(-1) protein, respectively. [References: 20].

3727 Sharma, TR.; Dawa, T.; Plaha, P. (1995) **EFFECT OF 6X AND 4X WHEAT CYTOPLASMS ON SOME AGROMORPHOLOGICAL CHARACTERISTICS**. *Cereal Research Communications*. 23(1-2):71-72. English. [HIMACHAL PRADESH AGR UNIV DEPT PLANT BREEDING & GENET PALAMPUR 176062 HIMACHAL PRADESH INDIA].

3728 Singh, S.; Sethi, GS. (1995) **STOMATAL SIZE, FREQUENCY AND DISTRIBUTION IN TRITICUM AESTIVUM, SECALE CEREALE AND THEIR AMPHIPLOIDS**. *Cereal Research Communications*. 23(1-2):103-108. English. [PAU REG RES STN FARIDKOT 151203 PUNJAB INDIA].

Stomatal frequency and size were determined in the leaves of eight bread wheat cultivars, one self-fertile, homozygous, dwarf rye cultivar and their newly synthesized amphiploids. All the wheat cultivars, rye and their amphiploids showed greater number of stomata per unit area, in their flag leaf than in the penultimate leaf, and also in the adaxial surface than in the abaxial surface. The wheats and the amphiploids showed significant differences for stomatal frequency on the whole as well as individually among themselves. The rye cultivar showed significantly greater number of stomata than the wheats and most of the amphiploids. However, a few amphiploids resembled rye for stomatal frequency in the penultimate leaf. The stomatal size was significantly smaller in the rye compared with the wheats and the amphiploids, and similarly, the wheats had significantly shorter stomata as compared with most of the amphiploids. Significant differences were also observed for stomatal size individually within wheats and amphiploids. Differences were also observed for stomatal frequency with respect to ploidy level. Significant positive correlation was observed between adaxial and abaxial surfaces for stomatal frequency in both the leaves, but a negative association was observed between stomatal frequency and size. The estimates of heritability were found to be quite high for both traits. The genetic advance was found to be the highest for stomatal frequency on abaxial surface of the penultimate leaf.

3729 Tsuchiya, Y.; Araki, S.; Sahara, H.; Takashio, M.; Koshino, S. (1995) **IDENTIFICATION OF MALTING BARLEY VARIETIES BY GENOME ANALYSIS**. *Journal of Fermentation & Bioengineering*. 79(5):429-432. English. [SAPPORO BREWERIES LTD BREWING RES LABS 10 OKATOHE SHIZUOKA 425 JAPAN].

In this article, we present a useful method to identify malting barley varieties by genome analysis. To identify primer sets that permit the detection of polymorphism, various regions of genes of enzymes or proteins relevant to brewing were amplified by the polymerase chain reaction (PCR). The PCR-amplified fragments were analyzed by temperature gradient gel electrophoresis, and then sequenced. We developed the useful primer sets from the sequences of alpha-amylase, beta-amylase, beta-glucanase, and B1-hordein. The 10 typical barley varieties tested in this study were successfully distinguished by the restriction enzyme digest patterns of products amplified using these primer sets. [References: 10].

3730 Walker, DJ.; Smith, SJ.; Miller, AJ. (1995) **SIMULTANEOUS MEASUREMENT OF INTRACELLULAR PH AND K+ OR NO3- IN BARLEY ROOT CELLS USING TRIPLE-BARRELED, ION-SELECTIVE MICROELECTRODES**. *Plant Physiology*. 108(2):743-751. English. [AFRC

The manufacture and use of triple-barreled microelectrodes, which are capable of simultaneous *in vivo* measurement of intracellular pH and the activities of K⁺ or NO₃⁻ and cell membrane potential (E(m)), are described. Scanning electron micrographs showed that the three tips were aligned and that the overall tip diameter was approximately 0.8 μ m. When filled with 100 mM KCl, all three barrels simultaneously reported identical transmembrane potentials, showing that all three tips were located in the same subcellular compartment. Intracellular estimates of E(m) in barley (*Hordeum vulgare* L. cv Klaxon) root epidermal cells obtained with these triple-barreled microelectrodes were indistinguishable from those obtained using single- or double-barreled microelectrodes. Measurements made with triple-barreled K⁺ and pH-selective microelectrodes in root cells of 7-d-old barley plants grown in a nutrient solution containing 0.5 mM K⁺ yielded cytosolic and vacuolar populations having mean K⁺ activity values of 71.3 and 68.7 mM, respectively. The associated mean pH values ($\pm$ SE) were 7.26 $\pm$ 0.06 (cytosol) and 5.18 $\pm$ 0.08 (vacuole). Analysis of whole-tissue digests confirmed the microelectrode measurements. Measurements made using triple-barreled pH- and nitrate-selective microelectrodes confirmed earlier double-barreled measurements of pH and nitrate in barley root epidermal cells growing in 10 mM nitrate. [References: 41].

3731 Werner, WE. (1995) FERGUSON PLOT ANALYSIS OF HIGH MOLECULAR WEIGHT GLUTENIN SUBUNITS BY CAPILLARY ELECTROPHORESIS. *Cereal Chemistry*. 72(3):248-251. English. [PERKIN ELMER DIV APPL BIOSYST FOSTER CITY, CA USA].

The high molecular weight glutenin subunits of wheat endosperm migrate anomalously in sodium dodecyl sulfate (SDS) polyacrylamide gel electrophoresis. This anomalous migration was studied by capillary electrophoresis employing an entangled polymer solution that contained SDS. The nonrigid solution nature of the sieving matrix allowed for the easy preparation of the different matrix concentrations required for the construction of a Ferguson plot. A Ferguson plot analysis of these proteins suggested that the high molecular weight glutenin subunits possessed frictional coefficients similar to those determined for standard proteins of the same size, indicating that anomalous migration in polyacrylamide gels was due to decreased binding of SDS and not to a unique structural conformation in the presence of SDS. [References: 31].

3732 West, M.M.; Ockenden, I.; Lott, J.N.A. (Department of Biology, McMaster University, Hamilton, Ont. L8S 4K1 (Canada)) (1994) Leakage of phosphorus and phytic acid from imbibing seeds and grains. *Seed Science Research (United Kingdom)* v. 4(2) p. 97-102. 45 ref. English. (AGRI 95-087956).

3733 Wraith, J.M.; Baker, J.M.; Blake, T.K. (1995) WATER UPTAKE RESUMPTION FOLLOWING SOIL DROUGHT - A COMPARISON AMONG FOUR BARLEY GENOTYPES. *Journal of Experimental Botany*. 46(288):873-880. English. [MONTANA STATE UNIV DEPT PLANT SOIL & ENVIRONM SCI BOZEMAN, MT 59717 USA].

Soil water resulting from episodic growing season rainfall evaporates rapidly in semi-arid regions. Plants may not benefit from such water additions if near-surface roots are unable to resume water uptake rapidly following periods of soil water deficit. Our objectives were to develop a means of quantifying root uptake responses in the upper soil layer following rewetting after soil water deficit, and to evaluate the existence of genotypic differences among four diverse barley (*Hordeum vulgare* L.) genotypes in this regard. Plants were grown in replicate soil columns having hydraulically isolated surface and subsoil layers, and instrumented with time-domain reflectometry (TDR) waveguides. The upper 0.05 m soil layer was allowed to dry to -1.8 to -3.0 MPa for 10-14 d, during which time subsoil wetness was maintained at about -0.6 to -0.7 MPa. The time-course of soil water uptake was monitored at 0.5 h intervals following rewetting of the surface layer. Substantial water uptake began 1 d after rewetting following 10 d, and 2-3 d after rewetting following 14 d of water deficit. Rate of water uptake was more rapid in response to a second rewetting 5-7 d later. Consistent genotypic responses in terms of cumulative water uptake on a whole plant and leaf area-specific basis were observed during each trial. These results have application to evaluating drought hardiness

and interspecific competitive ability under semi-arid conditions, and to investigations of root physiological and morphological changes that contribute to recovery from water deficit. [References: 38].

3734 Young, I.M. (1995) VARIATION IN MOISTURE CONTENTS BETWEEN BULK SOIL AND THE RHIZOSHEATH OF WHEAT (*TRITICUM AESTIVUM* L. CV WEMBLEY). *New Phytologist*. 130(1):135-139. English. [SCOTTISH CROP RES INST DEPT CELLULAR & ENVIRONM PHYSIOL SOIL PLANT DYNAM GRP DUNDEE DD2 5DA SCOTLAND].

There is conflicting evidence as to whether rhizosheath soil can be wetter or drier than bulk soil. The gravimetric moisture contents of bulk soil and the rhizosheath of wheat were determined for plants grown in a glasshouse over a range of dry bulk densities (1.0, 1.1 and 1.3 Mg m⁻³). Plants were also grown in soil at 1.1 Mg m⁻³ at 15 degrees C in a controlled environment. No significant differences in soil moistures over the initial dry bulk density range examined were found. Overall, rhizosheath soil was significantly ($P < 0.05$) wetter than bulk soil. In the second experiment, under controlled environment conditions, significant differences ($P < 0.05$) were found only at the lowest depth range examined. The mechanism behind preferential wetting of the rhizosheath is examined with reference to other work on transfer of water to soil from roots, physical changes in the rhizosheath, and root exudates. The most likely explanation of these results is that the presence of mucigel within the rhizosheath increases the water-holding capacity of that soil. [References: 24].

3735 Zhang Rongping; Wang Zhenyi; Xue Gang (Northwestern Agricultural Univ., Yangling, Shaanxi (China). Lab. of Plant Physiology) (1994) Effect of light on the lipoxygenase activity and lipid peroxidation in young wheat leaves. *Acta Botanica Boreali-Occidentalia Sinica (China)* v. 14(3) p. 198-202. 3 tables; 1 ill., 17 ref. Chinese. (AGRI 95-087931).

F61 PLANT PHYSIOLOGY-NUTRITION

3736 Abad, M.S.; Rosenberger, C.A.; Shah, D.M. (1995) A GENOMIC CLONE ENCODING A PHOSPHOLIPID TRANSFER PROTEIN FROM BARLEY. *Plant Physiology*. 108(2):871. English. [MONSANTO CO 700 CHESTERFIELD VILLAGE PKWY CHESTERFIELD, MO 63198 USA].

3737 Alonso, V.; Martin, A.; Borja, R. (1995) ANAEROBIC DIGESTION OF WASTEWATER PRODUCED IN THE MANUFACTURE OF CELLULOSE PULP FROM WHEAT STRAW IN IMMOBILISED CELL BIOREACTORS. *Resources Conservation & Recycling*. 13(2):129-138. English. [UNIV CORDOBA FAC CIENCIAS DEPT INGN QUIM AVDA SAN ALBERTO MAGNO S-N E-14004 CORDOBA SPAIN].

The kinetics of the anaerobic digestion of wastewater produced in the manufacture of cellulosic pulp from wheat straw (GOD of 38.8 g/l) were studied. Laboratory experiments were carried out in 1-l bioreactors containing supports of different chemical composition and features, namely: saponite, montmorillonite, bentonite, sepiolite (pansil) and PVC, to which the microorganisms responsible for the process adhered. The process was simultaneously performed in a control digester with suspended biomass. The bioreactors used were batch fed by incrementing the volume loads from 10 to 200 ml over a period of 5 months. Inhibition phenomena and low biodegradability of the wastewater (29-30%) were observed in the COD range studied (0.4-7.8 g/l) due to the accumulation of lignin and its derivatives. The model used showed a slight influence of the support on the kinetics of the biodegradation.

3738 Aslam, M.; Travis, R.L.; Huffaker, R.C. (1995) EFFECT OF PH AND CALCIUM ON SHORT-TERM NO₃⁻ FLUXES IN ROOTS OF BARLEY SEEDLINGS. *Plant Physiology*. 108(2):727-734. English. [UNIV CALIF DAVIS DEPT AGRON & RANGE SCI DAVIS, CA 95616 USA].

The effect of pH and Ca²⁺ on net NO₃⁻ uptake, influx, and efflux by intact roots of barley (*Hordeum vulgare* L.) seedlings was studied. Seedlings were induced with NO₃⁻ or NO₂⁻. Net NO₃⁻ uptake and efflux, respectively, were determined by following its depletion from, and accumulation in, the external solution. Since roots of both uninduced and NO₂⁻-induced seedlings contain little internal NO₃⁻, initial net uptake rates are equivalent to influx (M. Aslam, R.L. Travis, R.C. Huffaker [1994]

Plant Physiol 106: 1293-1301). NO₃- uptake (influx) by these roots was little affected at acidic pH. In contrast, in NO₃-induced roots, which accumulate NO₃-, net uptake rates decreased in response to acidic pH. Under these conditions, NO₃- efflux was stimulated and was a function of root NO₃- concentration. Conversely, at basic pH, NO₃- uptake by NO₃- and NO₂-induced and uninduced roots decreased, apparently because of the inhibition of influx. Calcium had little effect on NO₃- uptake (influx) by NO₃-induced roots at either pH 3 or 6. However, in NO₃-induced roots, lack of Ca²⁺ at pH 3 significantly decreased net NO₃- uptake and stimulated efflux. The results indicate that at acidic pH the decrease in net NO₃- uptake is due to the stimulation of efflux, whereas at basic pH, it is due to the inhibition of influx. [References: 39].

3739 Aspegren, K.; Mannonen, L.; Ritala, A.; Puupponenpiimä, R.; Kurten, U.; Salmenkalliomarttila, M.; Kauppinen, V.; Teeri, TH. (1995) **SECRETION OF A HEAT-STABLE FUNGAL BETA-GLUCANASE FROM TRANSGENIC, SUSPENSION-CULTURED BARLEY CELLS.** *Molecular Breeding*. 1(1):91-99. English. [UNIV HELSINKI INST BIOTECHNOL POB 45 SF-00014 HELSINKI FINLAND].

Transgenic plant cell cultures have a potential for production and secretion of important proteins and peptides. To assess the possibilities of using a stable barley suspension culture for secretion of heterologous proteins in active form, we expressed the cDNA of the thermostable beta-glucanase (EGI) of *Trichoderma reesei* in barley suspension cells. The cDNA coding for EGI and its signal sequence was placed under the control of the CaMV 35S promoter and the construction was transferred to the cells by particle bombardment. Stably transformed lines were obtained by selecting for a cotransformed antibiotic resistance marker. The expression of EGI cDNA led to accumulation of EGI in the culture medium, as shown by analysis with EGI-specific antibodies. Enzymatic assays confirmed that the EGI secreted by the suspension cells retained its activity and thermostable character. Furthermore, it was shown that the enzyme produced by the transgenic suspension culture could be used for degradation of soluble beta-glucans during mashing. [References: 31].

3740 Awad, F. (Soils and Water Use Dept. NRC, Cairo (Egypt)); Roemheld, V.; Marschner, H. (1994) **Effect of root exudates on mobilization in the rhizosphere and uptake of iron by wheat plants.** *Plant and Soil (Netherlands)* v. 165(2) p. 213-218. 28 ref. English. (AGRI 95-077968).

3741 Balkemboomstra, AG.; Mastebroek, HD. (1995) **EFFECT OF POWDERY MILDEW (ERYSIPHE GRAMINIS F SP HORDEI) ON PHOTOSYNTHESIS AND GRAIN YIELD OF PARTIALLY RESISTANT GENOTYPES OF SPRING BARLEY (HORDEUM VULGARE L).** *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 114(2):126-130. English. [CTR PLANT BREEDING & REPROD RES DLO POB 16 6700 AA WAGENINGEN NETHERLANDS].

The effect of powdery mildew on the photosynthesis and grain yield of partially resistant spring barley was investigated. The effect of powdery mildew on the CO₂ exchange rate (CER) of inoculated and non-inoculated leaves was measured in several glasshouse experiments. Grain yield reduction by powdery mildew was determined in three field experiments. The CER of the inoculated leaves was reduced by infection but that of the non-inoculated leaves was not significantly different from that of the corresponding leaves of the control plants. The reduction in CER of the different genotypes was closely related to the percentage leaf area infected with powdery mildew. The correlation between degree of mildew infection and grain yield reduction varied between $r = 0.84$ (significant at $P = 0.01$) and $r = 0.41$ (not significant). Differences in greenness of the crop were correlated better with grain yield reduction ($r = 0.66$, $P = 0.01$) than powdery-mildew infection itself. Low percentages of powdery-mildew infection did not lead to significant reduction in grain yield. Partial resistance to powdery mildew could thus be a valuable attribute of future barley varieties. [References: 14].

3742 Bort, J.; Brown, RH.; Araus, JL. (1995) **LACK OF C-4 PHOTOSYNTHETIC METABOLISM IN EARS OF C-3 CEREALS.** *Plant Cell & Environment*. 18(6):697-702. English. [UNIV BARCELONA FAC BIOL UNITAT FISIOL VEGETAL AVDA DIAGONAL 645 E-08028 BARCELONA SPAIN].

There is continuing controversy over whether a degree of C-4 photosynthetic metabolism exists in ears of C-3 cereals. In this context, CO₂ exchange and the initial products of photosynthesis were examined in flag leaf blades and various ear parts of two durum wheat (*Triticum durum* Desf.) and two six-rowed barley (*Hordeum vulgare* L.) cultivars. Three weeks after anthesis, the CO₂ compensation concentration at 210 mmol mol⁻¹ O-2 in durum wheat and barley ear parts was similar to or greater than that in flag leaves. The O-2 dependence of the CO₂ compensation concentration in durum wheat ear parts, as well as in the flag leaf blade, was linear, as expected for C-3 photosynthesis. In a complementary experiment, intact and attached ears and flag leaf blades of barley and durum wheat were radio-labelled with (CO₂)-C-14 during a 10s pulse, and the initial products of fixation were studied in various parts of the ears (awns, glumes, inner bracts and grains) and in the flag leaf blade. All tissues assimilated CO₂ mainly by the Calvin (C-3) cycle, with little fixation of (CO₂)-C-14 into the C-4 acids malate and aspartate (about 10% or less). These collective data support the conclusion that in the ear parts of these C-3 cereals C-4 photosynthetic metabolism is nil. [References: 40].

3743 Cairney, J.; Newton, RJ.; Funkhouser, EA.; Chang, SJ. (1995) **NUCLEOTIDE SEQUENCE OF A CDNA FROM ATRIPLEX CANESCENS (PURSH) NUTT - A HOMOLOG OF A JASMONATE-INDUCED PROTEIN FROM BARLEY.** *Plant Physiology*. 108(3):1289-1290. English. [INST PAPER SCI & TECHNOL DEPT FOREST BIOL 500 10T ST NW ATLANTA, GA 30318 USA].

3744 Champigny, M.L. (Universite de Paris 11, Orsay (France). Laboratoire de Photosynthese et Metabolisme) (1995) **Use of the stable isotope 15 N and of emission spectrometry for studying uptake and assimilation of nitrate in leaves and roots of wheat.** *Utilisation de l'isotope lourd 15 N et de la spectrometrie d'emission pour l'etude de l'absorption et de l'assimilation des nitrates par les feuilles et racines de ble.* *Colloques de l'INRA (France)*; no. 70 p. 197-206. INRA. 17 ref. p. 197-206. French. (AGRI 95-088280).

3745 Chirkova, TV.; Walter, G.; Leffler, S.; Novitskaya, LO. (1995) **CHLOROPLASTS AND MITOCHONDRIA IN THE LEAVES OF WHEAT AND RICE SEEDLINGS EXPOSED TO ANOXIA AND LONG-TERM DARKNESS - SOME CHARACTERISTICS OF ORGANELLE STATE.** *Russian Journal of Plant Physiology*. 42(3):321-329. English. [ST PETERSBURG STATE UNIV FAC BIOL & SOIL SCI UNIVERSITetskaya NAB 7-9 ST PETERSBURG 199034 RUSSIA].

The seedlings of wheat (*Triticum aestivum* L.) and rice (*Oryza sativa* L.), which contrast in their tolerance to hypoxia, were used to study the effect of anaerobiosis and long darkness on the content of pigments (chlorophylls a and b, carotenoids), ATP, proteins, the photochemical activity of isolated chloroplasts, and the succinate dehydrogenase (SDH) activity of mitochondria. Anoxia and darkness caused a similar destruction of pigments and proteins in the first true (physiologically older) leaves of wheat seedlings. The pigments and proteins in rice seedlings were more stable than those in wheat plants. After transferring plants from darkness and a nitrogen atmosphere to light and aeration, rice chloroplasts showed a complete recovery of photochemical activity, whereas wheat chloroplasts remained inactive, even after shorter treatments. The impairment of photochemical activity appeared earlier in Photosystem II than in Photosystem I, especially in intolerant wheat plants. In wheat seedlings, the ATP content and SDH activity decreased to such low levels after 48-h-long anaerobiosis that it was impossible to restore them after transferring the plants to aeration. In rice seedlings, the loss of ATP and reduction in SDH activity were slight, even after 72-h-long anoxia, and were restored rapidly with onset of aeration. These data lead to the conclusion that anoxia and prolonged darkness cause considerably less damage to chloroplasts and leaf mitochondria in rice seedlings than to these organelles in wheat. [References: 36].

3746 Cowan, AK.; Botha, CEJ.; Hartley, BJ.; Cross, RHM. (1995) **ULTRASTRUCTURAL CHANGES IN AGING LEAVES OF A LIGHT-GROWN ACHLOROPHYLLOUS MUTANT OF BARLEY.** *Physiologia Plantarum*. 94(3):391-398. English. [UNIV NATAL DEPT HORT SCI PIETERMARITZBURG 3209 SOUTH AFRICA].

The pattern and sequence of cellular degradation during the course of leaf senescence remains obscure and the nature of the trigger that induces cell senescence is unknown. In order to probe the pre-mortem phase of senescence temporal changes in cell ultrastructure were studied in aging leaves of light-grown achlorophyllous *Hordeum vulgare* L. cv. Dyan mutant seedlings. Electron microscope examination of the ultrastructure of mesophyll cell plastids revealed the absence of ribosomes and a highly disorganized prolamellar body. Both the number and size of plastoglobuli increased with aging and this change coincided with depletion of starch grains and dilation of lamellar membranes. Aging of mesophyll cells occurred coincident with a decline in ribosome content of the cytoplasm and loss of matrix granularity. Loss of ribosomes associated with the outer nuclear envelope membrane and a reduction in chromatin were also apparent. Only after 10 days was there evidence of loss of internal membrane integrity and swelling of mitochondrial cristae. Compartmentation was thus maintained during the aging process with membrane dissolution occurring late in senescence. These results suggest that an inability to produce chlorophyll and carotenoids and form thylakoid stacks due to the absence of plastid ribosomes, contributes to the rapid onset of senescence in light-grown achlorophyllous seedlings. Furthermore, disruption of chloroplast ribosome synthesis/assembly may constitute part of the plastid signal involved in triggering cell senescence. [References: 27].

3747 Holappa, LD.; Walkersimmons, MK. (1995) THE WHEAT ABSCISIC ACID-RESPONSIVE PROTEIN KINASE MRNA, PKABA1, IS UP-REGULATED BY DEHYDRATION, COLD TEMPERATURE, AND OSMOTIC STRESS. *Plant Physiology*. 108(3):1203-1210. English. [WASHINGTON STATE UNIV USDA ARS 209 JOHNSON HALL PULLMAN, WA 99164 USA].

The effects of dehydration, cold-temperature treatment, and osmotic and salt stress on the expression of an abscisic acid-responsive protein kinase mRNA (PKABA1) were determined in wheat (*Triticum aestivum* L.) seedlings. The PKABA1 transcript was detectable at basal levels in tissues of nonstressed plants and accumulated to higher levels in shoot, scutellar, and root tissues of stressed plants. PKABA1 transcript accumulated rapidly within 2 h following dehydration and within 24 h following other treatments (cold, osmotic stress, and high salt). The accumulation of PKABA1 mRNA could not be separated temporally from that of a wheat group 3 late embryogenesis abundant mRNA during dehydration and cold treatment. High PKABA1 mRNA levels were observed in field-grown plants growing under cold winter conditions but not under warmer summer conditions. A recent GenBank data base search indicated that other plant protein kinases with similar acidic amino acid stretches as in PKABA1 have been identified, and some of these kinases are responsive to environmental signals. These results suggest that PKABA1 may be part of general environmental stress responses in wheat. [References: 42].

3748 Huang, J.; Redmann, RE. (1995) SOLUTE ADJUSTMENT TO SALINITY AND CALCIUM SUPPLY IN CULTIVATED AND WILD BARLEY. *Journal of Plant Nutrition*. 18(7):1371-1389. English. [UNIV SASKATCHEWAN DEPT CROP SCI & PLANT ECOL SASKATOON SK S7N 0W0 CANADA].

Ion relations, water content, leaf water potential, and osmotic adjustment were determined for cultivated barley (cv Harrington) and wild barley grown under mixed sulphate (SO₄) salts with varied calcium (Ca) supply using a hydroponic system. Salinity induced significant increases of leaf, stem and root sodium (Na) concentrations in both species. Salt-stressed wild barley roots accumulated more Na than shoots, and transport of Na from roots to shoots was low compared to Harrington. Cultivated barley had lower Ca concentrations than wild barley, especially in the low Ca salt treatment. Although potassium (K/Na) and Ca/Na ratios were higher in control wild barley plants than in Harrington, they declined under salt stress, irrespective of Ca supply. Major osmotica in wild barley leaves were K, sugars, organic acids, and quaternary ammonium compounds, while in Harrington they were cations, including Na, K and Mg, and anions such as phosphate (PO₄) and SO₄. Wild barley maintained better water status than Harrington under low Ca salt treatment. Supplemental Ca improved water status more in Harrington than in wild barley. Lack of osmotic adjustment to salinity in wild barley apparently resulted from its ion exclusion. Low Ca salt treatment caused Ca deficiency, Na toxicity, and loss of turgor in Harrington. In the high

Ca salt treatment, Harrington had improved water and ion relations, as well as positive turgor. [References: 44].

3749 Koleva, A.; Toneva, V.; Minkov, I. (1995) PHOTODYNAMIC EFFECT OF 2, 2'-DIPYRIDYL AND GLUTAMIC ACID ON WHEAT AND VEGETABLE MARROW PLANTS. *Photosynthetica*. 31(2):189-196. English. [PAISIJ HILENDARSKI UNIV PLOVDIV DEPT PLANT PHYSIOL BU-4000 PLOVDIV BULGARIA].

The possibility of simultaneously used chlorophyll (Chi) synthesis precursor (glutamic acid) and metal chelator (2, 2'-dipyridyl) as a photodynamic inhibitor of the chlorophyll synthesis was studied. Wheat (*Triticum aestivum* L.) and vegetable marrow (*Cucurbita moschata* Duch.) leaves were treated with 2, 2'-dipyridyl (2, 2'-DP), and 2, 2'-DP along with glutamic acid which increased the protochlorophyllide (Pchl_{ide}) content in the vegetable marrow plants to a higher extent. An irradiation of the treated leaves caused an inhibition of Pchl_{ide} reduction which was more notable in those of the dicotyledonous vegetable marrow plant. [References: 20].

3750 Laerke, PE.; Streibig, JC. (1995) FOLIAR ABSORPTION OF SOME GLYPHOSATE FORMULATIONS AND THEIR EFFICACY ON PLANTS. *Pesticide Science*. 44(2):107-116. English. [DANISH INST PLANT & SOIL SCI DEPT FORAGE CROPS & POTATOES RES CTR FOULUM POB 21 DK-8830 TJELE DENMARK].

Uptake of various doses (0.27-4.06 g litre⁻¹) of glyphosate acid formulated with various concentrations (0.27-5.42 g litre⁻¹) of two polyethoxylated alcohol surfactants 'Genapol' T-150, 'Genapol' T-250 in wheat (*Triticum aestivum* L. cv. Ralle) 24 h after application was studied. Both surfactants greatly enhanced glyphosate uptake at concentrations up to 1.35 g litre⁻¹. Uptake could be slightly further improved by 'Genapol' T-150 up to 5.42 g litre⁻¹ while 'Genapol' T-250 at this high concentration antagonized uptake a little. Uptake of glyphosate-monoammonium formulated with a quaternary ammonium surfactant ('Trimao' (8PO)) in wheat and white mustard (*Sinapis alba* L. cv. Alba) was also studied. Uptake of glyphosate-monoammonium in wheat was enhanced at surfactant concentrations up to 1.35 g litre⁻¹. Beyond this concentration uptake continued to increase slightly but not significantly. Generally, glyphosate-monoammonium formulated with 'Trimao' (8PO) was not taken up as extensively by mustard as by wheat, and the optimum surfactant concentration is probably higher on mustard. The optimal combinations of surfactant concentration and glyphosate dose based on uptake 24 h after application were used in a time-course study. Results from uptake studies were compared with the efficacy of similar formulations on wheat. The surfactant concentration range which gave the most pronounced effect on glyphosate uptake was found to be similar (0-1 g litre⁻¹) in both studies. However, the surfactant concentration providing maximum herbicide uptake was found to be higher in the uptake study compared to the surfactant concentration providing optimal efficacy in the dose-response experiments. A dose rate of 0.5 g litre⁻¹ of 'Tween' 20 (sorbitan monolaurate surfactant) improved efficacy of a formulation with an optimal mix of glyphosate-monoammonium and 'Trimao' (8PO). Ammonium sulfate (5.0 g litre⁻¹) did not improve this formulation further. [References: 38].

3751 Malkanthi, DRR.; Moritsugu, M.; Yokoyama, K. (1995) EFFECTS OF LOW PH AND Al ON ABSORPTION AND TRANSLOCATION OF SOME ESSENTIAL NUTRIENTS IN EXCISED BARLEY ROOTS. *Soil Science & Plant Nutrition*. 41(2):253-262. English. [KAGAWA UNIV FAC AGR MIKI KAGAWA 76107 JAPAN].

Effects of low pH (3.8) and Al (200 µmol L⁻¹) soluble Al, pH 3.8) on the absorption and translocation of P, K(Rb-86), Ca, Mn, and Zn in roots excised from 5-d old barley seedlings were examined using a multi-compartment transport box and radioisotopes. Effects of pH and Al on the nutrient absorption were first examined, with emphasis placed on the accumulation, cortical efflux, redistribution and xylem exudation fractions. Radioactive tracers were applied in two different root zones, the apex (0 to 10 mm from tip) and the translocation peak zones (root zones between 13 to 50 mm from the tip, where absorbed nutrients zones are translocated more efficiently as compared to the apex) of the respective nutrients in barley roots. When a radioactive target ion was applied to a root apex, the rate of accumulation was apparently highest among all the

absorbed fractions, and this phenomenon is common to all the present treatments (-Al at pH 5.5, -Al at pH 3.8, and +Al at pH 3.8) except for the case of Ca. The absorption and translocation of the nutrients in the root apex and the translocation peak zones were inhibited by a low pH, and the inhibition was severe for Zn and slight for P and K(Rb-86). The presence of Al in the ambient solution clearly inhibited the absorption and translocation of Ca and Mn in both loading zones. In contrast, Al in the low pH ambient solution enhanced P absorption, by increasing both rates of the accumulation and the translocation in the apex and the translocation peak zones. Similarly, Al stimulated the absorption and translocation of K(Rb-86) in both loading zones. Despite the differences in the magnitude of inhibition or stimulation in the accumulation, cortical efflux, redistribution and xylem exudation fractions in both loading zones, the effect of a low pH or a low level of Al on nutrient absorption appeared to be uniform throughout a certain area of young barley roots. [References: 25].

3752 Martens, D.A. (California Univ., Riverside, CA (USA). Dept. of Soil and Environmental Sciences); Frankenberger, W.T. Jr. (1994) **Assimilation of exogenous 2'-(14)C-indole-3-acetic acid and 3'-(14)C-tryptophan exposed to the roots of three wheat varieties.** *Plant and Soil (Netherlands)* v. 166(2) p. 281-290. 38 ref. English. (AGRIS 95-077967).

3753 Muller, J.; Wernecke, P.; Claus, S.; Muhle, H. (1995) **A MODEL OF CANOPY GAS EXCHANGE IN WINTER WHEAT.** *Photosynthetica* 31(2):177-187. English. [UNIV HALLE WITTENBERG AGROKOSYST FORSCH QUEDLINBURG NEUER WEG 22 D-06484 QUEDLINBURG GERMANY].

Modelling the exchange and transformation of matter and energy in ecosystems requires the development of hierarchical structured models of the considered ecosystem compartments. In this context, a model describing the coupled CO₂ and H₂O gas exchange of a winter wheat canopy was developed and calibrated. The formulation of the model was related to the problems of linking processes at different system levels. For model calibration, ecophysiological gas exchange characteristics and micro-meteorological data were obtained on both leaf and canopy levels and completed by results of structural and chemical plant analysis. The gas exchange was measured by a computer-controlled multi-channel system. On the basis of this data pool, the canopy gas fluxes were calculated by the model as the integral of the corresponding local fluxes over the area elements of the canopy. The model describes correctly physiological interactions and gas exchange characteristics at both the leaf and canopy levels. [References: 34].

3754 Nie, GY.; Hendrix, DL.; Webber, AN.; Kimball, BA.; Long, SP. (1995) **INCREASED ACCUMULATION OF CARBOHYDRATES AND DECREASED PHOTOSYNTHETIC GENE TRANSCRIPT LEVELS IN WHEAT GROWN AT AN ELEVATED CO₂ CONCENTRATION IN THE FIELD.** *Plant Physiology* 108(3):975-983. English. [BROOKHAVEN NATL LAB DEPT APPL SCI DIV BIOSYST & PROC SCI UPTON, NY 11973 USA].

Repression of photosynthetic genes by increased soluble carbohydrate concentrations may explain acclimation of photosynthesis to elevated CO₂ concentration. This hypothesis was examined in a field crop of spring wheat (*Triticum aestivum* L.) grown at both ambient (approximately 360 $\mu\text{mol mol}^{-1}$) and elevated (550 $\mu\text{mol mol}^{-1}$) atmospheric CO₂ concentrations using free-air CO₂ enrichment at Maricopa, Arizona. The correspondence of steady-state levels of mRNA transcripts (coding for the 83-kD photosystem I apoprotein, sedoheptulose-1, 7-bisphosphatase, phosphoribulokinase, phosphoglycerokinase, and the large and small subunits of ribulose-1, 5-bisphosphate carboxylase/oxygenase) with leaf carbohydrate concentrations (glucose-6-phosphate, glucose, fructose, sucrose, fructans, and starch) was examined at different stages of crop and leaf development and through the diurnal cycle. Overall only a weak correspondence between increased soluble carbohydrate concentrations and decreased levels for nuclear gene transcripts was found. The difference in soluble carbohydrate concentration between leaves grown at elevated and current ambient CO₂ concentrations diminished with crop development, whereas the difference in transcript levels increased. In the flag leaf, soluble carbohydrate concentrations declined markedly with the onset of grain filling; yet transcript levels also declined. The results suggest

that, whereas the hypothesis may hold well in model laboratory systems, many other factors modified its significance in this field wheat crop. [References: 52].

3755 Ohlen, E.; Ingemarsson, B.; Campbell, WH.; Larsson, CM. (1995) **RELATIONSHIPS BETWEEN EXTERNAL NITRATE AVAILABILITY, NITRATE UPTAKE AND EXPRESSION OF NITRATE REDUCTASE IN ROOTS OF BARLEY GROWN IN N-LIMITED SPLIT-ROOT CULTURES.** *Planta* 196(3):485-491. English. [UNIV STOCKHOLM DEPT BOT S-10691 STOCKHOLM SWEDEN].

Despite the large number of studies of nitrate metabolism in plants, it remains undetermined to what extent this key plant system is controlled by overall plant N nutrition on the one hand, and by the nitrate ion itself on the other hand. To investigate these questions, V-max for nitrate uptake (high-affinity range), and nitrate reductase (NR) mRNA and activity, were measured in roots of N-limited barley (*Hordeum vulgare* L. cv. Golf) grown under conditions of constant relative addition of nitrate, with the seminal roots split between two culture compartments. The total amount of nitrate added per unit time (0.09 d^{-1}) was distributed between the two root parts (subroots) in ratios of 100:0, 98:2, 95:5, 90:10, 80:20, and 50:50. These nitrate-addition ratios resulted in nitrate fluxes ranging from 0 to 23 $\mu\text{mol nitrate} \cdot \text{g}^{-1} \text{DW root} \cdot \text{h}^{-1}$, while the external nitrate concentrations varied between 0 and 1.2 mM . The apparent V-max for net nitrate uptake showed saturation-type responses to nitrate flux maintained during preceding growth. The flux resulting in half-maximal "induction" of nitrate uptake was approximately 4 $\mu\text{mol nitrate} \cdot \text{g}^{-1} \text{DW root} \cdot \text{h}^{-1}$, corresponding to an external nitrate concentration of 0.7 mM . The activity of NR and levels of NR mRNA did not saturate within the range of nitrate fluxes studied. None of the parameters studied saturated with respect to the steady-state external nitrate concentration. At the zero nitrate addition - the 0%-root - initial uptake activity as determined in shortterm N-15-labelling experiments was insignificant, and NR activity and NR mRNA were not detectable. However, nitrate uptake was rapidly induced, showing that the 0%-root had retained the capacity to respond to nitrate. These results suggest that local nitrate availability has a significant impact on the nitrate uptake and reducing systems of a split-root part when the total plant nitrate nutrition is held constant and limiting. [References: 37].

3756 Omarova, EI.; Bogdanova, ED.; Polimbetova, FA. (1995) **REGULATION OF WATER LOSS BY THE LEAVES OF SOFT WINTER WHEAT WITH DIFFERENT ORGANIZATION OF LEAF STRUCTURE.** *Russian Journal of Plant Physiology* 42(3):383-385. English. [NATL ACAD SCI KAZAKHSTAN INST PLANT PHYSIOL GENET & BIOENGN UL TIMIRYAZEVA 45 ALMA ATA 480070 KAZAKHSTAN].

The parameters of water status (water content and transpiration rate) were compared in two winter wheat (*Triticum aestivum* L.) genotypes contrasting in leaf structure and leaf position relative to solar radiation. An adaptive trait, "leaf rolling," contributed to a better yield by retaining a higher water content in plant tissues due to the reduced transpiration rate. [References: 10].

3757 Oscarson, P.; Lundborg, T.; Larsson, M.; Larsson, CM. (1995) **GENOTYPIC DIFFERENCES IN NITRATE UPTAKE AND NITROGEN UTILIZATION FOR SPRING WHEAT GROWN HYDROPONICALLY.** *Crop Science* 35(4):1056-1062. English. [SWEDISH UNIV AGR SCI DEPT PLANT BREEDING S-26831 SVALOV SWEDEN].

The physiological background for variation in grain protein content of cultivars of spring wheat (*Triticum aestivum* L.) is still unclear. This study was performed to investigate whether differences in nitrate uptake and nitrogen utilization could explain the observed differences. Four cultivars of spring wheat were grown hydroponically to maturity. Growth was controlled by daily additions of growth-limiting amounts of nitrate at preset and stepwise decreased relative rates. The plants showed a relevant ontogeny when compared to field-grown plants. The kinetics of net nitrate uptake were measured regularly from 16 to 102 d of culturing. The maximal net nitrate uptake rate of the plant, i.e., V-max, increased until anthesis, and subsequently decreased. There were no major changes in the affinity for nitrate, i.e., K-m during the development. When uptake capacity was put in relation to the need of the plant in order to maintain growth rate and tissue-nitrogen concentration, it was clear that the plants had a substantial overcapacity for net nitrate uptake at all times. There

were no major genotypic differences in either V-max or K-m. Frequent sampling of plants made it possible to calculate the remobilization of nitrogen from vegetative tissues to the grains, and these data could be used to discuss further differences in grain protein yield. [References: 27].

3758 Patel, K.P.; Jain, J.M. (Indian Agricultural Research Institute, New Delhi. Division of Soil Science and Agricultural Chemistry) (1993) Changes in soil N fractions and utilization of recently immobilized fertilizer N by wheat as influenced by application of some organic chemicals in rice-wheat sequence. *Journal of Nuclear Agriculture and Biology (India)* v. 22(2) p. 100-107. 4 tables; 11 ref. English. (AGRI 95-077965).

3759 Pearson, J.N.; Rengel, Z. (1995) UPTAKE AND DISTRIBUTION OF ZN-65 AND MN-54 IN WHEAT GROWN AT SUFFICIENT AND DEFICIENT LEVELS OF ZN AND MN. 1. DURING VEGETATIVE GROWTH. *Journal of Experimental Botany*. 46(288):833-839. English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

The uptake and distribution of Zn-65 and Mn-54 by wheat (*Triticum aestivum* cv. Aroona) was investigated. Plants were grown in a chelate-buffered nutrient solution with either sufficient Zn and Mn, low Zn or low Mn. A single representative seminal root from 14-d-old and 42-d-old plants was dual-labelled with Zn-65 and Mn-54. The 14-d-old plants were harvested every 10 min from 10-140 min of labelling, whilst the 42-d-old plants were harvested after 2 h of labelling. At harvest, each plant was separated into leaves, main stem, unexposed roots, and tillers. In addition, the crown was separated from the stem in the 14-d-old plants. In the control plants labelled at 14 d, Zn-65 was first detected and accumulated in the crown of the roots after 40-60 min. Labelled Zn was then detected in the stem, followed by the leaves. The oldest and youngest leaves received less Zn-65 than the second and third oldest leaves. The plants grown under low Zn conditions accumulated more Zn-65 in their older leaves and transferred Zn-65 to the unexposed roots. Distribution of Mn-54 was similar in the controls to that of Zn-65, except the older leaves received no Mn-54. At the second harvest, a similar distribution pattern of Zn-65 and Mn-54 was observed with regard to leaf age. Large amounts of Zn-65 and Mn-54 were detected within the unexposed roots of all treatments. It is suggested that the distribution of root-supplied Zn and Mn may be determined by micronutrient status and its relationship with leaf transpiration rates. [References: 18].

3760 Pearson, J.N.; Rengel, Z. (1995) UPTAKE AND DISTRIBUTION OF ZN-65 AND MN-54 IN WHEAT GROWN AT SUFFICIENT AND DEFICIENT LEVELS OF ZN AND MN. 2. DURING GRAIN DEVELOPMENT. *Journal of Experimental Botany*. 46(288):841-845. English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

We investigated the uptake and distribution of Zn and Mn in wheat during grain development. Plants were grown in a chelate-buffered nutrient solution with one of the following treatments: control, low Zn or low Mn. Plants were dual-labelled with Zn-65 and Mn-54 at 2 and 8 wk post-anthesis for 5 and 24 h, respectively. After labelling, the plants were separated into individual components for analysis. In the plants harvested at 8 wk after anthesis, spikelets were separated into individual structures and analysed for radioactivity. Little or no root-supplied Mn-54 was distributed to the leaves of both the controls and low-Mn plants during the grain development stages studied here. More Mn-54 was distributed to the head at 8 wk than at 2 wk post-anthesis. In contrast, root-supplied Zn-65 was transported to the leaves at 2 and 8 wk post-anthesis. More Zn-65 was distributed to the leaves of the low-Zn plants than the controls during grain development. More Zn-65 was detected in the head towards grain maturity. Relatively larger amounts of Mn-54 than Zn-65 were found in different parts of the florets. Labelled Mn was found in relatively large quantities in the palea, lemma and in the glumes, even though most Mn-54 was found in the grain. A large percentage of the grain Mn-54 was in the outer pericarp. During grain development leaves may still require Zn but not Mn, which may be due to the requirement of Zn in maintaining membrane structure and function. Distribution of Zn and Mn within the spikelets suggests that Zn may enter the grain via the phloem while Mn may enter the grain via the xylem. [References: 14].

3761 Robertson, E.J.; Williams, M.; Harwood, J.L.; Lindsay, J.G.; Leaver, C.J.; Leech, R.M. (1995) MITOCHONDRIA INCREASE THREE-FOLD AND MITOCHONDRIAL PROTEINS AND LIPID CHANGE DRAMATICALLY IN POSTMERISTEMATIC CELLS IN YOUNG WHEAT LEAVES GROWN IN ELEVATED CO₂. *Plant Physiology*. 108(2):469-474. English. [UNIV YORK DEPT BIOL YORK YO1 5DD N YORKSHIRE ENGLAND].

A dramatic stimulation in mitochondrial biogenesis during the very early stages of leaf development was observed in young wheat plants (*Triticum aestivum* cv Hereward) grown in elevated CO₂ (650 μ mol L⁻¹). An almost 3-fold increase in the number of mitochondria was observed in the very young leaf cells at the base of the first leaf of a 7-d-old wheat plant. In the same cells large increases in the accumulation of a mitochondrial chaperonin protein and the mitochondrial 2-oxoglutarate dehydrogenase complex and pyruvate dehydrogenase complex were detected by immunolabeling. Furthermore, the basal segment also shows a large increase in the rate of radiolabeling of diphosphatidylglycerol, a lipid confined to the inner mitochondrial membrane. This dramatic response in very young leaf cells to elevated CO₂ suggests that the numerous documented positive effects of elevated CO₂ on wheat leaf development are initiated as early as 12 h postmitosis. [References: 27].

3762 Ruhland, M. (Bayerische Landesanstalt fuer Ernährung, Muenchen (Germany)); Engelhardt, G.; Schaefer, W.; Wallnoefer, P. (1994) [Metabolism of mycotoxin ochratoxin A in plant cell cultures]. *Metabolismus des Mykotoxins Ochratoxin A in pflanzlichen Zellkulturen*. LAF-Informationen. Sonderheft (Germany); no. 1 p. 150-153. Selbstverlag. 5 ref. p. 150-153. German. (AGRI 95-088270).

3763 Sachdev, P.; Sachdev, M.S.; Deb, D.L. (Indian Agricultural Research Institute, New Delhi. Nuclear Research Laboratory) (1993) Uptake of Nickel and other micronutrients from sewage sludge by wheat. *Journal of Nuclear Agriculture and Biology (India)*. v. 22(3-4) p. 178-183. 1 ill., 3 tables; 15 ref. English. (AGRI 95-077966).

3764 Samuelson, M.E.; Ohlen, E.; Lind, H.; Larsson, C.M. (1995) NITRATE REGULATION OF NITRATE UPTAKE AND NITRATE REDUCTASE EXPRESSION IN BARLEY GROWN AT DIFFERENT NITRATE/AMMONIUM RATIOS AT CONSTANT RELATIVE NITROGEN ADDITION RATE. *Physiologia Plantarum*. 94(2):254-260. English. [UNIV STOCKHOLM DEPT BOT S-10691 STOCKHOLM SWEDEN].

Barley (*Hordeum vulgare* L. cv. Golf) was cultured using the relative addition rate technique, where nitrogen is added in a fixed relation to the nitrogen already bound in biomass. The relative rate of total nitrogen addition was 0.09 day⁻¹ (growth limiting by 35%), while the nitrate addition was varied by means of different nitrate: ammonium ratios. In 3- to 4-week-old plants, these ratios of nitrate to ammonium supported nitrate fluxes ranging from 0 to 22 μ mol g⁻¹ root dry weight h⁻¹, whereas the total N flux was 21.8 $\pm$ 0.25 μ mol g⁻¹ root dry weight h⁻¹ for all treatments. The external nitrate concentrations varied between 0.18 and 1.5 μ M. The relative growth rate, root to total biomass dry weight ratios, as well as Kjeldahl nitrogen in roots and shoots were unaffected by the nitrate: ammonium ratio. Tissue nitrate concentration in roots were comparable in all treatments. Shoot nitrate concentration increased with increasing nitrate supply, indicating increased translocation of nitrate to the shoot. The apparent V-max for net nitrate uptake increased with increased nitrate fluxes. Uptake activity was recorded also after growth at zero nitrate addition. This activity may have been induced by the small, but detectable, nitrate concentration in the medium under these conditions. In contrast, nitrate reductase (NR) activity in roots was unaffected by different nitrate fluxes, whereas NR activity in the shoot increased with increased nitrate supply. NR-mRNA was detected in roots from all cultures and showed no significant response to the nitrate flux, corroborating the data for NR activity. The data show that an extremely low amount of nitrate is required to elicit expression of NR and uptake activity. However, the uptake system and root NR respond differentially to increased nitrate flux at constant total N nutrition. It appears that root NR expression under these conditions is additionally controlled by factors related to the total N flux or the internal N status of the root and/or plant. The method used in this study may facilitate

separation of nitrate-specific responses from the nutritional effect of nitrate. [References: 25].

3765 Sandovalvilla, M.; Alcantargonzalez, G.; Tiradotorres, J.L. (1995) **USE OF AMMONIUM IN NUTRIENT SOLUTIONS.** *Journal of Plant Nutrition*. 18(7):1449-1457. English. [COLEGIO POSTGRAD CIENCIAS AGR INST RECURSOS NAT PROGRAMA EDAFOL MONTECILLO 56230 MEXICO MEXICO].

Three experiments were conducted in greenhouse under hydroponic conditions to study the response of wheat to: i) different ammonium/nitrate (NH_4/NO_3) ratios, ii) the application of NH_4 during different phenological states, and iii) the addition of calcium carbonate (CaCO_3) for maximum replacement of NO_3 by NH_4 . Small amounts of NH_4 considerably increased yield and grain quality. The best response was observed with a 2/5 ratio NH_4/NO_3 (meq/L). The application of small fractions of NH_4 during grain fill increased production. Dry matter (DM) production decreased when large quantities of NH_4 were applied. However, when CaCO_3 was used in amounts similar to those of NH_4 , it was possible to neutralize the acidifying effect of reduced nitrogen (N) and to recuperate DM and grain production, thus increasing the harvest index. [References: 12].

3766 Shadchina, T.M.; Dmitrieva, V.V. (1995) **LEAF CHLOROPHYLL CONTENT AS A POSSIBLE DIAGNOSTIC MEAN FOR THE EVALUATION OF PLANT NITROGEN UPTAKE FROM THE SOIL.** *Journal of Plant Nutrition*. 18(7):1427-1437. English. [NATL ACAD SCI UKRAINE INST PLANT PHYSIOL & GENET VASILKOVSKAYA STR 31-17 KIEV 252022 UKRAINE].

The influence of temperature, irradiance, and soil humidity on the nitrogen (N) concentration in some organs, chlorophyll in the leaves, N uptake and accumulation of dry matter in plants of winter wheat was investigated. In the plants grown under equal initial N supplement but in contrasting conditions of the environment, the correlation between concentration of total N and chlorophyll in the leaves was absent. No interrelationship was found between concentration of total N in the leaves and accumulation of N and dry matter in the whole plants. There is a close correlation between chlorophyll in the leaves, accumulation of total N, and dry matter of the whole plant. It was concluded that chlorophyll is a more stable informative parameter for the estimation of the N uptake from the soil under different growth conditions than leaf N concentration. [References: 18].

3767 Skaloud, V.; Manev, M.; Stehno, Z. (1995) **EVALUATION OF THE METHOD OF WHEAT SEED DRY MATTER DETERMINATION BY MEANS OF MIXED SAMPLES.** *Rostlinna Vyroba*. 41(7):321-324. Czech. [RES INST CROP PROD DRNOVSKA 507 CR-16106 PRAGUE 6 CZECH REPUBLIC].

We have compared results of dry matter determination in seeds of more wheat cultivar mixed-samples weight method. Mixed samples of six cultivars were used in the amount of 5 g, in 10 min manual set up and temperature 130 degrees C. The results of both methods were not different. Therefore, the determination of dry matter on the analyzer MA 30 is possible to use instead of the more laborious and time-consuming weight method.

3768 Tuladhar, J.K. (Lumle Regional Agricultural Research Centre, P.O. Box 1, Pokhara (Nepal)) (1994) **Micronutrient fertilizer Annapurna-M as a nutrient source for cauliflower and wheat.** *LARC Working Paper (Nepal)*; no. 94/9 9 p. Lumle Regional Agricultural Research Centre. English. (AGRIS 95-088308).

The pot experiment had been carried out at Lumle Agricultural Research Centre in order to test effectiveness of micronutrient fertilizer Annapurna-5 (AM). The experiment was conducted from November 1992 until April 1993 for cauliflower and wheat. The experiment was laid out in 2 factorial with and without AM, and compost of chemical (NPK) fertilizer application treatments. The application of AM at rate of 20 kg per hectare did not show any significant effect on cauliflower production while chemical fertilizer (100:60:40 kg NPK per hectare) and compost (20 ton per hectare) increased quality and quantity of cauliflower significantly. The application of AM is also not cost effective, therefore application of Annapurna-M can not be recommended.

3769 Walter, A.; Pich, A.; Scholz, G.; Marschner, H.; Romheld, V. (1995) **EFFECTS OF IRON NUTRITIONAL STATUS AND TIME OF DAY ON CONCENTRATIONS OF PHYTOSIDEROPHORES AND NICOTIANAMINE IN DIFFERENT ROOT AND SHOOT ZONES OF BARLEY.** *Journal of Plant Nutrition*. 18(8):1577-1593. English. [UNIV HOHENHEIM INST PFLANZENNAHRUNG 330 POSTFACH 700562 D-70593 STUTTGART GERMANY].

The diurnal pattern in concentrations of phytosiderophores (PS) and its precursor nicotianamine (NA) was studied in different root and shoot zones of iron (Fe)-sufficient and Fe-deficient barley (*Hordeum vulgare* L. cv. Europa) grown in nutrient solution. Roots were separated into apical (0-3 cm) and basal zones (>3 cm) and shoots into young (3 cm basal. zones of youngest two leaves) and old (remaining zones of youngest two leaves and oldest leaf) parts. The main PS in barley was identified as epi-hydroxymugineic acid (epi-HMA). Regardless of the sampling zone and time of day, epi-HMA concentrations were several times higher in Fe-deficient than in Fe-sufficient plants and several times higher in the roots than in the shoots. In roots and shoots, epi-HMA concentrations were always higher in the younger compared with the older zones. In both root zones of Fe-deficient plants, an inverse diurnal rhythm occurred in epi-HMA concentrations and in its release by the roots. In contrast, such a rhythm was absent in roots of Fe-sufficient plants and in the shoots regardless of the Fe nutritional status. Nicotianamine concentrations in roots were not affected by the Fe nutritional status in apical zones but slightly enhanced under Fe deficiency in basal zones. In contrast to roots, NA concentrations in both shoot parts were lower in Fe-deficient than in Fe-sufficient plants. Regardless of the Fe nutritional status in roots and shoots, NA concentrations were higher in young than in old parts and no consistent diurnal variations were observed. The results suggest that PS are also synthesized in the shoot, although at much lower rates than in roots. As with roots, PS synthesis in the shoot is enhanced under Fe deficiency and is mainly localized in young growing tissue. The distinct diurnal rhythm in PS release in roots is apparently not regulated by variation in the rate of PS synthesis during the day. [References: 31].

3770 Wang Zhimin; Wang Shuan (Beijing Agricultural Univ. (China). Dept. of Agronomy) (1994) **Accumulation and remobilization of stem reserves in wheat.** *Acta Agriculturae Universitatis Pekinensis (China)* v. 20(4) p. 369-374. 26 ref. Chinese. (AGRIS 95-088282).

3771 Wheeler, D.M.; Power, I.L. (1995) **COMPARISON OF PLANT UPTAKE AND PLANT TOXICITY OF VARIOUS IONS IN WHEAT.** *Plant & Soil*. 172(2):167-173. English. [NEW ZEALAND PASTORAL AGR RES INST LTD RUAKURA AGR CTR PRIVATE BAG 3123 HAMILTON NEW ZEALAND].

The effects of varying solution concentrations of manganese (Mn), zinc (Zn), copper (Cu), boron (B), iron (Fe), gallium (Ga) and lanthanum (La) on plant chemical concentrations, plant uptake and plant toxicity were determined in wheat (*Triticum aestivum* L.) grown in a low ionic strength (2.7×10^{-3} M solution culture). Increasing the solution concentration of Mn, Zn, Cu, B, Fe, Ga and La increased plant concentrations of that ion. Asymptotic maximum plant concentrations were reached for Zn (10 mg kg DM(-1) in the roots), Ga (2 mg kg DM(-1) in the tops and 18 mg kg DM(-1) in the roots) and La (0.4 mg kg DM(-1) in the tops and 4 mg kg DM(-1) in the roots). Plant ion concentrations were, on average, 3 times higher in the roots than the tops for Mn and Zn, 7 times for Cu, 9 times for Fe, 12 times for Ga and 15 times for La. In contrast, B concentrations were higher in the tops than the roots by, on average, 2 times. The estimated toxicity threshold (plant concentration at which a rapid decrease in yield occurred) in the tops was 0.4 mg g DM(-1) for B, 2 for Zn, 0.075 for Cu and 0.09 for La and in the roots 0.2 mg g DM(-1) for B, 5 for Zn, 0.3 for Cu and 3 for La. Plant uptake rates of the ions (as estimated by the slope of the relationship between solution ion concentrations and plant ion concentrations) was in the order $B < Fe < Mn < La < Zn < Ga < Cu$ for the tops and $B < Mn < Fe < Zn < La < Cu < Ga$ for the roots. In the roots, the uptake rates of La, Cu and Ga was exceptionally high (> 250 mg kg DM(-1) μM^{-1}). Plant toxicity was estimated as the reciprocal of the plant concentration that reduced yield by 50% (change in relative yield per mg ion kg DM(-1)). The plant toxicity of the ions tested was in the order $Mn < Zn < B < Fe = Ga < La < Cu$ in the tops and $Mn < Ga < Zn < Fe = La < Cu$

B in the roots. Copper was unusual in that plant uptake and plant toxicity was high for a plant trace nutrient. [References: 19].

3772 Wu Jinsui (Beijing Agricultural Univ. (China). Coll. of Basic Science and Technology) (1994) **Study on uptake mineral elements of rice following wheat.** *Acta Agriculturae Universitatis Pekinensis (China)* v. 20(3) p. 268-275. 4 ill., 4 ref. Chinese. (AGRIC 95-088277).

3773 Yukawa, T.; Watanabe, Y.; Yamamoto, S. (1995) **EFFECTS OF COLD-DARK TREATMENT ON FRUCTAN METABOLISM IN BARLEY [Japanese].** *Japanese Journal of Crop Science*. 64(2):317-322. Japanese. [HOKURIKU NATL AGR EXPTL STN JOETSU NIIGATA 94301 JAPAN].

To clarify the relationship between fructans and snow tolerance in barley (*Hordeum vulgare* L. cv. Minorimugi), changes in fructans and fructan hydrolase were studied at 3 degrees C in darkness and after the treatment. Concentration of fructans in basal stem decreased under the treatment, while activities of phleinsase (beta-2, 6 fructan hydrolase) and inulinase (beta-2, 1 fructan hydrolase) remained constant. Inulinase activity was higher than phleinsase. During the recovery at 20 degrees C under light condition after the cold-dark treatment, phleinsase activity increased rapidly and decreased thereafter. The concentration of fructans was inversely related to the activity of phleinsase, while inulinase remained at a low level. Functions of inulinase and phleinsase under snow and after thaw were discussed.

F62 PLANT PHYSIOLOGY-GROWTH AND DEVELOPMENT

3774 Abbate, PE.; Andrade, FH.; Culot, JP. (1995) **THE EFFECTS OF RADIATION AND NITROGEN ON NUMBER OF GRAINS IN WHEAT.** *Journal of Agricultural Science*. 124(Part 3):351-360. English. [INST NACL TECNOL AGROPECUARIA ESTAC EXPTL AGROPECUARIA BALCARCE UNIDAD INTEGRADA CC 276 RA-7620 BALCARCE ARGENTINA].

The possible interacting effects of shading and N supply on number of grains of *Triticum aestivum* L. (cv. Buck Nandu) were investigated at Balcarce, Argentina, during the 1988/89 and 1989/90 growing seasons. Shading was imposed from c. 13 days before anthesis to 6 days after, and four rates of N fertilization were supplied within each shading treatment around the date of terminal spikelet formation. Water and other nutrients were not limiting. Total grain yield was strongly correlated with grain number/m², regardless of shading or N supply. At the highest N rates, grain number and dry weight of spikes at anthesis were linearly related to a photothermal quotient, i.e. the ratio of intercepted photosynthetically active radiation (PAR) to mean temperature minus 4.5 degrees C, during the period from 20 days before anthesis to 10 days after. The response of grain number to the photothermal quotient was interpreted in terms of the supply of assimilates to the spike at anthesis, which determined flower survival. The response of dry weight of spikes to photothermal quotient was interpreted in terms of crop growth rate since there was a linear relationship between crop growth rate and intercepted radiation. The lowest N rates reduced the number of grains/m², at any given photothermal quotient. Since the reduction in grain number also occurred at any given dry weight of spikes, it cannot be explained by a reduced supply of assimilates to the spikes. Grain number responded directly to the supply of N to the spike, probably through the survival of differentiated flowers. The relationship between spike growth rate and crop growth rate was not affected by N supply. Crop growth rate was reduced by reduced N supply, because less radiation was intercepted and because radiation-use efficiency was lowered. These results indicate that current models for determining yield and number of grains/m², based on crop growth, are not adequate when N is deficient. [References: 25].

3775 Abokassem, E.; Sharafeldin, A.; Rozema, J.; Foda, EA. (1995) **SYNERGISTIC EFFECTS OF CADMIUM AND NaCl ON THE GROWTH, PHOTOSYNTHESIS AND ION CONTENT IN WHEAT PLANTS.** *Biologia Plantarum*. 37(2):241-249. English. [TANTA UNIV FAC SCI DEPT BOT TANTA EGYPT].

The addition of NaCl to cadmium had significant synergistic effect on the wheat root and shoot fresh mass, relative growth rate and net

assimilation rate, while showed no significant effects on the dry mass production, leaf area, leaf area ratio, leaf mass ratio and specific leaf area. Additive depression of the rate of photosynthesis and the stomatal conductance was recorded, while no significant effect on the transpiration rate was observed. The Cd stress disturbed the mineral nutrition of the wheat plants either directly or indirectly, NaCl markedly reduce the uptake and internal concentration of K and Ca in the shoot. The combination of cadmium and NaCl showed no additive effects on the content of ions in the root as well as in the shoot of wheat plants.

3776 Akin, DE. (1995) **MICROSPECTROPHOTOMETRIC CHARACTERIZATION OF AROMATIC CONSTITUENTS IN CELL WALLS OF HARD AND SOFT WHEATS.** *Journal of the Science of Food & Agriculture*. 68(2):207-214. English. [USDA ARS RICHARD B RUSSELL AGR RES CTR POB 5677 ATHENS, GA 30604 USA].

Cell walls of epidermis, hypodermis, nucellar epidermis, aleurone, and endosperm in hard and soft wheat (*Triticum aestivum* L) kernels were evaluated for aromatic constituents using ultraviolet (UV) absorption microspectrophotometry. Wheat varieties sampled were soft red winter Caldwell, hard red winter varieties Tam 200 and Karl, and hard red spring varieties Len and Yecora rojo. Spectra of cell walls of epidermis and hypodermis (beeswing cells) suggested larger amounts and a greater degree of polymerization of aromatic constituents in these walls compared to those of other cell types. Results also suggested the presence of ester-linked ferulic acid. Nucellar epidermal walls also had polymerized aromatics and ferulic acid, but amounts appeared to be much less than in the walls of the beeswing cells. UV spectra of aleurone walls suggested that the predominant aromatic was ester-linked ferulic acid; anticlinal walls had substantially more aromatic constituents than outer or inner periclinal walls. Endosperm walls lacked any indication of aromatics by this method. Grain hardness did not appear to be related to cell wall aromatics. UV absorption microspectrophotometry indicated significant variations in wall aromatics of different cell types of wheat grains. [References: 30].

3777 Alamgir, ANM.; Bhuiyan, AKMS. (1995) **EFFECTS OF HGCL2 ON SEED GERMINATION AND SEEDLING GROWTH OF ELEVEN HIGH YIELDING VARIETIES OF WHEAT.** *Bangladesh Journal of Botany*. 24(1):91-93. English. [CHITTAGONG UNIV DEPT BOT CHITTAGONG 4331 BANGLADESH].

3778 Arz, MC.; Grambow, HJ. (1995) **ELICITOR AND SUPPRESSOR EFFECTS ON PHOSPHOLIPASE C IN ISOLATED PLASMA MEMBRANES CORRELATE WITH ALTERATIONS IN PHENYLALANINE AMMONIA-LYASE ACTIVITY OF WHEAT LEAVES.** *Journal of Plant Physiology*. 146(1-2):64-70. English. [RHEIN WESTFAL TH AACHEN INST BIOL 3 WORRINGERWEG D-52074 AACHEN GERMANY].

Injection of Pgt(DEAE)-elicitor prepared from germ tubes of *Puccinia graminis* f.sp. *tritici* into the intercellular space of wheat leaves induced an 8-fold increase in phenylalanine ammonia-lyase (PAL; EC 4.3.1.5) activity within 24 h. The elicitor activity could be significantly suppressed to about 40 % of its level in the elicitor-treated controls by simultaneous application of an intercellular washing fluid fraction (IWFG2) of susceptible stem rust infected wheat leaves. Additional experiments revealed an obvious correlation between the effects of the elicitor/suppressor-preparations on the wheat leaf PAL activity and on the plasma membrane associated phospholipase C activity (PLC; EC 3.1.4.3) hydrolyzing phosphatidylinositol 4, 5-bisphosphate (PIP2). Apparently, the Pgt(DEAE)-elicitor Stimulated the PLC activity slightly between 9 and 36 % over the control level, while the IWFG2-fraction inhibited PIP2 cleavage substantially to about 50 % of the controls. Our results point to an involvement of the phosphoinositide metabolism in the Pgt-elicitor mediated wheat/stem rust-interaction. In contrast, when using a chitin-derived elicitor preparation (COS), different results were obtained, indicating that COS may act through a different mechanism. [References: 45].

3779 Auranen, M. (1995) **PRE-HARVEST SPROUTING AND DORMANCY IN MALTING BARLEY IN NORTHERN CLIMATIC CONDITIONS [Review].** *Acta Agriculturae Scandinavica Section B-Soil &*

Plant Science. 45(2):89-95. English. [CORNELL UNIV DEPT PLANT BREEDING & BIOMETRY ITHACA, NY 14853 USA].

Pre-harvest sprouting and seed dormancy cause financial losses for the barley seed users and end product processors. These phenomena are problems especially in rainy harvesting seasons. In barley research work has concentrated on morphological, anatomical and hormonal features of cultivars that affect the tendency to pre-harvest sprouting. Farmers and maltsters would need a mathematical model to predict the best harvesting time for malting barley. Biochemical markers can be used to test pre-harvest sprouting. A genome map and an RFLP map of barley have been created. [References: 58].

3780 Baek, H.J. (Rural Development Administration, Suwon (Korea Republic). Agricultural Biotechnology Institute); Choi, W.Y. (Chonnam National University, Kwangju (Korea Republic). College of Agriculture) (1994) Effects of water stress on germination in winter barley. *Korean Journal of Crop Science (Korea Republic)* v. 39(2) p. 139-145. 7 illus.; 1 table; 26 ref. Korean. (AGRIS 95-088375).

3781 Blomback, K.; Stahli, M.; Eckersten, H. (1995) SIMULATION OF WATER AND NITROGEN FLOWS AND PLANT GROWTH FOR A WINTER WHEAT STAND IN CENTRAL GERMANY. *Ecological Modelling*. 81(1-3):157-167. English. [SWEDISH UNIV AGR SCI DEPT SOIL SCI POB 7014 S-75007 UPPSALA SWEDEN].

Two linked simulation models were applied to an experimental loam site at Neuenkirchen, Germany, for the years 1989 and 1991, using a data set with soil and plant properties for winter wheat. Simulations of soil water and heat dynamics were performed with the SOIL model. Both years were rather dry. For the first year, soil water content and soil water tension were calibrated by tuning the saturated hydraulic conductivity. The simulations showed good correspondence with the measurements during the first six months down to 130 cm depth. However, the dynamics of the simulated water tension in deeper layers was poor compared to the measurements. Using the same parameterization for 1991, the model simulated soil moisture dynamics reasonably well in the upper 70 cm. Below this depth, the water content was underestimated. Soil and plant nitrogen dynamics, litter decomposition and plant biomass production were simulated with the SOILN model. The model was tested against measurements of leaf, stem and grain biomass and nitrogen, leaf area and soil nitrate and ammonium content. It was calibrated for the first year (1989) and validated in 1991. Parameters related to translocation of assimilates and nitrogen from different tissues to grain were estimated by calibration. The simulated plant properties in 1989 explained about 95% of the variations in measured values. A similar agreement was obtained for the validation year. The corresponding value for soil mineral nitrate in 1989 was only 38%, mainly due to problems in reproducing the dynamics in the upper 30 cm in connection to fertilization applications. In deeper layers up to 90% of the variation was explained. For nitrate in 1991 and ammonium the agreement between simulated and measured values was poor. [References: 16].

3782 Bregitzer, P.; Poulson, M. (1995) AGRONOMIC PERFORMANCE OF BARLEY LINES DERIVED FROM TISSUE CULTURE. *Crop Science*. 35(4):1144-1148. English. [USDA ARS POB 307 ABERDEEN, ID 83210 USA].

The practical application of in vitro genetic manipulations to plant breeding may be hindered by unselected and potentially undesirable somaclonal variation. To determine the potential for recovering cultivars from tissue cultures without somaclonal variation, 30 families of tissue culture derived lines from six barley (*Hordeum vulgare* L.) cultivars were analyzed for agronomic performance. Each family was derived from a single regenerated plant that in turn was derived from an immature embryo callus culture. Four to six R(2) plants were selected from each family based on phenotypic similarity to the uncultured parental controls. One-hundred-seventy-four R(2) derived lines were advanced by bulking to the R(5) generation. The results of replicated field trials indicated that the agronomic performance for the majority of these lines was altered by passage through tissue culture and that the alterations were generally undesirable. Cultivar-dependent differences were noted in the frequency and degree of agronomic alterations. Families within cultivars was an important source of variation, but selections within families was not.

Successful selection of tissue culture derived barley Lines without somoclonal variation therefore may be cultivar dependent and may require screening large populations of regenerated plants. [References: 27].

3783 Brooking, IR.; Jamieson, PD.; Porter, JR. (1995) THE INFLUENCE OF DAYLENGTH ON FINAL LEAF NUMBER IN SPRING WHEAT. *Field Crops Research*. 41(3):155-165. English. [NEW ZEALAND INST CROP & FOOD RES LTD PRIVATE BAG 4704 CHRISTCHURCH NEW ZEALAND].

The influence of daylength on final leaf number was determined in four field-sown wheat cultivars with no vernalisation requirement. Leaf and primordium appearance was monitored in plots sown at two-month intervals during an annual cycle. The timing of the response to daylength varied substantially among cultivars. In one, final commitment of the last leaf primordium occurred close to the time of initiation of that primordium while, in another cultivar, commitment did not occur until terminal spikelet or later. In the other two cultivars, commitment occurred midway through spikelet initiation. Late timing of response to daylength is a useful adaptation that allows cultivars with no vernalisation response sown in autumn to set more leaves than when sown in spring, and hence to delay flowering. Based on the analysis, a simple iterative procedure was developed that successfully predicted final leaf number, the dates of appearance of the flag ligule and anthesis for one of the cultivars grown in an independent experiment. [References: 22].

3784 Campbell, LD.; Boila, RJ.; Stothers, SC. (1995) VARIATION IN THE CHEMICAL COMPOSITION AND TEST WEIGHT OF BARLEY AND WHEAT GRAIN GROWN AT SELECTED LOCATIONS THROUGHOUT MANITOBA. *Canadian Journal of Animal Science*. 75(2):239-246. English. [UNIV MANITOBA DEPT ANIM SCI WINNIPEG MB R3T 2N2 CANADA].

Cultivars of wheat (n = 8) and barley (n = 6) were grown at 12 locations throughout Manitoba over 3 consecutive years. Test weight (TWT = weight of whole grain per volume), and the concentrations of protein, starch, fat, NDF and ADF in the grain from wheat and barley differed (P < 0.05) among cultivars of each grain. Correlation coefficients between measurements were calculated for barley: TWT vs. starch, r = 0.43; TWT vs. NDF, r = -0.66; TWT vs. ADF, r = -0.51; starch vs. NDF, r = -0.49; and they were also calculated for wheat: TWT vs. protein plus starch, r = 0.26; TWT vs. NDF, r = -0.44; TWT vs. ADF, r = -0.31; protein vs. starch, r = -0.50. Variation for TWT and the concentrations of protein, starch, fat, NDF and ADF in the grain from barley and wheat were due both to differences among cultivars and the effect of environment (location and year of growth) on those differences among cultivars. Effects of environment differed among measurements. Variance due to the interaction between cultivar, and location and year of growth (cultivar X environmental variance) was 7.5 and 14.0% of total variance (total variance = environmental variance plus cultivar X environmental variance) for protein in barley and wheat, respectively. Cultivar X environmental variance was also low and ranged from 24.0 to 35.4% of total variance for starch, NDF and ADF in barley and for ADF in wheat. The lower the percentage of cultivar X environmental variance the more predictable were the differences for a measurement among cultivars of a grain across environments. [References: 24].

3785 Choudhary, M.; Bailey, LD.; Grant, CA.; Leisle, D. (1995) EFFECT OF ZN ON THE CONCENTRATION OF CD AND ZN IN PLANT TISSUE OF TWO DURUM WHEAT LINES. *Canadian Journal of Plant Science*. 75(2):445-448. English. [AGR & AGRI FOOD CANADA BRANDON RES CTR POB 1000 A RR 3 BRANDON MB R7A 5Y3 CANADA].

Irrespective of fertilizer treatments, durum wheat (*Triticum turgidum* L. var durum) Cd concentration was lowest in the grain and highest in the roots and was in the order: root > leaf > stem > grain. Soil-applied Zn decreased the Cd concentrations in durum wheat grain, leaf, stem, and root. But, foliar application of Zn resulted in Zn loading of the leaf and stem and had little effect on plant Cd concentration. Application of P and N plus P fertilizer increased tissue Cd concentration and decreased stem and leaf Zn concentration to near insufficiency, while application of Zn to soil with N plus P fertilizers increased tissue Zn concentration to

sufficiency level and decreased plant Cd concentration of the two durum wheat lines. [References: 15].

3786 Chung, D.H. (Rural Development Administration, Muan (Korea Republic). Mokpo Branch of Crop Experiment Station); Min, K.S. (Chonnam National University, Kwangju (Korea Republic). College of Agriculture); Chun, J.U. (Sunchon National University, Sunchon (Korea Republic). College of Agriculture) (1994) Improvement of plant generation rate in in vitro cultured haploidy embryos from *Hordeum vulgare* pollinated with *Hordeum bulbosum*. *Korean Journal of Crop Science (Korea Republic)* v. 39(2) p. 193-197. 1 illus.; 3 tables; 21 ref. Korean. (AGRI 95-088370).

3787 Craigh, J.; Atherton, J.G.; Sweet, N. (1995) MODELLING THE EFFECTS OF VERNALIZATION ON PROGRESS TO FINAL LEAF APPEARANCE IN WINTER WHEAT. *Journal of Agricultural Science*. 124(Part 3):369-377. English. [UNIV NOTTINGHAM FAC AGR & FOOD SCI SUTTON BONINGTON CAMPUS LOUGHBOROUGH LE12 5RD LEICS ENGLAND].

A simple model of vernalization, originally developed to quantify the vernalization response of field-grown carrots, was fitted to previously published experimental results for winter wheat cv. Norin 27. The optimum temperature for vernalization indicated by the model was c. 5.2 degrees C, as this induced the fastest progress to final leaf appearance, expressed as the reciprocal of number of days from sowing to final leaf. This rate decreased linearly with temperature rise or fall on either side of the optimum, extrapolating to zero at -4.8 degrees C (T-min) and 26.6 degrees C (T-max). When all the treatment temperatures and durations were expressed as vernalizing degree days > -4.8 degrees C (V degrees C d), there was a linear increase in post-treatment development rate with increasing vernalization up to c. 275 V degrees C d. Ending the effective treatment duration for vernalization at the estimated time of initiation of the final leaf primordia brought many of the data points closer to the linear trend which described the rest of the data. Effects of using leaf number, which is linearly related to thermal time, instead of days as the unit of time to compensate for temperature differences in the original experiment were examined. Unvernalized plants had the potential to produce 1s leaves before flowering and therefore rates were expressed as the fraction of the potential total leaf number that each new leaf represented. All plants were assumed to have an initial development rate of 1/18 per leaf. This rate was assumed to increase linearly with time during the vernalizing treatment periods and then remain constant after treatment until the final leaf appeared. Leaf numbers reported from the original experiment were used with these assumptions to estimate the rate at the end of each treatment. The relationship between these rates and treatment temperatures was similar to that for rates based on post-treatment durations. There was an optimum temperature c. 5.5 degrees C and T-min and T-max of -5.1 and 18.8 degrees C estimated by extrapolating the decreasing linear trends to the base rate of 1/18. When plotted against V degrees C d calculated from these temperatures, the rates from the full data set were well represented by the model line which had been fitted to the data from just one treatment duration. [References: 19].

3788 Cuello, J.; Sanchez, M.D.; Sabater, B. (Departamento de Biología Vegetal, Facultad de Biología, Universidad de Murcia, 30100 Murcia (Spain)) (1994) Retardation of senescence by UV-A light in barley (*Hordeum vulgare* L.) leaf segments. *Environmental and Experimental Botany (United Kingdom)* v. 34(1) p. 1-8. 23 ref. English. (AGRI 95-088377).

3789 Demchenko, N.P. (Russian Academy of Sciences, Saint Petersburg (Russian Federation). Komarov Botanical Inst.) (1994) The completion of cell proliferation and growth in wheat radicle. *Plant and Soil (Netherlands)* v. 167(1) p. 43-49. 24 ref. English. (AGRI 95-078081).

3790 Evans, L.T.; Blundell, C.; King, R.W. (1995) DEVELOPMENTAL RESPONSES BY TALL AND DWARF ISOGENIC LINES OF SPRING WHEAT TO APPLIED GIBBERELLINS. *Australian Journal of Plant Physiology*. 22(3):365-371. English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

Tall (rht) and dwarf (Rht) isogenic lines of two Mexican spring wheat cultivars were grown at 25/20 degrees C day/night in short (8 h) days of either natural or artificial light to determine their relative stem, leaf and flowering responses to one or two long days, 11 different gibberellins (GAs) and the growth retardant Cycocel (CCC). Although stem and leaf elongation in the dwarf lines did not respond to a GA application, inflorescence initiation and development was enhanced by several GAs, reduced by CCC, and restored by subsequent GA application. The floral response of tall lines to GAs was greater than that of the dwarf lines, whereas the reverse was the case with their exposure to long days. These results suggest that endogenous GAs are involved in the floral induction of wheat, and that although the stems and leaves of dwarf lines may not be able to respond to exogenous GAs, their shoot apices can do so and are sensitive to endogenous GA levels. [References: 23].

3791 Ganeva, G.; Karadimova, M.; Bocheva, N.; Zozikova, E.; Djambova, G.; Bochev, B. (1995) EFFECTS OF HORDEUM VULGARE L 2H AND OF SECOND HOMEOLOGOUS TRITICUM AESTIVUM L GROUP CHROMOSOMES ON IN VITRO PLANT RESPONSE TO EXOGENOUS AUXINS. *Cereal Research Communications*. 23(1-2):35-43. English. [BULGARIAN ACAD SCI INST GENET BU-1113 SOFIA BULGARIA].

The behavior of immature embryos of a *T. aestivum* L. cv. Chinese Spring line with a disomic addition of the 2H chromosome from *H. vulgare* cv. Betzes and of tetrasomic Chinese Spring lines placed on callus initiation culture medium was studied with respect to the following factors: chromosome composition, concentration of 2, 4-D in the culture medium. Inhibition of the zygotic embryo germination depended mainly on the chromosome composition and 2, 4-D content in the medium. The effect of these factors was slightly affected by the growing conditions of the donor plants. The frequency of callus formation and somatic embryogenesis was more dependent on the environment. Effects of the alien generic chromosome and of the chromosome dose of wheat second group on in vitro response with respect to 2, 4D level were established. The increased dose of homeologous group two wheat chromosomes and disomic addition of 2H chromosome to its genome changed the embryo reaction to exogenous auxins in vitro. By their degree of similarity the chromosomes could be divided in two groups: 2A and 2D; 2H and 2B. Four doses of 2A or of 2D chromosomes increased the number of the total and the embryogenic calli produced by the respective tetrasomes at lower 2, 4-D concentrations. Endogenous auxin content in the coleoptiles of barley cv. Betzes was two times higher than that of wheat. Chromosomes 2H, 2A, 2B and 2D took part in the regulation of endogenous auxin level in vivo. The long arm of chromosome 2D showed the highest effect in this regulation.

3792 Jamieson, P.D.; Martin, R.J.; Francis, G.S. (1995) DROUGHT INFLUENCES ON GRAIN YIELD OF BARLEY, WHEAT, AND MAIZE. *New Zealand Journal of Crop & Horticultural Science*. 23(1):55-66. English. [NEW ZEALAND INST CROP & FOOD RES LTD PRIVATE BAG 4704 CHRISTCHURCH NEW ZEALAND].

The response of three grain crops to drought was determined in a series of experiments in a mobile rainshelter at Lincoln, Canterbury, New Zealand. For winter wheat and spring barley, the critical potential soil moisture deficit (D-c) beyond which yield was affected was independent of drought timing, but was much smaller for barley than wheat. Both crops showed similar yield responses to drought above their D-c. In contrast, D-c for maize increased as the season progressed, and yield was much less sensitive to drought once D-c was exceeded. Although yield response was mostly associated with grain number in wheat and barley, mean kernel mass was also reduced as drought stress increased. Grain yield in maize was correlated with mean kernel mass, and uncorrelated with grain number. [References: 21].

3793 Kelly, J.T.; Bacon, R.K.; Gbur, E.E. (1995) RELATIONSHIP OF GRAIN YIELD AND TEST WEIGHT IN SOFT RED WINTER WHEAT. *Cereal Research Communications*. 23(1-2):53-57. English. [UNIV ARKANSAS DEPT AGRON FAYETTEVILLE, AR 72701 USA].

Test weight and grain yield were measured among closely related wheat (*Triticum aestivum* L.) lines for three growing seasons. The correlation between these two traits varied greatly across years. Under stress conditions where yields were low, there was a strong positive relationship.

When environmental conditions were favorable and yields were high, there was a relatively strong negative correlation between yield and test weight.

3794 Kernich, GC.; Halloran, GM.; Flood, RG. (1995) VARIATION IN DEVELOPMENTAL PATTERNS OF WILD BARLEY (*HORDEUM SPONTANEUM* L) AND CULTIVATED BARLEY (*H-VULGARE* L). *Euphytica*. 82(2):105-115. English. [UNIV MELBOURNE CTR CROP IMPROVEMENT DEPT AGR PARKVILLE VIC 3052 AUSTRALIA].

Six wild barley (*Hordeum spontaneum*) accessions, from a diverse range of habitats, and two spring-cultivated barleys, were examined for variation in durations of development phases. The durations of the leaf initiation and spikelet initiation phases were longer and spikelet growth phases shorter, in wild than in cultivated barley. Across all wild and cultivated barleys the rate and duration of spikelet initiation were negatively correlated, but neither was related to the number of spikelets per spike. The number of spikelets was positively correlated with the number of leaves and the ratio of the number of spikelets to the number of leaves declined with increasing time to anthesis, indicating that each successive leaf was associated with a diminishing increase in the number of spikelets. The duration of culm elongation and final culm length were shorter in accessions of cultivated barley compared with wild barley. This paper also discusses the feasibility for increasing the number of spikelets per spike through breeding for genetic changes in lengths of pre-anthesis phases of development. [References: 26].

3795 Kernich, GC.; Slafer, GA.; Halloran, GM. (1995) BARLEY DEVELOPMENT AS AFFECTED BY RATE OF CHANGE OF PHOTOPERIOD. *Journal of Agricultural Science*. 124(Part 3):379-388. English. [UNIV MELBOURNE CTR CROP IMPROVEMENT DEPT AGR PARKVILLE VIC 3052 AUSTRALIA].

The rate of leaf appearance of barley varies substantially with time of sowing. This variation has been related to both the length and the rate of change of photoperiod at the time of plant emergence. An outdoor pot experiment was conducted to test if rate of change of photoperiod directly affects phasic development and rate of leaf emergence of spring barley. Two photoperiod-sensitive cultivars (Bandulla and Galleon) were subjected to five photoperiod regimes: two constant photoperiods, of 14 and 15.5 h, and three different rates of change of photoperiod of c. 2, 9 and 13 min/day from seedling emergence to awn initiation. Photoperiod treatments significantly affected the duration from seedling emergence to awn initiation in both cultivars. Rate of change of photoperiod did not affect the rate of development towards awn initiation independently of the absolute daylength it produced. Although Bandulla had a longer duration than Galleon at any photoperiod regime, the cultivars did not vary in their sensitivity to photoperiod. When this phase was divided into the leaf initiation (LI) and spikelet initiation (SI) phases, it was evident that the sensitivity to photoperiod was not constant, being in general higher during the SI than during the LI phase. However, the magnitude of the change in sensitivity was cultivar-dependent, indicating that sensitivity to photoperiod during the different phases could be under independent genetic control. Final numbers of primordia (leaves together with maximum spikelet number) were negatively affected by increasing photoperiods, but once again, there was no evidence of any effect of the rate of change of photoperiod which was independent of the average photoperiod. Both cultivars showed similar sensitivities for final leaf number but maximum spikelet number was more sensitive to photoperiod in Galleon than in Bandulla. Highly significant linear relationships between leaf number and thermal time were found for all combinations of cultivars and photoperiod regimes ($r^2 > 0.98$). The rate of leaf appearance (RLA) was similar for both cultivars (c. 0.0185 leaves/degrees Cd) and did not alter during plant development or in response to the change in photoperiod at awn initiation. The range in RLA was greater for Galleon (0.0170-0.0205 leaves/degrees Cd) than for Bandulla (0.0173-0.0186 leaves/degrees Cd). Neither of these cultivars exhibited a significant relationship between rate of leaf emergence and photoperiod or rate of change of photoperiod. The lack of significant relationships between RLA and length or rate of change of photoperiod is in contrast with previous reports using time of sowing as a main treatment. [References: 39].

3796 Khalil, IA. (1995) CHLOROPHYLL AND CAROTENOID CONTENTS IN CEREALS AS AFFECTED BY GROWTH

RETARDANTS OF THE TRIAZOLE SERIES. *Cereal Research Communications*. 23(1-2):183-189. English. [UNIV UDINE DIPARTIMENTO PROD VEGETALE & TECNOL AGRARIE VIA SCI 208 I-33100 UDINE ITALY].

The recently developed plant growth regulator paclobutrazol (PP333, ICI) and its structural analogues diclobutrazol (Vigil, ICI), and triadimefon (Bayleton, Bayer) applied as a soil drench retarded the growth and produced compact intense green seedlings of barley and wheat. The greening effect hypothetically related to the enhanced chlorophyll and/or carotenoid biosynthesis could not be confirmed experimentally. The greening effect was actually associated with the growth compaction induced by the three triazoles.

3797 Kondratev, MN.; Lebedinskaya, SO. (1995) NITRATE REDUCTASE AND PROTEASE ACTIVITIES IN WHEAT DURING REPRODUCTIVE GROWTH. *Russian Journal of Plant Physiology*. 42(3):350-357. English. [RUSSIAN ACAD SCI KA TIMIRYAZEV AGR ACAD UL TIMIRYAZEVA 49 MOSCOW 127550 RUSSIA].

The time-courses of nitrate reductase and protease activities were monitored during the development of two spring wheat cultivars of different ecotypes (steppe and North Russian types). The total activity of nitrate reductase (NRA), as calculated per plant basis, was measured under conditions of sufficient and insufficient watering. During the reproductive growth, NRA declined rapidly in both cultivars. Water deficiency at the early developmental stages depressed enzyme activity significantly whereas insufficient watering during the reproductive growth period did not influence it. Additional nitrogen application during postanthesis resulted in nitrate accumulation in the vegetative organs but hardly affected nitrate reduction. Proteolytic activity was measured at different levels of nitrogen nutrition and under different photoperiods. The total proteolytic activity was stabilized or activated during the period of grain ripening. Continuous illumination did not affect the protease activity, whereas nitrogen application during postanthesis enhanced the activity at the beginning of reproductive growth. The contribution of various plant organs to the total nitrate reductase and protease activities during plant development was evaluated. A conclusion was drawn that the decrease in the total NRA at the postanthesis period was due to plant senescence rather than to a diminished nitrate uptake. Proteolytic activity during reproductive growth comprises both the activity of "senescence proteases," responsible for the formation of a mobile nitrogen pool, and the activity of proteases that are involved in the continuous turnover of protein molecules. Reproducible differences between wheat cultivars in terms of nitrate or protease activity levels were not observed. [References: 11].

3798 Kumar, D.; Batra, VIP. (1994) EXCEPTIONALLY HIGH ACTIVITY OF GLUTAMATE PYRUVATE TRANSAMINASE IN DEVELOPING ENDOSPERM OF MUTANT BARLEY. *National Academy Science Letters-India*. 17(11-12):203-205. English. [HARYANA AGR UNIV CCS HISAR 125004 HARYANA INDIA].

Developing endosperms of a relatively high protein barley (*Hordeum vulgare* L.) mutant genotype Notch-2 possessed exceptionally high activity of glutamate pyruvate transaminase (EC 2.6.1.2), compared with that in its normal parent NP 113 genotype. Possibly, this enzyme plays a dominant role in the transformation of amino nitrogen in developing endosperm of Notch-2 mutant barley.

3799 Lazar, MD.; Salisbury, CD.; Worrall, WD. (1995) VARIATION IN DROUGHT SUSCEPTIBILITY AMONG CLOSELY RELATED WHEAT LINES. *Field Crops Research*. 41(3):147-153. English. [TEXAS A&M UNIV CTR AGR RES & EXTENS 6500 AMARILLO BLVD W AMARILLO, TX 79106 USA].

Drought resistance is a complex trait for which systematic improvement has been difficult. One means of simplifying analysis of such a trait is through examination of variability among closely related genotypes. Sister lines of wheat exhibiting significant variation for rainfed yield, irrigated yield, and a drought susceptibility index, S, were identified among derivatives of a backcross breeding program. Of seven sister lines compared in a 2-y field study at Bushland, Texas, three were found significantly less susceptible than a related cultivar, TAM-107, two were significantly more susceptible than TAM-107 and two were not

distinguishable from TAM-107. Relatively small, but significant, variability was observed among the lines for developmental variables, including anthesis date, date of physiological maturity and length of the grain-filling period. No meaningful correlations could be established, however, between developmental variables and yield or susceptibility index. While some differences may exist among these lines in mechanism underlying relative drought susceptibility, lack of correlation with developmental variables indicates that this set of lines may be valuable in identifying useful drought resistance mechanisms in wheat. [References: 14].

3800 Mosaad, MG.; Ortizferrara, G.; Mahalakshmi, V. (1995) **TILLER DEVELOPMENT AND CONTRIBUTION TO YIELD UNDER DIFFERENT MOISTURE REGIMES IN TWO TRITICUM SPECIES.** *Journal of Agronomy & Crop Science-Zeitschrift für Acker und Pflanzenbau.* 174(3):173-180. English. [INT CTR AGR RES DRY AREAS GERMPLASM PROGRAM POB 5466 ALEPPO SYRIA].

The number of productive tillers is an important yield component in wheat and is affected by water stress and genetic factors. A greenhouse experiment was conducted during spring 1992 at ICARDA, Tel Hadya, Syria, with eight genotypes representing two Triticum species (Triticum turgidum L. ssp. durum and Triticum aestivum L. ssp. aestivum) under four soil-moisture regimes (95 %, 75 %, 55 %, and 35 % field capacity) to study the effect of water deficit on tiller development and tiller contribution to grain yield. In the highest watering regime appearance of Tiller 1 was delayed in both species. Also Tiller 2 was suppressed in this treatment in durum, while its appearance was delayed in aestivum. In the driest treatment, a majority of the tillers were suppressed and the ones which emerged were delayed. In durum, the heat units required to produce successive leaves on the tillers were higher than that for the main stem and increased with increasing water stress, causing high rate of tiller abortion. In aestivum, each tiller, once produced, developed leaves at the same rate as on the main stem. Phyllochron of tillers as well as main stem was not affected by water stress in aestivum. In aestivum, contribution by tillers to yield was higher than that of durum in all treatments. Results indicate that early appearance of tillers and faster rate of leaf appearance under water stress result in higher tiller survival and greater tiller contribution to final yield. Hence, tiller dynamics under water stress can be used as a selection criterion for breeding for drought tolerance. [References: 14].

3801 Mosaad, MG.; Ortizferrara, G.; Mahalakshmi, V.; Hamblin, J. (1995) **LEAF DEVELOPMENT AND PHENOLOGY OF TRITICUM AESTIVUM AND T-DURUM UNDER DIFFERENT MOISTURE REGIMES.** *Plant & Soil.* 170(2):377-381. English. [INT CTR AGR RES DRY AREAS GERMPLASM PROGRAM POB 5466 ALEPPO SYRIA].

Wheat grain yield production in the rain-fed areas is limited by water deficits during crop growth. A greenhouse experiment was conducted during spring 1992 at ICARDA, Tel Hadya, Syria, with eight genotypes representing two Triticum species (Triticum turgidum var. durum and Triticum aestivum L.) under four soil-moisture regimes (95%, 75%, 55%, and 35% field capacity) to study the effect of water deficit on leaf development. The phyllochron was similar in the two species across the watering regimes. The range in variation in phyllochron among the genotypes was similar in the two species. Phyllochron response to water stress among genotypes was distinct in the driest regime in both species. Cham 6 (T. aestivum) and Gallareta (T. turgidum var. durum) had similar phyllochron across all moisture regimes whereas in other genotypes phyllochron was higher in the driest regime. Leaf area decreased with increasing moisture stress. Triticum turgidum var. durum genotypes were later in flowering as they had, on average, one leaf more than Triticum aestivum genotypes with similar leaf appearance rates. [References: 18].

3802 Nam, J.H.; Song, H.S.; Park, M.W.; Lee, C.K.; Park, H.H. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station) (1994) **Influence of sprouted degree of barley on viviparity for regermination, yield and grain quality.** *Korean Journal of Crop Science (Korea Republic)* v. 39(2) p. 115-120. 6 illus.; 3 tables; 5 ref. Korean. (AGRS 95-088374).

3803 Oyanagi, A. (National Agriculture Research Center, Tsukuba (Japan)) (1994) **Gravitropic response growth angle and vertical distribution of roots of wheat (Triticum aestivum L.).** *Plant and Soil (Netherlands)* v. 165(2) p. 323-326. 14 ref. English. (AGRS 95-078115).

3804 Pati, BR.; Sengupta, S.; Chandra, AK. (1995) **IMPACT OF SELECTED PHYLLOSPHERIC DIAZOTROPHS ON THE GROWTH OF WHEAT SEEDLINGS AND ASSAY OF THE GROWTH SUBSTANCES PRODUCED BY THE DIAZOTROPHS.** *Microbiological Research.* 150(2):121-127. English. [VIDYASAGAR UNIV DEPT BOT & FORESTRY MICROBIOL LAB MIDNAPORE 721102 W BENGAL INDIA].

The impact of two phyllospheric diazotrophs, Azotobacter chroococcum (REN)(2) and Asomonas macrocytogenes (JN(2)) on the growth of wheat seedlings were studied in laboratory conditions. Cultures of different incubation periods and different dilutions were tested for the best effect. Maximum increase in root and shoot lengths were obtained by 5 days old crude cultures of both organisms. Production of plant growth substances by the two diazotrophs was tested by TLC and HPLC and evaluated by bioassay methods. Both organisms produced detectable amounts of extracellular indole acetic acid (IAA) and gibberellins (GA). However, when grown in nitrogen-free growth medium supplemented with DL-tryptophan, both nitrogen fixing strains produced high quantities of extracellular IAA.

3805 Peng Yongkang; Qi Zhongzhan (Nankai Univ., Tianjin (China). Dept. of Biology) (1994) **Effects of low temperature pretreatment on the growth of young plants and activity of ATPase isozymes in their roots.** *Acta Botanica Boreali-Occidentalia Sinica (China)* v. 14(3) p. 210-215. 1 table; 4 ill., 11 ref. Chinese. (AGRS 95-088462).

3806 Petruzzelli, L.; Harren, F.; Reuss, J. (Istituto Germoplasma, CNR, 70126 Bari (Italy)) (1994) **Patterns of C₂H₄ production during germination and seedling growth of pea and wheat as indicated by a laser-driven photoacoustic system.** *Environmental and Experimental Botany (United Kingdom)* v. 34(1) p. 55-61. 30 ref. English. (AGRS 95-088439).

3807 Schroder, U.; Richter, O.; Velten, K. (1995) **PERFORMANCE OF THE PLANT GROWTH MODELS OF THE SPECIAL COLLABORATIVE PROJECT 179 WITH RESPECT TO WINTER WHEAT.** *Ecological Modelling.* 81(1-3):243-250. English. [TECH UNIV CAROLO WILHELMINA BRAUNSCHWEIG INST GEOG & GEOECOL SPECIAL COLLABORAT PROJECT 179 D-38106 BRAUNSCHWEIG GERMANY].

In the Special Collaborative Project 179 (SCP), a plant model has been developed as a submodel of a comprehensive site model called SIMULAT. The mathematical structure of this plant model is briefly presented. Then, the link of the plant model with other submodels of SIMULAT is discussed. The plant model has been calibrated for winter wheat data from 1989. Afterwards, it has been applied to data of several years which have been obtained from another investigation site of the same catchment. Model results and data are compared. [References: 7].

3808 Sinnaeve, G.; Dardenne, P. (Centre de Recherches Agronomiques de l'Etat, Libramont (Belgium). Station de Haute Belgique); Herman, J.L.; Couvreur, L.; Vrebos, D. (1994) **[Qualitative situation of the [Belgian] winter wheat production in 1993]. Situation qualitative de la production de froment d'hiver en 1993. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993. Seutin, E.; Falisse, A. (eds) (Qualite) p. 7-16. 8 tables. French. (AGRS 95-078075).**

3809 Slafer, GA.; Rawson, HM. (1995) **BASE AND OPTIMUM TEMPERATURES VARY WITH GENOTYPE AND STAGE OF DEVELOPMENT IN WHEAT.** *Plant Cell & Environment.* 18(6):671-679. English. [UNIV MELBOURNE DEPT AGR CTR CROP IMPROVEMENT PARKVILLE VIC 3052 AUSTRALIA].

Some assumptions concerning development in wheat (Triticum aestivum, L.) were examined. These are that (i) the rate of development towards anthesis increases linearly with temperature, (ii) the base temperature is 0 degrees C, (iii) the optimum temperature is above the range at which wheat is normally grown, (iv) base and optimum

temperatures do not change with development, and (v) the relationships for different cultivars are similar. We tested these assumptions in studies using a naturally lit phytotron with four cultivars and six temperature regimes between 10 and 25 degrees C. Seedlings were vernalized for 50 d and then grown under a photoperiod of 18 h to avoid confounding the responses to vernalization and photoperiod with those to temperature. In cultivars Sunset and Rosella, the rate of development for the full period to anthesis increased linearly between base and optimum temperatures. However, in cultivars Condor and Cappelle Desprez, a linear fit was not statistically acceptable. For these cultivars, the rate of development towards anthesis increased rapidly with increase in temperature from 10 to 19 degrees C, but temperatures higher than 19 degrees C had little or no further accelerating effect. When a linear relationship was fitted by ignoring data for temperatures above 19 degrees C, base temperatures calculated for the full period to anthesis were c. 5.5, 5.5, 4.0 and 2.5 degrees C for Sunset, Condor, Rosella and Cappelle Desprez, respectively (i.e. an average value of c. 4 degrees C). The full period to anthesis was subdivided into three phases for further analysis. These were (i) from the beginning of the experiment to terminal spikelet initiation, (ii) from terminal spikelet initiation to heading, and (iii) from heading to anthesis. When these sub-phases were analysed a linear relationship was found to be appropriate for all combinations of cultivar and developmental phase. However, both base and optimum temperatures calculated from the relationships increased as development progressed from (i) to (iii). Averaging across cultivars, base temperatures for the three phases were -1.9, +1.2 and +8.1 degrees C, respectively, while optimum temperatures were <22, 25 and >25 degrees C, respectively. Cultivars differed substantially in all these parameters. The progressive increase in optimum temperature with phasic development was apparently the main reason why linear fits for the three sub-phases became a curvilinear fit for the full phase to anthesis. [References: 33].

3810 Smith, RE. (1995) OPUS SIMULATION OF A WHEAT SUGARBEET PLOT NEAR NEUENKIRCHEN, GERMANY. *Ecological Modelling*. 81(1-3):121-132. English. [USDA ARS AERC FOOTHILL CAMPUS FT COLLINS, CO 80522 USA].

The model Opus was used to simulate five years of soil water and crop growth data for a loam soil site. Simulations for water flow match the general trends, but there is some difference in the values. The results for crop growth were relatively good. Nitrogen was not simulated very well, but there are reasons to suspect the measured data. Pesticide dissipation was simulated with reasonable accuracy. [References: 9].

3811 Stahl, D.; Perrissinabert, D.; Blouet, A.; Guckert, A. (1995) CONTRIBUTION OF THE WHEAT (TRITICUM AESTIVUM L.) FLAG LEAF TO GRAIN YIELD IN RESPONSE TO PLANT GROWTH REGULATORS. *Plant Growth Regulation*. 16(3):293-297. English. [INRA ENSAIA AGRON & ENVIRONNEMENT LAB F-54500 VANDOEUVRE LES NANCY FRANCE].

In West-Europe, intensive cereal management uses plant growth regulators (PGRs) especially for wheat. A greenhouse experiment compared the effects of two PGRs on flag leaf characteristics and yield of winter wheat. Chlormequat chloride + choline chloride (CCC) and chlormequat chloride + choline chloride + imazaquin (CCC + I) were applied to winter wheat at growth stage 5 (Feekes Large scale). CCC and CCC + I significantly increased flag leaf surface area at anthesis. Both treatments also enhanced chlorophyll content of the main stem flag leaf. The grain filling period was extended with PGR application by 2 days. CCC and CCC + I significantly increased net CO₂ assimilation rates during the flag leaf life. No effects of PGR spraying were observed on the pattern of C-14 labelled assimilate distribution. Increased grain yield was due to the increase in average grain weight. The results indicate that PGR treatments increased flag leaf contribution to grain filling. The addition of imazaquin (I) to chlormequat (CCC) improved the effects of CCC. [References: 16].

3812 Stanko, SA.; Stanko, AD.; Netsvetaev, VP.; Rybalka, AI.; Kostyanovskii, RG. (1995) NITROGEN METABOLISM AND ESTERASE ACTIVITY IN WHEAT-SEED ENDOSPERM AT THE STAGE OF HETEROTROPHIC NUTRITION WITH NOVEL BIOREGULATORS OF THE FUMAR FAMILY. *Izvestiia Akademii Nauk SSSR. Seriya*

Biologicheskaya. (3):291-299. Russian. [RUSSIAN ACADEMY OF SCIENCES SEMENOV CHEM PHYS INST UL KOSYGINA 4 MOSCOW 117977 RUSSIA].

When used for the presowing treatment of wheat seeds over a wide concentration range (10⁻⁹ - 10⁻⁴ M), the novel bioregulators of the Fumar family outperform IAA and GA-3 in terms of utilization of the nitrogen reserves in the endosperm, the synthesis of structural and cytoplasmic proteins, esterase activity, and growth of seedlings and roots at the stage of heterotrophic nutrition of the germinants. A correlation has been found between the bioregulator-induced activation of certain physiological and biochemical processes and the activity of leaf and root esterases in the germinants. Wheat esterase activity is controlled by the Est12, Est1, Est2, Est4, and Est5 esterases in seedlings or by the Est1, Est2, Est4, Est5, and Est11 esterases in roots. The relationship between the expression of esterase genes and the structure of the bioregulators is discussed. [References: 22].

3813 Stieger, P.A. (Bern Univ. (Switzerland). Inst. of Plant Physiology); Feller, U. (1994) Senescence and protein remobilisation in leaves of maturing wheat plants grown on waterlogged soil. *Plant and Soil (Netherlands)* v. 166(2) p. 173-179. 33 ref. English. (AGRIS 95-078114).

3814 Svihra, J.; Talapka, S. (1995) GROWTH-PRODUCTION AND ACCUMULATION PROCESS OF SOME SPRING WHEAT VARIETIES. *Rostlinna Vyroba*. 41(6):249-253. Czech. [VYSOKA SKOLA POLNOHOSPODARSKA A HLINKU 2 NITRA 94976 SLOVAKIA].

Field trials conducted in the years 1991 to 1993 were aimed at solving the issue of growth-production and accumulation process of some varieties of spring barley: Bonus, Galan, Jubilant, Novum, Sladko and Svit. The investigated varieties had different values of specific rate of dry matter growth. The highest increments of dry matter were recorded with the variety Bonus (0.0503 g.m⁻².d⁻¹) and the lowest ones were in the Jubilant variety (0.0418 g.m⁻².d⁻¹). The values of specific rate of growth of leaf area (RGR(A)) were of the similar tendency. At the onset of the growing season during tillering to the phase of shooting the growth rate of leaf area ranged from 0.073 to 0.090 g.m⁻².d⁻¹ and the lowest values of growth rate were achieved during milk ripeness from 0.018 to 0.028 g.m⁻².d⁻¹. Out of statistical indicators of growth analysis the highest average value of pure performance of photosynthesis had the plants of the Bonus variety (13.62 g.m⁻².d⁻¹) and the lowest one had the plants of the Svit variety (12.87 g.m⁻².d⁻¹). The lowest value of productivity of photosynthesis (CGR) exhibited the plants of the Galan variety (36.68 g.m⁻².d⁻¹) and the highest value plants of the Sladko variety (39.48 g.m⁻².d⁻¹). The CGR value was based upon the leaf-area index (LAI) which was the lowest with the Bonus variety (2.77) and the highest was in the Sladko variety (3.01). The highest value on an average for three-year period gave the plants of the Svit variety (6.75 t.ha⁻¹) and the lowest was achieved by the plants of the Galan variety (5.64 t.ha⁻¹). It has been manifested after assessment of the crude protein content that the highest content was attained by grains in the Galan variety (12.01%) and the lowest grain content was recorded in the Jubilant variety (11.79%). Any significant differences in crude protein content were not between different crops, except for grains of the Sladko variety which reduced the crude protein content almost significantly compared with the control Bonus. After assessment of extract content the highest grain content exhibited the Bonus variety (78.9%) and the lowest grain content the Galan variety (78.4%). The differences between varieties were insignificant. Materialization of the genetic potential of spring barley varieties cultivated at that time greatly depends on adaptation to the growing environment when a decisive role is played by temperature and precipitation during the whole growing season and often temperature and moisture stress conditions after anthesis during filling of grains by assimilates. The greatest adaptability to the environment manifested the plants of the Jubilant variety, while the varieties Sladko and Svit to a lesser degree.

3815 Swinnen, J. (Instituut voor Agrobiologisch en Bodemvruchtbaarheidsonderzoek DLO, Wageningen (Netherlands)); Veen, J.A. van; Merckx, R. (1994) Losses of (14)C from roots of pulse-labelled wheat and barley during washing from soil. *Plant and Soil (Netherlands)* v. 166(1) p. 93-99. 14 ref. English. (AGRIS 95-078116).

3816 Tewari, SK.; Singh, M. (1995) INFLUENCE OF SOWING DATE ON PHASE DURATION AND ACCUMULATION OF DRY MATTER IN SPIKES OF WHEAT (TRITICUM AESTIVUM). *Indian Journal of Agronomy*. 40(1):43-46. English. [NATL BOT RES INST BANTHRA RES STN LAB LUCKNOW 226001 UTTAR PRADESH INDIA].

A field experiment was conducted during the winter (rabi) season of 1987-88 and 1988-89 to study the effect of sowing date on phase duration and dry-matter accumulation of 10 genotypes of wheat (*Triticum aestivum* L. emend. Fiori and Paol.). Late-sown crop had heavier spikes than timely sown one at anthesis; however, final spike-dry weight was lower in late-sown crop. The normal-sown crop continued to accumulate dry matter at later stages also. There was a reduction in the total life-span of the crop when sowing was delayed and the longest period of ear growth was available to normal-sown crop.

3817 Titov, AF.; Talanova, VV.; Boeva, NP.; Minaeva, SV.; Soldatov, SE. (1995) THE EFFECT OF LEAD IONS ON THE GROWTH OF WHEAT, BARLEY, AND CUCUMBER SEEDLINGS. *Russian Journal of Plant Physiology*. 42(3):403-407. English. [KARELIAN SCI CTR INST BIOL UL PUSHKINSKAYA 11 KARELIA 185610 RUSSIA].

The responses of winter wheat (*Triticum aestivum* L.), barley (*Hordeum vulgare* L.), and cucumber (*Cucumis sativus* L.) seedlings to lead nitrate were studied as functions of lead rates (concentration and duration of treatment), seedling age, and the presence of other salts. An increase in the lead nitrate concentration from 10(-6) to 10(-2) M and treatment duration from one to seven days resulted in greater inhibition of plant growth. The shoots were more tolerant to lead than the roots. The toxicity of lead nitrate was greatly reduced by the presence of other salts. The plant species studied showed species-specific quantitative differences in their responses to lead ions with respect to plant age. [References: 17].

3818 Tubiello, FN.; Rosenzweig, C.; Volk, T. (1995) INTERACTIONS OF CO₂, TEMPERATURE AND MANAGEMENT PRACTICES - SIMULATIONS WITH A MODIFIED VERSION OF CERES-WHEAT. *Agricultural Systems*. 49(2):135-152. English. [COLUMBIA UNIV GODDARD INST SPACE STUDIES 2880 BROADWAY NEW YORK, NY 10025 USA].

A new growth subroutine was developed for CERES-Wheat, a computer model of wheat (*Triticum aestivum*) growth and development. The new subroutine simulates canopy photosynthetic response to CO₂ concentrations and light levels, and includes the effects of temperature on canopy light-use efficiency. Its performance was compared to the original CERES-Wheat V-2.10 in 30 different cases. Biomass and yield predictions of the two models were well correlated (correlation coefficient $r > 0.95$). As an application, summer growth of spring wheat was simulated at one site. Modeled crop responses to higher mean temperatures, different amounts of minimum and maximum warming, and doubled CO₂ concentrations were compared to observations. The importance of irrigation and nitrogen fertilization in modulating the wheat crop climatic responses were also analyzed. Specifically, in agreement with observations, rainfed crops were found to be more sensitive to CO₂ increases than irrigated ones. On the other hand, low nitrogen applications depressed the ability of the wheat crop to respond positively to CO₂ increases. In general, the positive effects of high CO₂ grain yield were found to be almost completely counterbalanced by the negative effects of high temperatures. Depending on how temperature minima and maxima were increased, yield changes averaged across management practices ranged from -4% to 8%. [References: 36].

3819 Wahbi, A.; Gregory, PJ. (1995) GROWTH AND DEVELOPMENT OF YOUNG ROOTS OF BARLEY (HORDEUM VULGARE L.) GENOTYPES. *Annals of Botany*. 75(5):533-539. English. [UNIV READING DEPT SOIL SCI POB 233 READING RG6 6DW BERKS ENGLAND].

Barley (*Hordeum vulgare* L.) genotypes from countries with a Mediterranean climate were grown in temperature-controlled glasshouses in nutrient solution to determine whether the co-ordination of root branching and growth found by other workers applied to a wider range of up to 14 genotypes. There was substantial variation in the number of seminal axes produced by the genotypes, ranging from about seven for Hoshimasari and Swanneck to about four for Gerbel 'B'. The number of nodal axes was linearly related to the number of leaves and typically

between one and two mainstem leaves were required before nodal axes appeared. There were small genotypic differences in the number of axes produced per leaf with values ranging from 1.5 to 2.3. The production and growth of lateral roots were coordinated so that the mean length of laterals generally increased with time. Landraces (Arabic abiad and Arabic aswad) produced more lateral roots with a faster rate of extension compared with other genotypes. The length and number of primary and secondary lateral roots were related linearly, but no genotypic differences in this relation were evident. Length of primary lateral roots increased more rapidly than that of secondary lateral roots throughout the three to five leaf stage. The ratio of root weight to total plant weight decreased with time but there were only small differences within this range of genotypes. [References: 23].

3820 Wang, SY.; Ward, RW.; Ritchie, JT.; Fischer, RA.; Schulthess, U. (1995) VERNALIZATION IN WHEAT .1. A MODEL BASED ON THE INTERCHANGEABILITY OF PLANT AGE AND VERNALIZATION DURATION. *Field Crops Research*. 41(2):91-100. English. [MICHIGAN STATE UNIV DEPT CROP & SOIL SCI E LANSING, MI 48824 USA].

Vernalization treatments of 0 to 70 d initiated when 0 to 8 leaf tips were visible were applied to plants of the winter wheat (*Triticum aestivum* L.) cultivars Pioneer 2548 and Augusta. All plants headed irrespective of duration of vernalization. Unvernalized plants of Pioneer 2548 and Augusta had mean final leaf numbers (FLN) of 20.8 +/- 1.3 and 21.7 +/- 1.0, respectively. Increased duration of vernalization generally reduced FLN within an age treatment until an age-dependent point of vernalization insensitivity was reached. Estimates of the minimum days of vernalization required to reach vernalization insensitivity decreased in a linear fashion as plant age at the onset of vernalization treatment increased. The number of leaves appearing after the onset of vernalization insensitivity averaged 6.3 +/- 0.5. FLN minus six appears to be a valid estimate in our experimental conditions for the onset of vernalization insensitivity, at least for plants that had six or more leaves appearing after the end of vernalization treatment. Linear regressions of FLN minus six against days of vernalization were significant for both cultivars (for treatments with six or more leaves emerging after vernalization). The Y-intercepts of the fitted regressions were close to values obtained by subtracting six from FLN of unvernalized plants. Both intercept and slope were controlled genetically. Accumulated plant age, expressed as leaf stage, enables attainment of vernalization insensitivity, independent of, or in combination with vernalization treatment. [References: 41].

3821 Wardlaw, IF.; Moncur, L. (1995) THE RESPONSE OF WHEAT TO HIGH TEMPERATURE FOLLOWING ANTHESIS .1. THE RATE AND DURATION OF KERNEL FILLING. *Australian Journal of Plant Physiology*. 22(3):391-397. English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

Wheat (*Triticum aestivum* L.) plants were grown to anthesis at 18/13 degrees C day/night and either retained at 18/13 degrees C or transferred to a higher temperature (24/19 or 30/25 degrees C) for the grain-filling period. It was confirmed that high temperature resulted in a considerable drop in kernel dry weight at maturity and there was significant cultivar variation in the degree of the response, ranging from a 30 to 60% decrease in kernel dry weight at maturity for a rise in temperature from 18/13 to 30/25 degrees C. An analysis of the rate and duration of kernel filling of seven cultivars showed that those cultivars most tolerant of high temperature during kernel filling (least reduction of kernel dry weight at maturity) were those where the rate of kernel filling was most enhanced by high temperature, i.e. the increased rate compensated for the reduced duration of kernel filling. The importance of the rate of kernel filling in determining varietal responses to high temperature illustrates the need to isolate the effect of temperature on processes in the kernel during the linear phase of growth. [References: 40].

3822 Wardlaw, IF.; Moncur, L.; Patrick, JW. (1995) THE RESPONSE OF WHEAT TO HIGH TEMPERATURE FOLLOWING ANTHESIS .2. SUCROSE ACCUMULATION AND METABOLISM BY ISOLATED KERNELS. *Australian Journal of Plant Physiology*. 22(3):399-407. English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

The effect of temperature on [C-14]sucrose accumulation and the incorporation of C-14-label into starch by isolated kernels was followed in a range of wheat (*Triticum aestivum* L.) cultivars. To facilitate uptake the outer pericarp and embryo were removed from each kernel which was then split along the crease region to expose the starchy endosperm directly to a 4% [C-14]sucrose solution. There was an initial high rate of C-14-accumulation by the kernel followed by a slower linear increase in activity from 6 to 24 h after the start of the uptake period. The rate of accumulation of C-14 by the endosperm of individual kernels from plants growing at 15/10 degrees C day/night was greatest 30-42 days after anthesis, with a considerable fall in both the accumulation of [C-14]sucrose and the incorporation of label into starch 50 days after anthesis. Differences between cultivars in the accumulation of [C-14]sucrose and starch synthesis by the starchy endosperm of isolated kernels followed differences in the growth rate of kernels on the plant, although the absolute rates of sucrose accumulation and incorporation into starch were only about 65% of those observed in the intact plant system. Differences between cultivars in their response to high temperature were, however, not evident in the [C-14]sucrose uptake studies. The optimum temperature for kernel respiration, in the short term, was greater than 30 degrees C. However, above 25 degrees C the Q(10) for kernel respiration was below 2, which is an indication that physical factors may influence cell metabolism at this temperature. We suggest that greater consideration should be given to the effect of temperature on sucrose transfer from the vascular system in the crease region of the kernel, through the endosperm cavity to the starchy endosperm. [References: 26].

3823 Wasternack, C.; Atzorn, R.; Leopold, J.; Feussner, I.; Rademacher, W.; Parthier, B. (1995) SYNTHESIS OF JASMONATE-INDUCED PROTEINS IN BARLEY (*HORDEUM VULGARE*) IS INHIBITED BY THE GROWTH RETARDANT TETCYCLACIS. *Physiologia Plantarum*. 94(2):335-341. English. [INST PLANT BIOCHEM WEINBERG 3 D-06120 HALLE GERMANY].

Barley leaf segments treated with jasmonate respond with the synthesis of specific proteins, referred to as jasmonate-induced proteins (JIPs). Application of abscisic acid (ABA) also induced JIP synthesis (Weidhase et al. 1987). In this study the effects of inhibitors on sorbitol-induced increases of endogenous jasmonates and ABA were investigated. The promotion of jasmonates by sorbitol was inhibited by the growth retardant tetcyclacis at concentrations as low as 1 μ M. In parallel with the decrease of jasmonates, JIP gene expression was reduced as reflected by a decline in the level of a 23-kDa protein (JIP-23) and mRNAs of JIP-6 and JIP-23. 12-Oxo-phytodienoic acid, an intermediate in the lipoxygenase (LOX) pathway leading to jasmonic acid was able to overcome the inhibition by tetcyclacis and increases both the endogenous jasmonate content and transcript accumulation. This suggests that tetcyclacis acts upstream of 12-oxo-phytodienoic acid and in keeping with this proposal, an increase in relative LOX activity was detected after tetcyclacis treatment. Although tetcyclacis was shown to inhibit the degradation of ABA to phaseic acid, its effect on jasmonate synthesis is much more pronounced. [References: 45].

3824 White, N.; Jenkyn, JF. (1995) EFFECTS OF SOWING DATE AND VERNALISATION ON THE GROWTH OF WINTER BARLEY AND ITS RESISTANCE TO POWDERY MILDEW (*ERYSIPHE GRAMINIS* F SP HORDED). *Annals of Applied Biology*. 126(2):269-283. English. [AFRC INST ARABLE CROPS RES HARPENDEN AL5 2]Q HERTS ENGLAND].

Detailed studies on the production of individual leaves, and the development of powdery mildew on them, were made in field plots of winter barley sown on different dates. The greater severity of the disease on early-sown than on later-sown seedlings during the autumn and winter can probably be explained mainly by changes in the abundance of inoculum and the suitability of the weather for infection. Results from glasshouse experiments suggest that the differences may be reinforced by direct effects of vernalisation on the susceptibility of seedlings to the disease. Contrary effects of sowing date on mildew severity during summer are probably due to the progressively greater resistance to mildew of the later-formed than of seedling leaves, and the earlier appearance of corresponding leaves on early-sown than on later-sown plants. Early sowing can also increase the total number of leaves produced per stem. Therefore, because resistance of the leaves increases progressively, the maximum degree of resistance expressed by the later-formed (e.g. flag)

leaves will often be greater on early-sown than on later-sown plants. [References: 26].

3825 Wong, M.; Blouet, A.; Guckert, A. (1995) EFFECTIVENESS OF SC2053 AS A CHEMICAL HYBRIDIZING AGENT FOR WINTER WHEAT - IMPORTANCE OF DEVELOPMENTAL STAGES AND DOSES OF APPLICATION. *Plant Growth Regulation*. 16(3):243-248. English. [INRA ECOLE NATL SUPER AGRON & IND ALIMENTAIRES AGRON & ENVIRONNEMENT LAB 2 AVE FORET HAYE F-54500 VANDOEUVRE LES NANCY FRANCE].

The use of chemical hybridizing agents (CHA) allows production of hybrid wheat seeds. We evaluated the effectiveness of a new CHA (SC2053) to induce male sterility on winter wheat in controlled growth conditions. CHA effectiveness was measured with the application of 4 doses (0-400-700-1000 g.ha(-1)) at 7 stages. These stages were defined by the length of the main stem spike (1-4-7-11-15-20-40 mm). At heading, individual ears were isolated with a greaseproof paper bag. The seeds formed were counted on treated and control ears. The spikes' sterility was calculated three weeks after flowering. The sterility of the main stem's spike reached 95% to 100% for application of 700 g.ha(-1) and 1000 g.ha(-1) for main stem spike length of 7 mm to 20 mm. The effects of ear tillering (5 tillers per plant) on CHA effectiveness were also investigated. We observed a significant delay of ear development between the main stem and tillers so that complete sterilities were not reached for each dose. Since tillering in field conditions rarely exceeds 3 ears per plant, CHA effectiveness was studied on plants bearing 3 ears. The mean sterility of the first 3 ears was close to 100% for applications with 700 g.ha(-1) and 1000 g.ha(-1) at stages from 11 mm to 20 mm of main stem spike length. [References: 22].

3826 Yamanaka, A.; Matsuda, Y.; Okuda, T.; Sagisaka, S. (1995) CHARACTERIZATION OF OLIGO(DT)-BINDING PROTEINS FROM SEEDLINGS OF WINTER WHEAT. *Soil Science & Plant Nutrition*. 41(2):183-193. English. [HOKKAIDO UNIV INST LOW TEMP SCI SAPPORO HOKKAIDO 060 JAPAN].

Oligo(dT)-binding proteins of winter wheat (*Triticum aestivum* L.) seedlings were separated into two fractions by chromatography on oligo(dT)-cellulose; one fraction was eluted sequentially with 10 mM Tris-HCl (D fraction) and the other was eluted with the same buffer supplemented with 500 g L(-1) formamide (formamide fraction). The proteins associated with the oligo(dT)-cellulose were characterized by SDS-polyacrylamide gel electrophoresis (PAGE) and, out of the more than 17 polypeptides present in the fractions, a set of proteins common to both the D and formamide fractions had an apparent molecular mass of 55 kDa. Two other sets of the isoform proteins with a molecular mass of 35 and 29 kDa, respectively, were present in the formamide fraction. After growth under snow for three months, an apparent increase in the level of polypeptide with a molecular mass of about 80-kDa was detected. Studies with a cell-free translation system showed that the addition of each fraction resulted in a 1.7- to 3.8-fold stimulation of the rate of incorporation of L-[S-35]-methionine into acid-insoluble material relative to the control rate (without addition). The nature of the products of translation and the efficiency of their synthesis were influenced by the presence of added oligo(dT)-binding proteins. It is suggested that oligo(dT)-binding proteins of winter wheat seedlings are involved in the regulation of the translational activity of poly(A)(+) RNA. [References: 35].

3827 Yamanaka, A.; Matsuda, Y.; Okuda, T.; Sagisaka, S. (1995) POLY(A)(+)-BINDING PROTEINS FROM SEEDLINGS OF WINTER WHEAT. *Soil Science & Plant Nutrition*. 41(2):357-362. English. [HOKKAIDO UNIV INST LOW TEMP SCI SAPPORO HOKKAIDO 060 JAPAN].

In the preceding paper, we described the fractionation of oligo(dT)-binding proteins (Oligo(dT)BP) from seedlings of winter wheat by chromatography on oligo(dT)-cellulose according to the procedure of Jeffery (1977); one fraction (designated as fraction D) was eluted in buffer D (10 mM Tris-HCl, pH 7.4), and the other (the formamide fraction) was eluted in the same buffer supplemented with 500 g L(-1) formamide. Oligo(dT)BPs from the wheat seedlings in each fraction showed differences in the polypeptide composition. Eucaryotic mRNAs in their functional forms consisted of ribonucleoprotein complexes (Jeffery 1977; Van Venrooij et al. 1977; Baer and Kornberg 1980; Vincent et al. 1981). Major proteins in these complexes consist of poly(A)(+)-binding proteins (Poly(A)BPs),

which bind to the 3' poly(A) "tail" (Bernstein and Ross 1989). Poly(A)BPs have been identified in many species (Bernstein and Ross 1989; Drawbridge et al. 1990). In *Saccharomyces cerevisiae*, Poly(A)BPs are essential for cell viability and are considered to influence a wide variety of cellular processes that are involved in the turnover of mRNA, recruitment of ribosomal subunits, and translation (Sachs et al. 1987; Sachs and Davis 1989; Bernstein et al. 1989; Munroe and Jacobson 1990). Since the discovery of the poly(A)(+)-RNA-binding proteins (PABPs) associated with rabbit globin mRNA (Blobel 1973), most of the information about PABPs has been generated from studies on eucaryotes, such as *Drosophila melanogaster* (Drawbridge et al. 1990), human (Grange et al. 1987), *Strongylocentrotus purpuratus* (Drawbridge et al. 1990), *Xenopus laevis* (Zelus et al. 1989), and yeast (Sachs et al. 1987). In spite of their importance in the regulation of translation, little is known about the PABPs and poly(A)BPs of higher plants. PABPs fractionated from embryonic axes of dry pea seeds (*Pisum sativum*) contained 60-kDa proteins (Sielwanowicz 1987) that stimulated the translational activity in a cell-free system. Moreover, Yang and Hunt (1991) purified a 70-kDa protein from seedlings of the same plant with a high poly(A)-binding activity. This report describes the separation of poly(A) "tails" from cytoplasmic Oligo(dT)BPs (it seems more appropriate to use the term "oligo(dT)-binding proteins" than poly(A)(+)-RNA-binding proteins in the present paper), and an analysis of the polypeptide composition of Poly(A)BPs. [References: 23].

3828 Yang, P.; Taoka, K.I.; Nakayama, T.; Iwabuchi, M. (1995) **STRUCTURAL AND FUNCTIONAL CHARACTERIZATION OF TWO WHEAT HISTONE H2B PROMOTERS**. *Plant Molecular Biology*. 28(1):155-172. English. [KYOTO UNIV FAC SCI DEPT BOT SAKYO KU KYOTO 60601 JAPAN].

Two wheat histone H2B genes (TH123 and TH153) were isolated. Nucleotide sequence analysis revealed that some characteristic sequence motifs were conserved in both the 5'- and 3'-flanking regions. A canonical TATA box and several CCAAT sequences were present in the presumed promoter regions. Motifs similar or identical to the hexamer (ACGTCA) and octamer (CGCGGATC) motifs that are positive cis-acting elements of the wheat H3 (TH012) promoter were also observed in both the H2B promoters. A gel mobility shift assay indicated that the hexamer and hexamer-like motifs bound the wheat bZIP proteins HBP-1a and/or HBP-1b in vitro. A novel sequence motif, (A/T)(G/A)AAAT(A/G), was found downstream of a translational stop codon as observed in several plant histone H2B cDNAs. Promoter activity was analyzed with H2B promoter-GUS fusion genes in the transient system using tobacco protoplasts. Studies of the promoter function in transgenic tobacco plants showed that the H2B promoters were preferentially active in meristematic tissues. Taken together, our data indicate that the H2B genes are regulated, in part, by the same mechanism as found in H3 and H4 gene transcription. [References: 57].

3829 Zamski, E.; Grunberger, Y. (1995) **SHORT- AND LONG-EARED HIGH-YIELDING HEXAPLOID WHEAT CULTIVARS - WHICH HAS UNEXPRESSED POTENTIAL FOR HIGHER YIELD**. *Annals of Botany*. 75(5):501-506. English. [HEBREW UNIV JERUSALEM FAC AGR DEPT AGR BOT POB 12 IL-76100 REHOVOT ISRAEL].

This investigation was designed to assess unexpressed potential for high yield and evaluate the sink strength of two high-yielding wheat cultivars: a tall plant with long ears (LE), and a semi-dwarf with short ears (SE). This was done by (1) removing one-third of the ear's distal end (decapitation), thereby inducing the development of additional florets, which usually do not form, on the untouched portion of the ear, and (2) by increasing the competition between the ears and the vegetative tissues via the application of gibberellic acid (GA). The number of grains increased on the untouched basal spikelets of the decapitated ears in both cultivars. The LE type fully recovered (100%) the number and mass of grains on the untouched portion of the decapitated ear. The decapitated SE type recovered 91% of the grain number but only 80% of individual grain mass. Thus, the total yield (number x mass) achieved by the untouched portion of the decapitated ear was 100% in the LE type and only 80% in the SE type. Gibberellic acid treatment increased culm length in the tall LE plants but this did not affect grain number or mass. Conversely, GA had no significant effect on culm length of the semi-dwarf SE type but significantly decreased their total grain yield. This effect was due to a reduction in grain number by 64% of the control, rather than decreasing grain mass. Mean grain mass was not

affected by GA in either cultivar. A gradual increase in insoluble sugar concentration (starch and fructan) in the ear peduncle during the first month after anthesis, followed by a sharp decrease later, was found in the control and treated plants of both cultivars. In general, the concentrations of both soluble and insoluble sugars declined as grain filling progressed, except for a noticeable increase in total soluble sugars in the peduncles of the decapitated ears of the LE type. The results of this study suggest that of the two high-yielding wheat cultivars that usually give identical yields, the one with long multispiket ears (LE) and lighter grains has significantly greater unexpressed potential for high yield than the cultivar with shorter ears (SE) and heavier grains. [References: 29].

F63 PLANT PHYSIOLOGY-REPRODUCTION

3830 Atanassov, A.; Zagorska, N.; Boyadjiev, P.; Djilianov, D. (1995) **IN VITRO PRODUCTION OF HAPLOID PLANTS [Review]**. *World Journal of Microbiology & Biotechnology*. 11(4):400-408. English. [DE MONTFORT UNIV NORMAN BORLAUG CTR PLANT SCI RES 2232 KOSTINBROD BU-2232 KOSTINBROD BULGARIA].

Although several methods have been developed for producing haploid plants, the in vitro techniques are much more efficient than inter-specific hybridization or treatment with plant-growth regulators, temperature or irradiation. Androgenesis is the most universal of these techniques but ovule culture and the bulbosum method could complement or replace anther culture in those species or genotypes with less responsive male gametes. Genotype, environment, physiological status of the donor plant, and culture conditions and components all need to be taken into account when developing procedures for producing haploid and dihaploid plants. Suitable methods are already well established for a number of important crops. However, many problems, related to regeneration frequency, gametoclonal variation and albinism, are still unsolved. It is now clear that haploids and dihaploids form the ideal system for genetic manipulation in plants. Their key role in producing new theoretical and applied knowledge in plant science is an important aspect of our review. [References: 150].

3831 Cavallini, A.; Baroncelli, S.; Lercari, B.; Cionini, G.; Rocca, M.; Damato, F. (1995) **EFFECT OF LIGHT AND GIBBERELIC ACID ON CHROMOSOME ENDOREDUPPLICATION IN LEAF EPIDERMIS OF TRITICUM DURUM DESF**. *Protoplasma*. 186(1-2):57-62. English. [UNIV PISA DIPARTIMENTO BIOL PIANTE AGR SEZ GENET VIA G MATTEOTTI 1-B I-56124 PISA ITALY].

The first foliage leaf of *Triticum durum* Desf., cvs. Capelli and Creso, was studied for the action of light and gibberellic acid on different aspects of plant growth. Creso is a short-strawed cultivar carrying the Rht 1 gene, that influences both plant height and sensitivity to applied gibberellins. In this study, a cytophotometric analysis of chromosome endoreduplication in bulliform cells of the leaf epidermis was undertaken. The bulliform cells are arranged in lone rows and comprise 4C, 8C, and 16C cells. The relative percentage of these cells was recorded under different light regimes and in the presence or absence of gibberellic acid (GA(3)). Our data indicate that light strongly affects the occurrence of chromosome endoreduplication. Although cvs. Cappelli and Creso show the same frequency of endoreduplicated cells in the dark, all light treatments induce lower endopolyploidy in cv. Creso whereas, in cv. Cappelli, a reduction in endopolyploidy is observed when plants are irradiated with blue-lacking lights. This indicates that the action of a blue-light responsive photoreceptor determines high endopolyploidy. With respect to GA(3) treatment, cv. Creso is again shown to be insensitive to hormone application, whereas in cv. Cappelli, gibberellic acid influences endopolyploidy level in the dark, causing very high frequencies of 8C cells and relatively high frequencies of 16C cells. [References: 26].

3832 Hill, R.D.; Liu, J.H.; Durnin, D.; Lamb, N.; Shaw, A.; Abrams, S.R. (1995) **ABSCISIC ACID STRUCTURE-ACTIVITY RELATIONSHIPS IN BARLEY ALEURONE LAYERS AND PROTOPLASTS - BIOLOGICAL ACTIVITY OF OPTICALLY ACTIVE, OXYGENATED ABSCISIC ACID ANALOGS**. *Plant Physiology*. 108(2):573-579. English. [UNIV MANITOBA DEPT PLANT SCI WINNIPEG MB R3T 2N2 CANADA].

Optically active C forms of abscisic acid (ABA) and their oxygenated metabolites were tested for their biological activity by examining the effects

of the compounds on the reversal of gibberellic acid-induced Lu-amylase activity in barley (*Hordeum vulgare* cv Himalaya) aleurone layers and the induction of gene expression in barley aleurone protoplasts transformed with a chimeric construct containing the promoter region of an albumin storage protein gene. Promotion of the albumin storage protein gene response had a more strict stereochemical requirement for elicitation of an ABA response than inhibition of α -amylase gene expression. The naturally occurring stereoisomer of ABA and its metabolites were more effective at eliciting an ABA-like response. ABA showed the highest activity, followed by 7'-hydroxyABA, with phaseic acid being the least active. Racemic 8'-hydroxy-2', 3'-dihydroABA, an analog of 8'-hydroxyABA, was inactive, whereas racemic 2', 3'-dihydroABA was as effective as ABA. The differences in response of the same tissue to the ABA enantiomers lead us to conclude that there exists more than one type of ABA receptor and/or multiple signal transduction pathways in barley aleurone tissue. [References: 34].

3833 Leblanc, O.; Grimanelli, D.; Gonzalezdeleon, D.; Savidan, Y. (1995) **DETECTION OF THE APOMICTIC MODE OF REPRODUCTION IN MAIZE-TRIPSACUM HYBRIDS USING MAIZE RFLP MARKERS.** *Theoretical & Applied Genetics*. 90(7-8):1198-1203. English. [ORSTOM RESSOURCES GENET & AMELIORAT PLANTES TROP BP 5045 F-34032 MONTPELLIER FRANCE].

Polyploid plants in the genus *Tripsacum*, a wild relative of maize, reproduce through gametophytic apomixis of the diplosporous type, an asexual mode of reproduction through seed. Moving gene(s) responsible for the apomictic trait into crop plants would open new areas in plant breeding and agriculture. Efforts to transfer apomixis from *Tripsacum* into maize at CIMMYT resulted in numerous intergeneric F-1 hybrids obtained from various *Tripsacum* species. A bulk-segregant analysis was carried out to identify molecular markers linked to diplospory in *T. dactyloides*. This was possible because of numerous genome similarities among related species in the *Andropogoneae*. On the basis of maize RFLP probes, three restriction fragments co-segregating with diplospory were identified in one maize-*Tripsacum* *dactyloides* F-1 population that segregated 1:1 for the mode of reproduction. The markers were also found to be linked in the maize RFLP map, on the distal end of the long arm of chromosome 6. These results support a simple inheritance of diplospory in *Tripsacum*. Manipulation of the mode of reproduction in maize-*Tripsacum* backcross generations, and implications for the transfer of apomixis into maize, are discussed. [References: 39].

3834 Schultz, A.; Mirschel, W. (1995) **SIMULATING SOIL WATER BALANCE, NITROGEN BEHAVIOUR AND BIOMASS COMPONENTS, USING THE AGROECOSYSTEM MODEL AGROSIM-WINTERWHEAT AND DATA FROM THE NORTH GERMAN KRUMMBACH CATCHMENT.** *Ecological Modelling*. 81(1-3):133-144. English. [ZALF EV CTR AGR LANDSCAPE & LAND USE RES INST ECOSYST & PROC MODELLING D-16225 EBERSWALDE GERMANY].

The simulation model AGROSIM-Winter-Wheat for the development, the growth and the grain yield formation for a standing crop of winter wheat is described. It operates for the period from sowing in autumn till harvest and includes features for carbon, nitrogen and water balance. The model is tested and run with experimental data from the north German Krummbach catchment. The necessary adaptations are described and discussed. Finally the use of so-called simple approaches or models is argued. [References: 8].

F70 PLANT TAXONOMY AND GEOGRAPHY

3835 Breiman, A.; Graur, D. (1995) **WHEAT EVOLUTION [Review].** *Israel Journal of Plant Sciences*. 43(2):85-98. English. [TEL AVIV UNIV GEORGE S WISE FAC LIFE SCI DEPT BOT IL-69978 TEL AVIV ISRAEL].

Many wild and cultivated wheat species are amphidiploid, i.e., they are polyploid species containing two or more distinct nuclear genomes, each with its own independent evolutionary history, but whose genetic behavior resembles that of diploids. Amphidiploidy has important evolutionary consequences in wheat. Since the beginning of this century different methods have been employed to identify the diploid donors of the coexisting genomes in the polyploids. To date, several of the genomic

donors have been identified, and the search for the others has been narrowed down considerably. Molecular methodologies that are being increasingly used in studies aimed at reconstructing the evolutionary history of wheat species and their wild relatives have resolved many of the phylogenetic relationships among the various taxa. [References: 47].

3836 Tosa, Y.; Kusaba, M.; Fujiwara, N.; Nakamura, T.; Kiba, A.; Noda, T.; Furutsu, Y.N.; Noguchi, H.; Kato, K. (1995) **GEOGRAPHICAL DISTRIBUTION OF GENES FOR RESISTANCE TO FORMAE SPECIALES OF ERYSIPIHE GRAMINIS IN COMMON WHEAT.** *Theoretical & Applied Genetics*. 91(1):82-88. English. [KOCHI UNIV FAC AGR NANKOKU 783 KOCHI JAPAN].

The geographical distribution of Pm10, Pm11, Pm14, and Pm15 wheat genes for resistance to inappropriate formae speciales of *Erysiphe graminis* was investigated using gene-for-gene relationships. Pm10 and Pm15 were very common among many indigenous accessions of common wheat collected from various areas in the world. The diversity of genotypes, which consisted of allelic combination at those loci, was high near the center of origin of common wheat and decreased with increasing distance from the center. In Europe, an apparent contrast of predominant genotypes occurred between the south and the north, suggesting that these genes are useful markers for revealing the routes by which common wheat spread in Europe. On a whole, the genes for resistance to inappropriate formae speciales were observed to be widely distributed throughout the world. We suggest that the difference between these genes and the genes for resistance to faces of an appropriate forma specialis may only be in their distribution and that of their corresponding avirulence genes. [References: 22].

H01 PROTECTION OF PLANTS-GENERAL ASPECTS

3837 Greig Smith, P.; Frampton, G.; Hardy, A. (eds.) (Central Science Laboratory, Ministry of Agriculture, Fisheries and Food, Tangleway Place, Worplesdon, Surrey, GU3 3LQ (United Kingdom)) (1992) **Pesticides, cereal farming and the environment: the Boxworth Project.** H.M.S.O. ref. at ends of chapters. 296 p. English. (AGRIS 95-078321).

3838 Wiles, J.A.; Jepson, P.C. (1994) **Substrate-mediated toxicity of deltamethrin residues to beneficial invertebrates: estimation of toxicity factors to aid risk assessment.** *Archives of environmental contamination and toxicology (USA)* v. 27(3) p. 384-391. references. English. (AGRIS 95-088654).

H10 PESTS OF PLANTS

3839 [Aphid vectors of barley dwarfing yellows]. **Les pucerons vecteurs de la jaunisse nanisante de l'orge (JNO)** (1994) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 195) p. 11-12. French. (AGRIS 95-078475).

3840 Chen Bing Huey (Taiwan Agricultural Research Institute (Taiwan)); Araya, Jaime E.; Foster, John E.; Taylor, Paige L.; Ohm, Herb W. (1992) [Subpopulations of biotype M Hessian fly, *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae), obtained by selection of plants with the H6 gene for resistance, differ in damage caused to differential wheat cultivars]. **Subpoblaciones del biotipo M de la mosca de Hess, *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae), seleccionadas en plantas con el gen H6 de resistencia, difieren en el dano causado en cultivares diferenciales del trigo.** *Investigacion Agricola (Chile)* v. 12(1-2) p. 39-44. 30 ref. Spanish. (AGRIS 95-078329).

Hessian fly (HF), *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae) biotype M, which according to its definition cannot live on wheat, *Triticum aestivum* L. em Thell., cultivars with the H6 gene for resistance (Gallun, 1977), was selected through five generations, however, on wheat cultivars with this gene, and became capable of stunting these cultivars. After five generations of selection on "Fillmore" (H6) or "Auburn" (H6), the flies increased virulence on "Ella" (H9) from 1.1% susceptibility before selection to 58.4 and 61.7% stunting, respectively. Thus, the HF can overcome new genes for plant resistance in wheat,

supporting pyramiding genes in a wheat cultivar over sequential release of single resistance genes for obtaining durable resistance to this pest.

3841 Chen, Bing Huey (Taiwan Agricultural Research Institute (Taiwan)); Araya, Jaime E.; Foster, John E.; Ohm, Herb W.; Taylor, Paige L. (1992) [Response of wheat varieties with the H6 gene of resistance to biotype M Hessian fly, *Mayetiola destructor* (Say) (Diptera: Cecidomyiidae)]. *Reaccion de variedades de trigo con el gen de resistencia H6 al biotipo M de la mosca de Hess, Mayetiola destructor* (Say) (Diptera: Cecidomyiidae). *Investigacion Agricola (Chile)* v. 12(1-2) p. 33-37. 20 ref. Spanish. (AGRIS 95-078328).

Laboratory studies were conducted to determine the reaction of wheat cultivars, "Auburn", "Caldwell", "Fillmore", and "Knox 62", all having the H6 gene for resistance, to biotype M Hessian fly, *Mayetiola destructor* (Say). Larval survival and number of plants susceptible to biotype M differed significantly ($P \leq 0.05$) among cultivars. "Knox 62" had the least number of susceptible plants (2.7 ± 1.8), whereas "Fillmore" had the greatest (30.0 ± 8.7). The differences, presumably because "Knox 62" has both the H6 and the H7H8 genes, are discussed.

3842 Diaz, M. (Universidad Complutense, Madrid (Espagne). Facultad de Biologia, Departamento de Biologia Animal 1) (1994) [Granivory in cereal crop landscapes of central Spain: environmental correlates of the foraging impact of rodents, birds, and ants]. [Granivores dans les terres cerealieres de l'Espagne centrale: correlations environnementales de l'impact de recherche de nourriture des rongeurs, oiseaux et fourmis]. *Acta Oecologica (France)* v. 15(6) p. 739-751. 48 ref. English. (AGRIS 95-088851).

3843 Dong Yingcai; Wang Shize (Northwest Agricultural Univ., Yangling, Shaanxi (China)) (1994) The numerical responses of lady bird larva to two species of wheat aphid. *Acta Ecologica Sinica (China)* v. 14(4) p. 387-391. 4 tables; 10 ref. Chinese. (AGRIS 95-088684).

3844 Dutoit, F.; Wessels, WG.; Marais, GF. (1995) THE CHROMOSOME ARM LOCATION OF THE RUSSIAN HEAT APHID RESISTANCE GENE DN5. *Cereal Research Communications*. 23(1-2):15-17. English. [UNIV STELLENBOSCH DEPT GENET STELLENBOSCH 7600 SOUTH AFRICA].

Dn5, a gene for Russian wheat aphid resistance that was derived from the wheat accession PI 294994, was allocated to chromosome arm 7DL. Dn5 was found not to be linked to the chromosome 7D centromere.

3845 Easson, DL. (1995) THE EFFECTS OF OMITTING OR REDUCING PESTICIDE AND OTHER INPUTS ON THE DISEASE INCIDENCE AND YIELD COMPONENTS OF WINTER WHEAT IN NORTHERN IRELAND. *Journal of Agricultural Science*. 124(Part 3):343-350. English. [AGR RES INST NO IRELAND HILLSBOROUGH BT26 6DR NORTHERN IRELAND].

Omitting or changing various inputs to winter wheat, cv. Norman, were studied over the 1985/86, 1986/87 and 1987/88 crop years in Northern Ireland. Control plots received chemical inputs as commonly applied to intensively managed wheat, including herbicide, two broad spectrum fungicides and chlormequat and yielded 7.5, 9.3 and 6.3 t/ha in 1986, 1987 and 1988 respectively. Other treatments included no herbicide, no chlormequat, no late fungicide, no fungicide, no sprays, half seed rate, late sowing and late sowing with no sprays. Later sowing decreased take-all in 1986 and increased yield. All other treatments either reduced yield or had no effect. Omitting fungicide gave consistent and large decreases in yield by depressing the 1000-grain weight but the importance of early and late applications varied between years. The yield reductions from omitting fungicide were generally larger than those reported elsewhere. Lodging occurred in all years but chlormequat reduced it only in 1988 and gave a yield increase only in 1986, although the number of grains/ear was increased in all years. There was no evidence of any interactions between different pesticide inputs or with seed rate or sowing date. [References: 14].

3846 Fava, A.; Burlando, B. (1995) INFLUENCE OF FEMALE AGE AND GRAIN AVAILABILITY ON THE OVIPOSITIONAL PATTERN OF THE WHEAT WEEVIL SITOPHILUS GRANARIUS (COLEOPTERA,

CURCULIONIDAE). *European Journal of Entomology*. 92(2):421-425. English. [UNIV GENOA IST ZOOL VIA BALBI 5 I-16126 GENOA ITALY].

The ovipositional patterns of *Sitophilus granarius* females have been studied over time, and in response to different numbers of available wheat grains. The female fecundity and the degree of grain infestation show a maximum by 20th day of adult life, and a significant decrease after 30th day. Increasing grain availability leads to a rise of both female fecundity and grain infestation, until saturation is reached. The frequency distribution of the numbers of eggs per grain shows a contagious pattern due to a tendency of females to lay more than one egg within the same grain. This behaviour is independent of female age and grain availability, and consequently the possibility that it may be an adaptive reproductive strategy is discussed.

3847 Giller, PS.; Ryan, B.; Kennedy, T.; Connery, J. (1995) APHID-PARASITOID INTERACTIONS IN A WINTER CEREAL CROP - FIELD TRIALS INVOLVING INSECTICIDE APPLICATION. *Journal of Applied Entomology-Zeitschrift fur Angewandte Entomologie*. 119(3):233-239. English. [UNIV COLL CORK DEPT ZOOL LEE MALTINGS PROSPECT ROW CORK IRELAND].

Large scale field trials were conducted to investigate aphid-parasitoid interactions in winter wheat following spring applications of contact or systemic insecticides. Percentage parasitism was also investigated in the dominant aphid species using acrylamide-gel electrophoretic methods. *Sitobion avenae* (F.) *Metopolophium dirhodum* (Walk.) and *Rhopalosiphum padi* (L.) were the commonest aphids and showed typical patterns of abundance through the growing season. Six parasitoid species were found: *Aphidius rhopalosiphii* de St.-Per., *A. ervi* Hal., *A. picipes* (Nees) and *Praon volucre* (Hal.) being the most common primary parasitoids that attack the three main aphid species. The present work demonstrated a degree of temporal separation of these dominant cereal aphid parasitoid species which has rarely been documented. There was also evidence of earlier female activity in the crop in four of the six species. Parasitoid populations increased into June and peaked in July, coinciding with and continuing after peak aphid populations, before rapidly declining into August. Both contact and systemic insecticides sprayed in spring produced only a slight initial trend of suppression of aphid populations compared to control treatments; no influence on late summer populations was found. However, significant between-field differences occurred. Neither contact nor systemic insecticides had any effect on population sizes, species composition or life history of aphid parasitoids (Braconidae; Aphidiinae, Aphelinidae) compared to control plots in the present study. Percentage parasitism was likewise unaffected by insecticides and reached a peak, based on electrophoretic methods, of 40% at peak aphid densities at the end of June. Estimates of parasitism based on presence of mummies were up to 10 times lower. Possible reasons for the lack of effect of insecticide application in the present study include timing of application (prior to main immigration period of aphids and parasitoids), mobility of populations and insecticide-induced stimulation of reproduction in aphids. [References: 45].

3848 Hassanein, S.S.M. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) Effect of wheat varieties and foliar fertilization on incidence of corn leaf aphid, *Rhopalosiphum maidis* Fitch. *Zagazig Journal of Agricultural Research (Egypt)* v. 21(5) p. 1555-1563. 2 tables; 18 ref. English. (AGRIS 95-088844).

3849 Hopper, KR.; Aidara, S.; Agret, S.; Cabal, J.; Coutinot, D.; Dabire, R.; Lesieux, C.; Kirk, G.; Reichert, S.; Tronchetti, F.; Vidal, J. (1995) NATURAL ENEMY IMPACT ON THE ABUNDANCE OF DIURAPHIS NOXIA (HOMOPTERA, APHIDIDAE) IN WHEAT IN SOUTHERN FRANCE. *Environmental Entomology*. 24(2):402-408. English. [USDA ARS EUROPEAN BIOL CONTROL LAB BP 4168 PARC SCI AGROPOLIS F-34092 MONTPELLIER FRANCE].

Natural enemy impact on *Diuraphis noxia* (Mordvilko) abundance was measured with field enclosure experiments in wheat near Montpellier, France, during three springs. Plants were artificially infested with *D. noxia*; predators, parasitoids, and aphid-borne pathogens were excluded from some plants but not others; and subsequent changes in aphid densities were compared by destructive plant sampling. Each year, *D. noxia* density in all treatments increased and then declined as plant quality

detested but peak densities were 10- to 18-fold higher on closed-caged plants than on open-caged or uncaged plants. Differences in microclimate, emigration, and aphid competition were eliminated as explanations for differences in *D. noxia* densities. The mortality required to explain differences in dynamics between closed-caged and open-caged/uncaged *D. noxia* populations was calculated. Natural enemies were sampled in the surrounding wheat to assess their capacity to inflict this required mortality. The predatory coccinellid *Coccinella septempunctata* L. reached densities of 4-16 per square meter and the predatory syrphids *Episyrphus balteatus* De Geer, *Metasyrphus corollae* F., and *Sphaerophoria scripta* L. together reached one per square meter. The parasitoids *Aphelinus asychis* Walker, *Aphelinus varipes* (Foerster), *Diaeretiella rapae* (McIntosh), and *Aphidius matricariae* were also abundant. Given predator search capacities and observed parasitism rates, mortality from natural enemies could easily account for the differences in *D. noxia* densities between closed-caged and open-caged/uncaged plants. [References: 22].

3850 Ignacio, D.D. (Mariano Marcos State Univ., Batac, Ilocos Norte (Philippines)) (1992) **Wheat R and D [research and development] at MMSU; study title: insect population dynamics of wheat. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia p. 41-43. 2 tables. Received Nov 1994. English. (AGRI 95-078467).**

3851 Joergensen, L.N.; Jensen, P.E. (eds.); Bromand, B. (1994) [Pesticide trials, 1994: Agricultural crops, 6: Pests [Thrips angusticeps, Asyrthosiphon pisum, Decis, IS 002, Sumicidin, Fastac, Ac, Karate, Vectobac, Dimethoat, Ethyl parathion, NTN, Pirmor, Protax, Carboxin, Thiram, Aztec, Vitavax, Mavrik]]. *Pesticidafproevning 1994: Landbrugsafgroeder, 6: Skadedyr i landbrugsafgroeder. Statens Planteavlsforsoeg, Lyngby (Denmark). SP-Rapport (Denmark) v. 3(1) p. 83-101. 9 ill., 12 tables. Danish. (AGRI 95-088854).*

3852 Joergensen, L.N.; Jensen, P.E. (eds.); Schulz, H.; Bromand, B.; Hansen, M.S. (1994) [Pesticide trials 1994: Agricultural crops, 1: The growing season 1993-1994]. *Pesticidafproevning 1994: Landbrugsafgroeder, 1: Vaekstsaesonen 1993-1994. Statens Planteavlsforsoeg, Lyngby (Denmark). SP-Rapport (Denmark) v. 3(1) p. 7-23. 10 ill., 2 tables. Danish. (AGRI 95-088853).*

3853 Joergensen, L.N.; Jensen, P.E. (eds.); Secher, J.M. (1994) [Pesticide trials, 1994: Agricultural crops, 7: Results with PC-plant control 1994 [personal computer]]. *Pesticidafproevning 1994: Landbrugsafgroeder, 7: Resultater med PC-Plantevaern. Statens Planteavlsforsoeg, Lyngby (Denmark). SP-Rapport (Denmark) v. 3(1) p. 103-107. 3 tables. Danish. (AGRI 95-088855).*

3854 Mahaut, T. (Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium). Station de Zoologie Appliquee) (1994) [Noxious and useful fauna of the fallows [in Belgium]]. *Faune nuisible et utile des jacheres. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993. Seutin, E.; Falisse, A. (eds) jachere p. 32-37. 3 tables. French. (AGRI 95-078611).*

3855 Moon, CE.; Lewis, BE.; Murray, L.; Sanderson, SM. (1995) **RUSSIAN WHEAT APHID (HOMOPTERA, APHIDIDAE) DEVELOPMENT, REPRODUCTION, AND LONGEVITY ON HYDROPONICALLY GROWN WHEAT WITH VARYING NITROGEN LEVELS. Environmental Entomology. 24(2):367-371. English. [NEW MEXICO STATE UNIV DEPT ENTOMOL PLANT PATHOL & WEED SCI LAS CRUCES, NM 88003 USA].**

Possible changes in Russian wheat aphid, *Diuraphis noxia* (Mordvilko), biology caused by varying levels of nitrogen in wheat were studied. Apteræ of Russian wheat aphid were caged on wheat plants grown in hydroponic solutions containing levels of 4.2, 10.5, 52.5, or 210 ppm total nitrogen. Varying nitrogen levels did not significantly change duration of

prereproductive period, reproductive period, longevity, or the number of nymphs produced, although there was a trend for increased nymphal production with increased rates of nitrogen. Increases in nitrogen did significantly increase the percent of nymphs produced in the second reproductive quarter. This increase corresponded with decreased production in the third and fourth quarters. The shift in nymphal production did not significantly influence changes in the intrinsic rate of increase, $r(m)$. This study indicates that Russian wheat aphid populations infesting high input wheat, which is traditionally grown under irrigated conditions in the High Plains, may derive some reproductive benefit over populations infesting low input wheat. [References: 18].

3856 Ni Hanxiang; Ding Hongjian; Sun Jingrui (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Plant Protection) (1994) **Dynamics and integrated management strategy of wheat midge. Chinese Agricultural Science Bulletin (China) v. 10(3) p. 20-23. 6 tables; 3 ref. Chinese. (AGRI 95-088897).**

3857 Philis, J. (Agricultural Research Inst., Nicosia (Cyprus)) (1994) [Cultural practices for the control of *Xiphinema index* in Cyprus]. *Pratiche culturali per il controllo di Xiphinema index a Cipro. Nematologia Mediterranea (Italy) v. 22(2) p. 125-126. 1 table; 5 ref. English. (AGRI 95-088972).*

Experimental work for controlling the natural vector of the grape fan-leaf virus disease, *Xiphinema index* Thorne et Allen indicated that, under local conditions, fallow alone or fallow rotated with barley can decrease populations to non-detectable levels, between 40 to 52 months after up-rooting grapevine plantations.

3858 Pueyo, JJ.; Morgan, TD.; Ameenuddin, N.; Liang, C.; Reeck, GR.; Chrispeels, MJ.; Kramer, KJ. (1995) **EFFECTS OF BEAN AND WHEAT ALPHA-AMYLASE INHIBITORS ON ALPHA-AMYLASE ACTIVITY AND GROWTH OF STORED PRODUCT INSECT PESTS. Entomologia Experimentalis et Applicata. 75(3):237-244. English. [USDA ARS US GRAIN MKT RES LAB MANHATTAN, KS 66502 USA].**

Insect alpha-amylase inhibiting and/or growth inhibiting activities of proteinaceous inhibitors from red kidney bean (*Phaseolus vulgaris*) and hard red winter wheat (*Triticum aestivum*) were examined. The bean inhibitor was most effective in vitro against alpha-amylases from the red flour beetle (*Tribolium castaneum*) and the confused flour beetle (*T. confusum*), followed by those from the rice weevil (*Sitophilus oryzae*) and yellow mealworm (*Tenebrio molitor*). The insect enzymes were from two- to 50-fold more susceptible than human salivary Q-amylase. When the inhibitors were added at a 1% level to a wheat flour plus germ diet, the growth of red flour beetle larvae was slowed relative to that of the control group of larvae, with the bean inhibitor being more effective than the wheat inhibitor. Development of both the red flour beetle and flat grain beetle (*Cryptolestes pusillus*) was delayed by 1% bean inhibitor, but development of the sawtoothed grain beetle (*Oryzaephilus surinamensis*) and lesser grain borer (*Rhyzopertha dominica*) was not affected by either the bean or wheat inhibitor at the 1% level. Rice weevil adults fed a diet containing 1% bean or wheat inhibitor exhibited more mortality than weevils fed the control diet. When the wheat amylase inhibitor was combined with a cysteine protease inhibitor, E-64, and fed to red flour beetle larvae, a reduction in the growth rate and an increase in the time required for adult eclosion occurred relative to larvae fed either of the inhibitors separately. The bean inhibitor was just as effective alone as when it was combined with the protease inhibitor. These results demonstrate that plant inhibitors of insect digestive enzymes act as growth inhibitors of insects and possibly as plant defense proteins, and open the way to the use of the genes of these inhibitors for genetically improving the resistance of cereals to storage pests. [References: 28].

3859 Sandvol, L.E.; Stoltz, R.L. (1993) **Insect pests. Bulletin - Idaho Agricultural Experiment Station (USA) (no. 742) p. 26-28. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRI 95-088852).**

3860 Seguin, B. (Institut Technique des Cereales et des Fourrages, Paris (France); Deneufbourg, F. (1994) **New treatments for cereal seeds. Semences de cereales. Traitements de semences: un nouvel elan. Bulletin**

3861 Sun Shumei; Hu Jianwei (Tianshui Municipality Station of Plant Protection and Quarantine) (1994) A study on fuzzy synthetic judge model for forecasting technology of sprouting capacity (extent) of the wheat aphid. *Entomological Knowledge (China)* (no. 3) p. 140-143. 5 tables; 1 ref. Chinese. (AGRI 95-088898).

3862 Wallin, E.; Milberg, P. (1995) EFFECT OF BEAN GEESE (ANSER-FABALIS) GRAZING ON WINTER WHEAT DURING MIGRATION STOPOVER IN SOUTHERN SWEDEN. *Agriculture Ecosystems & Environment*. 54(1-2):103-108. English. [AGR SOC OSTERGOTLAND BOX 275 S-58102 LINKÖPING SWEDEN].

Large flocks of geese grazing on agricultural land near stopover areas are considered to cause economic losses. The effect of grazing by bean geese (*Anser fabalis*) on winter wheat was studied for four consecutive years near Lake Takern, an important stopover area in southern Sweden, which attracts tens of thousands of geese. Yield in grazed and ungrazed plots (enclosures) were compared in nine fields. There were no consistent differences between grazed and ungrazed plots. The four winters were milder than usual, which probably favoured survival and growth of the wheat. It is suggested that grazing during short periods in autumn and spring is less harmful than grazing in wintering areas. [References: 23].

3863 Wen, BR.; Brower, JH. (1995) COMPETITION BETWEEN ANISOPTEROMALUS CALANDRAE AND CHOETOSPILA ELEGANS (HYMENOPTERA, PTEROMALIDAE) AT DIFFERENT PARASITOID DENSITIES ON IMMATURE RICE WEEVILS (COLEOPTERA, CURCULIONIDAE) IN WHEAT. *Biological Control*. 5(2):151-157. English. [USDA ARS US GRAIN MKT RES LAB 1515 COLL AVE MANHATTAN, KS 66502 USA].

Competition between parasitoids was studied by exposing immature rice weevils, *Sitophilus oryzae* (L.), developing in wheat to *Anisopteromalus calandrae* (Howard) alone, *Choetospila elegans* Westwood alone, or both species together. With *A. calandrae* only, the emergence of *A. calandrae* progeny tended to peak near four or eight female parasitoids and parasitoid-induced mortality increased with increasing parasitoid numbers. With *C. elegans* only, parasitoid emergence increased, but parasitoid-induced mortality did not change with an increase in numbers of parasitoids. *A. calandrae* in combination with *C. elegans* produced similar reductions in rice weevil populations, as did *A. calandrae* alone. *C. elegans* alone was less efficient than *A. calandrae* alone at low parasitoid densities, but when numbers of *C. elegans* reached higher densities, rice weevil mortality was as great as that with *A. calandrae* alone. Under competitive conditions, the sex ratio (female percentage) of *C. elegans* was decreased by the presence of *A. calandrae*, but the sex ratio of *A. calandrae* was not affected by *C. elegans*. Competition reduced emergence of both *A. calandrae* and *C. elegans*; however, *A. calandrae* was clearly the dominant species when rice weevils were exposed to equal numbers of both species of parasitoids. (C) 1995 Academic Press, Inc. [References: 39].

3864 Xiang Jianye; Zhang Qinfeng; Lou Guozheng (Shaanxi Provincial Inst. of Plant Protection; Yangling (China)) (1994) Study on characteristics of transmission of virus of vector striped flea-bettle to blue dwarf disease of wheat. *Shaanxi Journal of Agricultural Sciences (China)* (no. 5) p. 4-6. Chinese. (AGRI 95-088901).

H20 PLANT DISEASES

3865 [Barley dwarfing yellows]. Jaunisse nanisante de l'orge: ne pas se laisser surprendre (1994) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 195) p. 36-37. French. (AGRI 95-078796).

3866 [Strategies for wheat fungicides treatments according to regional conditions]. Fongicides: strategies regionales fongicides pour les cultures de ble (1995) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 199) p. 80-98. 23 tableaux, 14 graph. French. (AGRI 95-078862).

3867 Aggarwal, R.; Srivastava, K.D.; Singh, D.V. (Indian Agricultural Research Institute, New Delhi. Division of Mycology and Plant Pathology) (1993) Raxil a potent fungicide to control loose smut of wheat. *Indian Phytopathology (India)* v. 46(2) p. 172-173. 1 table; 6 ref. English. (AGRI 95-078863).

3868 Alizadeh, A.; Barrault, G.; Sarrafi, A.; Rahimian, H.; Albertini, L. (1995) IDENTIFICATION OF BACTERIAL LEAF STREAK OF CEREALS BY THEIR PHENOTYPIC CHARACTERISTICS AND HOST RANGE IN IRAN. *European Journal of Plant Pathology*. 101(3):225-229. English. [ECOLE NATL SUPER AGRON 145 AVE MURET F-31076 TOULOUSE FRANCE].

Forty-four bacterial isolates were obtained from infected wheat, barley and various grasses from different regions of Iran. All isolates were bacteriologically similar to *Xanthomonas campestris* and some of their physiological and biochemical features can be useful for a primary differentiation between them. Depending on their pathogenicity, the isolates were split into two groups; the wheat group isolated from wheat, barley and grasses could infect artificially wheat, barley, rye, *Agropyron elongatum*, *Bromus inermis*, and *Lolium multiflorum* but not oat, whereas the barley group obtained from cultivated or wild barley was pathogenic to barley only. From their bacteriological characteristics and host range, the barley and the wheat group isolated were identified as *X. campestris* pvs. *hordei* and *cerealis*, respectively. *Aegilops* sp., *Scleroclhoa dura*, and *Heteranthelium* sp. were, for the first time, shown to be hosts of *X. c. pvs. cerealis*. [References: 16].

3869 Bai Huaifen; Li Mingli (General Station of Plant Protection, Shandong (China)) (1993) [The occurrence of *Rhizoctonia cerealis* in wheat and its control strategies in Shandong Province (China)]. *Plant Protection Technology and Extension (China)* (no. 2) p. 3-5. Chinese. (AGRI 95-089260).

3870 Bateman, GL.; Landau, S.; Welham, SJ. (1995) SENSITIVITY TO PROCHLORAZ IN POPULATIONS OF THE EYESPOT FUNGUS, PSEUDOCERCOSPORELLA HERPOTRICHOIDES, IN RELATION TO FUNGICIDE TREATMENTS AND THEIR EFFICACY IN CONTINUOUS WINTER WHEAT. *Annals of Applied Biology*. 126(2):235-247. English. [AFRC INST ARABLE CROPS RES HARPENDEN AL5 2]Q HERTS ENGLAND].

Eyespot was assessed and grain yields determined in the eighth and ninth years (1992 and 1993) of a field experiment in which the fungicides carbendazim and prochloraz were applied, separately or in mixtures, to plots of successive crops of winter wheat. Populations of the eyespot fungus, *Pseudocercospora herpotrichoides*, were characterised by the proportions of cultures grown on agar from infected stems that were W-type or R-type, or were carbendazim-resistant or carbendazim-sensitive. Sensitivity to prochloraz in agar was determined for isolates from populations sampled in 1992 using restricted maximum likelihood analysis of EC50s (concentrations needed to decrease colony growth by 50%), to deal with the unbalanced data, and comparisons were made by Wald statistics. Control by prochloraz was maintained but in 1992, as in some previous years, its application with carbendazim was more effective than its application alone. Selection by prochloraz for strains sensitive to carbendazim continued to occur and may have contributed to its sometimes relatively poorer performance in the absence of carbendazim. R-type isolates taken from prochloraz-treated plots, with or without carbendazim, in 1992 were less sensitive to prochloraz than were isolates from plots untreated with prochloraz. There was evidence of a greater range of sensitivities to prochloraz in R-type than in W-type isolates (although some uncertainty results from the small numbers of W-type isolates obtained from some treatments), which would explain the selection of the R-type by prochloraz. The significance of these findings to modern wheat growing practices is considered. [References: 21].

3871 Bateman, GL.; Munnery, IC. (1995) DEVELOPMENT OF EYESPOT AND BROWN FOOT ROT IN WHEAT PLANTS INOCULATED WITH MIXTURES OF PSEUDOCERCOSPORELLA HERPOTRICHOIDES TYPES AND FUSARIUM SPECIES. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 143(3):147-151. English. [AFRC INST

The effects of *Fusarium avenaceum*, *F. culmorum* and *Microdochium nivale* on eyespot development, and of types of the eyespot fungus, *Pseudocercospora herpotrichoides*, on brown foot rot caused by the *Fusarium* or *Microdochium* spp. were investigated by sequential inoculation of wheat plants grown in pots in a controlled environment. The W-type of the eyespot fungus induced more severe disease than the R-type, but its symptoms were suppressed to a greater extent by *Fusarium* spp., especially *F. avenaceum*. Brown foot rot symptoms were sometimes suppressed by *P. herpotrichoides* but were occasionally more severe when the *Fusarium* inoculum was applied after the *P. herpotrichoides*. The results are discussed in relation to observations of natural infections. [References: 16].

3872 Bonnefoy, M. (Institut Technique des Cereales et des Fourrages, Paris (France)); Bourserieau, J.; Chesneau, R. (1994) [Wheat varieties behaviour in front of mosaic diseases]. *Ble: comportement des varietes face aux mosaïques. Perspectives Agricoles (France) (no 192) p. 124-127. 5 graph. French. (AGRI 95-078860).*

3873 Camachocacas, M.A.; Kronstad, W.E.; Scharen, A.L. (1995) **SEPTORIA TRITICI RESISTANCE AND ASSOCIATIONS WITH AGRONOMIC TRAITS IN A WHEAT CROSS.** *Crop Science. 35(4):971-976. English. [OREGON STATE UNIV DEPT CROP & SOIL SCI CORVALLIS, OR 97331 USA].*

Septoria leaf blotch of wheat (*Triticum aestivum* L. em Thell) caused by the pathogen *Septoria tritici* Rob. in Desm. (teleomorph *Mycosphaerella ella graminicola* (Fuckel) J. Schroeter in Cohn) is a major disease reaching epidemic proportions in many parts of the world. Concerns have been expressed that widespread distribution of early maturing semidwarf cultivars and changes in cultural practices have contributed to its increased incidence. This study was undertaken to determine the mode of inheritance of Septoria leaf blotch resistance and possible associations between specific traits in a cross of two parents representing extremes in their reaction to Septoria leaf blotch. Parents, F-1, F-2, F-3, and backcrosses were evaluated under field conditions over a 3-yr period. Both natural and artificial inoculations were used. Generation mean analyses were employed to study gene effects for resistance to the disease. Phenotypic correlations and path coefficient analyses were calculated to determine associations among heading date, plant height, disease severity, and grain yield. Differences for all measured traits were observed in all generations. Frequency distribution of the F-2 population for disease reaction was continuous. Both additive and nonadditive gene action contributed to the expression of disease resistance with dominance and epistasis effects being the most important. Negative associations were observed for both plant height and heading date on disease severity with heading date having the largest direct effect. When the associations were examined in relation to grain yield, a negative association was observed between heading date and yield, whereas a positive association was noted between plant height and yield. A large negative, direct effect of disease severity on grain yield was measured from path coefficient analyses. Because no resistant progeny were observed that were as early and short as the susceptible parent, a compromise may have to be reached for these traits to achieve acceptable levels of disease resistance in this cross. [References: 27].

3874 Caron, D. (Institut Technique des Cereales et des Fourrages, Paris (France)) (1995) [Control of Fusarium head blight in wheat. Why is fungicide efficacy mean only?]. *Les fongicides contre la fusariose des epis (de ble). Pourquoi leur efficacite est-elle seulement moyenne? Perspectives Agricoles (France) (no 198) p. 80-82. French. (AGRI 95-078804).*

3875 Cavelier, M.; Couvreur, L. (1995) **EFFECT OF EYESPOT CONTROL ON THE YIELD OF WINTER WHEAT AND EYESPOT DAMAGE IN BELGIUM.** *Agronomie. 15(2):139-151. French. [CRA GEMBLOUX PHYTOPATHOL STN B-5030 GEMBLOUX BELGIUM].*

In Belgium and most cereal-growing countries of Western Europe, eyespot (*Pseudocercospora herpotrichoides*) is no longer considered as highly damaging to winter wheat, but still remains a major element of decision with farmers when contemplating fungicide application at the

stem elongation stage. This paradox stems from the fact that users often associate increases in the yield subsequent to treatment with the activity of the fungicide against eyespot even though the most commonly used fungicide (prochloraz) is also effective against *Septoria tritici* blotch. This may result in questionable interpretations of field trial data. The matter was investigated in 1994 by observing the field behaviour of 6 winter wheat cultivars subjected to an artificial inoculation with eyespot and a natural *Septoria* epidemic. Applications of chlorothalonil, which is specifically active against *Septoria tritici* blotch, and prochloraz, which is active against both *Septoria* and eyespot were made in order to discriminate the respective effects of the 2 diseases on the yield of winter wheat. The low level of yield losses caused by eyespot was again evidenced. The yield increases obtained with the fungicide applications at the first node and last leaf stages mainly resulted from the control of *Septoria tritici* blotch in both eyespot inoculated and uninoculated plots. Whatever the fungicide used (chlorothalonil or a mixture of chlorothalonil and prochloraz), the fungicide applications always resulted in higher yield increases in the eyespot-inoculated plots. Eyespot control is only economically advisable if associated with control measures against *Septoria*, which are actually sufficient to ensure high yields. This is probably the reason why, in the absence of *Septoria*, eyespot control did not give satisfactory results in previously conducted trials. The present trial confirms that eyespot does not result in significant yield losses as long as it is not producing white heads. The presumably overrated influence of eyespot control in winter wheat protection programs is discussed.

3876 Chauhan, R.S.; Singh, B.M. (1995) **VARIATION FOR SOME MORPHOLOGICAL TRAITS AND LEAF RUST REACTION AMONG REGENERANTS OF BREAD WHEAT CULTIVAR SONALIKA.** *Cereal Research Communications. 23(1-2):109-116. English. [HIMACHAL PRADESH KRISHI VISHVAVIDYALAYA PALAMPUR 176062 HIMACHAL PRADESH INDIA].*

Callus cultures were established and regenerants (somaclones) obtained from immature and mature embryos and coleoptile nodes of wheat cv. Sonalika on MS medium supplemented with various concentrations and combinations of auxins and cytokinins. Variation was observed for morphological traits such as albinism, sterility, grass-dwarfism, dwarfism, supernumerary heads, plant height and multi-floreted spikes. Variability for different plant morphological traits was greatest among regenerants derived from coleoptile nodes compared to those from other explants. Five regenerants were found resistant and three moderately resistant to a widely prevalent and highly virulent race 77A (109 R 31) of *Puccinia recondita tritici* in the R(1) generation. However, all the regenerants showed susceptible reaction to race K (47 S 102) of *P. striiformis*.

3877 Chauhan, R.S.; Sood, A.K.; Singh, B.M. (1995) **EVALUATION OF WHEAT (TRITICUM AESTIVUM) LINES FOR RESISTANCE TO SPECIFIC VIRULENCES OF HILL-BUNT FUNGI (TILLETIA FOETIDA AND T-CARIES).** *Indian Journal of Agricultural Sciences. 65(7):539-542. English. [HIMACHAL PRADESH KRISHI VISHVAVIDYALAYA CTR BIOTECHNOL PALAMPUR 176062 HIMACHAL PRADESH INDIA].*

An experiment was conducted during winter season (rabi) of 1989-90 and 1990-91 to evaluate 42 lines of wheat (*Triticum aestivum* L. emend. Fiori and Paol.) for resistance to specific virulences of hill-bunt fungi (*Tilletia foetida* (Wallr.) Lire and T. caries (DC.) Tul). Five specific virulences, viz T-A T-B, L-C, L-D and L-E, of T. caries and T. foetida were used for inoculation. Of the lines tested, 11 were found completely free from their infection. Fifteen lines showed resistant reaction including 3 ['NS 879/4' x 'NP 888 P 1 (F5)', 'HD 2009' x 'HS 86 P 3-3 (F6)' and 'VL 682'] giving differential reaction to different virulences. All the wheat varieties recommended for cultivation in the Northern Hills Zone were found susceptible to all the virulences tested.

3878 Couvreur, L.; Herman, J.L. (Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium). Station de Phytotechnie); Bodson, B. (1994) [Winter wheat varieties [grown in Belgium] and strategies of fungus control]. *Varietes et strategies de lutte fongicide. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993. Seutin, E.; Falisse, A. (eds) Lutte fongicide 6 p. 4 tables. French. (AGRI 95-078780).*

3884 Forster, R.L. (1993) Barley diseases. *Bulletin - Idaho Agricultural Experiment Station (USA)* (no. 742) p. 29-35. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRS 95-089234).

3885 Gao, J.G.; Nassuth, A. (1994) WHEAT STREAK MOSAIC VIRUS-INDUCED CYTOPLASMIC EXPANSION AND MEMBRANE PROLIFERATION. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 142(1):79-87. English. [UNIV GUELPH DEPT BOT GUELPH ON N1G 2W1 CANADA].

The cytoplasmic volume of wheat streak mosaic virus-infected cells was significantly greater than that of cells in healthy control tissue. Ultrastructural examination revealed that mainly cellular membranes and ribosomes filled the expanded cytoplasm. Imperfectly spherical inclusions, containing continuous endoplasmic reticulum membranes at the periphery and a mixture of membranes and ribosomes in the centre, were observed near nuclei at early infection stages. The inclusions became larger as infection progressed. Membranes and ribosomes proliferated also throughout the cell, forming a matrix in which organelles and various cytopathic structures were enclosed. Numerous Vesicles were observed in the cytoplasm of other WSMV-infected cells. Multi-layered membrane bodies were found at later infection stages. Virus particles were present in the central space of these myelin-like structures. The presence of apparently intermediate stages in myelin-like structure development in chloroplasts suggest that at least some of the myelin-like structures originated from the chloroplasts. [References: 24].

3886 Gaudet, DA.; Puchalski, BJ.; Entz, T. (1994) EFFECTS OF SEEDING DATE AND CULTIVAR SUSCEPTIBILITY ON EFFECTIVENESS OF CARBATHIIN FOR CONTROL OF COMMON BUNT (TILLETIA TRITICI AND T-LAEVIS) IN WINTER WHEAT IN SOUTHERN ALBERTA. *Canadian Journal of Plant Pathology-Revue Canadienne de Phytopathologie*. 16(4):304-310. English. [AGR & AGRIFOOD CANADA RES CTR BOX 3000 LETHBRIDGE AB T1J 4B1 CANADA].

Carbathiin (carboxin) was evaluated in three cultivars of winter wheat artificially inoculated with *Tilletia tritici* and *T. laevis* for efficacy as a seed treatment at three rates (0.55, 0.76, and 1.1 g ai/kg) on eleven seeding dates during 1989-92. The cvs. Norstar and Norwin, were susceptible and highly susceptible to common bunt, respectively, on all planting dates; cv. Sundance was moderately resistant when seeded in mid-September but susceptible when seeded in October. Efficacy of carbathiin for bunt control decreased with late seeding in all cultivars. A carbathiin rate of 0.55 g ai/kg was generally ineffective in controlling bunt, even in early-seeded treatments. Environmental conditions which promoted bunt severity reduced the efficacy of carbathiin at the 0.55 g ai/kg rate. Incomplete control of common bunt with the 0.55 g ai/kg rate was exacerbated by the high susceptibility of Norwin at the later seeding dates. At 0.76 g ai/kg, bunt levels were low in all cultivars except when seeded late. The highest carbathiin rate, 1.01 g ai/kg, controlled bunt regardless of cultivar or seeding date. At rates of 0.76 g ai/kg and higher, infection levels were low but variable, likely due to micro-environmental effects on efficacy. The nature of variability in efficacy of carbathiin at the different application rates is discussed and related to conditions in the seed micro-environment.

3887 Gaudet, DA.; Puchalski, BL.; Kozub, GC. (1995) REACTION OF CIMMYT AND CANADIAN RED SPRING WHEAT CULTIVARS TO COMMON BUNT (TILLETIA TRITICI AND T-LAEVIS). *Cereal Research Communications*. 23(1-2):141-146. English. [AGR & AGRIFOOD CANADA RES CTR BOX 3000 MAJN LETHBRIDGE AB T1J 4B1 CANADA].

Canadian and CIMMYT spring wheat cultivars were evaluated for their reaction to common bunt (*Tilletia tritici* and *T. laevis*) in the field at Lethbridge, AB, during 1991 and 1992. High infection levels were observed in the CIMMYT cultivars, Pitic 62, Ciano 67, Nape 63, Torim 73, Azteca 67, Jupeteco 73, Potem 70, Songlen, Inia 66, and Lerma 52, and the ancestral cultivars, Tezanos Pinto Precoc, Carazinho, Romany and Norin 10/Brevor. The Canadian cultivars, HY320 and Roblin were also highly susceptible. Low infection levels were observed in the CIMMYT cultivars, Jaral 66, Saric 70, Nainari 60, and Penjamo 62, in the Canadian

3879 Csosz, M.; Kertesz, Z.; Matuz, J.; Barabas, Z. (1995) MANIFESTATION OF INHERITANCE OF 1000 KERNEL MASS UNDER ARTIFICIAL STEM RUST INOCULATED AND DISEASE FREE CONDITIONS IN WHEAT. *Cereal Research Communications*. 23(1-2):133-140. English. [CEREAL RES INST POB 391 H-6701 SZEGED HUNGARY].

In a half-diallel experiment, 9 varieties differing in response to stem rust and all their 36 hybrid progenies were planted in stem rust-infected and protected environments in the years 1986 and 1987, with four replicates in each year. Entries were separated by stem rust-susceptible spreader rows. In the infected section, these spreader rows were artificially inoculated in the stem elongation (31) stage with a mixture of stem rust races 1, 11, 34, 218 and 331. The protected part was sprayed with Bayleton 25 WP at weekly intervals. Griffing diallel analysis revealed that mostly additive gene effects controlled the recorded characters of stem rust resistance and 1000 kernel mass, but the nonadditive genes also played an appreciable role. As concerns the general combining abilities with regard to the 1000 kernel mass, significant differences were found between the protected and the infected conditions. These differences were clearly caused by the resistance level of the parents. Covariance/variance regression showed that Aurora and GK Sagvari carried dominant genes for stem rust under both conditions, while GK Mini Mano, in spite of its low 1000 kernel mass, carried many dominant genes for high 1000 kernel mass under infected conditions, due to its resistance to stem rust. The conclusion may be drawn that study of the inheritance of stress-sensitive quantitative characteristics should be performed under stress-free conditions.

3880 Doussinault, G. (Institut National de la Recherche Agronomique (France). Centre de Rennes, Amelioration des Plantes) (1994) [Wheat behaviour in front of *Erysiphe graminis*]. *Le comportement du ble vis-a-vis de l'oidium. Perspectives Agricoles (France)* (no 192) p. 118-120. French. (AGRS 95-078859).

3881 Duan shuangke; Wang Bao Tong (Shaanxi Provincial Inst. of Plant Protection, Yangling(China)) (1994) Effect of filtrate from methane-generating tank on controlling wheat scab. *Shaanxi Journal of Agricultural Sciences (China)* (no. 2) p. 24-25. 2 tables. Chinese. (AGRS 95-089256).

3882 Duveiller, E.; Maraite, H. (1995) EFFECT OF TEMPERATURE AND AIR HUMIDITY ON MULTIPLICATION OF XANTHOMONAS CAMPESTRIS PV. UNDULOSA AND SYMPTOM EXPRESSION IN SUSCEPTIBLE AND FIELD-TOLERANT WHEAT GENOTYPES. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 143(4):227-232. English. [CIMMYT LISBOA 27 APDO POSTAL 6-641 COL JUAREZ MEXICO CITY 06600 DF MEXICO].

Multiplication of *Xanthomonas campestris* pv. *undulosa* in the leaf tissues of susceptible and field-tolerant wheat genotypes was determined at the seedling stage, under different incubation conditions of temperature and air humidity. Dry air conditions did not hamper the multiplication of the bacteria in the leaf tissues, and temperature had a direct effect on the population trend. Symptoms were not observed at 15 degrees C. The occurrence of lesions coincided with populations of bacteria that had reached an estimated threshold of 10(8) colony forming units/ leaf. Differences in populations between genotypes Alondra and Pavon were only noticeable at 25 degrees C and dry air conditions, without correlation to differences in symptom expression. Considering these two genotypes, resistance to bacterial leaf streak did not seem to operate at the seedling stage when plants were inoculated by infiltration. In both genotypes, lesions did not extend significantly. An active mechanism stopping bacterial growth which is apparently temperature-dependent or a saturation of the target sites was possibly involved, as shown in the different experiments by the fit-curves calculated for Alondra and Pavon. This study provided information on the role of climatic factors in relation to epidemics. Temperature appeared to have a major effect on the disease and results confirmed that the risk of bacterial leaf streak prevails in warmer non-traditional wheat growing areas. Several types of resistance are likely to exist in the *X. c. pv. undulosa*/wheat system. [References: 23].

3883 Fayed, M.A.M. (Alexandria Univ., Saba basha (Egypt). Faculty of Agriculture) (1994) Some metabolic alternations during wheat infection

cultivar. Columbus, and in the US cultivars Hope and Newthatch. The remaining cultivars tested exhibited intermediate infection levels. The putative origins of resistance and susceptibility among cultivars are discussed.

3888 Ges', D.K.; Syarova, Z.Ya. (Akadehmiya Navuk Belarusi, Minsk (Belarus). Instytut Ehksperymental'nej Botaniki) (1994) [Nucleases of *Helminthosporium teres* Sacc. fungus]. *Nukleazy gryba Helminthosporium teres* Sacc. *Vestsi Akademii Navuk Belarusi. Seryya Biyalagichnykh Navuk* (Belarus) (no.3) p. 14-17. 2 figures, 5 ref. Byelo Russian. (AGRI 95-089226).

3889 Glenz, H. (1994) [How does fungi work? A computer model for fungi control in wheat]. *Wie funktioniert Fungi? Computermodell zur Pilzbekämpfung in Weizen. DLZ - Computer Agrar* (Germany) v. 10(6) p. 45-47. 2 ill., 2 tables. German. (AGRI 95-089151).

3890 Goel, L.B.; Auja, S.S.; Singh, A.; Beniwal, M.S.; Sinha, V.C.; Singh, D.P.; Tiwari, A.N.; Grewal, A.S.; Karwasra, S.S. (1995) EVALUATION OF G 696 FUNGICIDE FOR CONTROLLING LOOSE SMUT OF WHEAT (*TRITICUM AESTIVUM*) CAUSED BY *USTILAGO SEGETUM* VAR *TRITICI*. *Indian Journal of Agricultural Sciences*. 65(7):536-538. English. [DIRECTORATE WHEAT RES KARNAL 132001 HARYANA INDIA].

A multi-location trial was conducted during 1986-92 to evaluate a new systemic fungicide 'G 696' (Provax) for controlling Loose smut of wheat (*Triticum aestivum* L. emend Fiori & Paol.) caused by *Ustilago segetum* (Pers.) Roussel var *tritici* Jensen [= U. nude (Jens.) Rostr. var *tritici* Schaf.]. The new fungicide was used as dry seed treatment, along with 2 recommended fungicides, viz carboxin and carbendazim. 0.2, 0.25 and 0.3%. G 696 0.25 and 0.3% proved significantly superior in controlling the disease (giving respectively 95 and 98% control) to the other treatments, except carboxin 0.3% which was on a par with it in effectiveness.

3891 Haegi, A.; Porta Puglia, A. (Istituto Sperimentale per la Patologia Vegetale, Rome (Italy)); Vannacci, G. (Pisa Univ. (Italy). Dipartimento di Coltivazione e Difesa delle Specie Legnose); Delogu, G. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) [Phytotoxic compounds in culture filtrates of *Pyrenophora graminea* [effects on barley varieties]]. *Presenza di un composto fitotossico nei filtri culturali di *Pyrenophora graminea* [effetti su varietà di orzo]*. *Patria (Italy)* v. 4(2) p. 181-191. 2 tables; 2 graphs; 28 ref. English. (AGRI 95-089233).

Culture filtrates of *Pyrenophora graminea* induce typical leaf-stripe symptoms following infiltration into leaves of susceptible barley plants. This indicates that one (or more) toxic compound is present in culture filtrates. A range of cultural conditions were tested to improve toxin production; the best results were obtained from liquid cultures grown in a modified Fries' medium at 25 deg C. Preliminary studies showed that the toxic compound is not dialyzable at 8,000-10,000 molecular weight cutoff, is stable at 121 deg C, is not extractable with organic solvents of different polarity, and can be precipitated by acetone. All the isolates of *P. graminea* tested produced phytotoxic compound(s) in culture. The barley cultivars tested, Onice, Jaidor, Mirko and Etrusco, were sensitive to the toxic effect of culture filtrates of four isolates of *P. graminea*. Culture filtrates showed no host-selectivity when infiltrated into non-host plants.

3892 Harder, D.E.; Dunsmore, K.M.; Anema, P.K. (1994) STEM RUSTS ON WHEAT, BARLEY, AND OAT IN CANADA IN 1993. *Canadian Journal of Plant Pathology-Revue Canadienne de Phytopathologie*. 16(4):329-334. English. [AGR & AGRIFOOD CANADA RES CTR 195 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

In 1993, stem rusts of wheat and barley (*Puccinia graminis* f. sp. *tritici*) and of pat (*P. graminis* f. sp. *avenae*) were first observed in Manitoba August 3. Lower than normal temperatures in the prairie region limited stem rust development. Maximum infections of 5% and 1% respectively developed in lines of susceptible wheat in nurseries and in commercial barley fields in the prairie region. These infection levels were too low to cause significant damage. Infections of wild oat were confined to Manitoba, and remained light. An additional subset of differential genes (Sr9a, Sr9d, Sr10, SrTnp) for *P. graminis* f. sp. *tritici* was added in 1993, thus identifying races with a four-letter code. Although race QCCJ

decreased in prevalence in the prairie region in 1993, it was the most common race (42.7%) collected from all sources in Canada, followed by race TPMK (40.2%). Race QCCJ was the most common (68.8%) in collections from cultivated barley, and race TPMK was most frequently isolated (58.6%) from wheat. Other races from wheat were QFCS (18.9%), QCCJ (16.7%), RCRS (3.6%), QFCJ (1.4%), RKQQ (0.5%), and RKRQ (0.5%); from cultivated barley, races were TPMK (23.4%), QFCS (7.1%), and TMRT (0.7%); and from wild barley, races QCCJ (42.7%), TPMK (38.7%), QFCS (13.3%), QCRS (1.3%), RCCJ (1.3%), RHRS (1.3%), and RKQQ (1.3%). All isolates of *P. graminis* f. sp. *tritici* from wheat from western Canada were virulent to genes Sr5, Sr21, Sr9g, Sr9d, and Sr17, and, in addition, to Sr10 from cultivated barley. All isolates were avirulent to genes Sr13, Sr22, Sr24, Sr25, Sr26, Sr27, Sr29, Sr30, Sr32, and Sr37. From eastern Canada, races NA26 and NA32 of *P. graminis* f. sp. *avenae*, virulent to gene Pg13, continued to increase in prevalence in 1993. From western Canada, races NA27 and NA29 were the most common, but these races are avirulent to the resistance genes now used in western Canadian oat cultivars.

3893 Jackson, K.E.; Pratt, P.W. (1994) Effect of foliar fungicides of foliar diseases of hard red winter wheat, north central Oklahoma. *Research report P (USA)* (no. 936) p. 8-14. English. (AGRI 95-089252).

3894 Joergensen, L.N.; Jensen, P.E. (eds.) (1994) [Pesticide trials 1994: Agricultural crops, 2: Fungal diseases in cereals]. *Pesticidafproevning 1994: Landbrugsafgroeder, 2: Svampesygdomme i korn*. Statens Planteavlssforsoeg, Lyngby (Denmark). *SP-Rapport* (Denmark) v. 3(1) p. 25-57. 17 ill., 11 tables. Danish. (AGRI 95-089228).

3895 Joergensen, L.N.; Jensen, P.E. (eds.); Nielsen, B.J. (1994) [Pesticide trials, 1994: Agricultural crops, 3: Seed borne diseases in cereals [AK-F-92-1, Vitavax 200FF, Fungazil A, Dividend 37, 5 LS, Sibutol LS 280, Sibutol FS, Albox C, Celeste 025 FS, Derosal M, Panocrine 30, Beret FS 0500, Premis Geta]]. *Pesticidafproevning 1994: Landbrugsafgroeder, 3: Udsædsbærne sygdomme i korn*. Statens Planteavlssforsoeg, Lyngby (Denmark). *SP-Rapport* (Denmark) v. 3(1) p. 59-69. 7 ill., 5 tables. Danish. (AGRI 95-089250).

3896 Jones, D.R. (1995) TIMING OF FUNGICIDE APPLICATION FOR CONTROL OF EYESPOT DISEASE OF WINTER WHEAT. *Crop Protection*. 14(3):247-256. English. [AGR DEV & ADVISORY SERV ROSEMAUND RES CTR HEREFORD HR1 3PG ENGLAND].

A series of 23 field experiments was undertaken from 1984 to 1986 to investigate the optimum timing of foliar application of prochloraz for control of eyespot on winter wheat. The possibility of delaying the prochloraz application from GS31 to GS32-33 or GS37-39 as a means of reducing the overall number of fungicides required to optimize profitability was investigated in a further series of 24 experiments from 1987 to 1989. Applications of prochloraz between GS30 and GS32-33 were equally effective for eyespot control at most sites, although in one year treatment was less effective at GS32-33 than at GS31. Later applications, at GS37-39, were less consistent, although in some years they were as effective as applications between GS30 and GS33. Early February was the optimum time of prochloraz application on one very advanced crop which reached GS30 by the end of January. In the 1987-1989 experiments, prochloraz alone at GS37-39 was less effective than the best treatments for control of yellow rust and *Septoria tritici*. Treatments with three fungicide applications for control of these foliar diseases gave the highest yields at many sites but, except where their incidence was particularly high, treatments with one or two fungicide applications were often more cost-effective. Yield increases following fungicide treatment were associated with increases in thousand-grain weight and, at some sites, in specific weight. It was concluded that where there was a high risk of either eyespot or foliar disease specific fungicide applications were required for each, but where the disease risk was lower it was sometimes possible to control both with a single application. [References: 14].

3897 Kajdi, F.; Pecs, S. (Pannon Agrartud. Egyet., Keszthely (Hungary). Georgikon Mezogazd. Tud. Kar) (1994) [Studies on the occurrence of powdery mildew on winter wheat cultivars under dry and irrigated conditions]. *Oszi buzafajtak liszharmatfertozottsegenek vizsgalata*

- ontozott es oztoztellen vizszonyok kozott. *Novenyvedelem (Hungary)* v. 30(3) p. 127-137. 10 tables; 1 ill. 5 ref. Hungarian. (AGRIS 95-089269).
- The authors studied the yield, raw protein content and raw protein yield of different winter wheat cultivars and cultivar candidates. The powdery mildew infection were studied under dry and irrigated conditions. On the experimental plots we grew 84 different cultivars and candidates in the 1991/92 vegetation period. The plants were irrigated at two occasions; 100 mm water was applied altogether. To evaluate the experiments we made a statistical analysis to study the relationships between the qualitative, quantitative characteristics and powdery mildew infections.
- 3898 Kamula, S.A. (Waterloo Univ., Waterloo, Ont. (Canada). Dept. of Biology); Peterson, C.A.; Mayfield, C.I. (1994) Impact of the exodermis on infection of roots by *Fusarium culmorum*. *Plant and Soil (Netherlands)* v. 167(1) p. 121-126. 20 ref. English. (AGRIS 95-078825).
- 3899 Kang Zhensheng; Li Zheqi; Shang Hongsheng (Northwestern Agricultural Univ., Yangling, Shaanxi (China). Dept. of Plant Protection) (1994) Discovery of new virulent strains of wheat strip rust in Mianyang wheat cultivars. *Acta Universitatis Agriculturae Boreali-Occidentalis (China)* v. 22(3) p. 7-11. 3 tables; 3 ref. Chinese. (AGRIS 95-089259).
- 3900 Keener, TK.; Stougaard, RN.; Mathre, DE. (1995) EFFECT OF WINTER WHEAT CULTIVAR AND DIFENOCONAZOLE SEED TREATMENT ON DWARF BUNT. *Plant Disease*. 79(6):601-604. English. [MONTANA STATE UNIV NW AGR RES CTR KALISPELL, MT 59901 USA].
- Four hard red and four soft white winter wheat cultivars (*Triticum aestivum*) of varying susceptibility to dwarf bunt (*Tilletia controversa*) were evaluated with and without difenoconazole seed treatment at 0.24 g a.i./kg. Difenoconazole provided complete control of dwarf bunt regardless of cultivar susceptibility. Percent winter kill was less among cultivars treated with difenoconazole in 1993. Winter wheat yields of difenoconazole treated and nontreated cultivars were similar in 1992, but average yields of treated cultivars were 21% greater in 1993, improving adjusted gross returns by \$147/ha. [References: 12].
- 3901 Kim, J.C.; Park, A.R.; Lee, I.W. (Seoul National University, Suwon (Korea Republic). College of Agriculture and Life Sciences); Yoon, H.J.; Cha, S.H. (Agency for Defense Development, Taejon (Korea Republic)) (1993) Variation in trichothecene and zearalenone production by *Fusarium graminearum* isolates from corn and barley in Korea. *Korean Journal of Microbiology (Korea Republic)* v. 31(4) p. 312-317. 4 illus.; 2 tables; 25 ref. English. (AGRIS 95-089240).
- 3902 Kogel, KH.; Ortel, B.; Jarosch, B.; Atzorn, R.; Schiffer, R.; Wasternack, C. (1995) RESISTANCE IN BARLEY AGAINST THE POWDERY MILDEW FUNGUS (*ERYSIPHE GRAMINIS* F SP HORDEI) IS NOT ASSOCIATED WITH ENHANCED LEVELS OF ENDOGENOUS JASMONATES. *European Journal of Plant Pathology*. 101(3):319-332. English. [RHEIN WESTFAL TH AACHEN INST BIOL 3 WORRINGER WEG D-52074 AACHEN GERMANY].
- Onset of acquired resistance of barley (*Hordeum vulgare*) chemically induced by 2, 6-dichloroisonicotinic acid (DCINA) correlated with the accumulation of mRNA homologous to cDNA pHvJ256 which codes for a soluble leaf-thionin with a Mr. of 6 kDa [Wasternack et al., 1994a]. In the present work, we extend this finding by showing that the thionin transcript also accumulated following treatment of barley with the resistance-inducing compounds 3, 5-dichlorosalicylic acid (DCSA), salicylic acid (SA), and an extract from *Bacillus subtilis*. The polypeptide showed antifungal activity against the biotrophic cereal pathogens *Erysiphe graminis* f.sp. hordei and *Puccinia graminis* f.sp. tritici which may indicate a possible role in the mechanism of acquired resistance in barley. A thionin transcript hybridizing to pHvJ256 accumulated also in response to application of jasmonates, or treatments that elevated endogenous amounts of the plant growth substance, pointing to the possibility that signaling mediating defense responses in barley involves jasmonates. However, a topical spray application of jasmonic acid (JA) or jasmonate methyl ester (JM) did not protect barley leaves against infection by *E. graminis*. Performing a kinetic analysis by an enzyme immunoassay

specific for (-)-JA, (-)-JM, and its amino acid conjugates, accumulation of jasmonates was detected in osmotically stressed barley but not at the onset of chemically induced or genetically based resistance governed by the powdery mildew resistance genes Mlg, Mla(12) or mlo(5). Furthermore, the jasmonate-inducible proteins JIP-23 and JIP-60 were strongly induced following JM- but not DCINA-treatment or inoculation with *E. graminis*. Hence, in barley, no indications were found in favour for the previously proposed model of a lipid-based signaling pathway via jasmonates mediating expression of resistance in plants against pathogens. [References: 55].

3903 Lamari, L.; Bernier, CC. (1994) TEMPERATURE-INDUCED RESISTANCE TO TAN SPOT (*PYRENOPHORA TRITICI-REPENTIS*) OF WHEAT. *Canadian Journal of Plant Pathology-Revue Canadienne de Phytopathologie*. 16(4):279-286. English. [UNIV MANITOBA DEPT PLANT SCI WINNIPEG MB R3T 2N2 CANADA].

Pyrenophora tritici-repentis (Ptr) induces tan necrosis and chlorosis in wheat. These symptoms are interaction phenotypes between individual isolates and specific wheat genotypes. The induction of tan necrosis is associated with the production of the Ptr-necrosis toxin by nec+ isolates of Ptr and the presence of a dominant gene for toxin sensitivity in the host. The effect of temperature on the development of tan necrosis and chlorosis was investigated using eight wheat genotypes differing in reaction to tan spot and three isolates from the three currently available virulent pathotypes of Ptr. The following constant temperature regimes were tested: 10, 15, 20, 22, 25, 27, and 30 degrees C. At 27 and 30 degrees C, a clear change towards resistance, both necrotic and chlorotic, was observed in the susceptible genotypes. Reaction types of the same lines/cultivars were not altered at temperatures of 25 degrees C or below. Throughout this study, no breakdown of resistance was observed. Temperature-induced resistance to the fungus was paralleled by temperature-induced insensitivity to the Ptr-necrosis toxin. No symptoms were observed in toxin-infiltrated sensitive Glenlea wheat plants kept at 30 degrees C. The data of this study suggest that, in the necrotic system, the induced resistance observed at temperatures above 27 degrees C may have resulted from the failure of the toxin to interact with its putative receptor.

3904 Legouis, J. (Institut National de la Recherche Agronomique, Estrees Mons (France). Centre de Lille, Genetique et Amelioration des Plantes) (1994) [Mosaic diseases in barley crops]. Orge: quelles sont les sources potentielles de resistances ? *Perspectives Agricoles (France)* (no 192) p. 128-130. 8 ref. French. (AGRIS 95-078813).

3905 Leitch, MH.; Jenkins, PD. (1995) INFLUENCE OF NITROGEN ON THE DEVELOPMENT OF SEPTORIA EPIDEMICS IN WINTER. *Journal of Agricultural Science*. 124(Part 3):361-368. English. [UNIV WALES DEPT AGR SCI ABERYSTWYTH SY23 3DD DYFED WALES].

Field experiments were undertaken at the University of Wales, Aberystwyth over two seasons to investigate the effects of N fertilizer rate and timing on the development of Septoria diseases (principally Septoria tritici) in winter wheat and its subsequent effect on crop growth. Rates of 100, 200 and 300 kg/ha N were applied at GS23, GS30, or split (GS23/30/38) in 1985/86 and 100 and 250 kg/ha N at GS23, GS30, GS23/30, or GS23/30/37 in 1987/88. Foliar diseases were allowed to develop or were controlled with fungicide. Early disease levels were temporarily enhanced soon after N application and were greater at the higher rates of N. In April and June a significant correlation between disease infection and concentration of N in leaf tissue was shown. Despite differences in the level of early infection, dry matter production up to and including anthesis was unaffected by disease. Infection during grain filling caused premature senescence of the flag leaf which significantly reduced grain yield, primarily through a reduction in grain size. Loss of yield was directly related to severity of disease on the flag leaf in early July, with a yield loss of 0.45 % for every 1 % increase in disease infection. The severity of Septoria post-anthesis increased with increasing rate of fertilizer N by an average of 11.1 % per 100 kg/ha N (translating to a potential yield loss of 5 % for each 100 kg/ha N given as fertilizer), but was unaffected by its timing of application. [References: 23].

3906 Li Gang (Gansu Provincial Station of Plant Protection and Quarantine, Lanzhou (China)) (1994) Analysis to the epidemic situations

of wheat stripe rust in eastern Gansu in 1990-1994 [China]. *Plant Protection Technology and Extension (China)* v. 14(5) p. 25-26. Chinese. (AGRS 95-089261).

3907 Liu Changhong; Duan Shangke (Shaanxi Provincial Inst. of Plant Protection, Yangling (China)) (1994) Study on different kinds of bactericide for controlling wheat powdery mildew. *Shaanxi Journal of Agricultural Sciences (China)* (no. 6) p. 11-13. 2 tables; 8 ref. Chinese. (AGRS 95-089258).

3908 Liu Siheng (Fujian Agricultural Univ., Fuzhou (China). Dept. of Agronomy) (1994) Research progress on physiological and biochemical resistance to wheat scab. *Fujian Science and Technology of Rice and Wheat (China)* v. 12(2) p. 43-47. 17 ref. Chinese. (AGRS 95-078781).

3909 Liu Wancai; Shao Zhengrun (Ministry of Agriculture, Beijing (China). General Station of Plant Protection) (1994) Epidemic patterns of wheat powdery mildew and analysis to infesting situation in the last few years. *Plant Protection Technology and Extension (China)* v. 14(6) p. 17-19. Chinese. (AGRS 95-089262).

3910 Loomis, P.; Leung, H. (1995) LOW-TEMPERATURE STORAGE OF MONOSPORIDIAL CULTURES OF THE WHEAT BUNT FUNGI. *Canadian Journal of Botany-Revue Canadienne de Botanique*. 73(5):758-760. English. [WASHINGTON STATE UNIV DEPT PLANT PATHOL PULLMAN, WA 99164 USA].

Collections of *Tilletia* species are commonly maintained in the form of sori harvested from smutted heads. This has been a convenient and effective storage method because teliospores enclosed in a sorus remain viable for over 20 years. However, mycelial cultures derived from germinated teliospores are genetically mixed because of meiotic segregation among sporidia. For the purposes of genetic analysis and establishing strain identity, it is necessary to maintain haploid sporidial cultures that can be readily retrieved for manipulations. We found that sporidial cultures of *Tilletia tritici* and *Tilletia controversa* can be preserved for at least 1 year by suspending a mixture of mycelia and sporidia in 15% glycerol and storing at -70 degrees C. Approximately 80% of the stored cultures were viable after 12 months in storage. Five out of nine monosporidial cultures of *T. tritici* and *T. controversa* tested retained their sexual fertility in interspecific crosses. The glycerol storage method has advantages over serial transfer in the maintenance of monosporidial cultures by reducing the accumulation of somatic mutations; however, the technique should be used cautiously until greater infectivity of stored cultures is demonstrated. [References: 8].

3911 Louw, J.P.; Victor, D.; Crous, P.W.; Holz, G.; Janse, B.J.H. (1995) CHARACTERIZATION OF PYRENOPHORA ISOLATES ASSOCIATED WITH SPOT AND NET TYPE LESIONS ON BARLEY IN SOUTH AFRICA. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 143(3):129-134. English. [UNIV STELLENBOSCH DEPT PLANT PATHOL STELLENBOSCH 7600 SOUTH AFRICA].

Single-spored isolates of *Pyrenophora* associated with spot and net type net blotch of barley were compared using total DNA banding patterns, morphological and cultural characteristics, symptomatology and mating studies. Isolates of spot and net type net blotch were found to vary regarding conidium length and cultural growth rate. Mating studies among and between ascospore, spot and net type isolates proved unsuccessful under the conditions studied. Total DNA polymorphisms of the net, spot and ascospore isolates digested with the restriction enzymes *HpaII* and *HaeIII* showed that the isolates have similar banding patterns. Random amplified polymorphic DNA (RAPD) showed that the banding patterns of the spot and net type isolates were again similar, but were distinct from outgroups such as *P. semeniperda* and *P. tritici-repentis*. The homology in DNA banding patterns of local isolates indicated that the difference in conidium length is insufficient to separate them as two species. It is concluded that spot and net type isolates occurring in South Africa belong to *P. teres*. Therefore, spot type lesions are caused by *P. teres* f. sp. *maculata*, and not by *P. japonica* as reported previously. [References: 38].

3912 Luqui, A.B.; Gomez, M. (1995) [Evaluation of the percentage of grain infected by *Fusarium* on the level of the toxins DON and T 2 in wheat during the campaign 1993 / 1994]. Evaluacion de la incidencia del porcentaje de granos danados por *Fusarium* en el nivel de toxinas Don y T 2 en trigo durante la campana 1993/1994. Secretaria de Agricultura, Ganaderia y Pesca, Buenos Aires (Argentina). Instituto Argentino de Sanidad y Calidad Vegetal. 21 p. Spanish. (AGRS 95-089150).

3913 Marley, P.S.; Adeoti, A.A. (1995) EFFECT OF SEED TREATMENT CHEMICALS ON SEEDLING EMERGENCE, ESTABLISHMENT AND CONTROL OF FOOT AND ROOT ROT DISEASES OF WHEAT IN NIGERIA. *Crop Protection*. 14(4):271-274. English. [AHMADU BELLO UNIV INST AGR RES DEPT CROP PROTECT PMB 1044 ZARIA NIGERIA].

Foot and root diseases caused by *Fusarium equiseti* and *Exserohilum rostratum* are a limiting factor to the production of irrigated wheat in Nigeria. Five seed treatment chemicals were tested for their ability to control these diseases in 1989 and 1990. Studies under screenhouse conditions showed treatments with a metalaxyl + carboxin + furathiocarb formulation had the highest control of the diseases. In the field this fungicide at 10 g kg⁻¹ seed gave complete control of these pathogens. [References: 15].

3914 Marshall, D.; Sutton, R.L. (1995) EPIDEMIOLOGY OF STRIPE RUST, VIRULENCE OF *PUCCINIA STRIIFORMIS* F SP *HORDEI*, AND YIELD LOSS IN BARLEY. *Plant Disease*. 79(7):732-737. English. [TEXAS A&M UNIV CTR RES & EXTENS TEXAS AGR EXPT STN 17360 COIT RD DALLAS, TX 75252 USA].

Barley stripe rust (caused by *Puccinia striiformis* f. sp. *hordei*) was found for the first time in the United States in 1991. This study was conducted from 1991 to 1994 to determine the occurrence and spread of the disease, the identity and relative frequency of races present, and the amount of yield loss attributable to the disease on cultivars having different levels of resistance. Surveys and urediniospore collections were made in commercial barley fields, barley breeding nurseries, and wild *Hordeum* spp. throughout Texas, southwest Oklahoma, and northeast New Mexico. Commercial fields of the cultivars Post and Tambar 500 in Winters and Era, Texas, were systematically assessed for stripe rust severity. Race determinations were made by inoculating the urediniospore collections onto a set of 18 differential cultivars. To determine yield loss, four fungicide treatments (triadimefon + mancozeb, propiconazole, tebuconazole, and flusilazole) were compared with untreated checks of seven barley cultivars. In 1991, *P. s. f. sp. hordei* was found only in the breeding nursery at Uvalde, and on *H. jubatum* and *H. leporinum* in the Uvalde area. Stripe rust occurred in commercial barley throughout the state in 1992 and 1993, yet was found only on highly susceptible cultivars in nurseries in 1994. The highest severity found in commercial barley was 8% at the soft dough development stage on cv. Post at Winters in 1993. From a total of 273 isolates, 255 were race 24, 14 were race 23, and 4 were of a different race, labeled TXG. The most grain yield loss was about 72% on cv. Perkins at Uvalde in 1992. We found that cv. Tambar 401 was resistant and cvs. Tambar 500 and Kold were moderately resistant to *P. s. f. sp. hordei*, and none of these three cultivars sustained significant yield loss to barley stripe rust. Over cultivars, locations, and years, all of the fungicide-treated plots had significantly less yield loss than untreated checks. Even though barley stripe rust has the potential to become a severe disease in the U.S., host resistance in winter barley and fungicides can effectively minimize yield [References: 24].

3915 Matijevic, D. (Institut za zastitu bilja i zivotnu sredinu, Beograd (Yugoslavia)) (1994) [Efficiency of fungicides in *Pyrenophora graminea* control and effect on barley yield]. Efikasnost fungicida u suzbijanju *Pyrenophora graminea* i uticaj na prinos jecma. Poljoprivredni fakultet, Novi Sad (Yugoslavia). *Zastita bilja (Yugoslavia)* v. 45(208) p. 107-123. 7 tables; 59 ref. Serbian. (AGRS 95-078827).

Among the most efficient precautions for the control of *Pyrenophora graminea* is the use of fungicides for seed treatment. In this paper was investigated the efficiency of 21 fungicides. The highest efficiency, over 80, had fungicides on the basis of TMTD+carboxin, maneb, guazaintriacetate and Cu-8-hydroxihynolate, and insufficient, under 60, all other fungicides. The highest increase, of 36, was at fungicides on the basis of

ipodion+carbendasim, and high efficiency of fungicides on the basis of mercury was not followed by the adequate increase of yield. The lowest yield was achieved at fungicides on the basis of triadimenol, which is the result of higher percentage of disease by *Pyrenophora graminea* than on the non-treated variant.

3916 Matijevic, D.; Rajkovic, S. (Institut za zastitu bilja i zivotnu sredinu, Beograd (Yugoslavia)) (1994) [Parasite *Tilletia caries* control on wheat by TMTD fungicides]. *Suzbijanje parazita Tilletia caries na pšenici primenom fungicida na bazi TMTD. Pesticidi (Yugoslavia) v. 9(2) p. 51-56. 14 tables; 16 ref. Serbian. (AGRS 95-078788).*

The results of investigation on the efficiency of different dosages of TMTD fungicides (formulations TS and WP) for *Tilletia caries* were presented. During the investigations (at lower degree of infection, up to 20) all dosages of TMTD (except 150 g a.m./100 kg) manifested a high efficiency. In the condition of the infection up to 60, fungicide dosages (formulation TS) of 300 g and dosages (formulations WP), of 400 and 480 g/100 kg manifested high efficiency, but not statistically different in relation to standard fungicides. However, with the infection of over 70, TMTD fungicide efficiency decreased and it is not on the level of triadimenol fungicides (standard).

3917 Maumene, C. (Institut Technique des Cereales et des Fourrages, Paris (France)); Maufra, J.Y.; Genette, S. (1994) [Best knowledge of fungicides]. *Fongicides: pour encore mieux les connaître. Perspectives Agricoles (France) (no 197) p. 36-43. French. (AGRS 95-078814).*

3918 Miletic, N.M.; Vuksa, P.V. (Poljoprivredni fakultet, Beograd (Yugoslavia)) (1994) [The efficacy of triazole, benzimidazole and imidazole fungicides in *E. graminis* [Erysiphe graminis] control]. *Efikasnost fungicida iz grupe triazola, benzimidazola i imidazola u suzbijanju E. graminis [Erysiphe graminis]. Pesticidi (Yugoslavia) v. 9(1) p. 5-7. 1 graph; 2 tables; 11 ref. Serbian. (AGRS 95-078787).*

During 1992, the efficacy of triazole (Flutriafol, Propiconazol, Triadimefon), imidazole (Prochloraz,) and benzimidazole (Carbendazim) was studied in *Erysiphe graminis* control. The efficacy of the triazole fungicides on flag leaf and the second leaf was 97.0 and 84.0-92.2, respectively. Prochloraz was less efficient for the flag leaf (92.0) and significantly less efficient for the second leaf (57.0). The efficacy of Carbendazim for the flag leaf was very low (36.2). Its efficacy for the second leaf was negligible.

3919 Milevoj, L. (Ljubljana Univ. (Slovenia). Biotechnical Fac., Agronomy Dept.) (1994) [Sensitivity of some corn hybrids on isolates of *Gibberella zeae* (Schw.) Petch from wheat]. *Obcutljivost nekaterih hibridov koruze za izolate gljive Gibberella Zeae (Schw.) Petch iz pšenice. Simpozij Novi izzivi v poljedelstvu (Symposium on New Challenges in Field Crop Production); Kocevje (Slovenia); 7-8 Sep 1994. [Proceedings of the Symposium on New Challenges in Field Crop Production]. Kotnik, T. (ed.). Ljubljana Univ. (Slovenia). Biotechnical Fac., Agronomy Dept. p. 185-189. 2 tables; 1 ill., 10 ref. Slovenian. (AGRS 95-089241).*

Gibberella zeae (Schw.) Petch was isolated from naturally infected wheat heads in Jablje, Nova Gorica, Rakican (SLO). Pathogenicity of two isolates of *Gibberella zeae* was tested in a field experiment. The isolates were pathogenic to the corn's stalks and ears. The disease indices with stalks and ears were between 44, 0 and 100, 0 and between 45, 2 and 100, 0 respectively. Some of the tested hybrids exhibit moderate resistance to corn stalk rot or ear rot caused by this fungus. The pathogenicity of three reisolates of *Gibberella zeae* tested in laboratory experiment with maize seed of hybrids BC 318 and Carla were positive.

3920 Nirenberg, H.I.; Schmitzelsherif, H.; Kling, C.I. (1995) **OCCURRENCE OF FUSARIA AND SOME BLACKENING MOULDS ON DURUM WHEAT IN GERMANY. 2. INCIDENCE OF SOME BLACKENING MOULDS.** *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 102(2):164-170. German. [BIOL BUNDESANSTALT LAND & FORSTWIRTSCHAFT INST MIKROBIOL KONIGIN LUISE STR 19 D-14195 BERLIN GERMANY].*

In the years 1985-1987, at growth stage 87 (hard dough) and 92 (caryopsis hard), durum wheat grains of the two cultivars 'Grandur' and 'Mondur' were inspected for their content of "blackening moulds". The

kernels were derived from control plots without fungicide treatment of field trials at four locations: Köln-Wahn (North Rhine-Westfalia), Herxheim (Rhineland-Palatinate), Ludwigsburg (Baden-Württemberg), and Hannover (Lower Saxony). The following more or less saprophytic fungi were found in decreasing frequency: *Alternaria*, *Epicoccum* and *Cladosporium*. In addition, phytopathogenic *Drechslera* species were identified as *D. sorokiniana* being the dominating species. Distinct differences in the occurrence of the fungi could be recognized neither at the different locations nor with the cultivars. [References: 8].

3921 O'Callaghan, J.R. (Newcastle upon Tyne Univ. (United Kingdom). Dept. of Agricultural and Environmental Science); Dahab, M.H.; Hossain, A.H.M.S.; Wyseure, G.C.L. (1994) **Simulation of Septoria tritici - winter wheat interactions.** *Computers and Electronics in Agriculture (Netherlands) v. 11(4) p. 309-321. 38 ref. English. (AGRS 95-078785).*

3922 Obst, A. (1994) [Integrated plant control in wheat]. *Krankheiten im Weizen gezielt bekämpfen: Integrierter Pflanzenschutz praxisgerecht. dtz. Die landwirtschaftliche Zeitschrift fuer Produktion - Technik - Management (Germany) v. 45(4) p. 48-53. 12 ill. German. (AGRS 95-089214).*

3923 Olsson, S. (Sveriges Lantbruksuniv., Uppsala (Sweden). Inst. foer Vaextpatologi) (1995) **On barley monoculture soil. Plant growth affecting microbiota in soil from three long-term field experiments on crop rotation.** *Sveriges Lantbruksuniv., Uppsala (Sweden). Sveriges Lantbruksuniv. 20 ref. A dissertation bound with a collection of 4 reprints. 35 p. English. (AGRS 95-089224).*

3924 Pageau, D.; Wauthy, J.M. (1995) **SEEDING DATE AND SEEDING RATE EFFECTS ON ERGOT DEVELOPMENT ON BARLEY.** *Canadian Journal of Plant Science. 75(2):511-513. French. [AGR & AGROALIMENTAIRE CANADA FERME RECH NORMANDIN PQ G0W 2E0 CANADA].*

A study was conducted from 1987 to 1991 at Saint-Eugene, Quebec, to evaluate the effect of seeding dates and rates on the susceptibility of barley to ergot. The experiment was seeded on three dates (early, intermediate and late) and at three seeding rates (160, 320 and 480 seeds m⁻²). The effect of seeding dates on sclerotia content was variable because of weather conditions. Consequently, it should not be considered for reducing the sclerotia content in barley. However, high seeding rates could possibly be used to reduce the sclerotia content in barley. [References: 10].

3925 Peltonen, S. (1995) **COMPARISON OF XYLANASE PRODUCTION BY FUNGAL PATHOGENS OF BARLEY WITH SPECIAL REFERENCE TO BIPOLARIS SOROKINIANA.** *Mycological Research. 99(Part 6):717-723. English. [HELSINKI UNIV DEPT PLANT BIOL PLANT PATHOL SECT POB 28 SF-00014 HELSINKI FINLAND].*

The production of endo-1, 4-beta-xylanase by fungal pathogens of barley infecting leaves (*Drechslera teres*, *D. graminea*, *Rhynchosporium secalis*), roots and stems (*Rhizoctonia solani*, *Fusarium culmorum*, *Gaeumannomyces graminis*), and leaves, roots and stems (*Bipolaris sorokiniana*) was followed during liquid culture using xylan from birchwood or a cell wall preparation of barley leaves as carbon sources. The rate and extent of xylanase activity measured differed among fungi and was influenced by the carbon source. *B. sorokiniana* and *R. solani* produced the most xylanase on cell wall preparation medium, but the most pathologically aggressive isolate of *B. sorokiniana* did not produce the highest xylanase activity in culture. *D. teres* and *D. graminea* were the only pathogens which produced considerable amounts of xylanase on both carbon sources. *R. secalis*, *F. culmorum* and *G. graminis* produced little or no xylanase on either carbon source. *B. sorokiniana*, *D. teres* and *D. graminea* had 30 kDa xylanases that were related serologically. [References: 41].

3926 Peltonen, S.; Karjalainen, R. (1995) **PHENYLALANINE AMMONIA-LYASE ACTIVITY IN BARLEY AFTER INFECTION WITH BIPOLARIS SOROKINIANA OR TREATMENT WITH ITS PURIFIED XYLANASE.** *Journal of Phytopathology-Phytopathologische Zeitschrift. 143(4):239-245. English. [UNIV HELSINKI DEPT PLANT BIOL PLANT PATHOL SECT POB 28 VIKKI 21 SF-00014 HELSINKI FINLAND].*

Phenylalanine ammonia-lyase (PAL) activity was determined from leaves and roots of two barley (*Hordeum vulgare* L.) cultivars after infection with a necrotrophic pathogen, *Bipolaris sorokiniana* (Sacc.) Shoem., and treatment with its purified xylanase. PAL activity increased in leaves of both cultivars 16 h after fungal inoculation but two phases, with activity peaks at 24-32 h and 40 h, were recorded only for the more resistant cultivar, Agneta. Attempts to use a PAL inhibitor, alpha-aminooxyacetic acid, to increase susceptibility to *B. sorokiniana* in barley leaves were unsuccessful. Treatments of leaves with purified xylanase resulted in more rapid (4-12 h after injection), although reduced, induction of PAL compared with fungal infection. The higher the concentration of xylanase applied the earlier the activity peaks were detected. Fungal inoculation only slightly increased PAL activity in barley roots while xylanase treatment had no effect. The basal level of PAL was, however, much higher in roots than in leaves. In wheat, *Triticum aestivum* L. resistant to *B. sorokiniana*, the time-course of PAL induction after fungal infection and xylanase treatment resembled that for cv. Agneta, while in oats, *Avena sativa* L. (non-host) PAL activity did not change after the treatments. The results suggest that the second phase of PAL induction, associated only with responses of barley cv. Agneta and wheat, is linked with their resistance to *B. sorokiniana* infection. The possible role of xylanase as an elicitor of PAL is discussed. [References: 51].

3927 Pradhanang, PM.; Sthapit, BR. (1995) EFFECT OF CULTIVAR MIXTURES ON YELLOW RUST INCIDENCE AND GRAIN YIELD OF BARLEY IN THE HILLS OF NEPAL. *Crop Protection*. 14(4):331-334. English. [LUMLE AGR RES CTR POST BOX 1 KASKI NEPAL].

The effect of three groups of mixtures of barley varieties, each containing two components of either susceptible or resistant varieties, were studied for incidence of yellow rust and yield stability for a period of 7 years between 1979 and 1985. In most years the intensity of yellow rust was low, and even during epidemic years the disease reduction in the mixture was not enough to significantly increase the yield of the mixture above that of the expected mixture yield. A mixture composed of Kudbidanda Local, X-Veola-14, and Des Desc-14, susceptible, medium susceptible and resistant varieties, respectively, was also studied with respect to yellow rust and yield stability at three sites in 1990. Grain yield of the susceptible variety was reduced significantly during a yellow rust epidemic at Lopre (2000 m). Yield of this variety was significantly higher ($p = 0.01$) than others under the disease free conditions at Lumle (1675 m) and Sabet (1800 m). At all sites the actual yield of the mixture was less than the expected yield. The intensity of yellow rust in the susceptible variety was reduced in mixture plots compared to the pure stand, but the reverse occurred in case of the medium susceptible variety. These differences reflect the change in inoculum pressure experienced in the mixture. [References: 5].

3928 Raymundo, A.D. (Philippines Univ., Los Banos, College, Laguna (Philippines). Dept. of Plant Pathology) (1992) Disease management in wheat. Wheat Review and Planning Workshop; Los Banos, Laguna (Philippines); 16-17 Aug 1989. *Wheat review and planning: proceedings of the Wheat Review and Planning Workshop. Philippine Council for Agriculture, Forestry and Natural Resources Research and Development, Los Banos, Laguna (Philippines); Centro Internacional de Mejoramiento de Maiz y Trigo, Bangkok (Thailand). Regional Wheat Program for Southeast Asia p. 97-102. 8 ref.* Received Nov 1994. English. (AGRIS 95-078786).

3929 Rossi, V.; Cervi, C.; Chiusa, G.; Languasco, L. (1995) FUNGI ASSOCIATED WITH FOOT ROTS ON WINTER WHEAT IN NORTHWEST ITALY. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 143(2):115-119. English. [UNIV CATTOLICA SACRO CUORE IST ENTOMOL & PATOL VEGETALE VIA EMILIA PARMENSE 84 I-29100 PIACENZA ITALY].

In a 3-year survey on bread and durum wheat grown in Northwest Italy, brown root rot was the most important disease of the basal part of culm. Year, wheat-growing area, cultivar and their interactions significantly influenced brown root rot incidence. The most important fungal species isolated from lower stems with browning were *Microdochium nivale*, *Drechslera sorokiniana*, *Fusarium avenaceum*, *F. graminearum*, and *F. culmorum*. *Wojnowicia hirta*, *F. equiseti*, *F. oxysporum*, *F. solani*, *F. moniliforme*, and *Pythium* spp. were frequently

isolated. *F. crookwellense* was also isolated. Sharp eyespot was a frequent disease; take-all and eyespot occurred only occasionally. [References: 26].

3930 Schenk, PM.; Antoniow, JF.; Batista, MD.; Jacobi, V.; Adams, MJ.; Steinbiss, HH. (1995) MOVEMENT OF BARLEY MILD MOSAIC AND BARLEY YELLOW MOSAIC VIRUSES IN LEAVES AND ROOTS OF BARLEY. *Annals of Applied Biology*. 126(2):291-305. English. [MAX PLANCK INST ZUCHTUNGSFORSCH GENET GRUNDLAGEN PFLANZENZUCHTUNG ABT CARL VON LINNE WEG 10 D-50829 COLOGNE GERMANY].

Leaves of barley plants were mechanically inoculated with barley mild mosaic virus (BaMMV) and roots were inoculated using viruliferous zoospores of the fungus vector *Polymyxa graminis*. At intervals after inoculation, leaves and roots were tested by different methods to detect virus coat protein (ELISA or Western blot) or nucleic acid (slot-blot or reverse transcriptase-PCR). Following inoculation with zoospores, virus could be detected in roots after 1 wk (Western blot or PCR) but not until 3-4 wk by ELISA. Virus moved to leaves in 5-6 wk but, except at temperatures of about 20 degrees C, plants had to be cut back close to soil level to stimulate virus movement. Following mechanical inoculation, virus could be detected in leaves of a susceptible cultivar within 5 days by ELISA and 3 days by the other methods. Western blots and PCR showed that virus was present in the roots by 5 days. BaMMV was not detected by any method in leaves or roots of a resistant cultivar, indicating that the virus did not multiply in it. When leaves were mechanically inoculated on a small area only, BaMMV capsid protein was detected below the inoculated site at 4 days and in young growing leaves and roots at 13 days after inoculation but never above the inoculation site or in older leaves. After stem extension began, new leaves of infected plants were free of symptoms. The results are compared to observations of plants infected with barley yellow mosaic virus (BaYMV). It is proposed that movement of BaMMV and BaYMV is strongly related to the phloem transport and to the source-sink pattern of winter barley plants. [References: 24].

3931 Sitton, JW.; Borsa, J.; Schultz, TR.; Maguire, J. (1995) ELECTRON BEAM IRRADIATION EFFECTS ON WHEAT QUALITY, SEED VIGOR, AND VIABILITY AND PATHOGENICITY OF TELIOSPORES OF TILLETIA CONTROVERSA AND T-TRITICI. *Plant Disease*. 79(6):586-589. English. [WASHINGTON STATE UNIV DEPT CROP & SOIL SCI SEED TECHNOL LAB PULLMAN, WA 99164 USA].

Wheat seed infested with sori or free teliospores of *Tilletia controversa* and *T. tritici*, respectively, were irradiated with high energy electrons at doses ranging from 0-10.2 kGy to determine the suitability of electron irradiation to disinfest wheat. The germination of spores was then assayed to determine the sensitivity of each smut species to irradiation. Data indicated that *T. controversa* teliospores were somewhat more resistant to electron beam radiation than were teliospores of *T. tritici*. For *T. tritici*, doses of 4.5 and 6.7 kGy completely eliminated germination of free teliospores and teliospores in intact sori. For *T. controversa*, 10.2 kGy was required to completely eliminate germination of both free teliospores and teliospores in sori. Substerilizing doses of radiation delayed germination of the teliospores of both species. There was no significant deleterious effect of irradiation on wheat quality measurements, except for reduced surface texture and water absorption. As expected, irradiation significantly reduced seed germination and seedling vigor. Irradiation dosages above 2.6 kGy on teliospores significantly eliminated *T. tritici* infection of wheat, while irradiation doses of 10.2 kGy on sori reduced infection from 75.5 to 0.08%. No *T. controversa* infection was observed in wheat seed inoculated with irradiated or nonirradiated teliospores. [References: 23].

3932 Smiley, RW.; Patterson, LM. (1995) WINTER WHEAT YIELD AND PROFITABILITY FROM DIVIDEND AND VITAVAX SEED TREATMENTS. *Journal of Production Agriculture*. 8(3):350-354. English. [OREGON STATE UNIV COLUMBIA BASIN AGR RES CTR POB 370 PENDLETON, OR 97801 USA].

Fungicide seed treatment is required to protect winter wheat (*Triticum aestivum* L.) from infection by smut fungi in the Pacific Northwest (PNW). Vitavax (carboxin-2, 3-dihydro-5-carboxanilido-6-methyl-1, 4-oxathiin) dominated this market for 25 yr before Dividend (difenoconazole-1-(2-[4-(4-chlorophenoxy)-2-chlorophenyl]-4-methyl-1, 3-dio lan-2-yl-methyl)-1H-1, 2, 4-triazole) was registered as a smut-control treatment in 1994.

Relative effects of these fungicides on productivity and profitability of winter wheat are not known; therefore, the objectives of this study were to collect data relative to those factors under commercial conditions. Twenty four experiments that included these fungicides were performed over 5 yr at 12 locations, using seven cultivars. Up to 44 comparisons of cultivar x location x year were possible for some fungicide treatments and application rates. Grain yields were equivalent for Vitavax-treated and untreated seed. Dividend increased yield 5% (2.7 bu/acre) over the Vitavax treatment, for an \$8.25 increase in net profit per acre. Profitability of Dividend was increased by reducing the application rate from the standard rate of 0.5 fl oz/cwt to 0.25 fl oz/cwt. Profitability of Dividend was higher in regions where wheat production is less than 40 bu/acre than in areas of higher productivity. Five winter wheat cultivars differed in yield response to Dividend. Neither fungicide affected test weight or kernel weight. This research demonstrated that, by using Dividend, producers can maintain profitability while reducing fungicide application rates by a factor of 10.

3933 Sykora, M.; Krippel, E.; Miklovicova, M.; Plesnik, S. (1995) **SENSITIVITY OF BARLEY POWDERY MILDEW (ERYSIPE GRAMINIS F SP HORDEI) POPULATIONS AGAINST SOME FUNGICIDAL SUBSTANCES IN CENTRAL EUROPE.** *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection.* 102(2):211-214. English. [COMENIUS UNIV BRATISLAVA DEPT GENET MLYNSKA DOLINA CS-84215 BRATISLAVA SLOVAKIA].

In 1993 in middle Europe (Slovakia, Hungary, Czechia and Austria), the sensitivity of barley powdery mildew populations (*Erysiphe graminis* f. sp. *hordei*) against the fungicidal substances triadimenol, tebuconazole, flutriafol, propiconazole and fenpropimorph was determined. A decreased sensitivity of the pathogen against all substances of the triazole group was found. Of the preparations investigated, tebuconazole and propiconazole are considered as the most effective ones. On the other hand, triadimenol and flutriafol had little effect. In comparison with the previous year, we can state that there was an increase of the pathogen sensitivity against triazole substances due to an increased heterogeneity of the pathogen populations. The sensitivity of the barley powdery mildew populations against fenpropimorph was on the level of sensitive standard isolates. However, the presence of isolates with decreased sensitivity against the morpholine substances was observed. [References: 11].

3934 Szunics, L. (Magyar Tud. Akad., Martonvasar (Hungary). *Mezőgazd. Kut. Int.*) (1994) [Wheat bunt. Will a disease we thought to have conquered raise its head again?]. *Buzakouszog egy tegnapi betegség holnap újra kopogthat az ajtónkon. Növényvédelem (Hungary)* v. 30(10) p. 461-465. 3 tables; 25 ref. Hungarian. (AGRI 95-089271).

The effect of genotype (registered varieties and those with known resistance genes) and year on the degree of infection with bunt (*Tilletia foetida*, *T. caries*) was studied in an artificial inoculation nursery between 1986 and 1993. The vast majority of the varieties are susceptible. The degree of infection is substantially influenced by climatic factors.

3935 Szunics, L.; Szunics, L. (1995) **RACE COMPOSITION AND VIRULENCE OF WHEAT POWDERY MILDEW (ERYSIPE GRAMINIS TRITICI) AND THE RESISTANCE OF WHEAT VARIETIES IN HUNGARY.** *Cereal Research Communications.* 23(1-2):117-125. English. [HUNGARIAN ACAD SCI AGR RES INST H-2462 MARTONVASAR HUNGARY].

The race composition and virulence of wheat powdery mildew as well as the effect of known resistance genes on the pathogen have been studied in Martonvasar since 1970. The powdery mildew population is very heterogeneous; a total of 72 physiological races were isolated, with between 15 (1993) and 35 (1986) races being identified each year. Within the pathogen population, the number of virulence genes per race rose steadily from 2.03 (1973) to 5.63 (1993). Significant changes have occurred in the race composition and virulence of the pathogen. Correlation coefficient (*r*) calculations and the results of principal component analysis (PCA) have confirmed that the wheat powdery mildew population during the period in question can be divided into at least four distinct groups on the basis of race composition and degree of virulence. The vast majority of powdery mildew isolates is virulent to genotypes with known resistance genes. Complete resistance is only provided by gene Pm 4a. The cultivation of varieties with vertical resistance due to the resistance genes Pm 8 and,

probably, Pm 2+6 has led to a change in the race composition and virulence of the pathogen. With the spread of races virulent to resistant genotypes, previously resistant varieties have become susceptible, so the search for new resistance sources providing efficient biological protection is a constant necessity, requiring the breeding and cultivation of new, resistant varieties. Resistance breeding is thus a permanent process. Among the wheat varieties developed in Martonvasar, Mv 22, Mv 23, Mv 24, Mv 25, Mv Magma and Fatima 2 have good powdery mildew resistance.

3936 Thylén, J. (1994) [Ecological role of Actinomycetes in the rhizosphere of selected crop plants (Streptomycetaceae, Aphanomyces euteiches)]. *Actinomyceters oekologiske betydning i rodzonen af udvalgte kulturplanter. Kongelige Veterinær- og Landbohøjskole, Copenhagen (Denmark). Sektion for Mikrobiologi. KVL. 19 ill., 37 tables: 358 ref. 222 p. Danish. (AGRI 95-089227).*

3937 Toth, A.; Szakal, M.; Petroczy, I. (Godolloi Agrartud. Egyet., Godollo (Hungary). *Növényvet. Tansz.*) (1994) [Dominance conditions of Fusarium species occurring in winter wheat kernels in Pest county]. *Oszi buza szemtermeseben előforduló Fusarium fajok dominancia-viszonyai Pest megyében. Növényvédelem (Hungary)* v. 30(10) p. 455-460. 2 tables; 25 ref. Hungarian. (AGRI 95-089270).

The occurrence of *Fusarium* species causing inner infection of wheat seeds was studied on samples containing kernels in the "milk-" and "full" ripeness. The results of the study are accentuated by the fact that among the dominant species there are ones that produce poisonous mycotoxins.

3938 Toubiarahme, H.; Alihaimoud, DE.; Barrault, G.; Albertini, L. (1995) **INHIBITION OF DRECHSLERA TERES SCLEROTIUM FORMATION IN BARLEY STRAW BY APPLICATION OF GLYPHOSATE OR PARAQUAT.** *Plant Disease.* 79(6):595-598. English. [ECOLE NATL SUPER AGRON TOULOUSE INGN AGRON LAB 145 AVE MURET F-31076 TOULOUSE FRANCE].

Field-grown barley straw was inoculated with *Drechslera teres* f. sp. *teres* or *D. t. maculata*, treated with two herbicides used in no-tillage barley production, and then incubated in controlled conditions to induce sclerotium structure morphogenesis (resting form). Formulated herbicides containing glyphosate or paraquat were applied at three different concentrations. Applied at the recommended field rate, these herbicides significantly reduced sclerotium structure production by *D. teres*. In addition, their morphology and myceliogenesis were modified in the presence of both herbicides at the recommended field rate. Glyphosate was more inhibitory than paraquat; no sclerotium structures were produced in straw when glyphosate was applied before colonization by *D. teres*. The effect of the herbicides at 10(-8) and 10(-4) M varied depending on the herbicide, concentration of the active ingredient, method of application, and forma specialis of the pathogen. [References: 15].

3939 Touzeau, J. (Ministère de l'Agriculture, Balma (France). SPV. Service de la Protection des Végétaux) (1993) [CERES: a decision-making system for fungicide treatments in wheat]. *Reflexions sur CERES, système d'aide à la décision pour les traitements fongicides du blé. Conférence sur les Systèmes Informatiques d'Aide à la Décision en Protection des Plantes. Conférence on Computerized Advisory Systems for Plant Protection; Esloev (Suede); 3-6 Nov 1992. Bulletin OEPP (EPPO)* v. 23(4) p. 551-555. French. (AGRI 95-078800).

3940 Trissler, R. (Hohenheim Univ., Stuttgart (Germany). Inst. fuer Tierernaehrung); Kling, C.; Mueller, H.M. (1994) [Investigations on parameters of Fusarium resistance in winter wheat varieties after inoculation with Fusarium strains]. *Untersuchungen zu Parametern der Fusarienresistenz bei Winterweizensorten nach Beimpfung mit Fusarienstämmen. LAF-Informationen. Sonderheft (Germany); no. 1 p. 165-168. Selbstverlag. 7 ref. p. 165-168. German. (AGRI 95-089215).*

3941 Varaku, H. (Instituti i Mbrojtjes se Bimeve, Durres (Albania)) (1994) [The main wheat disease. Phases and preparates of the control]. *Semundjet kryesore te grurit. Fazat dhe preparatet e luftimit. Bujqesia Shqiptare (Albania) (no.3)* p. 12-13. 2 tables; 3 ill.; 12 ref. Albanian. (AGRI 95-089254).

Determination is made of the dynamics of main wheat disease development as well as the fungicides for their controlling. The most spread diseases are *Erysiphe graminis*, *Septoria* sp., *Fusarium* sp., *Cercospora herpotrichoides* and *Puccinia recondita*. Intensity of these diseases depends on climatic conditions. Most likely treatments to be carried out with fungicides are: tilt 0, 5 kg/ha, sportak 0, 5 kg/ha, furmidor 3 kg/ha and horizon 1 kg/ha. These treatments are used one time in heading phase, respectively 60, 86 kv/ha, 58, 79 kv/ha, 60, 35 kv/ha and 56, 69 kv/ha.

3942 Vassilev, V.; Kolev, K.; Zaharieva, M.; Sevov, V. (1995) **RESISTANCE OF AEGILOPS, MAIZE AND WHEAT GENOTYPES TO PSEUDOMONAS SYRINGAE PATHOVARS ATROFACIENS AND SYRINGAE**. *Agronomie*. 15(1):25-29. English. [K MALKOFF INST PLANT GENET RESOURCES BU-1422 SADOVO PLOVDIV BULGARIA].

The resistance of cereal genotypes to the artificial inoculation of *Pseudomonas syringae* pathovars *atrofaciens* (PSA) and *syringae* (PSS) at third leaf growth stage of development was investigated. The methods of pricking and injecting were used. The injection method produced symptoms similar to natural infection, at level of inoculum at least 10(7) cfu/ml. At this stage of cereal growth there was a high level of resistance to PSA and PSS. None of the *Aegilops* species showed the symptoms of susceptible genotypes. Only one *Triticum* genotype was susceptible to strains V28 and Y4895 of PSA and PSS, respectively, at the highest level of inoculum. The leaves of all *Zea mays* genotypes were susceptible to PSS A106 at 10(9) cfu/ml.

3943 Watkins, JE.; Rutledge, SS.; Baenziger, PS. (1995) **VIRULENCE PATTERNS OF PUCCINIA RECONDITA F SP TRITICI IN NEBRASKA DURING 1992 AND 1993**. *Plant Disease*. 79(5):467-470. English. [UNIV NEBRASKA DEPT PLANT PATHOL LINCOLN, NE 68583 USA].

One hundred sixty-four urediniospore isolates of *Puccinia recondita* were collected in 1992 and 134 in 1993 from four wheat-growing regions in Nebraska. These were characterized for virulence to 16 near-isogenic, single-gene differentials in a Thatcher genetic background. Thirty-seven virulence combinations were identified from the isolates collected in 1992 and 46 were identified from those collected in 1993. Twenty-two new virulence phenotypes were detected in 1993 that were not found in 1992. Virulence was high during both years in all regions to Lr1, Lr2a, Lr2c, Lr3, Lr10, Lr11, Lr18, Lr21, Lr24, and Lr30. The virulence frequency was moderate to Lr26, and was low to Lr3ka, Lr9, Lr16, Lr17, and Lr19 during both years. The most prevalent virulence phenotypes were TFH-10, 18, 21 (virulent on Lr1, Lr2a, Lr2c, Lr3, Lr24, Lr26, Lr11, Lr30, Lr10, Lr18, and Lr21) in 1992 and TFH-10, 18 (virulent on Lr1, Lr2a, Lr2c, Lr3, Lr24, Lr26, Lr11, Lr30, Lr10, and Lr18) in 1993. Eighty-three percent of the 1992 isolates and 74% of the 1993 isolates had the Lr1, Lr2a, Lr2c, and Lr3 virulence phenotype. Virulence to resistance genes Lr3ka, Lr9, and Lr16 was only detected in 1993. Lr19 was resistant to all rust isolates collected both years. Combinations of these last four genes could provide resistance to Nebraska's current leaf rust population. [References: 19].

3944 Zaharieva, M.; Vassilev, V. (1995) **STUDY OF THE ADULT WHEAT AND AEGILOPS RESISTANCE TO PSEUDOMONAS SYRINGAE PATHOVARS ATROFACIENS**. *Agronomie*. 15(1):21-24. English. [K MALKOFF INST PLANT GENET RESOURCES BU-4122 SADOVO PLOVDIV BULGARIA].

The evaluation of the adult plant resistance of 28 genotypes belonging to *Triticum* L and *Aegilops* L to *Pseudomonas syringae* pathovar *atrofaciens* (PSA) were carried out at stage 10.1 (Large, 1954) after inoculation by the method of Vassilev and Karov (1986) in a glasshouse. The investigated genera showed a partial adult plant resistance to PSA. The proportion of genotypes susceptible to PSA at the highest concentration was larger for *Triticum* than for *Aegilops*.

3945 Zhao Xiaoming; Yang Hun; Liu Hawen (Shaanxi Provincial Inst. of Plant Protection, Yangling (China)) (1994) **The change of saccharinity in diseased leaf with a kind of rust disease (Yu-Xiu-Bing) of wheat**. *Shaanxi Journal of Agricultural Sciences (China)* (no. 4) p. 10-12. 4 tables; Chinese. (AGRIC 95-089257).

3946 Zhong Pei (Hanzhong Prefectural Station of Plant Protection, Shaanxi (China)) (1994) **Experiment on the efficacy of chemical controlling loose smut (*Ustilago tritici*) in wheat**. *Shaanxi Journal of Agricultural Sciences (China)* (no. 1) p. 27. 1 table. Chinese. (AGRIC 95-089255).

3947 Zhong Qinfeng; Zhu Xiangsan (Shaanxi Provincial Academy of Agricultural Sciences, Yangling (China)) (1994) **Wheat MLO diseases occurred in China**. *Shaanxi Journal of Agricultural Sciences (China)* (no. 1) p. 17-18. 2 ref. Chinese. (AGRIC 95-089272).

H50 MISCELLANEOUS PLANT DISORDERS

3948 [Lodging risks estimation]. **Verse: savoir apprecier le risque** (1995) Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France)* (no 199) p. 16-17. French. (AGRIC 95-079141).

3949 Akhtar, J. (Agriculture Univ., Faisalabad (Pakistan). Dept. of Soil Science); Gorham, J.; Qureshi, R.H. (1994) **Combined effect of salinity and hypoxia in wheat (*Triticum aestivum* L.) and wheat-Thinopyrum amphiploids**. *Plant and Soil (Netherlands)* v. 166(1) p. 47-54. 27 ref. English. (AGRIC 95-079145).

3950 Durieux, RP.; Bartlett, RJ.; Magdoff, FR. (1995) **SEPARATE MECHANISMS OF ALUMINIUM TOXICITY FOR NITRATE UPTAKE AND ROOT ELONGATION**. *Plant & Soil*. 172(2):229-234. English. [UNIV VERMONT DEPT PLANT & SOIL SCI BURLINGTON, VT 05405 USA].

Aluminium toxicity has been shown to decrease NO₃⁻ uptake in *Zea mays* seedlings during the first 30 minutes after addition of Al³⁺. This suggests that NO₃⁻ uptake inhibition could be a primary response to Al addition. We therefore tested the hypothesis that NO₃⁻ uptake and root elongation are affected differently by Al³⁺. Eight-day old seedlings were exposed to 100 μM Al³⁺ in the presence of 1 or 10 mM Ca²⁺, added as either CaSO₄ or CaCl₂. In the presence of Al³⁺, cumulative uptake of NO₃⁻ during an 8 h period was not affected by Ca²⁺ level (1 or 10 mM). Root elongation at 1 mM Ca²⁺ was decreased to 63% of the control by the presence of Al³⁺. Raising ambient Ca²⁺ from 1 to 10 mM in the presence of Al³⁺ restored elongation rates to 78% (CaCl₂) and 88% (CaSO₄) of elongation without Al. Because reductions in root elongation were partially overcome by added Ca²⁺, but lowered uptake of NO₃⁻ was not, it was concluded that Al³⁺ toxicity decreased root growth and NO₃⁻ uptake by different mechanisms. [References: 29].

3951 Gao Jiyin; Guan Jianping; Wang Mingzhen (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Crop Germplasm Resources) (1994) **A study on the salt-stress proteins in wheat seedlings**. *Crop Genetic Resources (China)* (no. 1) p. 25-27. 3 ill., 5 ref. Chinese. (AGRIC 95-089573).

3952 Gong Ming (Yunnan Normal Univ., Kunming (China). Dept. of Biology) (1994) **Difference of salt tolerance in *Hordeum vulgare* at different growth stages**. *Acta Botanica Boreali-Occidentalia Sinica (China)* v. 14(1) p. 1-7. 6 tables; 10 ill., 16 ref. Chinese. (AGRIC 95-089557).

3953 Halperin, SJ.; Barzilay, A.; Carson, M.; Roberts, C.; Lynch, J. (1995) **GERMANIUM ACCUMULATION AND TOXICITY IN BARLEY**. *Journal of Plant Nutrition*. 18(7):1417-1426. English. [PENN STATE UNIV DEPT HORT 102 TYSON BLDG UNIVERSITY PK, PA 16802 USA].

The accumulation of germanium (Ge) by barley (*Hordeum vulgare* cv. 'Arivat') grown at various Ge and pH levels was investigated because Ge is an industrially important metal and bioaccumulation of Ge is a potentially useful means of concentrating this trace metal. Six-day-old barley seedlings were grown in perlite and nutrient solution adjusted to a pH of 4.5, 6.0, or 7.5 supplemented with 20, 40, 60, or 80 μM Ge for seven days. The plants were divided into roots and shoots after harvesting; the dry weight and Ge content of the individual organs were measured, as was the peroxidase activity in the distal 1 cm of the primary leaves. Barley seedlings accumulated Ge in the roots and shoots; the shoots accumulated Ge linearly as medium Ge concentration increased. The dry weight of the organs was not affected, although necrosis was observed in the primary leaves of the seedlings treated with Ge concentrations greater than 20 μM.

M. Peroxidase activity in the primary leaves also increased as the Ge levels in the medium increased which indicated that elevated levels of Ge stimulated leaf senescence. These results demonstrate that barley plants can take up Ge and suggest that Ge is not toxic at the levels that might occur in areas where Ge is normally mined. [References: 20].

3954 Higuchi, K. (Tokyo Univ. (Japan). Dept. of Agricultural Chemistry); Kanazawa, K.; Nishizawa, N.K.; Chino, M.; Mori, S. (1994) Purification and characterization of nicotianamine synthase from Fe-deficient barley roots. *Plant and Soil (Netherlands)* v. 165(2) p. 173-179. 36 ref. English. (AGRIC 95-079127).

3955 Li Yan (Zhejiang Agricultural Univ., Hangzhou (China). Dept. of Agrochemistry) (1994) Effect of copper on nitrogen metabolism in wheat. *Tropical and Subtropical Soil Science (China)* v. 3(1) p. 53-55. 2 tables; 7 ref. Chinese. (AGRIC 95-089572).

3956 Mart, P.K.; Koebner, RMD. (1995) SODIUM AND CHLORIDE IONS CONTRIBUTE SYNERGISTICALLY TO SALT TOXICITY IN WHEAT. *Biologia Plantarum*. 37(2):265-271. English. [JOHN INNES CTR PLANT SCI RES CEREALS RES DEPT NORWICH RES PK NORWICH NR4 7UH NORFOLK ENGLAND].

The effects of supplying excess mineral salts, involving sodium as a cation and a range of counteranions, including chloride, on the growth and photosynthetic capacity of a salt susceptible bread wheat were studied. Plant performance was much more affected by the NaCl treatment than by the same concentration of either of the two component ions. With the exception of K⁺, other alkali metal chlorides also greatly inhibit plant growth and the electron flow through photosystem 2. The ranking of toxicity of these cations is Li⁺ > Na⁺ > K⁺. The synergistic effect of sodium (and other alkali and alkaline earth metals) and chloride shows that neither of these ions alone is responsible for salt stress induced damage.

3957 Nath, K.K.; Tiwari, P.N.; Gambhir, P.N.; Chahal, S.S.; Nagarajan, S. (Indian Agricultural Research Institute, New Delhi. Nuclear Research Laboratory) (1993) Rapid estimation of relative drought tolerance of wheat cultivars by low resolution NMR. *Journal of Nuclear Agriculture and Biology (India)*. v. 22(3-4) p. 143-149. 3 ill., 1 table; 21 ref. English. (AGRIC 95-079143).

3958 Owuochi, J.O.; Briggs, K.G.; Taylor, G.J.; Penney, D.C. (1995) RESPONSE OF EIGHT CANADIAN SPRING WHEAT (TRITICUM AESTIVUM L.) CULTIVARS TO COPPER - COPPER CONTENT IN THE LEAVES AND GRAIN. *Canadian Journal of Plant Science*. 75(2):405-411. English. [UNIV ALBERTA FAC AGR FORESTRY & HOME ECON DEPT AGR FOOD & NUTR SCI EDMONTON AB T6G 2P5 CANADA].

Concentrations of copper (Cu) in the youngest fully emerged leaves (YFEL) and grain of eight widely grown Canadian spring wheat (*Triticum aestivum* L.) cultivars, Biggar, Columbus, Conway, Katepwa, Laura, Oslo, Park and Roblin, were determined. Leaves were sampled at five growth stages from field plots grown in 1990 and 1991 on Cu-deficient soil or soil treated with 12.2 kg Cu ha⁻¹ as Cu sulphate. Symptoms of Cu deficiency, mainly rolling and wilting of young leaves and twisting and terminal dieback, were noted on Katepwa, Park and Roblin at Zadok growth stage 24. Significant (P less than or equal to 0.01) effects on Cu concentration in the YFEL were found due to cultivar, copper treatment, year and growth stage. The Cu concentrations in Katepwa, Park and Roblin not treated with Cu ranged between 4.6 and 5.7 µg g⁻¹ in 1990 and between 2.8 and 3.5 µg g⁻¹ in 1991 at Zadok growth stage 22. Cultivars Biggar, Columbus, Conway, Laura and Oslo did not show symptoms of Cu deficiency and had Cu concentrations in the range of 4.6-5.4 µg g⁻¹ in 1990 and 2.3-3.1 µg g⁻¹ in 1991. Deficiency symptoms were observed on Katepwa and Park supplied with Cu, although concentrations of Cu in the YFEL were relatively high. Grains sampled from the tillers generally had lower Cu concentrations than those from main stems, but the magnitude of this difference varied with the year. Significant correlations were found between Cu concentrations in the YFEL and grain yield (r = 0.90* in 1990 and 0.89* in 1991) and with floret fertility (r = 0.74* in 1990 and 0.94** in 1991). These large and significant correlations confirm the important role of Cu nutritional status in influencing floret fertility and grain yield. Critical levels of Cu in the leaves

needed for unlimited growth could not be defined because of year-to-year variability. In this study, Cu concentration in the YFEL was not a useful indicator of potential Cu use efficiency in different wheat cultivars. However, for individual plants under Cu-deficiency stress, Cu concentration in the YFEL was a good indicator of the grain yield potential of different cultivars. [References: 22].

3959 Panwar, R.S.; Malik, R.K.; Singh, S.; Balyan, R.S. (Haryana Agricultural University, Hisar (India). Department of Agronomy) (1994) Influence of tralkoxydim applied alone or as tank mixture on the control of grassy weeds in wheat. *Haryana Agricultural University Journal of Research (India)* v. 24(1) p. 25-32. 4 tables; 9 ref. English. (AGRIC 95-079142).

3960 Sairam, R.K.; Shukla, D.S.; Deshmukh, P.S. (1995) EFFECT OF TRIAZOLE-TRIADIMEFON ON TOLERANCE TO MOISTURE STRESS IN WHEAT (TRITICUM AESTIVUM). *Indian Journal of Agricultural Sciences*. 65(7):483-489. English. [INDIAN AGR RES INST DIV PLANT PHYSIOL NEW DELHI 110012 INDIA].

An experiment was conducted during winter season of 1989-90 and 1990-91 to study the effect of triadimefon on moisture stress in 'C 306', 'HD 2428' and 'HD 2329' genotypes of wheat (*Triticum aestivum* L. emend. Fiori and Paol.). Moisture stress decreased the relative water content (26%), transpiration (82%), chlorophyll (29%) and protein (27%). Triadimefon further reduced the transpiration and increased the relative water content and membrane stability under both the conditions. The effect of triadimefon was more in drought-tolerant genotype 'C 306' than the susceptible 'HD 2428'. Significant increase was also observed in chlorophyll content (24%) and protein content (56%) in triadimefon-treated plants. There was increase in tillers/plant, green leaves/plant and leaf area/plant, though the individual leaf size was slightly reduced by triadimefon application. Triadimefon 1 000 ppm significantly increased the yield (13%), grains/ear (10.5%), 1 000-grain weight (8%) and harvest index (13%). The stimulatory effect was more in drought-tolerant genotype than in susceptible one in pots as well as in field under moisture stress.

3961 Sasaki, M.; Kasai, M.; Yamamoto, Y.; Matsumoto, H. (1995) INVOLVEMENT OF PLASMA MEMBRANE POTENTIAL IN THE TOLERANCE MECHANISM OF PLANT ROOTS TO ALUMINIUM TOXICITY. *Plant & Soil*. 171(1):119-124. English. [OKAYAMA UNIV BIORESOURCES RES INST KURASHIKI OKAYAMA 710 JAPAN].

H⁺-ATPase activity of a plasma membrane-enriched fraction decreased after the treatment of barley (*Hordeum vulgare*) seedlings with Al for 5 days. A remarkably high level of Al was found in the membrane fraction of Al-treated roots. A long-term effect of Al was identified as the repression of the H⁺-ATPase of plasma membranes isolated from the roots of barley and wheat (*Triticum aestivum* cultivars, Atlas 66 (Al-tolerant) and Scout 66 (Al-sensitive). To monitor short-term effects of Al, the electrical membrane potentials across plasma membranes of both wheat cultivars were compared indirectly by measuring the efflux of K⁺ for 40 min under various conditions. The rate of efflux of K⁺ in Scout was twice that in Atlas at low pH values such as 4.2. Vanadate, an inhibitor of the H⁺-ATPase of the plasma membrane, increased the efflux of K⁺. Al repressed this efflux at low pH, probably through an effect on K⁺ channels, and repression was more pronounced in Scout. Al strongly repressed the efflux of K⁺ irrespective of the presence of vanadate. Ca²⁺ also had a repressive effect on the efflux of K⁺ at low pH. The effect of Ca²⁺, greater in Scout, might be related to the regulation of the net influx of H⁺, since the effect was negated by vanadate. The results suggest that extracellular low pH may cause an increase in the influx of H⁺, which in turn is counteracted by the efflux of K⁺ and H⁺. These results suggest that the ability to maintain the integrity of the plasma membrane and the ability to recover the electrical balance at the plasma membrane through a net influx of H⁺ and the efflux of K⁺ seem to participate in the mechanism of tolerance to Al stress under acidic conditions. [References: 15].

3962 Shaaya, E.; Desmarchelier, J.M. (1995) ANALYSIS, SORPTION AND RESIDUES OF A HOMOLOGOUS SERIES OF ISOTHIOCYANATES ON WHEAT. *Pesticide Science*. 44(3):249-253.

A series of isothiocyanates (R-NCS, R, 1-6 carbon atoms) was applied in the vapour phase to wheat in sealed containers. The speed of sorption, as measured by the rate of loss from the intergranular air space, was inversely proportional to molecular weight; e.g. the time for 50% sorption of hexyl isothiocyanate was over 100 times longer than for the methyl analogue. Despite extensive sorption, most of the applied chemicals was recovered from the fumigated wheat seven days after dosing, indicating that sorption did not lead to extensive degradation. Purge and trap techniques proved suitable for recovery of low-boiling, but not high-boiling chemicals. [References: 5].

3963 Slaski, J.J. (Warszawa Agricultural Univ. (Poland). Dept. of Plant Biochemistry and Physiology) (1994) **Differences in the metabolic responses of root tips of wheat and rye to aluminium stress.** *Plant and Soil (Netherlands)* v. 167(1) p. 165-171. 32 ref. English. (AGRI 95-079138).

3964 Wang Zhenying (Tianjin Normal Univ., Tianjin (China). Dept. of Biology) (1994) **Effect of caffeine on seed germination peroxidase isozymes and cell mitosis of wheat.** *Chinese Bulletin of Botany (China)* v. 11(3) p. 37-39. 2 tables; 2 ill., 4 ref. Chinese. (AGRI 95-079125).

3965 Wei Liulan; Wang Kaixi; Li Deyang (Academia Sinica, Yangling, Shaanxi (China). Northwestern Inst. of Botany) (1994) **Absorption and accumulation of cadmium and chromium in different kinds of sewage by wheat and maize.** *Shaanxi Journal of Agricultural Sciences (China)* (no. 5) p. 27-28. 4 tables; 5 ref. Chinese. (AGRI 95-089571).

3966 Weigel, H. J. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany). Inst. fuer Produktions und Oekotoxikologie); Bender, J. (1994) [Effects of ozone on plants]. **Auswirkungen von Ozon auf Pflanzen.** Landbauforschung Voelkenrode. Sonderheft (Germany); no. 148 p. 203-235. FAL, Selbstverlag. 7 ill., 6 tables. Bibliography p. 227-235. p. 203-235. German. (AGRI 95-089548).

3967 Wheeler, D.M. (New Zealand Agricultural Pastoral Research Inst. Ltd., Hamilton (New Zealand)) (1994) **Effects of growth period, plant age and changes in solution aluminium concentrations on aluminium toxicity in wheat.** *Plant and Soil (Netherlands)* v. 166(1) p. 21-30. 17 ref. English. (AGRI 95-079144).

H60 WEEDS

3968 Clay, S.A.; Gaffney, J.F.; Wrage, L.J. (1995) **SPRING WHEAT (TRITICUM AESTIVUM) CULTIVAR RESPONSES TO TRIFLURALIN AND POSTEMERGENCE HERBICIDES.** *Weed Technology*. 9(2):352-355. English. [S DAKOTA STATE UNIV DEPT PLANT SCI BROOKINGS, SD 57007 USA].

Trifluralin is used for weed control in wheat but may reduce vegetative growth and yield. Postemergence (POST) herbicides may cause additional plant stress to trifluralin-stressed wheat. Field studies at Groton, SD in 1991 and 1992 and at Highmore, SD in 1992 evaluated the effects of 2, 4-D-amine, difenzoquat, metsulfuron, and a combination of fenoxaprop-ethyl + 2, 4-D-ester + MCPA-ester on hard red spring wheat cultivars '2375', 'Prospect', and 'Butte 86' seeded in areas treated with preplant incorporated trifluralin either in the spring before seeding (0.56 kg ai/ha) or the previous year (1.12 or 2.24 kg ai/ha). Trifluralin applied alone in the spring, and followed by some POST herbicides, reduced shoot dry weight and grain yield. Trifluralin reduced the yield of Prospect the most and the yield of 2375 the least. Yields of trifluralin-treated wheat were reduced 23% by metsulfuron and 14% by fenoxaprop-ethyl + 2, 4-D + MCPA compared to yields of wheat treated with only the respective POST herbicide. Yields were not reduced with any trifluralin-POST herbicide combination when trifluralin was applied a year prior to seeding wheat.

3969 Conn, J.S.; Deck, R.E. (1995) **OPTIMAL GLYPHOSATE APPLICATION TIME FOR CONTROL OF FOXTAIL BARLEY (HORDEUM JUBATUM).** *Weed Technology*. 9(2):267-269. English. [USDA ARS RES AGRON & BIOL LAB TECH 309 ONEILL BLDG POB 757200 FAIRBANKS, AK 99775 USA].

Optimal time of application of the isopropylamine salt of glyphosate for long-term control of foxtail barley was studied near Delta Junction, AK in 1992 and 1993. Applications of either 0.6 or 1.1 kg/ha of glyphosate with 2.2 kg/ha of ammonium sulfate and 0.5% (v/v) nonionic surfactant were made to different foxtail barley plots at approximately 2-wk intervals from May to September. Control was rated in July of the year following application. The 0.6 kg/ha rate produced less than or equal to 60% control on all application dates. At 1.1 kg/ha, foxtail barley control was best from applications made between early August and mid-September. May and mid-June applications provided up to 80% control in 1993 but less than or equal to 50% control in 1992. For both rates, applications made from late June through July, during foxtail barley flowering and seed fill, consistently provided little control (< 50%). Nomenclature: Glyphosate, N-(phosphonomethyl)glycine; foxtail barley, *Hordeum jubatum* L. # (3) HORJU.

3970 Elmore, C.D.; Heatherly, L.G.; Wesley, R.A. (1995) **WEED CONTROL IN NO-TILL DOUBLECROP SOYBEAN (GLYCINE MAX) FOLLOWING WINTER WHEAT (TRITICUM AESTIVUM) ON A CLAY SOIL.** *Weed Technology*. 9(2):306-315. English. [USDA ARS APPL & PROD TECH RES UNIT POB 36 STONEVILLE, MS 38776 USA].

Weed control was evaluated in no-till planted soybean in both burned and standing wheat stubble for 3 yr. High, intermediate, low, and no weed management following no-till planting of soybean were compared with a tilled treatment with high weed management. Herbicides for the high weed management were metribuzin plus metolachlor PRE followed by POST applications, as needed, of bentazon, acifluorfen, and fluzifop or quizalofop. Intermediate management included all of the above except metolachlor, plus the as-needed use of chlorimuron or lactofen POST. Low management had no PRE herbicide applications but included the above POST herbicides. Glyphosate was used as a preplant foliar applied desiccant in the stubble-planted soybean of all weed management levels. Yield of soybean was not affected by standing, burned, or tilled wheat stubble. Soil organic matter in the 0 to 2.5 cm of soil was not significantly affected at the end of the 3 yr. Yield of wheat was reduced by standing wheat stubble in the first year of the study. Total POST weed control was sufficient for maximum soybean yields in the second and third years of the study. The weed spectrum changed during the experiment for the no-weed-control treatment in soybean and in wheat. The major weeds present in soybean after 3 yr of no-till were southern crabgrass, nodding spurge, redvine, prickly sida, barnyardgrass, and johnsongrass; in wheat they were Italian ryegrass, little barley, mayweed chamomile, and hairy buttercup. Nomenclature: Acifluorfen, 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoic acid; bentazon, 3-(1-methylethyl)-(1H)-2, 1, 3-benzothiadiazin-4(3H)-one 2, 2-dioxide; chlorimuron, 2-[[[4-chloro-6-methoxy-2-pyrimidinyl]amino]carbonyl]amino]sulfonyl]benzoic acid; fluzifop, (+/-)-2-[4-[[5-(trifluoromethyl)-2-pyridinyl]oxy]phenoxy]propanoic acid; glyphosate, N-(phosphonomethyl)glycine; lactofen, (+/-)-2-ethoxy-1-methyl-2-oxyethyl 5-[2-chloro-4-(trifluoromethyl)phenoxy]-2-nitrobenzoate; metolachlor, 2-chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl)acetamide; metribuzin, 4-amino-6-(1, 1-dimethylethyl)-3-(methylthio)-1, 2, 4-triazin-5(4H)-one; quizalofop, (+/-)-2-[4-[[6-chloro-2-quinolalyl]oxy]phenoxy]propanoic acid; wheat, *Triticum aestivum* L., soybean, *Glycine max* (L.) Merr., southern crabgrass, *Digitaria ciliaris* (Retz.) Keel. # (3) DIGSP; nodding spurge, *Euphorbia nutans* Lag. # EPHNU; redvine, *Brunnichia ovata* (Walt.) Shinn. # BRVCI; prickly sida, *Sida spinosa* L. # SIDSP; barnyardgrass, *Echinochloa crus-galli* (L.) Beauv. # ECHCG; johnsongrass, *Sorghum halepense* (L.) Pers. # SORHA; Italian ryegrass, *Lolium multiflorum* Lam. # LOLMU; little barley, *Hordeum pusillum* Nutt. # HORPU; mayweed chamomile, *Anthemis cotula* L. # ANTCO; hairy buttercup, *Ranunculus sardous* Crantz # RANSA.

3971 Joergensen, L.N.; Jensen, P.E. (eds.); Hansen, M.S. (1994) [Pesticide trials, 1994: Agricultural crops, 8: Weed control, wilting and growth regulation [Boxer EC, Butisan S, CL-23702, CQ-1523, DPX E9636, Duplosan M ester, Express, Starane, Focus Ultra, Grasp 400 WG, TF 8035, Gratil, Halbard, Inter Napropamid, Inter Trifluralin, Kemifam Pro WG, Renol S, KH 94-2, Moddus, Panther, Roundup dry, Toloran, Approval]]. **Pesticidafproevning 1994: Landbrugsafgroeder, 8: Ukrudtsbekaempelse, nedvisning og vaekstregulering i**

landbrugsafgrøder. Statens Planteavlssforsoeg, Lyngby (Denmark). SP-Rapport (Denmark) v. 3(1) p. 117-161. 20 ill. Danish. (AGRI 95-089757).

3972 Joergensen, L.N.; Jensen, P.E. (eds.); Rydahl, P. (1994) [Pesticide trials, 1994: Agricultural crops, 7.2: PC-Plant control: weeds: survey of validation trials [personal computer]]. Pesticidafproevning 1994: Landbrugsafgrøder, 7.2: PC-planter, ukrudt: oversigt over valideringsforsoeg. Statens Planteavlssforsoeg, Lyngby (Denmark). SP-Rapport (Denmark) v. 3(1) p. 108-115. 4 tables. Danish. (AGRI 95-089771).

3973 Kozaczenco, H. (Akademia Techniczna Rolnicza, Olsztyn (Poland). Katedra Ochrony Roslin) (1994) [Efficiency of some herbicides of new generation for spring wheat]. Skuteczność kilku herbicydów nowej generacji stosowanych w pszenicy jarej. *Fragmenta Agronomica (Poland)* v. 11(2) p. 25-29. 2 tables; 10 ref. Polish. (AGRI 95-089740).

In the experiments following herbicides were used: Glean 75 DF, Chisel 75 DF, Chwastox M, Granstar 75 DF, and mixtures of Glean 75 DF + Atpol (sa adjuvant) and Granstar 75 DF + Atpol. Beside the biological activity of herbicides their effect on yield and quality of seeds was studied. High effectiveness of all herbicides was obtained. Studied herbicides had no negative effect on yield of wheat, germination capacity and total protein content of seeds.

3974 Marshall, E.J.P. (Long Ashton Research Station, Long Ashton, Bristol BS18 9AF (United Kingdom)) (1992) Weeds. Pesticides, cereal farming and the environment: the Boxworth Project. Greig-Smith, P.; Frampton, G.; Hardy, A. (eds.) p. 25-36. H.M.S.O. 10 ref. English. (AGRI 95-079245).

3975 Matic, R.; Black, I.D. (South Australian Research and Development Inst., Adelaide. Northfield Research Lab.) (1994) Short- and long-term chemical control of field bindweed (*Convolvulus arvensis* L.) sprayed during summer and resultant crop yields. *Plant Protection Quarterly (Australia)* v. 9(3) p. 111-113. 1 table, 15 ref. English. (AGRI 95-079284).

A field experiment was carried out using a range of herbicides at Freeling, South Australia. None of the treatments showed control of new stems of field bindweed in the next growing season and they did not increase the yield of wheat or barley. Glyphosate applied in 2 successive years at rates of 2.2 and 3.2 kg per ha resulted in an average 27 percent control of bindweed stems the year after final application, and increased wheat and barley yields. Imazapyr applied at 0.38 and 0.75 kg per ha in 1 year only showed an average 97 and 100 percent control in both the first and second year after application respectively, and 100 percent in the third. Wheat yield was reduced by 52 percent and 97 percent respectively due to residual imazapyr. Barley yield increased 80 and 60 percent respectively, the year following imazapyr treatments.

3976 Melander, B. (1993) [Avoid barren brome grass, soft brome grass and silky bent-grass in the grass seed crop [*Agrostis spica ventii*]]. Undgaa gold hejre, bloed hejre og vindaks i graesfroevlen. *Tidsskrift for Froevl (Denmark)* v. 82(2) p. 4-5. Danish. (AGRI 95-089769).

3977 Morishita, D.W.; Thill, D.C. (1993) Weeds. *Bulletin - Idaho Agricultural Experiment Station (USA)* (no. 742) p. 24-25. In the series analytic: Idaho spring barley production guide / edited by L.D. Robertson and J.C. Stark. English. (AGRI 95-089712).

3978 Orlando, D. (Institut Technique des Cereales et des Fourrages, Paris (France)) (1994) [Pendiron SC and Pronto: new herbicides for cereal crops, mixed herbicides, herbicide tolerance of soft wheat varieties]. Desherbage des cereales: quoi de neuf avant d'aborder la prochaine campagne ? [Pendiron SC (chlortoluron + pendimethaline), Pronto (fluroxypyr + metosulam)]. *Perspectives Agricoles (France)* (no 193) p. 89-95. French. (AGRI 95-079299).

3979 Orlando, D. (Institut Technique des Cereales et des Fourrages, Paris (France)); Jouy, L.; Citron, G. (1994) [Control of weeds in wheat]. Les clés du succès en 1993/1994: un desherbage precoce et une bonne connaissance des herbicides. *Perspectives Agricoles (France)* (no 194) p. 30-32. French. (AGRI 95-079270).

3980 Panwar, R.S.; Malik, R.K.; Balyan, R.S.; Punia, S.S.; Rath, S.S. (1995) PERFORMANCE OF CLOPYRALID, ISOPROTURON AND 2, 4-D ON THE CONTROL OF CANADA THISTLE (*CIRSIIUM ARVENSE*) IN WHEAT (*TRITICUM AESTIVUM*). *Indian Journal of Agronomy*. 40(1):102-104. English. [CHAUDHARY CHARAN SINGH HARYANA AGR UNIV DEPT AGRON HISAR 125004 HARYANA INDIA].

3981 Qian Xi (Huanghai State Farm, Jiangsu (China)) (1994) Studies on weed occurrence and control in wheat fields in reclamation region of Jiangsu, China. *Journal of Weed Science (China)* v. 8(2) p. 23-39. 7 tables; 6 ref. Chinese. (AGRI 95-089735).

3982 Tang Zhongming; Li Zhongkuan (Shanke Farm, Xinjiang (China)) (1994) Studies on occurring feature of wild oat in wheat fields and, its weeding technology. *Plant Protection Technology and Extension (China)* v. 14(3) p. 18. Chinese. (AGRI 95-089737).

3983 Yang Yucang (Shaanxi Provincial General Station of Plant Protection, Xian (China)) (1994) Experiment of controlling wild oat in wheat fields by soluble powder of difenzoate AC. *Shaanxi Journal of Agricultural Sciences (China)* (no. 4) p. 22-23. 1 table. Chinese. (AGRI 95-089734).

3984 Zhang, N.; Chaisattapagon, C. (1995) EFFECTIVE CRITERIA FOR WEED IDENTIFICATION IN WHEAT FIELDS USING MACHINE VISION. *Transactions of the ASAE*. 38(3):965-974. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT BIOL & AGR ENGN MANHATTAN, KS 66506 USA].

A machine vision system was used to identify weeds commonly found in Kansas wheat fields, including Russian thistle, redroot pigweed, Palmer amaranth, wild buckwheat, and kochia. Three different approaches, color analysis, shape analysis, and texture analysis, were used in the study. For the color analysis approach, ratios of pixel gray levels in images taken using four selected color filters were useful in classifying pixels into five different categories-wheat leaf weed leaf, weed stem, soil, and sand. A red/green filter pair was found effective in identifying reddish stems of redroot pigweed, Russian thistle, and kochia. Five shape parameters, eccentricity, compactness, and three invariant moments, were used in leaf shape studies and were found effective in distinguishing broadleaf weed species such as redroot pigweed, wild buckwheat, and kochia from wheat. For the texture analysis approach, Fourier spectra of selected windows within leaf areas of wheat and weed species were analyzed. An index of fineness was defined using the spectra. Leaves with fine textures such as kochia can be distinguished from others using this index. Curves of normalized radial spectral energy were derived from the spectra. Leaves with distinct directionality features such as wheat and some broadleaf weed species can be distinguished using parameters defined using these curves. This study is the first step of a project with an overall goal of developing techniques of selective herbicide application based on weed deflection. [References: 27].

III HANDLING, TRANSPORT, STORAGE AND PROTECTION OF PLANT PRODUCT

3985 Alagusundaram, K.; Jayas, D.S.; Muir, W.E.; White, N.D.G.; Sinha, R.N. (1995) DISTRIBUTION OF INTRODUCED CARBON DIOXIDE THROUGH WHEAT BULKS CONTAINED IN BOLTED-METAL BINS. *Transactions of the ASAE*. 38(3):895-901. English. [UNIV MANITOBA DEPT AGR ENGN WINNIPEG MB CANADA].

The distribution and maintenance of introduced carbon dioxide (CO₂) gas were studied in three empty or wheat-filled bins of 5.56 m diameter. One bin had a 0.46-m-diameter x 4.7-m-long circular aeration duct on the concrete floor, the second bin had a fully perforated floor, and the third bin had a concrete floor. The effects on CO₂ distribution and maintenance of sealing various portions of the bin, the point of application, the amount and frequency of application, the mode of application of dry ice, and the grain surface left open or covered with polyvinylidene chloride (PVDC) sheet were determined. Irrespective of the point of application, the CO₂ concentrations were greater in the bottom than the top portions of the grain bulk. Introducing dry ice on the grain surface resulted in greater CO₂ concentrations in the top portions of the grain bulk than introducing it near the bottom. Placing insulated boxes filled with dry ice blocks on the grain

surface was less labor intensive and maintained high levels of CO₂ in the grain bulk for long durations. A new method of estimating retention efficiency ($\eta(r)$) is demonstrated. Due to uncontrollable leaks in the bin the $\eta(r)$ was generally low. [References: 16].

3986 Cofie Agblor, R. (Manitoba Univ., Winnipeg, Man. (Canada). Dept. of Agricultural Engineering); Muir, W.E.; Sinha, R.N. (1995) **Comparative heat of respiration of five grain beetles in stored wheat. *Postharvest Biology and Technology* (Netherlands) v. 5(1-2) p. 167-175. 16 ref. English. (AGRIS 95-079389).**

3987 Cofieagblor, R.; Muir, W.E.; Sinha, R.N. (1995) **COMPARATIVE HEAT OF RESPIRATION OF FIVE GRAIN BEETLES IN STORED WHEAT. *Postharvest Biology & Technology*. 5(1-2):167-175. English. [UNIV MANITOBA DEPT AGR ENGN WINNIPEG MB R3T 2N2 CANADA].**

The heat production of five grain beetles in wheat of 14.5% moisture content was measured at two initial grain temperatures of 20 and 30 degrees C in 10 h using a computer-controlled adiabatic calorimeter. Heat production per individual at both temperatures was highest in *Sitophilus granarius* (66.1 and 81.4 μ W) and lowest in *Rhyzopertha dominica* (12.5 and 35.3 μ W). *S. oryzae* had the highest heat production rate per unit biomass at 25.3 and 30.6 μ W/mg at 20 and 30 degrees C respectively. Heat production by all species was higher at 30 degrees C than at 20 degrees C; the difference was greater for *Tribolium castaneum*, *T. confusum*, and *R. dominica* than for *S. granarius* and *S. oryzae*. The rate of heat production by *S. granarius* at 30 degrees C decreased with time, the average rate during the first 6 h was 93.7 μ W/insect, while during the final 2 h the rate was 58.7 μ W/insect. Heat production rates of *S. granarius*, *S. oryzae*, and *R. dominica* increased with time at 20 degrees C. For all species at both temperatures, the measured heat production was greater than the amount calculated from the respiratory exchange. [References: 16].

3988 Khalaf, S.A. (Zagazig Univ. (Egypt). Faculty of Science) (1993) **The protective effect of gamma irradiation against fusaria infection and zearalenone production in storage wheat grains. *Zagazig Veterinary Journal* (Egypt) v. 21(5) p. 840-851. 1 ill. 3 tables; 19 ref. English. (AGRIS 95-089805).**

3989 Kljajic, P.; Peric, Z.; Peric, I. (Institut za istrazivanja u poljoprivredi "Srbija", Beograd (Yugoslavia). Centar za pesticide i zastitu zivotne sredine) (1994) **Interactions between extreme temperatures and insecticide effects on grain weevil (*Sitophilus granarius* L.) adults. Interakcije ekstremnih temperatura i delovanja insekticida na adulte zitnog ziska, *Sitophilus granarius* (L.). *Pesticidi* (Yugoslavia) v. 9(2) p. 57-63. 10 tables; 16 ref. Serbian. (AGRIS 95-079390).**

Based on the results obtained an increasing susceptibility of the grain weevil to Chlorpyrifos-methyl and Deltamethrin was recorded with grain weevil adults previously exposed to temperatures 45, 50 and 55 deg C. However, the effects of Chlorpyrifos-methyl treatments on insects previously exposed to 60 deg C were slower. On the other hand the effects of Deltamethrin on these insects was similar to the one recorded on insects which had previously not been exposed to high temperatures. Significant insecticide effects on grain weevil previously exposed to low temperature were also noted. In simultaneous treatments of both high temperatures and insecticides the effects on grain weevil was more rapid compared with the effects of either insecticide or temperature treatments only.

3990 Sinicio, R.; Muir, W.E.; Jayas, D.S.; Cenkowski, S. (1995) **THIN-LAYER DRYING AND WETTING OF WHEAT. *Postharvest Biology & Technology*. 5(3):261-275. English. [UNIV MANITOBA DEPT AGR ENGN WINNIPEG MB R3T 5V6 CANADA].**

The research objectives were to determine accurate thin-layer drying and wetting equations for 'Katepwa' wheat. Equilibrium moisture content (EMC) equations for adsorption and desorption were also developed based on the experimental drying and wetting data. The modified Chung-Pfost equation predicted reasonably well the EMC for both adsorption and desorption of wheat. The range of test conditions were: temperature 7.6-35.1 degrees C; relative humidity 28-92%; air velocity 0.04-0.2 m s⁻¹; and initial moisture content 9.2-16.7% (wet mass basis). Thin-layer drying of wheat was affected by air temperature, relative humidity, and initial

moisture content while thin-layer wetting also slightly depended on air velocity. The semi-empirical equation of Page was more accurate than the theoretical diffusion equation with the diffusion coefficient dependent on temperature only. [References: 35].

3991 Varnava, A.; Navarro, S.; Donahaye, E. (1995) **LONG-TERM HERMETIC STORAGE OF BARLEY IN PVC-COVERED CONCRETE PLATFORMS UNDER MEDITERRANEAN CONDITIONS. *Postharvest Biology & Technology*. 6(1-2):177-186. English. [CYPRUS GRAIN COMMISS DEPT INSPECT NICOSIA CYPRUS].**

A method for the bulk storage of barley in the open air under Mediterranean conditions was developed. A large (75 x 25 m) concrete platform with low walls was filled with barley and covered with a PVC overliner and a polyethylene underliner. The barley formed a pile of 4018 tonnes with a peak 7 m high and was stored for 34 months under hermetic seal. Periodic monitoring was carried out to determine temperature fluctuations, intergranular gas composition, insect infestation, and grain quality parameters. Ambient temperatures were shown to create temperature gradients in the upper layers, and moisture migration occurred towards the peak of the grain bulk. However, the resulting spoilage by moulds was limited to 0.22% weight loss on an annual basis. An additional 0.12% loss due to insect damage, and spillage resulted in an annual storage loss of 0.34%. Possible solutions to this problem were discussed. The platform successfully protected the grain against insect, bird, and rodent attack and provided safe storage during the rainy season. At the end of storage the PVC overliner, which had been used continuously since 1988, remained with low gas-permeability, retained its mechanical characteristics and was suitable for reuse. [References: 8].

3992 Wu Junxiang; Liu Shaoyou; He Minyun (Northwestern Agricultural Univ., Yangling, Shaanxi (China). Dept. of Plant Protection) (1994) **Influence of temperature and moisture on growth and reproduction of wheat moth. *Shaanxi Journal of Agricultural Sciences* (China) (no. 6) p. 1-3. 3 tables; 5 ref. Chinese. (AGRIS 95-089804).**

L01 ANIMAL HUSBANDRY

3993 Adams, N.J.; McNutt, R. (1992) **Stocker cattle performance and implant management on wheat pasture. *PR - Texas Agricultural Experiment Station* (USA) (no. 4969) p. 67-69. English. (AGRIS 95-090354).**

3994 Viveros, A.; Arijia, I.; Canales, R. (Universidad Complutense de Madrid (Espana). Facultad de Veterinaria); Brenes, A. (1994) **Effect of enzyme addition on plasma minerals, cholesterol and caecal volatile fatty acids concentrations in broiler diets based on barley. *Investigacion Agraria. Produccion y Sanidad Animales* (Espana) v. 9(2) p. 109-118. 6 tab.; 33 ref. English. (AGRIS 95-090466).**

L02 ANIMAL FEEDING

3995 Abbas, A.M. (Ministry of Agriculture, Cairo (Egypt). Animal Production Research Inst.); Soliman, A.Z.; Abd El Malak, M.S. (1994) **Effect of replacing yellow corn with barley in laying hen diets on egg production and quality. *Journal of Agricultural Sciences, Mansoura Univ. (Egypt)* v. 19(5) p. 1633-1643. 3 tables; 28 ref. English. (AGRIS 95-090745).**

3996 Anon. (1993) **[Trials in bacon pigs. Effect of introducing high level of pea in diets on palatability for pig. Slaughter and growing performance of pigs fed low protein wheat - soybean meal based diets]. *Essais sur porcs charcutiers* (Vendome). Effet de l'incorporation de quantites elevees de pois dans le regime sur l'appetence chez le porc charcutier. Effet dans les regimes simples, equilibres en acides amines digestibles, de la diminution de la matiere azotee totale sur les performances de croissance de porcs charcutiers. [Use of cereals and protein crops by animals. Report of the 1992 experiments by the "Service Valorisation Animale" (ITCF [Technical institute for cereals and forages])]. Valorisation animale des cereales et proteagineux. Compte rendu des experimentations 1992 du Service Valorisation Animale (ITCF [Institut technique des cereales et fourrages]). Institut Technique des Cereales et des Fourrages, Paris (France) p. 33-38. ITCF. 6 tableaux. French. (AGRIS 95-090675).**

3997 Anon. (1993) [Trials in cocks]. *Essais sur coqs (Boigneville)*. [Use of cereals and protein crops by animals. Report of the 1992 experiments by the "Service Valorisation Animale" (ITCF [Technical institute for cereals and forages])]. *Valorisation animale des cereales et proteagineux. Compte rendu des experimentations 1992 du Service Valorisation Animale (ITCF [Institut technique des cereales et fourrages])*. Institut Technique des Cereales et des Fourrages, Paris (France) p. 45-55. ITCF. 6 tableaux. French. (AGRI 95-090716).

Results of the following trials. Measurement of endogenous energy excretion in adult cockerels. Feeding value of one batch of red sorghum and one batch of white sorghum in adult cockerels. Effect of the feeding technique and the fineness of grinding on feeding value of wheat and pea in adult cockerels. Feeding value in adult cockerels of 3 wheat varieties. Feeding value of preharvest sprouted wheats in adult cockerels.

3998 Anon. (1993) [Trials in young turkey. Digestibility trials on turkey poults: effect of age of poults and comparison with adult cockerels]. *Essais sur dindonneaux (Boigneville)*. Mesures de digestibilite chez le dindonneau: effet de l'age et comparaison avec les mesures sur coq adulte. [Use of cereals and protein crops by animals. Report of the 1992 experiments by the "Service Valorisation Animale" (ITCF [Technical institute for cereals and forages])]. *Valorisation animale des cereales et proteagineux. Compte rendu des experimentations 1992 du Service Valorisation Animale (ITCF [Institut technique des cereales et fourrages])*. Institut Technique des Cereales et des Fourrages, Paris (France) p. 57-60. ITCF. French. (AGRI 95-090759).

3999 Anon. (1993) [Trials with piglets: performance of weaned piglets fed a diet containing by-product derived from the distillery of wheat]. *Essais sur porcelets (Vendome): valorisation de dreches de ble issues de la fabrication de bio-ethanol par le porcelet sevre*. [Use of cereals and protein crops by animals. Report of the 1992 experiments by the "Service Valorisation Animale" (ITCF [Technical institute for cereals and forages])]. *Valorisation animale des cereales et proteagineux. Compte rendu des experimentations 1992 du Service Valorisation Animale (ITCF [Institut technique des cereales et fourrages])*. Institut Technique des Cereales et des Fourrages, Paris (France) p. 17-20. ITCF. French. (AGRI 95-090674).

4000 Bodart, C.; Thielemans, M.F. (Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium). Station de Zootechnie) (1994) [Diminishing the protein rate in (swine) diets based on wheat: effect on the zootechnical performances and the quantity of excreted nitrogen]. *Diminution du taux proteique dans des regimes a base de froment: influence sur les performances zootechniques et la quantite d'azote excrete*. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. *Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993*. Seutin, E.; Falisse, A. (eds) (Zootechnie) 3 p. 4 tables. French. (AGRI 95-080467).

4001 Brand, TS.; Olckers, RC.; Vandermerwe, JP. (1995) TRITICALE (TRITICO SECALE) AS SUBSTITUTE FOR MAIZE IN PIG DIETS. *Animal Feed Science & Technology*. 53(3-4):345-352. English. [ELSENBURG AGR DEV INST PRIVATE BAG X01 ELSENBURG 7607 SOUTH AFRICA].

An experiment was conducted to quantify the effect of the inclusion of triticale (cv. Usgen 19) in the diets of pigs, on certain metabolism and production parameters. Three diets were formulated on an iso-nutrient basis (approximately 13.9 MJ kg⁻¹ dry matter (DM) metabolizable energy, 17.2% crude protein, 1.00% lysine, 0.69% methionine and cystine and 0.23% tryptophan on a DM basis) so that maize meal was substituted by increasing levels of triticale meal (0%, 33% and 67%). In a metabolism and nitrogen (N) balance study with 18 SA Landrace x Great White boars, DM digestibility, apparent N digestibility, digestible energy (DE) and metabolizable energy (ME) contents were largely independent of the substitution of maize by triticale. Apparent N retention tended (P less than or equal to 0.09) to be better on the triticale-containing diets. The diets were evaluated according to a 2 (sex) x 3 (diet) factorial arrangement of treatments in terms of dry matter intake (DMI), average daily gain (ADG) and feed conversion ratio (FCR), in a growth study with 13 SA Landrace x Large White pigs per diet. Mean (+/- SE) initial live mass of the pigs was 23.4 +/- 0.3 kg. Pigs were fed ad libitum. The experiment ended when the pigs were slaughtered at a live mass of 90.6 +/- 0.2 kg, and carcass characteristics were determined. Daily DMI of pigs decreased linearly (P less than or equal to 0.01) by 198 (SE(b) = 71) g day⁻¹ per unit substitution

of maize by triticale. Daily gain was similarly affected, with a corresponding linear (P less than or equal to 0.01) decline of 95 (SE(b) = 34) g day⁻¹. The substitution of maize with triticale up to 67% did not affect FCR significantly; the mean FCR was 2.72 kg DMI required per kg live mass gain. Mean dressing percentage, eye muscle area or back fat thickness did not differ significantly between diets (means of 80.5%, 38.8 cm(2) and 17.6 mm), although pigs on the 100% maize diet tended (P less than or equal to 0.07) to have thicker back fat than pigs on the triticale diets. Efficiency was thus largely unaffected by the substitution of maize by triticale. Triticale may therefore be used to substitute maize up to 67% provided that the lower DMI and resultant poorer growth rate is taken into consideration. [References: 22].

4002 Depies, KK.; Armentano, LE. (1995) PARTIAL REPLACEMENT OF ALFALFA FIBER WITH FIBER FROM GROUND CORN COBS OR WHEAT MIDDINGS. *Journal of Dairy Science*. 78(6):1328-1335. English. [UNIV WISCONSIN DEPT DAIRY SCI MADISON, WI 53706 USA].

This trial examined the effect of using corn cobs or wheat middlings to replace alfalfa partially as the dietary fiber source for lactating cows. Multiparous midlactation cows were used in three 4 x 4 Latin squares with 21-d periods. A low fiber, basal diet contained 26.8 g of total NDF, including 14.7 g of alfalfa NDF/100 g of dietary DM. Dietary fiber was increased by addition of more alfalfa, corn cobs, or wheat middlings to obtain 27.4, 28.9, and 27.9%, respectively, of total dietary NDF. Intake (24.9 kg of DM/d) and milk yield (31.6 kg/d) were not different among treatments. Nonforage fiber sources raised milk fat concentration above basal amounts (3.1% to 3.4% fat) and decreased ruminating time below that of the high alfalfa diet (423 to 390 min/d). Fat test was raised approximately one-half as much per unit of NDF from these nonforage feeds as it was per unit of NDF from alfalfa. When additional dietary fiber came from nonforage sources, milk protein concentration (3.3%) was greater than when alfalfa provided the added fiber (3.2%). [References: 21].

4003 Duefelsiek, U. (Landwirtschaftskammer Westfalen Lippe, Muenster (Germany)) (1994) [Does supplementary wheat pay its way in broiler fattening?]. *Rechnet sich die Weizenbeifutterung in der Broilermast? Deutsche Gefluogelwirtschaft und Schweineproduktion (Germany) v. 46(47) p. 15-16*. 1 ill., 2 tables. German. (AGRI 95-090724).

4004 Jeroch, H.; Engerer, K.H. (Institute of Animal Nutrition, Martin Luther University Halle Wittenberg, Emil Abderhalden Strasse 25 b, 4020 Halle (Germany)) (1992) Effect of a beta-glucanase-containing multienzyme preparation to geese fattening mixtures on barley basis. *Proceedings 9th International Symposium on Waterfowl, Pisa, Italy, 16-18 September 1992*. p. 159-161. World's Poultry Science Association. 3 ref. English. (AGRI 95-090755).

4005 McGregor, B.A. (Victorian Dept. of Agriculture, Attwood (Australia). Victorian Inst. of Animal Science) (1994) Wheat can be rapidly introduced to Angora goats. *Mohair Australia (Australia) v. 3(3) p. 8-9*. English. (AGRI 95-080446).

4006 Mcniven, MA.; Weisbjerg, MR.; Hvelplund, T. (1995) INFLUENCE OF ROASTING OR SODIUM HYDROXIDE TREATMENT OF BARLEY ON DIGESTION IN LACTATING COWS. *Journal of Dairy Science*. 78(5):1106-1115. English. [UNIV PRINCE EDWARD ISL DEPT HLTH MANAGEMENT CHARLOTTETOWN PE C1A 4P3 CANADA].

Three cannulated, lactating cows were used in a 3 x 3 Latin square design to determine the effect of roasting or NaOH treatment of barley on ruminal fermentation and site and extent of digestion of nutrients. Experimental treatments were rolled barley, roasted (exit temperature, 135 degrees C) and rolled barley, and treated with 4% NaOH and 220 L of H₂O/tonne of barley. Diets also consisted of grass silage and soybean meal. Treatment with NaOH reduced concentrations of several AA, starch, and NDF in the barley. Starch digestibility in the rumen was lower for barley that was treated with NaOH but was unaffected for roasted barley. Digestibilities of N and starch in the small intestine were reduced for barley treated with NaOH, but values for rolled and roasted barley were similar. Apparent total tract digestibility of starch was reduced for the NaOH treated barley. Treatment of barley with NaOH tended to have a detrimental effect on feed intake, digestibility, and milk production.

Roasting of barley did not appear to affect the site or extent of carbohydrate digestion, but roasting protected N from ruminal degradation. The protective effect on the carbohydrate fraction would be expected to be greater if the grain were cooled prior to rolling so that the protein matrix of the starch granule remained intact. [References: 35].

4007 Okiely, P.; Moloney, AP. (1995) **PERFORMANCE OF CATTLE OFFERED WHOLE-CROP BARLEY OR WHEAT SILAGE.** *Irish Journal of Agricultural & Food Research*. 34(1):13-24. English. [TEAGASC GRANGE RES CTR DUNSANY MEATH IRELAND].

Factors affecting the nutritive value of whole-crop cereal silage for beef cattle were examined. In Experiment 1, finishing steers offered barley silage, harvested at the milky (262 g dry matter (DM)/kg) or mealy (347 g DM/kg) stages of grain ripeness, for 95 days, had carcass gains of 292 and 442 (s.e. 33.2) g/day, respectively. Animals offered no supplement, 3 kg rolled barley, 3 kg of a barley plus soyabean meal mixture (154 g crude protein (CP)/kg DM) or 1 kg soyabean meal (470 g CP/kg DM) per head daily had carcass gains of 173, 442, 529 and 324 (s.e. 46.9) g/day, respectively. In Experiment 2, untreated (340 g DM/kg) or urea (19 kg/t DM) treated barley silage, supplemented with 2.9 kg concentrates per head daily, supported carcass gains of 629 and 634 (s.e. 20.5) g/day, respectively, in heifers during a 101-day finishing period. In Experiment 3, finishing heifers offered barley silages, made with no additive, urea (34 kg/t DM) or urea (30 kg/t DM) plus NaOH (21 kg/t DM) had carcass gains of 374, 477 and 534 (s.e. 23.0) g/day, respectively, over an 84-day experimental period. Supplementation with 2 kg concentrates per head daily increased mean carcass gain from 355 to 568 (s.e. 18.8) g/day. In Experiment 4, whole-crop wheat silage made without additive (431 g DM/kg; pH 4.1), with 56 kg urea/t DM (pH 5.6) or 111 kg urea/t DM (pH 7.6), and grass silage (218 g DM/kg; pH 4.1), all supplemented with 2 kg barley per head daily, supported liveweight gains in young beef heifers, over 112 days, of 645, 509, 362 and 719 (s.e. 34.7) g/day, respectively. It is concluded that (1) the carcass weight gain of cattle offered whole-crop barley silage was higher when harvesting was later, when the DM concentration of the silage was high (greater than or equal to 460 g/kg) and when the silage was treated with urea or urea plus NaOH, and (2) the intake and performance of cattle offered extensively fermented whole-crop wheat silage were reduced by excessive urea addition at ensiling.

4008 Richter, G. (Thueringer Landesanstalt fuer Landwirtschaft, Remderoda (Germany)) (1994) [Enzymes in broiler feed: is it possible to improve the feed value of rye and triticale?]. *Enzyme im Broilerfutter: Kann der Futterwert von Roggen und Triticale verbessert werden?* *Deutsche Gefluesselwirtschaft und Schweineproduktion (Germany)* v. 46(48) p. 6-8. 1 ill., 3 tables. German. (AGRI 95-090725).

4009 Richter, G. (Landwirtschaftliche Untersuchungs und Forschungsanstalt Thueringen, Remderoda (Germany). Sachgebiet Tierernaehrung); Lemser, A. (1994) [Domestic triticale used as feed for chicken and pullets]. *Einheimisches Triticale bei Kueken und Junghennen. Kraftfutter (Germany)* (no.10) p. 380, 382-384, 386-387. 4 tables. German. (AGRI 95-090737).

4010 Ristic, M.; Rauch, H.W. (Bundesanstalt fur Fleischforschung, E.C. Baumann Strasse 20, 8650 Kulmbach (Germany)) (1992) **Chemical composition of meat and fat of geese on pasture as influenced by supplementary feeding of oats or wheat.** *Proceedings 9th International Symposium on Waterfowl, Pisa, Italy, 16-18 September 1992*. p. 243-246. World's Poultry Science Association. 2 ref. English. (AGRI 95-090756).

4011 Sarker, A.A. (Bangladesh Sericulture Research and Training Institute, Rajshahi (Bangladesh). Serichemistry Section); Absar, N. (1994) [Effect of wheat bran in artificial diet on rearing the adult larvae of the silkworm, *Bombyx mori* L.]. *Effet du son de ble dans l'aliment artificiel sur l'elevage des larves de ver a soie Bombyx mori aux 4. et 5. ages larvaires.* *Sericulture (France)* v. 34(1) p. 123-132. 21 ref. (En, Fr). (AGRI 95-090773).

4012 Seiwert, C. (1994) [Investigations of the necessary use of crystalline tryptophan and isoleucine in protein reduced rations for different phases in pig fattening]. *Untersuchungen zum notwendigen Einsatz von kristallinem Tryptophan und Isoleucin in proteinreduzierten*

Futtermischungen fuer verschiedene Phasen der Schweinemast. Bonn Univ. (Germany). Inst. fuer Tierernaehrung. Shaker. 2 ill., 54 tables. Bibliography 91 ref. 129 p. German. (AGRI 95-090691).

4013 Spiekens, H. (Landwirtschaftskammer Rheinland, Bonn (Germany)) (1994) [Barley is scarce and expensive - what has to be done?]. *Gerste ist knapp und teuer - was tun?* *Schweinezucht und Schweinemast (Germany)* v. 41(2) p. 24-27. 1 ill., 3 tables. German. (AGRI 95-090696).

4014 Tan, ZL.; Chen, HP.; He, LH.; Fang, RJ.; Xing, TX. (1995) **VARIATION IN THE NUTRITIONAL CHARACTERISTICS OF WHEAT STRAW.** *Animal Feed Science & Technology*. 53(3-4):337-344. English. [CHINESE ACAD SCI CHANGSHA INST AGR MODERNIZAT CHANGSHA 410125 PEOPLES REPUBLIC OF CHINA].

A number of agronomic, morphological and nutritive measurements were determined for three varieties of wheat from two types of soil in Northern China. The results were as follows: (1) higher neutral detergent fibre and lignin contents but lower crude protein and neutral detergent soluble contents were noted for the whole wheat straw plant during maturation; (2) the feed nutritive value of leaf blades (LB) is highest, then leaf sheath, and that of the stem (S) the lowest; however, as the stem constitutes more than 50% of the whole plant, the nutritive value of wheat straw is dependent on the nutritive quality of the stem; (3) from top to bottom of the plant, the nutritive value of wheat straw is from high to low; (4) the height of the plant and proportion of stem to whole plant are correlated negatively with the dry matter disappearance (DMD), but the thousand grain weight and the ratio leaf blade to leaf stem are correlated positively with DMD. It is possible, therefore, to predict the nutritive value of wheat straw on the basis of its agronomic, morphological and chemical features and their relationship with the DMD value. [References: 9].

4015 Tortuero, F.; Fernandez, E. (1995) **EFFECTS OF INCLUSION OF MICROBIAL CULTURES IN BARLEY-BASED DIETS FED TO LAYING HENS.** *Animal Feed Science & Technology*. 53(3-4):255-265. English. [CSIC INST FRIO DEPT NUTR & METAB AVDA RAMIRO MAEZTU S-N CIUDAD UNIV E-28040 MADRID SPAIN].

The effect of a mix of freeze dried *Lactobacillus acidophilus* plus *Lactobacillus casei* (2.3×10^8 colony forming units (cfu) kg⁻¹ feed), or concentrates of *Bacillus cereus* (CIC-953) (10^9 cfu kg⁻¹ feed), or *Streptococcus faecium* (CL-15) (1.5×10^9 cfu kg⁻¹) on laying performance and mineral metabolism in White Leghorn hens was investigated in three 16-week experiments. A maize-barley (50/50) based diet (Experiment 1) or a barley based diet (Experiments 2 and 3) was used. The first experiment involved two treatments: a control diet and the same diet with *L. acidophilus* plus *L. casei* mixed culture. Supplementation improved hen day egg production ($P < 0.01$), feed conversion ratio ($P < 0.01$), egg weight ($P < 0.05$) and albumen quality ($P < 0.05$). Feed consumption and egg specific gravity were not influenced by the treatments. The second experiment also involved two treatments: an unsupplemented control diet and the same diet with *B. cereus* concentrate. Increased ($P < 0.01$) egg weight and albumen quality were observed in hens receiving the *B. cereus* culture. There were no significant differences in feed consumption, feed conversion ratio or egg specific gravity. The third experiment involved four dietary treatments: control diet; control diet with *L. acidophilus* plus *L. casei* mixed culture; control diet with *B. cereus* concentrate; or control diet with *S. faecium* concentrate. The *L. acidophilus* plus *L. casei* mix improved hen day egg production ($P < 0.01$), egg weight ($P < 0.05$), and albumen quality ($P < 0.01$). Feed consumption and feed conversion ratio were not affected by the addition of lactobacilli to the diet. Supplementation of *B. cereus* to the diet determined similar response to that indicated in Experiment 2. Birds receiving *S. faecium* produced greater egg mass ($P < 0.01$), egg weight ($P < 0.01$) and albumen quality ($P < 0.01$). Feed consumption, feed conversion ratio and egg specific gravity did not differ from the control group. Although calcium retention was not significantly affected by feeding the microorganisms cultures, it tended to improve by 2.4-4.2%. Addition of bacterial cultures to barley diet increased ($P < 0.01$) shell calcium. Plasma calcium, phosphorus, magnesium and zinc levels were similar to those of hens on the control diet. Feeding the *S. faecium* culture decreased ($P < 0.05$) serum copper. Laying hens fed an *L.*

acidophilus plus L. casei mixed culture showed a decrease in serum iron ($P < 0.01$). [References: 26].

L51 ANIMAL PHYSIOLOGY-NUTRITION

4016 Gareis, M. (Bundesanstalt fuer Fleischforschung, Kulmbach (Germany). Inst. fuer Mikrobiologie und Toxikologie) (1994) [Maskierte mykotoxine. Maskierte Mykotoxine. DLG-Tagung Grenzwerte fuer umweltrelevante Spurenstoffe; Suhl (Germany); 7-8 Sep 1993. Uebersichten zur Tierernaehrung (Germany) v. 22(1) p. 104-113. 7 ill.; 10 ref. German. (AGRS 95-091369).

4017 Liebert, F. (Christian Albrechts Univ. Kiel (Germany). Inst. for Animal Nutrition and Metabolism Physiology); Wecke, C. (1994) Aspects of feed enzymes in nutrient utilization of chicken. Eighth Forum of Applied Biotechnology; Brugge (Belgium); 28-30 Sep 1994. Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 59(4b) p. 2263-2272. 6 ill.; 6 tables; 12 ref. English. (AGRS 95-091391).

4018 Saluzzi, L.; Colin, CS.; Flint, HJ.; Smith, A. (1995) PLASMALOGENS OF MICROBIAL COMMUNITIES ASSOCIATED WITH BARLEY STRAW AND CLOVER IN THE RUMEN. FEMS Microbiology Ecology. 17(1):47-56. English. [ROWETT RES INST GREENBURN RD BUCKSBURN AB2 9SB ABERDEEN SCOTLAND].

Microbial plasmalogen aldehydes (detected as dimethyl acetals, DMA) have been used to compare microbial populations associated with clover and barley straw incubated in nylon mesh bag in the rumen of a cow. The results suggest that the populations involved in the digestion of these substrates differ substantially and that population changes occur as digestion proceeds: these conclusions were supported by electron-microscopic observations. Analysis of DMA suggested that populations associated with the particles of straw and clover differed more markedly than the corresponding populations in the liquid phase. When straw was pre-incubated with the rumen cellulolytic bacterium Ruminococcus flavefaciens strain 17, the DMA characteristic of this bacterium were present at increased levels during subsequent incubation of the straw in the rumen, though the R. flavefaciens DMA tended to contribute a smaller proportion of the total DMA as the incubation time in the rumen was increased from 24 to 72h. [References: 34].

N20 AGRICULTURAL MACHINERY AND EQUIPMENT

4019 Markowski, M.; Trajer, J. (Szkoła Główna Gospodarstwa Wiejskiego, Warszawa (Poland). Katedra Inżynierii Procesów Rolniczych) (1993) [Modelling and computer simulation of the process of drying cereal grain in the drum drier. Pt. 3. Verification of the model]. Modelowanie i symulacja komputerowa procesu suszenia ziarna zbóż w suszarce bebnowej. Cz. 3. Weryfikacja modelu. Roczniki Nauk Rolniczych. Seria C - Technika Rolnicza (Poland); Polish Agricultural Annual. Series C - Agricultural Engineering v. 79(2) p. 105-108. 3 fig.; 5 ref. Polish. (AGRS 95-092819).

Results of the simulation investigations performed by the method as described in the parts 1 and 2 of the papers are compared with the results of empirical drying wheat grain method as proposed by Szyszko. The preliminary estimation of the model was based on the comparison of results obtained in the simulational test with known results.

P01 NATURE CONSERVATION AND LAND RESOURCES

4020 Schulz, A.; Mirschel, W. (1994) [Models being put to the test - How accurate are agro-ecological simulation models?]. Modelle auf dem Prüfstand - Wie genau sind agrarökologische Simulationsmodelle? Zeitschrift fuer Agrar-informatik (Germany) v. 2(2) p. 22-29. 10 graphs; 14 ref. German. (AGRS 95-082592).

P10 WATER RESOURCES AND MANAGEMENT

4021 El Hamdi, K.F.; Taha, A.A. (Mansoura Univ. (Egypt). Faculty of Agriculture); Saleh, H.H. (1993) Role of added calcium to the saline sodic irrigation water in growth and nutrient uptake of barley plants. Journal of Agricultural Sciences, Mansoura Univ. (Egypt) v. 18(2) p. 595-602. 4 tables; 25 ref. English. (AGRS 95-093184).

P33 SOIL CHEMISTRY AND PHYSICS

4022 Asmar, F.; Singh, T.; GAHOONIA.; Nielsen, NE. (1995) BARLEY GENOTYPES DIFFER IN ACTIVITY OF SOLUBLE EXTRACELLULAR PHOSPHATASE AND DEPLETION OF ORGANIC PHOSPHORUS IN THE RHIZOSPHERE SOIL. Plant & Soil. 172(1):117-122. English. [ROYAL VET & AGR UNIV DEPT AGR SCI SOIL & WATER & PLANT NUTR SECT THORVALDSENSVEJ 40 DK-1871 FREDERIKSBURG DENMARK].

In the present investigation we studied the extent of variation among barley genotypes (Hordeum vulgare L. cv. Alexis, Canut, Digger, Etna, Peel) in their ability: i) to induce activity of soluble extracellular phosphatase in rhizosphere soil. ii) to withdraw bicarbonate extractable organic phosphorus ($\text{NaHCO}_3\text{-P-o}$). All the genotypes induced 3-4 times higher phosphatase activities in rhizosphere soil as compared to bulk soil. Among the genotypes, there were significant ($p > 0.01$) differences in soluble extracellular and non-soluble phosphatase activities and depletion of $\text{NaHCO}_3\text{-P-o}$ in soil near their root mats. Etna induced highest phosphatase activities and depleted most $\text{NaHCO}_3\text{-P-o}$ from the rhizosphere soil. A high correlation ($r = 0.79$) was found between the activity of soluble extracellular phosphatase and the quantity of $\text{NaHCO}_3\text{-P-o}$ withdrawn from the rhizosphere soil by the barley genotypes. [References: 24].

4023 Bosch, OJH.; Otto, WM. (1995) THE EXTENT OF SOIL ACIDITY IN THE DRYLAND WHEAT PRODUCTION REGIONS OF SOUTH AFRICA. Cereal Research Communications. 23(1-2):179-181. English. [AGR RES COUNCIL CTR SMALL GRAIN PRIVATE BAG X29 BETHLEHEM 9700 SOUTH AFRICA].

The extent of soil acidity in the different dryland wheat production regions of South Africa was determined. Soil analyses indicated that 80, 9% of the wheat fields in the Eastern Free State, 26% in the Central Free State and even 14, 3% in the Western Cape had acidity levels that exceeded the critical soil acidity level for economically viable wheat production.

4024 Gruen, M. (Agrar und Umweltanalytik GmbH, Jena (Germany)); Machelett, B.; Kronemann, H.; Martin, M.; Schneider, J.; Podlesak, W. (1994) [Heavy metals in food chain with special regards to the transfer from soil to plant]. Schwermetalle in der Nahrungskette unter besonderer Beruecksichtigung des Transfers vom Boden zur Pflanze. DLG-Tagung Grenzwerte fuer umweltrelevante Spurenstoffe; Suhl (Germany); 7-8 Sep 1993. Uebersichten zur Tierernaehrung (Germany) v. 22(1) p. 7-16. 12 tables; 7 ref. German. (AGRS 95-093429).

4025 Hoevelmann, L. (Bonn Univ. (Germany). Inst. fuer Pflanzenbau); Franken, H. (1993) [Penetration resistance and dynamics of root development under winter wheat grown on reclaimed loess soils in dependence on basic tillage]. Eindringwiderstand und Dynamik der Wurzelentwicklung unter Winterweizen auf rekultivierten Boeden aus Loess in Abhaengigkeit von der Grundbodenbearbeitung. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft (Germany); no. 71 p. 53-56. Deutsche Bodenkundliche Gesellschaft. 3 ill.; 2 ref. p. 53-56. German. (AGRS 95-083266).

4026 Mrhar, M.; Poje, T. (Agricultural Institute of Slovenia, Ljubljana (Slovenia)) (1994) [The system of soil tillage and physical-mechanical condition of soil after tillage]. Sistem obdelave tal in fizikalno mehanicno stanje tal po obdelavi. Simpozij Novi izzivi v poljedelstvu (Symposium on New Challenges in Field Crop Production); Kocevje (Slovenia); 7-8 Sep 1994. [Proceedings of the Symposium on New Challenges in

Field Crop Production]. Kotnik, T. (ed.). Ljubljana Univ. (Slovenia). Biotechnical Fac., Agronomy Dept. p. 77-83. 2 ill., 4 ref. Slovenian. (AGRI 95-093432).

Soil tillage is a measure which most efficiently influences growth conditions. The tillage system significantly affects porosity of soil and soil consolidation. This paper discusses influence of soil tillage systems and that of working conditions on the physical-mechanical soil conditions at winter wheat production.

4027 Springob, G.; Lebert, M.; Vonreichenbach, HG. (1995) **IMPROVED CORRELATION BETWEEN SOIL EXCHANGEABLE K AND PLANT K CONTENTS ON A TISSUE WATER BASIS.** *Plant & Soil*. 172(1):163-165. English. [UNIV HANNOVER INST SOIL SCI HERRENHAUSER STR 2 D-30419 HANNOVER GERMANY].

The correlation between the exchangeable K of 184 loess topsoils and K in field grown winter wheat at stem elongation was higher for the tissue water K ($r(2) = 0.602$) than for the classical K in dry matter ($r(2) = 0.278$). The tissue water K versus soil K function levelled out at an upper plateau of 207 mmol kg⁻¹. Tissue water K is shown to be a useful indicator to derive critical values of soil K whereas the classical dry matter K is considered to be an inadequate plant K indicator under practical agricultural conditions. [References: 15].

4028 Tong, Y.; Rengel, Z.; Graham, RD. (1995) **EFFECTS OF TEMPERATURE ON EXTRACTABLE MANGANESE AND DISTRIBUTION OF MANGANESE AMONG SOIL FRACTIONS.**

Communications in Soil Science & Plant Analysis. 26(11-12):1963-1977. English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

Fertiliser manganese (Mn) does not have good residual value in calcareous soils in southern Australia. The interaction of biotic and abiotic factors determining availability of fertiliser Mn is not well understood. Effects of autoclaving and temperature of moist incubation on DTPA (diethylenetriamine-pentaacetic acid)-extractable Mn and the distribution of Mn among soil fractions was tested in a sandy, calcareous Wangary soil. In the topsoil receiving 10 or 40 mg Mn/kg, higher incubation temperature (26 degrees C) accelerated a decrease in DTPA-Mn and weakly adsorbed Mn during 0-14 d incubation compared with the lower temperature (15/10 degrees C, 12 h each) regardless of whether soil was autoclaved or not. In a Wangary soil mixed in 1:1 ratio of topsoil to subsoil and supplemented with Mn, higher temperature during soil incubation resulted in higher DTPA-Mn compared to the lower incubation temperature after 36 d. The decrease in weakly adsorbed Mn with incubation time was mainly due to: (i) Mn fixation by chemisorption on calcite, and (ii) Mn oxidation by soil microflora; the higher the incubation temperature, the quicker the fixation. Autoclaving of the soil fertilised with Mn caused the amounts of Mn in various soil fractions to remain almost constant throughout the 24-d incubation period regardless of the incubation temperature. The present study indicates that the reduction of Mn availability in soils results when dry non-autoclaved soil is re-moistened and incubated at relatively higher temperatures as occurs in the autumn in Mediterranean climates such as that of South Australia. [References: 29].

4029 Uhlen, G.; Haugen, L.E.; Singh, B.R. (Norges Landbrukshegskole, Aas (Norway). Dept. of Soil and Water Sciences) (1994) **Nitrogen leaching under different water regimes in a 4-year lysimeter experiment.** *Avdelningsmeddelande - Sveriges Lantbruksuniversitet, Institutionen foer Markvetenskap, Avdelningen foer Lantbrukets Hydroteknik (Sweden); no. 5 p. 29-33. p. 29-33. English. (AGRI 95-083195).*

4030 Xu Zhuling (Beijing Agricultural Univ. (China). Coll. of Agricultural Resources and Environmental Sciences) (1994) **A study of water balance in wheat fields in experimental areas of improved sand soil in Hebei Daming, China.** *Acta Agriculturae Universitatis Pekinensis (China) v. 20(3) p. 262-268. 7 tables; 3 ill., 3 ref. Chinese. (AGRI 95-093469).*

4031 Yamulki, S.; Goulding, KWT.; Webster, CP.; Harrison, RM. (1995) **STUDIES ON NO AND N2O FLUXES FROM A WHEAT FIELD.** *Atmospheric Environment*. 29(14):1627-1635. English. [UNIV BIRMINGHAM INST PUBL & ENVIRONM HLTH BIRMINGHAM B15 2TT W MIDLANDS ENGLAND].

The importance of soil parameters and the other environmental conditions that affect emission rates of NO and N2O were studied over a fertilised wheat field. Open-chamber and closed-chamber techniques were used for the flux measurement of NO and N2O, respectively. Both gases showed variation in the emission rates which followed the seasonal variation in the available HN4+ and NO3- and the moisture content of the soil. Whilst N2O emission rates increased with the moisture content of the soil, NO emissions decreased with increasing soil moisture and rainfall. The results suggested that most soil variables and atmospheric parameters had similar effects on both NO and N2O emission rates but that the overriding influence upon the NO/N2O emission ratio is the soil moisture content. The NO flux showed a clear diurnal variation which followed the surface soil temperature with an activation energy of 108 kJ mol⁻¹. The annual NO flux estimated from this study (0.79 kg N ha⁻¹) was approximately half the corresponding N2O (1.42 kg N ha⁻¹). [References: 44].

P34 SOIL BIOLOGY

4032 Broek, A. vande (1994) **Histochemical and genetic analysis of the Azospirillum brasilense - wheat root association.** Katholieke Univ. Leuven (Belgium). Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. *Dissertationes de Agricultura (Belgium); no. 267 155 p. KUL. 20 ill.; 13 tables; bibliography p. 132-155. English. (AGRI 95-093565).*

4033 Grant, RF. (1995) **DYNAMICS OF ENERGY, WATER, CARBON AND NITROGEN IN AGRICULTURAL ECOSYSTEMS - SIMULATION AND EXPERIMENTAL VALIDATION.** *Ecological Modelling*. 81(1-3):169-181. English. [UNIV ALBERTA DEPT SOIL SCI EDMONTON AB T6G 2E3 CANADA].

If soil-plant-atmosphere models are to perform reliably under the wide range of edaphic, climatic and management conditions encountered in ecosystem studies, then the use of explanatory vs. functional algorithms must be expanded in these models. In this article, the soil-plant-atmosphere model ecosys, based mainly upon explanatory algorithms, is described and tested against field data recorded during a 1990-1991 sugar beet-barley rotation on a sandy sediment in the Eisenbach catchment north of Braunschweig, Germany. Water movement below 0.50 m was underestimated by the model, likely because hydraulic conductivity was underestimated for the extremely sandy subsoil in this catchment. The period of time that N in extractable mineral form resided in the topsoil following fertilization was overestimated, as has been found elsewhere by this and other models. Ways by which these overestimations could be resolved are discussed. The model was able to reproduce general trends in the distribution of water and mineral N in the soil, and of C and N in the crops during the two-year field study without the use of site-specific values for any of its parameters. Examples of hourly model output for soil and crop water relations during a selected 3-day period in June 1991 are presented as examples of how the model could be more rigorously validated in studies carried out at higher temporal resolution. Because parameters used in explanatory algorithms have values that are independent of the model itself, models based on such algorithms are well adapted to perform reliably under a wide range of environmental conditions. Examples of such adaptations are given for the model used in this study. [References: 40].

4034 Griffiths, B.S. (Scottish Crop Research Institute, Invergowrie (Royaume Uni). Cellular and Environmental Physiology Department, Soil Plant Dynamics Group); Van Vuuren, M.M.I.; Robinson, D. (1994) **[Microbial grazer populations in a 15N labeled organic residue and the uptake of residue N by wheat]. [Populations consommantes de microorganismes dans un residu organique marque au 15N et absorption de residu azote par le ble].** *European Journal of Agronomy (France) v. 3(4) p. 321-325. 26 ref. English. (AGRI 95-093573).*

4035 Griffiths, B.S.; Ritz, K.; Wheatley, R.E. (Cellular and Environmental Physiology, Scottish Research Institute, Invergowrie, Dundee (United Kingdom)) (1994) **Nematodes as indicators of enhanced microbiological activity in a Scottish organic farming system.** *Soil Use and Management (United Kingdom) v. 10(1) p. 20-24. 25 ref. English. (AGRI 95-093570).*

4036 Guaiquil, Victor H.; Godoy B. Roberto (Universidad Austral de Chile, Valdivia (Chile). Inst. de Botanica) (1993) [Isolation and evaluation of *Azospirillum* spp. strains in cultivated and forage gramineous plants]. Aislamiento y evaluación de cepas de *Azospirillum* spp. en plantas gramíneas de cultivo y forrajeras. *Agro Sur (Chile)* v. 21(2) p. 95-101. 15 ref. Spanish. (AGRIS 95-083441).

The study of nitrogen fixing microorganisms associated with gramineous plants is not a well developed field in our country, however bacterial commercial inoculants have been developed in other countries as a good substitute for nitrogen fertilization. The present work attempts to identify the kinds of forage and cultivated gramineous plants that can form bacteria-plant associations, isolate these strains and determine their effects as inoculants in controlled condition assays. *Zea mays*, *Triticum aestivum*, *Hordeum vulgare*, *Dactylis glomerata*, *Holcus lanatus*, *Lolium perenne* and *Lolium multiflorum* were used in a field assay to isolate root associated *Azospirillum*. The effect of the bacterial inoculation was determined using three *Azospirillum* strains in these species of plants. In four of the species of plants a better yield was observed in inoculated plants than in uninoculated controls.

4037 Hartmann, A. (GSF Forschungszentrum fuer Umwelt und Gesundheit Muenchen, Neuherberg (Germany). Inst. fuer Bodenökologie); Schlöter, M.; Bode, W.; Assmus, B.; Kirchhof, G. (1993) [Possibilities and problems of in situ-population analysis of microorganisms in soils by help of gene probes and antibodies]. Möglichkeiten und Probleme der In situ-Populationsanalyse von Mikroorganismen in Böden mit Gensonden und Antikörpern. Mitteilungen der Deutschen Bodenkundlichen Gesellschaft (Germany); no. 71 p. 327-330. Deutsche Bodenkundliche Gesellschaft. 2 ill.; 9 ref. p. 327-330. German. (AGRIS 95-083437).

4038 Zagal, E. (Swedish Univ. of Agricultural Sciences, Uppsala (Sweden). Dept. of Soil Sciences) (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 (14)CO₂-atmosphere. *Plant and Soil (Netherlands)* v. 166(1) p. 63-74. Bibliography (50 ref.). English. (AGRIS 95-083440).

4039 Zelles, L. (Institut fuer Bodenökologie, Oberschleissheim (Germany)); Rackwitz, R.; Bai, Q.Y.; Beck, T.; Beese, F. (1995) Discrimination of microbial diversity by fatty acid profiles of phospholipids and lipopolysaccharides in differently cultivated soils. *Plant and Soil (Netherlands)* v. 170(1) p. 115-122. 28 ref. English. (AGRIS 95-083448).

P35 SOIL FERTILITY

4040 Barbarick, KA.; Ippolito, JA.; Westfall, DG. (1995) BIOSOLIDS EFFECT ON PHOSPHORUS, COPPER, ZINC, NICKEL, AND MOLYBDENUM CONCENTRATIONS IN DRYLAND WHEAT. *Journal of Environmental Quality*. 24(4):608-611. English. [COLORADO STATE UNIV DEPT SOIL & CROP SCI FT COLLINS, CO 80523 USA].

When biosolids that are low in trace elements are applied on cropland, the tissue concentrations of trace elements may approach a concentration plateau as cumulative quantity of the element added increases. If the plateau concentration is less than that of safe threshold, the application may continue indefinitely. We found that wheat (*Triticum aestivum* L. 'Vona' or 'TAM107') grain concentrations of P, Cu, Zn, and Ni from an 11-yr field study of biosolids land application follow a plateau model. The grain concentrations of P, Cu, and Zn approach the calculated plateau maximum after 11 applications (in fallow rotation, we completed six applications to one set of plots plus five applications to a second set). Grain Ni levels show a linear response to cumulative inputs of biosolids Ni. Possibly, the biosolids are providing a labile source of Ni. The Mo concentrations did not change significantly as cumulative inputs of biosolids Mo increased. Our results indicate that plateau modeling can describe the changes in wheat grain concentrations associated with biosolids application. [References: 14].

4041 Geleto, T.; Tanner, DG.; Mamo, T.; Gebeyehu, G. (1995) RESPONSE OF RAINFED BREAD AND DURUM WHEAT TO

SOURCE, LEVEL, AND TIMING OF NITROGEN FERTILIZER ON TWO ETHIOPIAN VERTISOLS .1. YIELD AND YIELD COMPONENTS. *Communications in Soil Science & Plant Analysis*. 26(11-12):1773-1794. English. [CIMMYT CIDA E AFRICAN CEREALS PROGRAM POB 5689 ADDIS ABABA ETHIOPIA].

In trials conducted at two highland Vertisol sites in Ethiopia in 1990 and 1991, two locally popular spring bread wheat (*Triticum aestivum* L.) and durum (*T. durum* Desf.) cultivars were supplied with nitrogen (N) fertilizer at 0, 60, and 120 kg N/ha in the form of large granular urea (LGU), standard urea prills, or ammonium sulfate. Nitrogen was applied all at sowing, all at mid-tillering, or split-applied between these two stages (1/3:2/3). Bread wheat exhibited the highest productivity and was the most responsive to applied N. Grain and biomass yields and most grain yield components were positively affected by increasing N rate and yield responses in each site-season were economic up to the highest rate of N used in this study. Split application of N had a favorable effect on grain yield as did the use of LGU as the N source, particularly under conditions of severe water-logging and at the high N rate. Split applications of N tended to nullify the positive effects of LGU, presumably by approximating the delayed release of N achieved with LGU. Grain yield was closely related to the number of grains/m² and grains/spike. [References: 16].

4042 Gries, D.; Brunn, S.; Crowley, DE.; Parker, DR. (1995) PHYTOSIDEROPHORE RELEASE IN RELATION TO MICRONUTRIENT METAL DEFICIENCIES IN BARLEY. *Plant & Soil*. 172(2):299-308. English. [UNIV CALIF RIVERSIDE DEPT SOIL & ENVIRONM SCI RIVERSIDE, CA 92521 USA].

Phytosiderophore release occurs under both iron and zinc deficiencies in representative Poaceae and has been speculated to be a general adaptive response to enhance the acquisition of micronutrient metals. To test this hypothesis, phytosiderophore (PS) release rates from barley (*Hordeum vulgare* cv. CM72) subjected to deficiencies of Fe, Zn, Mn, and Cu were compared using chelator-buffered nutrient solutions. PS release rates were determined at two day intervals during onset and development of deficiency symptoms. Plant dry matter yields and nutrient concentrations, measured at three time points were used to construct growth curves for calculation of PS release per unit root mass and estimation of critical internal nutrient levels associated with PS release. In comparison to trace metal-sufficient control plants, dry matter production was markedly reduced in the Zn, Mn, and Cu deficiency treatments, with final relative yields of 49, 61, and 34%, respectively. Relative yields for Fe-deficient plants grown at three suboptimal Fe levels ranged from 95 to 33% of control, and provided a basis for comparison of PS release rates by Zn-, Mn-, and Cu-deficient plants at similar levels of growth inhibition. Under Fe deficiency, PS release increased with severity of the deficiency as measured by foliar Fe concentration, yield reduction, and chlorosis. Changes in PS release rates over time suggested a cyclical pattern that may be regulated by Fe concentration in the plant shoot. The highest rate of PS release (35 μ mol g⁻¹ root dw 2 h⁻¹) was measured after 10 days of growth at pFe 19, whereas control plants adapted for growth at pFe 17 released only 2 to 3 μ mol g⁻¹ root dw 2 h⁻¹. In a second experiment, maximum PS release rates for barley subjected to Zn, Mn, and Cu deficiencies were only 2.6, 2.5 and 1 μ mol g⁻¹ 2 h⁻¹, respectively, and were only slightly elevated over those of the control plants (ca. 1 μ mol g⁻¹ root dw 2 h⁻¹) grown at pFe 16.5. Moreover, enhanced PS release under Zn deficiency occurred much later, after the deficiency had already caused severely reduced growth. The results suggest that phytosiderophore release in this barley cultivar is a specific response to Fe deficiency and is not significantly induced in response to deficiencies of other trace metals. [References: 34].

4043 Huang, JW.; Grunes, DL.; Kochian, LV. (1995) ALUMINIUM AND CALCIUM TRANSPORT INTERACTIONS IN INTACT ROOTS AND ROOT PLASMALEMMA VESICLES FROM ALUMINIUM-SENSITIVE AND TOLERANT WHEAT CULTIVARS. *Plant & Soil*. 171(1):131-135. English. [CORNELL UNIV USDA ARS US PLANT SOIL & NUTR LAB ITHACA, NY 14853 USA].

Recent research from our laboratory indicates that aluminium (Al) and calcium (Ca) transport interactions may play an important role in the mechanisms of Al phytotoxicity. In this study, we investigated the effects of Al on Ca²⁺ transport in intact roots of winter wheat (*Triticum aestivum*

L.) cultivars (Al-tolerant Atlas 66 and Al-sensitive Scout 66). We used both a vibrating Ca²⁺-microelectrode technique and Ca-45(2+) to monitor Ca²⁺ influx in intact roots. Root apical Ca²⁺ uptake was immediately inhibited, when roots were exposed to Al levels that ultimately decreased root growth in Al-sensitive Scout 66. The Al-tolerant cultivar was able to resist this Al inhibition of Ca²⁺ uptake, and to resist Al inhibition of Ca-45(2+) translocation from roots to shoots. We also studied Ca²⁺ transport in right-side out plasmalemma vesicles isolated from roots of Al-sensitive and tolerant wheat cultivars. Calcium influx into the vesicles was mediated by a voltage-gated Ca²⁺ channel. Aluminium blocks the Ca²⁺ channel equally well in the plasmalemma vesicles isolated from Al-sensitive and Al-tolerant wheat roots. The results indicate that the differential response observed in intact roots is not due to differences in Ca²⁺ channels. The Al-tolerant wheat cultivar may have an ability to reduce Al³⁺ activity in the rhizosphere, thus reducing the Al-inhibition of Ca²⁺ influx. [References: 17].

4044 Jenkinson, D.S.; Coleman, K.; Harkness, D.D. (1995) **THE INFLUENCE OF FERTILIZER NITROGEN AND SEASON ON THE CARBON-13 ABUNDANCE OF WHEAT STRAW**. *Plant & Soil*. 171(2):365-367. English. [ROTHAMSTED EXPTL STN AFRC INST ARABLE CROPS RES BBSRC HARPENDEN AL5 2]Q HERTS ENGLAND].

Carbon-13 abundance, expressed as delta(13)C in parts per thousand, was measured in wheat straw grown between 1984 and 1989 on the Broadbalk Continuous Wheat Experiment at Rothamsted. In all six years, straw grown without fertilizer N contained less carbon-13 (i.e. delta(13)C was more negative) than straw grown with fertilizer, although the magnitude of this difference varied with year. In a dry year, when dry matter response to fertilizer N was relatively small, there was a large difference between the delta(13)C of straw grown with and without N. Conversely, in a wet year, when there was a marked response to N, there was little difference in the isotopic composition of N-fertilized and unfertilized straw. Over the six years, the difference between the delta(13)C value of straw grown with and without nitrogen ((DC)-C-13, in parts per thousand) was related to drought, measured as the calculated soil water deficit on 15 July (W-j, in mm), by the equation (DC)-C-13 = -0.299 + 0.01034 W-j (r = 0.87). [References: 7].

4045 Jensen, L.S. (1994) **Temporal variation of soil microbial biomass size and activity: an indicator for the turnover of soil carbon and nitrogen after the input of organic matter or under different soil physical conditions [nitrogen turnover, including 5 articles]**. Kongelige Veterinaer- og Landbohøjskole, Copenhagen (Denmark). Soil, Water and Plant Nutrition. KVL. 5 ill., 97 ref. 117 p. English. (AGRI 95-093635).

4046 Mohammad, M.J.; Pan, W.L.; Kennedy, A.C. (1995) **WHEAT RESPONSES TO VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGAL INOCULATION OF SOILS FROM ERODED TOPOSEQUENCE**. *Soil Science Society of America Journal*. 59(4):1086-1090. English. [WASHINGTON STATE UNIV DEPT CROP & SOIL SCI PULLMAN, WA 99164 USA].

Low fertility of eroded soils is often attributed to the loss of topsoil, an important source of nutrients for microorganisms and plants. Vesicular-arbuscular mycorrhizal (VAM) fungi are known to improve nutrient uptake by plants from infertile soil. The objective of this study was to determine whether wheat (*Triticum aestivum* L.) responses to VAM fungal inoculation differ among eroded and noneroded soils from the same toposequence. Spring wheat plants were grown under growth chamber conditions in soils collected from three landscape positions of a typical toposequence in eastern Washington, with and without VAM fungal inoculation. Noninoculated soils exhibited 13 to 26% VAM root colonization, while inoculation increased VAM colonization up to 49 to 55% by 5 wk after planting. The VAM fungal inoculation of eroded soils increased shoot dry weight and tiller number, advanced the leaf stage, and increased root length compared with the noninoculated controls. Shoot concentrations of P and Zn were increased by VAM inoculation. In contrast, shoot concentrations of Cu and Mn were unchanged, while Fe was decreased. While VAM fungal inoculation also increased P, Zn, and Cu concentrations in water-stressed plants, Mn and Fe concentrations decreased. No responses to VAM fungal inoculation were observed in soil

from a noneroded toeslope, although VAM colonization was similar to that observed in the eroded soils. These results indicate the potential role of VAM fungi for improving dryland wheat productivity on eroded soils. [References: 44].

4047 Rees, R.M. (School of Agriculture, Edinburgh (Royaume Uni). Soil Science Department); McTaggart, I.P.; Smith, K.A.; Stockdale, E.A. (1994) **[Methodology for the study of N mineralization in the field]**. *[Methodologie pour l'étude de la minéralisation de l'azote au champ]*. *European Journal of Agronomy (France)* v. 3(4) p. 301-309. 45 ref. English. (AGRI 95-093634).

4048 Uslar S, Dietter Hans (1992) **[Evaluation of nitrogen losses and exchangeable bases by leaching on the yield of a winter wheat in Valdivia]**. *Evaluación de las pérdidas de nitrógeno y bases de intercambio por lixiviación en el rendimiento de un cultivo de trigo de invierno en Valdivia*. Universidad Austral de Chile, Valdivia (Chile). Fac. de Ciencias Agrarias. 30 ref. 54 p. Spanish. (AGRI 95-093640).

The study about leaching of nitrogen and exchangeable bases for a winter wheat crop was carried out at Santa Rosa experimental farm from the Universidad Austral de Chile. Using a total nitrogen doses of 180 kg/ha, there was studied the effect of partialization on leaching amounts of nitrogen. Furthermore there were taken measurements about leaching of interchangeable bases (potassium calcium, magnesium and sodium), extraction of nitrogen by crop and production of dry matter. About leaching, results shows that in case of nitrogen, partialization reduced it from 73, 2 kg N/ha (all at seed-time) to 45, 7 kg N/ha (1/2 at seed-time and 1/2 at cluster), and to 29, 3 kg N/ha (1/3 at seed-time, 1/3 at cluster and 1/3 at stalks). Although it was observed that when there was not vegetal cover, high application of nitrogen (180 kg/ha) produced a leaching of 111, 7 kg N/ha, whereas without application it reached only 2, 9 kg N/ha. For interchangeable bases amounts of leaching varied between 6, 27 and 29, 78 kg/ha for potassium; 31, 40 and 78, 27 kg/ha for calcium; 4, 12 and 15, 06 kg/ha for magnesium and between 58, 34 and 99, 18 kg/ha for sodium. In general leaching and distribution through the period of study where hardly influenced by amounts of water percolated across the soil, which depended on precipitation amounts.

4049 Zeissler, A. (Umweltforschungszentrum Leipzig Halle GmbH, Bad Lauchstädt (Germany). Sektion Bodenforschung) (1992) **[Computer simulation as measure for environmentally acceptable land management]**. *Computersimulation als Hilfsmittel zur umweltgerechten Landbewirtschaftung*. Symposium "Dauerfeldversuche und Nährstoffdynamik"; Bad Lauchstädt (Germany); 9-12 Jun 1992. (Proceedings of the symposium "Continuous field experiments and nutrient dynamics"). Umweltforschungszentrum Leipzig-Halle GmbH, Bad Lauchstädt (Germany). Sektion Bodenforschung p. 264-267. Druck-Strom GmbH. 3 ill., 1 table. German. (AGRI 95-083572).

P36 SOIL EROSION, CONSERVATION AND RECLAMATION

4050 Patil, R.G.; Sarkar, M.C. (Indian Agricultural Research Institute, New Delhi. Division of Soil Science and Agricultural Chemistry) (1993) **Forms of soil nitrogen as affected by application of labelled urea and sesbania to previously wheat straw amended paddy soil**. *Journal of Nuclear Agriculture and Biology (India)*. v. 22(3-4) p. 170-177. 2 ill., 2 tables; 14 ref. English. (AGRI 95-083629).

4051 Rossi Pisa, P.; Gardi, C.; Ventura, F.; Campanini, L.; Gaspari, N. (Bologna Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee) (1994) **[Concentration times influenced by rainfall intensity and canopy in sloping fields (Emilia-Romagna)]**. *Tempi di corruzione parcellare in funzione dell'intensità di pioggia e della copertura vegetale su terreni in pendio [Emilia Romagna]*. Società Italiana di Agronomia. 28. Annual meeting on agronomic aspects of soil conservation on slopes and the safeguard of the environment; Potenza (Italy); 6-9 Jul 1993. *Rivista di Agronomia (Italy)* v. 28(4) p. 392-399. 1 table; 14 graphs; 8 ref. Italian. (AGRI 95-093705).

In a trial carried out to evaluate runoff and erosion, time between beginning of rainfall and beginning of runoff was measured by automatic

equipment. The research was carried out in 7000 square m area, 15% slope, divided in 8 plots of 350 square m (50x7), hydrologically insulated. The two thesis in comparison, both cultivated with maize, were cover crop (barley) and bare soil. Rainfall data were recorded each ten minutes, rainfall data continuously during the event, and soil moisture every week. Rainfall samples were collected by automatic equipment, and analyzed to determine sediment yield. The 1992 results show how cover crop prevent runoff and soil erosion (1.7 mm with cover crop, 11 mm with bare soil). The minimum rainfall quantity for runoff starting is 8 mm. Runoff rate seems to increase with rainfall quantity.

4052 Rossi Pisa, P.; Vicari, A.; Catizone, P. (Bologna Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee) (1994) [Effect of barley (*Hordeum vulgare* L.) cover crop on soil and runoff losses (Emilia-Romagna)]. *Effetto della copertura vegetale di orzo (Hordeum vulgare L.) sull'erosione e sulla qualità delle acque di ruscellamento (Emilia Romagna)*. Società Italiana di Agronomia. 28. Annual meeting on agronomic aspects of soil conservation on slopes and the safeguard of the environment; Potenza (Italy); 6-9 Jul 1993. *Rivista di Agronomia (Italy)* v. 28(4) p. 384-391. 3 tables; 4 graphs; 41 ref. Italian. (AGRIC 95-093704).

In a hilly area at Ozzano dell'Emilia (Bologna), plots were used to study the effect of cover crop with barley on soil, runoff, herbicide and nitrate losses from maize fields with a 15% slope. The influence of controlled release formulations (CR) of herbicides on surface water quality was also evaluated. Cover crop (C) drastically reduced runoff water and erosion compared to plots without cover crop (NC). Runoff water losses were reduced by 39.6 and 88.6% by cover crop, respectively in 1991 and 1992, while soil losses were reduced by 99.8%, in both years. Atrazine, metolachlor and terbuthylazine losses in NC plots were below 0.45% of applied rate, while with cover crop the losses did not exceed 0.08% and 0.003%, respectively in 1991 and 1992. CR formulations did not affect total herbicide losses, but modified herbicide distribution between water and sediment. In 1992, nitrate losses from NC and C plots were 3.22 and 0.22 kg ha sup⁻¹ year sup⁻¹, respectively. Results show that use of cover crop in maize may be a favourable technique for soil conservation and for surface water quality safeguard, without maize yield reduction.

4053 Sibbesen, E. (1995) [Loss of soil and phosphorus from agricultural soil to the aquatic environment through surface runoff and erosion]. *Tab af jord og fosfor fra landbrugsjorden til vandmiljøet ved overfladeafstrømning og erosion. Vækst (Denmark)* v. 116(1) p. 14-15. 3 ref. Danish. (AGRIC 95-093693).

P40 METEOROLOGY AND CLIMATOLOGY

4054 Friedrich, S. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany). Zentrale Agrarmeteorologische Forschungsstelle des Deutschen Wetterdienstes) (1994) [Effect of changed climatic factors on plant diseases and pests]. *Wirkung veränderter klimatischer Faktoren auf Pflanzenkrankheiten und Pflanzenschädlinge*. Landbauforschung Voelkenrode. Sonderheft (Germany); no. 148 p. 295-301. FAL, Selbstverlag. 1 table; 14 ref. p. 295-301. German. (AGRIC 95-093751).

4055 Hennessy, K.J. (Commonwealth Scientific and Industrial Research Organisation, Mordialloc (Australia). Div. of Atmospheric Research.) (1994) *Climate change scenarios for Australia in 2030 [wheat]*. [Conference abstract]. 44. Royal Chemical Institute Cereal Chemistry Conference; Ballarat, Vic. (Australia); 12 Sep 1994. *Chemistry in Australia (Australia)* v. 61(9) p. 498. English. (AGRIC 95-083732).

4056 Hertstein, U. (Giessen Univ. (Germany). Inst. fuer Pflanzenoekologie); Daemmgen, U.; Jaeger, H. J.; Mirschel, G.; Obenauf, S.; Rogasik, J. (1994) [Effects of a changed climate on primary agricultural production]. *Wirkungen eines veränderten Klimas auf die landwirtschaftliche Primaerproduktion*. Landbauforschung Voelkenrode. Sonderheft (Germany); no. 148 p. 237-286. FAL, Selbstverlag. 10 ill., 9 tables. Bibliography p. 274-286. p. 237-286. German. (AGRIC 95-093731).

4057 Oger, R. (Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium). Bureau d'Informatique et de Statistique Appliquée); Poelaert, J.;

Bodson, B. (1994) [General idea about climate and phytotechnical implications during the cultural years 1992 and 1993]. *Aperçu climatologique et implications phytotechniques pour les années culturelles 1992 et 1993*. [Cereal crops manure and protection. Conclusions of the research performed in 1993 [in Belgium]]. *Fumure et protection phytosanitaire des céréales. Conclusions des recherches effectuées en 1993*. Seutin, E.; Falisse, A. (eds) (Climatologie) 5 p. 1 ill.; 1 table. French. (AGRIC 95-083729).

4058 Tattari, S.; Ikonen, J.P.; Sucksdorff, Y. (1995) A COMPARISON OF EVAPOTRANSPIRATION ABOVE A BARLEY FIELD BASED ON QUALITY TESTED BOWEN RATIO DATA AND DEARDORFF MODELLING. *Journal of Hydrology*. 170(1-4):1-14. English. [FINNISH ENVIRONM AGCY POB 140 SF-00251 HELSINKI FINLAND].

Assessment of the quality of evapotranspiration data is essential if databases valid for modelling purposes are to be constructed. In this study a quality control technique was applied to test the validity of long-term evapotranspiration data. Approximately 53% of daytime data proved to be reliable. Unreliable data are caused not only by weather conditions, such as unfavourable wind direction and rain events, but also by the condensation of water inside the air intake tubing and filters of the instruments. The Deardorff model was applied to calculate evapotranspiration. The appropriateness of the parametrization used to obtain the leaf area index and the stomatal resistance was evaluated for a barley field located in southern Finland. The equation of Noilhan and Planton to calculate $r(s)$ proved to be the best. The discrepancies between the measurements and the modelled data were assessed by critical examination of the measurements. [References: 19].

Q01 FOOD SCIENCE AND TECHNOLOGY

4059 Andrews, DC.; Caldwell, RA.; Quail, KJ. (1995) SULFHYDRYL ANALYSIS .1. DETERMINATION OF FREE SULFHYDRYLS IN WHEAT FLOUR DOUGHS. *Cereal Chemistry*. 72(3):326-329. English. [UNIV SYDNEY DEPT AGR CHEM & SOIL SCI SYDNEY NSW 2006 AUSTRALIA].

Methodology was developed for the determination of free sulphhydryls in wheat flours and doughs using NBD-Cl (7-chloro-4-nitrobenzo-2-oxa-1, 3-diazole). The solubilization of protein by sonication in sodium dodecyl sulfate (SDS) was compared to proteolysis with Proteinase K in SDS. Oxidation during proteolysis and disulfide cleavage during sonication are the likely reasons for observed differences between the two solubilization methods. The sulphhydryl determination and both extraction procedures work effectively on model doughs and full bread formula. [References: 20].

4060 Andrews, DC.; Caldwell, RA.; Quail, KJ. (1995) SULFHYDRYL ANALYSIS .2. FREE SULFHYDRYL CONTENT OF HEATED DOUGHS FROM 2 WHEAT CULTIVARS AND EFFECT OF POTASSIUM BROMATE. *Cereal Chemistry*. 72(3):330-333. English. [UNIV SYDNEY DEPT AGR CHEM & SOIL SCI SYDNEY NSW 2006 AUSTRALIA].

The combined effects of heat and potassium bromate (KBrO₃) on the free sulphhydryl content of doughs prepared from two Australian commercial wheat flours were investigated. Flour derived from the cultivar Janz was not responsive to KBrO₃ in baking, whereas flour from the cultivar Oxley was responsive. Heating of dough samples with or without KBrO₃ caused a large decline in free sulphhydryls for both samples. Doughs prepared from each sample showed a significant loss of KBrO₃ during the heating protocol. Mixing alone caused a nearly 50% decline in the level of KBrO₃ from the quantity added. Results of this investigation indicate that although KBrO₃ had reacted during the period of heating, it was not directly linked to the decrease in free sulphhydryls. [References: 32].

4061 Cabrera, G.; Grossmann, MVE.; Beleia, AP. (1995) LABORATORY SPROUTING OF WHEAT - EFFECT ON GRAIN AND FLOUR QUALITY. *Arquivos de Biologia e Tecnologia*. 38(1):1-13. Portuguese. [UNIV ESTADUAL LONDRINA DEPT TECNOL ALIMENTOS & MEDICAMENTOS CAIXA POSTAL 6001 BR-86051970 LONDRINA SP BRAZIL].

The effect of controlled laboratory germination on three wheat cultivars, ANAHUAC, BR 23 and IAC 5, was studied. The wheats were germinated, after full hydration, for 15 and 30 hr, at 25 ± 2 degrees C Biochemical, milling and rheological properties of heats and flours were evaluated.

Longer germination time caused decrease in hectoliter weight, changes in chemical composition and different milling extractions. Rheological properties were also affected: tolerance index, calorimetric value (farinograph) and deformation energy (alveograph) decreased. Cultivar BR 23 had the least desirable rheological properties among the flours.

4062 Chen, YR.; Delwiche, SR.; Hruschka, WR. (1995) **CLASSIFICATION OF HARD RED WHEAT BY FEEDFORWARD BACKPROPAGATION NEURAL NETWORKS.** *Cereal Chemistry*. 72(3):317-319. English. [USDA ARS BELTSVILLE AGR RES CTR INSTRUMENTAT & SENSING LAB BELTSVILLE, MD 20705 USA].

Because of breeding practices, visual determination of kernel morphology is becoming less dependable for classification of hard red wheat as winter or spring. Because of the price differential between these classes, it is important to develop rapid, accurate, and automatable alternative methods. This study was conducted to determine whether feedforward backpropagation neural networks applied to near-infrared (NIR) diffuse reflectance spectra of ground kernels could perform the classification. The NIR diffuse reflectance spectra (1, 100-2, 500 nm) of 2, 403 ground hard red wheat samples representing the United States crop for 1987-1990 were used with commercially available neural network software. Mathematical pretreatments included $\log_{10}(1/\text{reflectance})$ and second differences of the log data. Networks with and without hidden layers were used with various subsets of the full spectral region as inputs. When developed on samples from the 1987-1989 crop years, the best neural network models yielded 97.0 and 96.8% accuracies for calibration and validation sets, respectively, utilizing the full wavelength range. This performance declined slightly to calibration and validation accuracies of 96.3 and 95.9%, respectively, when the wavelength range of 2, 142-2, 472 nm was used. When applied to the 1990 crop year, the prediction accuracies of the full and abbreviated wavelength range models were 95.1 and 95.6%, respectively. These models performed better than a previously reported principal component analysis with Mahalanobis distance classifier. Neural networks, combined with second difference pretreatment, should be a very useful component of a NIR-based classification system. [References: 6].

4063 Every, D.; Gilpin, M.J.; Larsen, NG. (1995) **CONTINUOUS SPECTROPHOTOMETRIC ASSAY AND PROPERTIES OF ASCORBIC ACID OXIDISING FACTORS IN WHEAT.** *Journal of Cereal Science*. 21(3):231-239. English. [NEW ZEALAND INST CROP & FOOD RES GRAIN FOODS RES UNIT PRIVATE BAG 4704 CHRISTCHURCH NEW ZEALAND].

A continuous spectrophotometric assay was developed to measure ascorbic acid oxidation in crude Na_2SO_4 extracts of flour. The rate of ascorbic acid oxidation in flour extracts measured using this method was similar to the rate in flour-water suspensions and 2-4 fold less than the rate in dough measured using an indophenol-xylene extraction method. Flour extracts appeared to contain two ascorbic acid oxidising factors; one with optimal activity at pH 6.3 and 30 degrees C and the other with optimal activity at pH 10 and 40 degrees C. The pH 6.3 factor had properties similar to those of ascorbate oxidase (EC 1.10.3.3) in its pH and temperature stability, strong inhibition by NaN_3 , KCN and diethyldithiocarbamate, inactivation by proteases, and greater stereospecificity towards L-ascorbic acid than D-isoascorbic acid. The pH 6.3 factor was most concentrated in the pollard milling fraction of wheat and was lowest in flour. The pH 10 factor had several properties indicating non-enzymic oxidation of ascorbic acid; it was not inactivated by proteases, it was inhibited poorly or not at all by the above ascorbate oxidase inhibitors, and it had low specificity for stereoisomers of ascorbic acid. [References: 29].

4064 Gan, Z.; Ellis, PR.; Schofield, JD. (1995) **GAS CELL STABILISATION AND GAS RETENTION IN WHEAT BREAD DOUGH [Review].** *Journal of Cereal Science*. 21(3):215-230. English. [UNIV READING DEPT FOOD SCI & TECHNOL POB 226 READING RG6 6AP BERKS ENGLAND].

Gas cell stabilisation and gas retention are of considerable interest because of their technological significance in bread making. We review recent studies in relation to the stabilisation of gas cells and the mechanisms of gas retention, and discuss how these may be affected by

the liquid phase of dough. The possibility is discussed of the involvement of surface active materials, such as proteins and pentosans dissolved in the dough aqueous phase, and, perhaps more importantly, non-starch polar lipids in the formation and stabilisation of gas cells. There is accumulating evidence for the hypothesis that liquid films play a critical role in the mechanisms of gas retention in dough. The hypothesis proposes that two closely related, consecutive stages are involved in dough expansion. During the first stage, the expanding gas cells remain discrete until discontinuities develop in the starch-protein matrix, leaving areas containing only a liquid film. The timing and the degree to which such discontinuities occur is largely dependent on gluten proteins. The second stage involves an increase in the surface area of the liquid film as discontinuities become increasingly frequent during expansion. Failure of the lamellar film to maintain the rate at which new surface area is generated leads to the rupture of this film and, consequently, the loss of gas retention. Consideration is also given to the role of bakery fat in gas retention and to additional factors that affect gas retention in wholemeal doughs, in particular the physical disruption of the foam structure of such doughs by components of the outer layers of the grain. [References: 100].

4065 Markovic, I.; Deponte, R.; Maric, V.; Johanides, V. (1995) **ENZYMIC HYDROLYSIS OF PROTEIN DURING BARLEY SPENT GRAINS MASHING.** *Process Biochemistry*. 30(5):411-419. English. [PLIVA RES INST PRILAZ BARUNA FILIPOVICA 25 ZAGREB 41000 CROATIA].

High nitrogen barley syrup (HNBS) was obtained by mashing barley spent grains with neutral proteinase. The total nitrogen to carbohydrate ratio in the HNBS was three times higher than in typical barley syrup. In order to enhance the liberation of free amino acids, the spent grains were hydrolysed simultaneously with proteinase and barley peptidase extract; the alpha-amino to total nitrogen ratio increased from 11.4 to 14.6%. During mashing with peptidase extract, the protein solubilization rate was lower than during mashing with neutral proteinase only. Data analysis by means of the modified Foster-Niemann equation suggested that endopeptidase inhibitors, possibly present in the peptidase extract, caused the decrease of protein solubilization rate. The isolation of the bacterial proteinase inhibitors from peptidase extract indicates that they affected the protein solubilization process. [References: 35].

4066 Nagao, S. (1995) **WHEAT PRODUCTS IN EAST ASIA.** *Cereal Foods World*. 40(7):482-487. English. [NISSHIN FLOUR MILLING CO LTD CEREAL RES LAB TOKYO JAPAN].

4067 Sindic, M.; Bollen, L. (Faculte des Sciences Agronomiques de Gembloux (Belgium). Unite de Technologie Alimentaire. Centre d'Etude de la Qualite du Froment); Agnessens, R. (1994) [New determination criteria of the technological quality of wheat]. *Nouveaux criteres de determination de la qualite technologique du ble. [Cereal crops manure and protection. Conclusions of the research performed in 1993 (in Belgium)]. Fumure et protection phytosanitaire des cereales. Conclusions des recherches effectuees en 1993. Seutin, E.; Falisse, A. (eds) (Qualite) p. 1-6. 1 ill. French. (AGRI 95-083738).*

4068 Vida, G.; Jolankai, M. (1995) **STUDIES ON WHEAT VARIETIES WITH DIFFERENT BREADMAKING QUALITY IN DIFFERENT YEARS AND UNDER VARIOUS GROWING CONDITIONS.** *Novenytermeles*. 44(1):43-54. Hungarian. [MTA MEZOGAZDASAGI KUTATO INTEZETE PF 19 H-2462 MARTONVASAR HUNGARY].

The breadmaking quality of winter wheat varieties was examined under different growing conditions. In the course of the investigations, changes in four quality traits (wet and dry gluten content, farinographic water absorption and farinographic quality index) were measured on three Martonvasar varieties of differing quality. The results indicate that the year has a substantial influence on the breadmaking quality of the wheat varieties. Observations suggest that breadmaking quality depends on plentiful rainfall in April and May and a low level of precipitation in June and July. As the results of irrigation the breadmaking quality declined in all cases, depending on the year. The greatest deterioration in quality was observed at a low level of nutrition and in the year giving the best breadmaking quality. As the result of fertilisation there was a significant rise in the farinographic index of the varieties tested. Studies were also made on interactions between genotype, year, irrigation and fertilisation.

The quality order of the varieties tested did not change as the result of the growing conditions. Even under favourable agroecological and agronomic conditions, the grain quality of the poor quality variety was not satisfactory.

4069 Vrkoc, F.; Vach, M.; Skala, J. (1995) **THE EFFECT OF GROWING METHODS, SITES AND YEARS ON THE NUTRIENT CONTENT AND BAKING QUALITY OF WINTER WHEAT GRAIN.** *Rostlinna Vyroba.* 41(7):315-319. Czech. [RES INST CROP PROD DRNOVSKA 507 CR-16106 PRAGUE 6 CZECH REPUBLIC].

Results of three series of polyfactorial field experiments conducted with winter wheat at three different sites were analyzed from the standpoint of various forecrops and increased nitrogen doses effects. Complex evaluation made possible to determine following descending order of factors decisive for individual nutrient content and selected indices of baking quality of winter wheat grain: nitrogen - site, fertilizing, forecrop, year; phosphorus - year, site, fertilizing, forecrop; potassium - site, forecrop, year, fertilizing; calcium, magnesium - year, site, forecrop, fertilizing; gluten content - year (57%), site (28%), nitrogen fertilizing (15%); gluten index - site (95%), year (4%), nitrogen fertilizing (1%); falling number - year (68%), site (28%), nitrogen fertilizing (4%). In comparison with less fertile soil (cambisol) higher nitrogen contents in grain were found on more fertile soils (luvisol) after leguminous crops as forecrops. The increased nitrogen content in grain after nitrogen fertilizing was significantly higher on less fertile soil, but the level of nitrogen content in grain on more fertile soils was not reached. The gluten content, gluten index and falling number were practically not affected by nitrogen fertilizing, with the exception of minimal changes in gluten content only. Nutritive quality and technological quality of wheat grain are determined, besides by the variety, by on-site factors and year to a greater extent than by cultural practices. The differences between the sites and years cannot be blurred even by intensive fertilizing.

Q02 FOOD PROCESSING AND PRESERVATION

4070 Alvarez, J.B.; Ballesteros, J.; Arriaga, H.O.; Martin, L.M. (1995) **THE RHEOLOGICAL PROPERTIES AND BAKING PERFORMANCES OF FLOURS FROM HEXAPLOID TRITORDEUMS.** *Journal of Cereal Science.* 21(3):291-299. English. [UNIV CORDOBA ESCUELA TECN SUPER INGN AGRON & MONTES DEPT GENET APDO 3048 E-14080 CORDOBA SPAIN].

Hexaploid tritordeum (X Tritordeum Ascherson et Graebner) is the amphiploid obtained from the cross between a South American wild barley (*Hordeum chilense* Roem. et Schulz.) and durum wheat (*Triticum turgidum* conv. durum Desf. em. M.K.). The bread making characteristics of eight lines of hexaploid tritordeum have been analysed, together with those of one bread wheat cultivar. The results indicated that, in general, the tritordeums yielded flours with quality properties similar to those of bread wheat, although their rheological and baking characteristics were slightly poorer. Despite the small number of samples, a range of variation was shown for some quality characters. This intra-specific variability suggests that, using well-established breeding procedures, it may be feasible to produce better quality tritordeums. [References: 29].

4071 Anon. (1994) [Program of investment is closed for the present. New equipments: Maltery Zimmermann, Baustetten]. *Investitionsprogramm vorlaeufig abgeschlossen. Neue Anlagen im Blickpunkt: Maelzerei Zimmermann, Baustetten. Brauwelt (Germany) v. 134(45) p. 2478-2480.* 4 ill. German. (AGRI 95-093852).

4072 Bruemmer, J. M. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Neumann, H. (1994) [Deep freezing of pre-baked wheat rolls]. *Tiefkuehlung von vorgebackenen Weizenbroetchen. Getreide Mehl und Brot (Germany) v. 48(5) p. 59-64.* 7 ill., 2 graphs, 5 tables; 7 ref. German. (AGRI 95-083842).

4073 Csonka, K. (1993) [Mathematical estimation of the wheat milling process and practical application of the method]. *A buzaorles muveleteinek matematikai ertekelese es a modszer alkalmazasa a gyakorlatban. Gabonaitar (Hungary) v. 40(3) p. 1-6.* 3 tables; 10 ill. Hungarian. (AGRI 95-093859).

The efficiency of the milling process (E) is the function of the transfer factor (a) (that is what percentage of the kernel gets into the product) and the "goodness" factor (j) (that is the percentage of testa that does not get into the product). The milling efficiency of the most modern mills with the most advanced technology is about 80 o/o. This is 20 o/o less than optimal. By the help of the formula given above specialist can determine which stages of the milling process are most responsible for this loss. Also, the formula allows us to compare different machines and technologies more realistically.

4074 Cunin, C.; Handschin, S.; Walther, P.; Escher, F. (1995) **STRUCTURAL CHANGES OF STARCH DURING COOKING OF DURUM WHEAT PASTA.** *Food Science & Technology-Lebensmittel-Wissenschaft & Technologie.* 28(3):323-328. English. [ETH ZURICH DEPT FOOD SCI CH-8092 ZURICH SWITZERLAND].

Textural quality of Durum wheat pasta is influenced by the properties and transformation of the protein and starch fraction. The aim of this study was to evaluate changes in the structure of dried pasta during cooking in relation to surface and internal structure of Durum wheat spaghetti. Light microscopy with two specific staining procedures for protein and starch, respectively, and scanning electron microscopy were used. Cooking in excessive water resulted in a disintegration of the starch granules with a substantial leakage of amylose in the outer layer of the strand, and in the formation of domains containing high amounts of starch in the protein matrix. In the centre of pasta, starch granules retained their shape due to a limited water diffusion, and the protein network remained dense. On the surface of dry spaghetti, numerous loosely attached starch granules were visible. With increasing cooking time, the surface of the spaghetti became rough, and parts of gelatinized starch granules were well recognizable. It is likely that both the state of starch and the surface structure contribute to the development of the elastic texture and in particular to the stickiness of pasta. [References: 16].

4075 Graybosch, R.A.; Peterson, C.J. (Nebraska Univ., Lincoln (USA). USDA ARS); Shelton, D.R. (Nebraska Univ., Lincoln (USA). Dept. of Agronomy) (1994) **Environmental modification of wheat flour quality and protein composition in the Northern Great Plains of North America.** [Conference abstract]. 44. Royal Chemical Institute Cereal Chemistry Conference; Ballarat, Vic. (Australia); 12 Sep 1994. *Chemistry in Australia (Australia) v. 61(9) p. 498.* English. (AGRI 95-083854).

4076 Hauner, M. (1994) [Construction of modern kilns and germinating-kilning systems]. *Bau von modernen Darren sowie Keim-Darr-Systemen. Brauerei-Forum (Germany) v. 9(27) p. 341-345.* 8 ill.; 3 ref. German. (AGRI 95-083846).

4077 Hesser, J.M. (International Wheat Gluten Association, Prairie Village, KS (USA)) (1994) [Wheat gluten: A comprehensive study about production and usage of this vital functional protein]. *Weizenkleber. Eine umfassende Studie ueber die Produktion und die Verwendung dieses besonderen Proteins. Getreide Mehl und Brot (Germany) v. 48(5) p. 21-25.* 8 tables; 11 ref. German. (AGRI 95-083783).

4078 Hooshmand, H.; Klopfenstein, C.F. (1995) **EFFECTS OF GAMMA IRRADIATION ON MYCOTOXIN DISAPPEARANCE AND AMINO ACID CONTENTS OF CORN, WHEAT, AND SOYBEANS WITH DIFFERENT MOISTURE CONTENTS.** *Plant Foods for Human Nutrition.* 47(3):227-238. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT GRAIN SCI & IND MANHATTAN, KS 66506 USA].

The effects of gamma irradiation on degradation of aflatoxin B-1 in wheat, corn, and soybeans and of T-2 toxin in wheat, deoxynivalenol (DON) in soybeans, and zearalenone in corn at 9, 13, and 17% moisture were studied. Radiation doses of 5, 7.5, 10 or 20 kGy were applied to spiked grain samples, and the residual toxins were measured using an enzyme linked immunosorbent assay (ELISA). Irradiation doses of up to 20 kGy did not significantly affect aflatoxin B-1 in any of the three grains, but significant reductions occurred in T-2 toxin, DON, and zearalenone concentration at doses of 10 or 20 kGy and in T-2 toxin at the 7.5 kGy dose. Two-way analysis of variance with Tukey's Multiple Range Test showed no significant interaction between radiation dose and grain moisture level. Irradiation of the ground grains at doses higher than 5 kGy resulted in

small, but significant, losses of lysine in corn (only at 7.5 kGy), wheat, and soybeans, and methionine was reduced in wheat and corn samples. In some cases, phenylalanine decreased in corn and wheat, and histidine levels in wheat were reduced in samples receiving 7.5 kGy of irradiation. Other essential amino acids were not affected significantly by irradiation.

4079 Horimoto, Y.; Durance, T.; Nakai, S.; Lukow, OM. (1995) **NEURAL NETWORKS VS PRINCIPAL COMPONENT REGRESSION FOR PREDICTION OF WHEAT FLOUR LOAF VOLUME IN BAKING TESTS.** *Journal of Food Science*. 60(3):429-433. English. [UNIV BRITISH COLUMBIA DEPT FOOD SCI VANCOUVER BC V6T 1Z4 CANADA].

Neural networks (NN) provide a simple means of predicting outcomes that depend upon complex, possibly nonlinear, relationships between many variables. A trained neural network was created and used to predict loaf volume of breads made from different wheat cultivars. Although creating the NN required specialized skills and considerable computational time, using the "trained" NN to estimate remix loaf volume, was very rapid and required only basic computer skills. Random Centroid Optimization (RCO) was also employed to choose the best training parameters: learning rate = 0.820, smoothing factor = 0.723, noise = 0.056, number of hidden neurons = 5. NN was more accurate, faster and easier than Principal Component Regression Analysis. [References: 17].

4080 Keck, B.; Kohler, P.; Wieser, H. (1995) **DISULPHIDE BONDS IN WHEAT GLUTEN - CYSTINE PEPTIDES DERIVED FROM GLUTEN PROTEINS FOLLOWING PEPTIC AND THERMOLYTIC DIGESTION.** *Zeitschrift für Lebensmittel-Untersuchung und -Forschung*. 200(6):432-439. English. [DEUTSCH FORSCH ANSTALT LEBENSMITTEL-CHEM LICHTENBERGSTR 4 D-85748 GARCHING GERMANY].

Gluten from the wheat variety Rektor was extracted with 70% aqueous ethanol. The insoluble portion (whole glutenin) was partially hydrolysed with trypsin at pH 6.5 and separated on a Sephadex G25 column. The high molecular weight fraction 1 was further hydrolysed with pepsin at pH 2.0. To remove low molecular weight proteins, a portion of whole glutenin was extracted with dilute acetic acid. The residue (enriched glutenin), which contained mostly LMW and HMW subunits of glutenin, was hydrolysed with thermolysin at pH 6.5. The peptic and tryptic hydrolysates were separated on a Sephadex G25 column and the peptide fractions with the highest cystine content were separated further by reversed-phase high-performance liquid chromatography (RP-HPLC). Cystine peptides were detected by differential chromatography (RP-HPLC) prior to and after reduction of disulphide bonds) and then isolated by preparative RP-HPLC. After reduction, cysteine peptides were alkylated and analysed for their amino acid sequence. Altogether, 19 cystine peptides were characterized and assigned to known sequences of gluten proteins; 16 peptides confirmed the positions of disulphide bonds present in LMW subunits and gamma-gliadins, as described previously. For the first time, a cystine peptide has been isolated, representing an intermolecular disulphide bond between the y-type of HMW and LMW subunits. Furthermore, a cystine peptide was assigned to gamma-gliadins; thus, all cysteine residues of gamma-gliadins are documented by at least one cystine peptide. One peptide analysed came from the alpha-amylase inhibitor CM 16. Altogether the results indicate that the intramolecular linkages of gluten proteins are not formed at random, but are strongly directed. For intermolecular linkages, however, different combinations were found. [References: 22].

4081 Klockiewicz-kaminska, E.; Warchalewski, JR.; Piaseckakwiatkowska, D. (1995) **THE ALPHA-AMYLASE, ALPHA-AMYLASE INHIBITOR AND PROTEINASE INHIBITOR ACTIVITIES OF PROTEINS EXTRACTED FROM WHEAT VARIETIES AND THEIR INFLUENCE ON THE BAKING QUALITY.** *Nahrung*. 39(3):209-218. English. [AGR UNIV DEPT FOOD BIOCHEM & ANAL 48 MAZOWIECKA ST 60-623 PL-60623 POZNAN POLAND].

The grain of six winter and spring wheat varieties, harvested in 1987, differing in baking quality were included in the study. A number of technological analysis were performed. Albumins, globulins and gliadins were washed out. The location of inhibitory activities in extracted proteins, against α -amylases of various origin, were tested and compared to the baking quality of the wheat grain. Also, the location of antitryptic activity and endogenous amylase activity in extractable proteins was compared to

baking quality factors. Among the studied inhibitory activities against mammalian α -amylases some correlation were found between the inhibition activity of hog pancreas α -amylase and sedimentation test ($r = 0.88$). Furthermore inhibitory activities of wheal proteins towards insects α -amylase shown significant correlation between the inhibitors of *Anagasta kuehniella* α -amylase and sedimentation test ($r = 0.90$), as well as crude protein content ($r = 0.86$). Also the inhibition activity against *Sitophilus granarius* α -amylase versus sedimentation test presented some correlation ($r = 0.80$). Endogenous amylase activities (α - and β -amylase) have an inversely proportional correlation to crude protein content ($r = -0.82$) and sedimentation test ($r = -0.85$). [References: 9].

4082 Lee, Y.T.; Seog, H.M.; Kim, S.S.; Kim, K.T.; Hong, H.D. (Korea Food Research Institute, Sungnam (Korea Republic)) (1994) **Changes in physicochemical characteristics of immature barley kernels during roasting.** *Korean Journal of Food Science and Technology (Korea Republic)* v. 26(3) p. 336-342. 3 illus.; 5 tables; 24 ref. Korean. (AGRI 95-093853).

4083 Moe, T.; Adlernissen, J. (1994) **MASHING OF RICE WITH BARLEY MALT UNDER NONCONVENTIONAL PROCESS CONDITIONS FOR USE IN FOOD PROCESSES.** *International Journal of Food Science & Technology*. 29(6):635-649. English. [TECH UNIV DENMARK DEPT BIOTECHNOL BLOCK 221 DK-2800 LYNGBY DENMARK].

Non-conventional mashing conditions are relevant in the development of a lactic acid-fermented soymilk beverage where mashed rice is the source of carbohydrates for the fermentation and sweetness of the beverage. Advantages in the process layout could be achieved by mashing at higher pH and lower malt concentrations than normally used in the brewing industry. The work reported here assessed the consequences of mashing under non-conventional conditions. Malt concentration in the cereal part was varied from 25% to 70% (w/w), pH was varied within 5.3 to 7.1, and prolongation of the holding times at 50 degrees C and 62 degrees C was investigated. Regression equations have been established for predicting yields of soluble protein, low molecular weight sugars and total fermentability as functions of pH and malt concentration. The results showed that the maltose yield was constant while glucose, maltotriose and total fermentable sugar yields decreased slightly with increasing pH and decreasing malt concentration. Prolonged mash holding times at 50 degrees C and 62 degrees C gave minor increases in protein yields only. It is concluded that it is quite acceptable to use nonconventional mashing conditions when a mashing step is integrated in other food processes. [References: 17].

4084 Roels, S.P.; Delcour, J.A. (Katholieke Univ. Leuven (Belgium). Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Onderzoekseenheid Levensmiddelenchemie) (1994) **[Wheat protein in the breadmaking]. Tarweproteinen in de broodbereiding.** *Cerevisia and Biotechnology (Belgium)* v. 19(4) p. 34-40. 5 ill.; 1 table; 15 ref. Dutch. (AGRI 95-093951).

The unique properties of wheat flour for the production of bread and other bakery products mainly arise from the presence of gluten proteins. The quantity and quality of such proteins is of great importance. Gluten consists of two groups of proteins, gliadins and glutenins. They differ in physical and physico-chemical characteristics. Differences and similarities between these two protein groups are discussed and the consequences for their different behaviour in the breadmaking process are illustrated. Furthermore, some models of the structure of glutenin polymers are discussed. Insight in such structures facilitates their manipulation. Ultimately, this may lead to a more diversified high quality product range.

4085 Seibel, W. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) **[Bread from non bread cereals in trend (buckwheat, oat, barley, rice, sorghum, corn)]. Mehrkomprodukte. Absolut im Trend.** *Brot und Backwaren (Germany)* v. 42(9) p. 20-23. 4 tables; 6 ref. German. (AGRI 95-083865).

4086 Toth, Z. (1993) **[Wheat scouring on double line in the mill of Hajdunanas]. Kétfonalas búzakoptatás a Hajdunánsi Malomban.** *Gabonaipar (Hungary)* v. 40(3) p. 26-30. 4 ill. Hungarian. (AGRI 95-093860).

A new wheat scouring system was implemented by the mill of Hajdunanas. The basic concept of the system is that different quality grains need different treatment for optimal milling efficiency. Optimal conditioning before the first break is 8-12 hours by 16-17 o/o water content for hard wheats and 3-6 hours by 14-15.5 o/o water content for soft wheats. In the endosperm of hard wheats the protein is linked strongly to the starch. It is easier to grind and its flour is more granular. The proportion of grits can reach 50 o/o. The flour of soft wheats is finer and sticky, hard to sift. The proportion of grits can be as low as 20 o/o. The mill of Hajdunanas is a highly automated, safe and modern mill where the wheat mixtures are made according to recipes to meet customers needs, and the soft and hard wheats are conditioned separately for optimal results. Different shipments of wheat are stored according to one of six different storage programmes, then they are mixed to create even quality mixtures. Conditioning is done on two parallel lines. One of six computer-controlled programmes can be chosen for conditioning. At the end of the line the wheat is cleaned and wetted.

4087 Zwingelberg, H. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) [Impact grinder in wheat milling. Part 1: Disintegration of semolina and middlings]. *Die Stiftmuehle in der Weizenvermahlung. Mitteilung 1: Zerkleinerung von Griessen und Dunsten. Muehle + Mischfuettertechnik (Germany) v. 131(34) p. 443-445. 1 ill., 11 tables; 8 ref. German. (AGRI 95-083782).*

4088 Zwingelberg, H. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) [Impact grinder in wheat milling. Part 2: Impact disintegration of intermediate products of break and flour passage]. *Die Stiftmuehle in der Weizenvermahlung. Mitteilung 2: Prallung von Zwischenprodukten aus Schrot- und Mahlpasagen. Muehle + Mischfuettertechnik (Germany) v. 131(36) p. 476-478. 5 graphs, 7 tables; 2 ref. German. (AGRI 95-083784).*

4089 Zwingelberg, H. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) [Impact grinder in wheat milling. Part 3: Dual disintegration - Roller mill and/or impact grinder]. *Die Stiftmuehle in der Weizenvermahlung. Mitteilung 3: Zweifachzerkleinerung - Walzenstuhl und/oder Stiftmuehle. Muehle + Mischfuettertechnik (Germany) v. 131(38) p. 508, 511-512. 11 tables; 7 ref. German. (AGRI 95-083785).*

Q03 FOOD CONTAMINATION AND TOXICOLOGY

4090 Baitinger, A. (1994) [Quality management systems according to DIN ISO 9000 ff. for flour mills]. *QM-Systeme nach DIN ISO 9000 ff. fuer Muehlenbetriebe. Muehle + Mischfuettertechnik (Germany) v. 131(38) p. 495-496. 3 graphs. German. (AGRI 95-084035).*

4091 Forssell, F.; Wieser, H. (1995) **SPELT WHEAT AND COELIAC DISEASE.** *Zeitschrift fur Lebensmittel-Untersuchung und -Forschung.* 201(1):35-39. English. [DEUTSCH FORSCH ANSTALT LEBENSMITTEL-CHEM LICHTEBERGSTR 4 D-85748 GARCHING GERMANY].

Spelt wheat (*Triticum spelta* L.) has not been investigated for the toxicity on coeliac disease patients until now. Because clinical studies are out of considerations for ethical reasons, spelt wheat and coeliac-active bread wheat (*Triticum aestivum* L.) were compared by the analysis of N-terminal sequences of alpha-gliadins, which have been proposed to be responsible for the toxic effect. The gliadin fractions of the spelt wheats 'Roquin' and 'Schwabekorn' and of the bread wheat 'Rektor' were preparatively separated by RP-HPLC and major alpha-gliadin components were then compared by N-terminal sequence analysis. The results did not reveal any significant difference between spelt and bread wheats within the first 25 positions. For the determination of sequences further from the N-terminus, the gliadin fractions of the spelt wheats were hydrolyzed with pepsin and trypsin. The resulting peptides were successively separated by gel permeation chromatography and RP-HPLC. Those peptides derived from the N-terminal part of alpha-gliadins were identified by reference peptides isolated previously from bread wheat [this journal 194: 229

(1992)]. Retention times upon RP-HPLC and amino acid compositions of corresponding peptides confirmed the identity of spelt and bread wheat concerning the N-terminal sequences of alpha-gliadins from position 3 to 56. For these reasons, it can be concluded that spelt wheat is a coeliac-toxic cereal and has to be avoided by coeliac patients. [References: 20].

4092 Gerlach, M. (1994) [Possibilities to avoid mycotoxin contamination and decontamination of foodstuffs and feedstuffs]. *Moeglichkeiten zur Vermeidung von Mykotoxin-Kontaminationen und zur Dekontamination von Lebens- und Futtermitteln. DLG-Tagung Grenzwerte fuer umweltrelevante Spurenstoffe; Suhl (Germany); 7-8 Sep 1993. Uebersichten zur Tierernaehrung (Germany) v. 22(1) p. 118-128. 8 tables; 6 ref. German. (AGRI 95-094152).*

4093 Jahn Deesbach, W. (Justus Liebig Univ., Giessen (Germany). Inst. fuer Pflanzenbau und Pflanzenzuechtung); Schipper, A.; Heck, H. (1994) [Cadmium contents in wheat, depending on variety and environment]. *Cadmium-Gehalte in Weizen in Abhaengigkeit von Sorte und Umwelt. Getreide Mehl und Brot (Germany) v. 48(5) p. 26-30. 3 graphs, 11 tables; 22 ref. German. (AGRI 95-084036).*

4094 Lauber, U. (Hohenheim Univ., Stuttgart (Germany). Inst. fuer Tierernaehrung); Mueller, H.M. (1994) [Investigations on determination of xanthomegnin and viomellein in wheat by means of high pressure liquid chromatography/UV/VIS-ELCD]. *Untersuchungen zur Bestimmung von Xanthomegnin und Viomellein in Weizen mittels Hochleistungsfluessigkeitschromatographie/UV/VIS-ELCD. LAF-Informationen. Sonderheft (Germany); no. 1 p. 192-195. Selbstverlag. 1 table; 5 ref. p. 192-195. German. (AGRI 95-094155).*

4095 Lew, H. (Bundesanstalt fuer Agrarbiologie, Linz (Austria)) (1994) [About taxonomy, frequency distribution and toxigenicity of Fusaria in cereals]. *Zur Taxonomie, Haeufigkeitsverteilung und Toxigenitaet der Getreidefusarien. LAF-Informationen. Sonderheft (Germany); no. 1 p. 77-80. Selbstverlag. 3 tables; 12 ref. p. 77-80. German. (AGRI 95-094154).*

Q04 FOOD COMPOSITION

4096 [Quality specification of German wheat and rye cultivars 1994]. *Qualitaetsbeschreibung der deutschen Weizen- und Roggensorten 1994 (1994) Bundesanstalt fuer Getreide-, Kartoffel- und Fettforschung, Detmold (Germany); Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau, Freising (Germany); Technische Univ. Muenchen (Germany). Inst. fuer Pflanzenzuechtung; Bundessortenamt, Hannover (Germany). Muehle + Mischfuettertechnik (Germany) v. 131(34) p. 445-447. 3 tables. German. (AGRI 95-084198).*

4097 Abu El Azm, Y.Z.; Allam, M.A. (Ministry of Agriculture, Cairo (Egypt). Food Technology Research Inst.) (1994) *Influence of initial moisture content and heat treatment on physiochemical properties of wheat flour and effect on baking properties. Zagazig Journal of Agricultural Research (Egypt) v. 21(4) p. 1205-1212. 5 tables; 12 ref. English. (AGRI 95-094480).*

4098 Anger, H. M. (1994) [Versuchs- und Lehranstalt fuer Brauerei, Berlin (VLB) - analytical results for "raw-material" and "intermediate products" 1993]. *VLB-Analysenergebnisse "Rohstoffe" und "Zwischenprodukte" 1993. Brauerei-Forum (Germany) v. 9(24) p. 281-282. 9 tables. German. (AGRI 95-084173).*

4099 Back, W.; Narziss, L.; Sacher, B.; Ketterer, M.; Stich, S.; Brand, O. (1994) *Testing new brewing barley from the 1992 harvest. Examen de nouvelles orges brassicoles de la recolte 1992. Untersuchungen an neuen Braugersten der Ernte 1992. Monatsschrift fuer Brauwissenschaft (Germany) v. 47(9) p. 272-277. 11 tables. German. (AGRI 95-084174).*

4100 Badamchian, M.; Spangelo, B.L.; Hagiwara, Y.; Hagiwara, H.; Ueyama, H.; Goldstein, A.L. (1995) **ALPHA-TOCOPHEROL SUCCINATE, BUT NOT ALPHA-TOCOPHEROL OR OTHER VITAMIN E ANALOGS, STIMULATES PROLACTIN RELEASE FROM RAT ANTERIOR PITUITARY CELLS IN VITRO.** *Journal of Nutritional*

We have previously reported the isolation of a vitamin E analog (alpha-tocopherol succinate) from a green barley leaf extract, which stimulates the release of prolactin and growth hormone from rat anterior pituitary cells in vitro. In the present study, we tested the commercially available forms of alpha-tocopherol and also succinic acid. Normal anterior pituitary cells were treated with different commercially available forms of tocopherol (100 mu g/ml) and succinic acid (50 to 100 mu g/ml). Only alpha-tocopherol succinate caused a significant increase ($P < 0.01$) in prolactin release. In addition, alpha-tocopherol, delta-tocopherol, alpha-tocopherol acetate, alpha-tocopherol nicotinate, succinic acid disodium salt, and succinic acid butenedioic acid did not affect the prolactin release in vitro. The data demonstrate that of all the biologically active forms of vitamin E, only alpha-tocopherol succinate possesses the ability to enhance anterior pituitary hormone release in vitro. [References: 15].

4101 Buckee, G.K.; Benard, M. (1995) DETERMINATION OF THE MOISTURE CONTENT OF BARLEY. *Monatsschrift für Brauwissenschaft*. 48(5-6):191-194. English.

The method of the International Organization for Standardization, (ISO 712 - 1985) for the determination of moisture in cereals and cereal products, has been tested by members of the Analysis Committee of the European Brewery Convention on samples of barley. The method, which relies on loss in mass on drying at 130 - 133 degrees C for 2 h, is recommended for use as a replacement for the current method, based on loss in mass on drying at 105 - 107 degrees C for 3 h. It was judged that precision values were independent of concentration over the range 11 to 13% m/m. Repeatability ($r(95)$) and Reproducibility ($R(95)$) values of 0.13 and 0.55 respectively were obtained over this range. At a mean level of 21.7% m/m, the $r(95)$ and $R(95)$ values were 0.27 and 2.6 respectively. This was probably due to errors associated with the double drying technique which is necessary for samples at this moisture content.

4102 Chang, C.Y.; Seitz, L.M.; Chambers, E. (1995) VOLATILE FLAVOR COMPONENTS OF BREADS MADE FROM HARD RED WINTER WHEAT AND HARD WHITE WINTER WHEAT. *Cereal Chemistry*. 72(3):237-242. English. [KANSAS STATE UNIV DEPT FOODS & NUTR MANHATTAN, KS 66506 USA].

Volatile components of white pan bread and whole wheat bread made from hard red winter or hard white winter wheat were collected on a Tenax TA trap by dynamic headspace concentration. Bread crumb and crust were studied separately. A total of 74 compounds was separated and identified by gas chromatography-Fourier transform infrared spectrometry-mass spectrometry. Among the compounds that possessed some odor qualities, 11 of them had breadlike odors. Most of the carbonyls and pyrazines were higher in relative quantities in the crust than in the crumb. Many differences were noticed between white pan and whole wheat breads. However, many fewer differences were found between breads made from hard red winter and hard white winter wheats. [References: 26].

4103 Chen, W.Z.; Hoseney, R.C. (1995) WHEAT FLOUR COMPOUND THAT PRODUCES STICKY DOUGH - ISOLATION AND IDENTIFICATION. *Journal of Food Science*. 60(3):434-437. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT GRAIN SCI & IND SHELLENBERGER HALL MANHATTAN, KS 66506 USA].

Some wheats have a 1B/1R translocation and may produce flours that give sticky doughs, even with optimum mixing time and water absorption. Studies showed that the water-soluble fraction caused sticky dough. Dialysis experiments indicated that the responsible substance had low molecular weight. Ionic exchange showed it to be either neutral or negatively charged. Gel filtration chromatography indicated it was both carbohydrate and W-absorbing. Saponification caused it to lose ability to cause sticky dough. The W-absorbing material and the carbohydrate had to be linked for the compound to be active. HPLC mass spectrometry indicated the UV-absorbing fraction was ferulic acid and the carbohydrate was a hexose. [References: 17].

4104 De Marchi, F. (Barilla G.e.R.F.lli S.p.A., Parma (Italy). Development and Quality) (1994) [Durum wheat and pasta quality]. *Durumweizen- und Teigwarenqualitaet. Getreide Mehl und Brot (Germany)* v. 48(5) p. 94-96. 18 ref. German. (AGRIS 95-084287).

4105 DeFrancischi, M.L.P.; Salgado, J.M.; Carvalho, M.T.V.; Derbyshire, E. (1994) ELECTROPHORETIC ANALYSIS OF MEAL OF BUCKWHEAT IN COMPARISON WITH COMMON WHEAT FLOUR. *Archivos Latinoamericanos de Nutricion*. 44(4):274-276. Spanish. [UNIV SAO PAULO ESCUELA SUPER AGR LUIS DE QUEIROZ SETOR NUTR HUMAN & ALIMENTOS CX POSTAL 09 BR-13418900 PIRACICABA SP BRAZIL].

The composition of the alcohol soluble proteins (prolamins) obtained from buckwheat meal and common wheat flour by two procedures were analysed by electrophoresis at pH 3.1 and, after dissociation, in the presence of sodium dodecyl sulphate at pH 8. The profiles obtained from the prolamin fraction of buckwheat were very different, qualitatively and quantitatively, from those of the prolamin of common wheat. It is probable therefore that the adverse effects associated with the presence of wheat gliadin in diets of patients with celiac disease would be reduced and possibly avoided if wheat flour was substituted by flour from buckwheat.

4106 Doheim, M.A.; Sharobeem, S.F.; Amer, M.M.A.; Ghanem, A.M. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) Relationship between electrophoretic behaviour of wheat proteins and their quality properties. *Zagazig Journal of Agricultural Research (Egypt)* v. 21(4) p. 1109-1124. 2 ill. 2 fig. 5 tables; 33 ref. English. (AGRIS 95-094380).

4107 Fajardo, J.E.; Dexter, J.E.; Roscoe, M.M.; Nowicki, T.W. (1995) RETENTION OF ERGOT ALKALOIDS IN WHEAT DURING PROCESSING. *Cereal Chemistry*. 72(3):291-298. English.

The retention of six alkaloids in hard red spring wheat infected by ergot (*Claviceps purpurea*) was determined in mill streams and in processed Oriental noodles, pasta, and pan bread. Individual and total alkaloids (ergonovine, ergosine, ergotamine, ergocornine, alpha-ergokryptine, and ergocristine) were determined by a modification of a previously reported reversed-phase high-performance liquid chromatography procedure. Generally, ergocristine was the predominant alkaloid present, followed by ergotamine. Ergot is more plastic than hard wheat endosperm, hence it flattened during smooth-roll reduction grinding. After milling, ergot alkaloids were concentrated in the late reduction streams and in the shorts derived from the reduction system. Low concentrations of ergot alkaloids were retained in high quality patent flour. Ergot alkaloids were quite stable during end-use processing. Processing of flour into pasta and Oriental noodles had little effect on levels of ergot alkaloids, and a substantial proportion of alkaloids were still present after cooking. However, cooked noodles with alkaline kansui contained less alkaloids than either cooked noodles with salt or cooked pasta. Processing flour into pan bread had a minimal effect on alkaloid levels. More alkaloids were present in the crumb than in the outer crust of bread. [References: 41].

4108 Feher, G.; Banyasz, I. (1993) [Comparison of the farinographic and alveographic qualities of different wheat varieties]. A buzafajtak farinografos es alveografos tulajdonsagainak osszehasonlitas. *Gabonai par (Hungary)* v. 40(2) p. 9-12. 3 tables; 7 ill., 12 ref. Hungarian. (AGRIS 95-094383).

While in Hungarian flour rating practice the farinograph plays the main role, in some other countries the alveograph is more widespread. The two instruments are based on different principles but some correlation can be found between the farinographic and alveographic ratings of the same dough. Statistical analysis has shown that there is a strong linear correlation between the alveographic "W" and the farinographic value. Multiple regression analysis has uncovered even more and stronger relationships between alveographic "G" value and farinographic water absorption, and alveographic "P/L" value and farinographic water absorption. The correlation factor was 0.88 and 0.86 respectively.

4109 Gabr, S.A.; Sharobeem, S.F.; Ghazlan, M.S.; Ghanem, A.M. (Zagazig Univ. (Egypt). Faculty of Agriculture) (1994) In-vitro biological value and molecular weight sub units of wheat protein. *Zagazig Journal of Agricultural Research (Egypt)* v. 21(4) p. 1125-1140. 2 ill. 1 fig. 7 tables; 34 ref. English. (AGRIS 95-094381).

4110 Hap, I. (Vysoka Skola Zemedelska, Brno (Czech Republic)) (1995) [Triticum spelta]. Co je dobre znat o pšenici spalde. Vyziva a Potraviny (Czech Republic) v. 40(1) p. 5. 1 ill. Czech. (AGRI 95-084192).

4111 Hoffmann, M. (1994) [Electrochemical screening test for malting barley]. Elektrochemischer Screening-Test fuer Braugerste. Brauwelt (Germany) v. 134(37) p. 1806-1808. 2 ill.; 3 ref. German. (AGRI 95-084175).

4112 Ito, S.; Sato, A.; Hoshino, T. (1995) STUDIES ON GRAIN AND FLOUR QUALITY OF WHEAT IN TOHOKU DISTRICT. 4. RELATION AMONG GRAIN AND FLOUR QUALITIES IN DOMESTIC AND FOREIGN WHEAT CULTIVARS BASED ON THE HARD AND SOFT WHEATS (Japanese). Japanese Journal of Crop Science. 64(2):221-226. Japanese. [TOHOKU NATL AGR EXPTL STN MORIOKA IWATE 02001 JAPAN].

Thirty Tonoku and 30 foreign wheat cultivars were grown under the same cultured condition, and grain and flour qualities were analyzed based on the hard and soft classification of wheats. Grain and flour qualities of the hard wheats were different from the soft wheats. Some factors differed between hard and soft wheats. For examination of grain and flour quality of wheat cultivar, it is necessary that cultivars be classified by hardness. It was suggested that milling characteristics were related to the ash content of grain. The relationship between milling characteristics and protein content of grain was not significant. In both the hard and soft wheats, the correlation coefficient between flour yield and flour color was significantly positive. It is suggested that higher flour yield wheat always ameliorate flour color. In the hard wheats, the correlation coefficient between ash content and flour color of A flour was significantly negative. It is shown that the selection of low ash content wheat cultivars improved flour color. In neither group the protein content of A flour was correlated with flour color. In the hard wheats, the sedimentation tests were negatively correlated with ash content. It is suggested that there is a negative correlation between the bread quality and ash content.

4113 Johansson, E.; Svensson, G. (1995) CONTRIBUTION OF THE HIGH MOLECULAR WEIGHT GLUTENIN SUBUNIT-21-ASTERISK TO BREADMAKING QUALITY OF SWEDISH WHEATS. Cereal Chemistry. 72(3):287-290. English. [SWEDISH UNIV AGR SCI DEPT PLANT BREEDING RES S-26831 SVALOV SWEDEN].

Different technological tests were used to evaluate the functional value of the newly detected high molecular weight (HMW) subunit 21* of glutenin. Progenies of two different crosses, both comprising one parent with 21* and one without 21*, were used. This allows comparison of the functional value of subunit 21* with other HMW subunits of glutenin that share a similar genetic background. Progenies containing subunit 21* have higher sedimentation volumes than those containing allelic subunits 1 or 2*. The progenies containing subunit 21* also had higher loaf volumes than those containing subunit 1. In glutograph and mixograph tests, deformation and development times were no longer for progenies containing 21* than progenies containing subunits 1 or 2*; the times obtained for progenies containing the HMW subunits 5+10, however, were very long and did indicate a gluten strength too high for Swedish baking conditions. Since the development times were not too long, the glutenin subunit 21* seems to be of potential value for wheat improvement in Sweden. [References: 27].

4114 Johansson, E.; Svensson, G.; Heneen, WK. (1995) COMPOSITION OF HIGH-MOLECULAR-WEIGHT GLUTENIN SUBUNITS IN SWEDISH WHEATS. Acta Agriculturae Scandinavica Section B-Soil & Plant Science. 45(2):112-117. English. [SWEDISH UNIV AGR SCI DEPT PLANT BREEDING RES S-26831 SVALOV SWEDEN].

The high-molecular-weight (HMW) glutenin subunit composition of Swedish wheat cultivars and advanced breeding lines was determined by using polyacrylamide gel electrophoresis in the presence of sodium dodecyl sulphate. The HMW glutenin subunit composition was found to vary slightly among the Swedish commercial cultivars. Only a few of the most recently bred spring wheat cultivars were found to contain bands implying high gluten strength, such as 14 + 15 or 5 + 10. The most common banding patterns were 2*, 6 + 8 or 7 + 9, and 2 + 12. A more

extensive variation prevailed among the breeding lines, although the most frequent patterns of HMW subunits of glutenin remained the same as found in the cultivars. Increased variation in the breeding lines will provide breeders with greater opportunities to incorporate new subunit combinations in bread wheats that would achieve the gluten strength requested by the milling and baking industries. [References: 23].

4115 Kaufmann, B. (Ireks GmbH, Kulmbach (Germany)); Kuhn, M. (1994) [Rheology of wheat doughs with bakers' yeast]. Rheologie von Weizenteigen mit Hefe. Getreide Mehl und Brot (Germany) v. 48(5) p. 50-52. 3 graphs; 4 ref. German. (AGRI 95-084285).

4116 Kim, HR.; Bushuk, W. (1995) SALT SENSITIVITY OF ACETIC ACID-EXTRACTABLE PROTEINS OF WHEAT FLOUR. Journal of Cereal Science. 21(3):241-250. English. [UNIV MANITOBA DEPT FOOD SCI WINNIPEG MB R3T 2N2 CANADA].

The sensitivities of flour proteins to precipitation by NaCl at acid pH were investigated by extraction with 0.05 M acetic acid solution containing varying concentrations of salt and by precipitation of the proteins extractable in acetic acid solution by addition of salt to varying concentrations. Flours of two Canadian hard red spring wheat cultivars (Glenlea and Katepwa) were used because of their different dough strengths. Electrophoresis results showed that as the NaCl concentration was raised, higher M(r) proteins of gliadins and glutenins were less extractable and were more easily precipitated. This tendency was more evident for the proteins of cv. Glenlea than those of cv. Katepwa, indicating that the former (stronger) is more sensitive to NaCl than the latter. SDS-PAGE results indicated that differences in the molecular size and subunit composition (i.e. relative proportion of high:low M(r) glutenin subunits, and relative proportion of x-y-type high M(r) glutenin subunits) of glutenin polymer contribute to differences in NaCl sensitivity. The differences appear to be related to the baking strength of the flour. [References: 25].

4117 Lang, W.; Sosulski, F.W.; Irudayaraj, J.; Sokhansanj, S. (1993) Effects of oil treatment and storage temperature on milling quality of HRS wheat. Paper - American Society of Agricultural Engineers (USA); no. 936021 11 p. references. Paper presented at the "1993 International Summer Meeting sponsored by The American Society of Agricultural Engineers and The Canadian Society of Agricultural Engineering," June 20-23, 1993, Spokane, Washington. English. (AGRI 95-084191).

4118 Lindhauer, M.G. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Ruppel, H.G.; Nierle, W.; Kersting, H.J.; Kahmann, U.; Wolff, J. (1994) 5th International Workshop on Gluten Proteins 1993 in Detmold. Characterization of protein components during ontogenesis of wheat - Physico-chemical aspects. 5th International Workshop on Gluten Proteins; Detmold (Germany); 7-9 Jun 1993. Gluten Proteins 1993, Detmold (Germany); Association of Cereal Research p. 96-104. 5 graphs, 3 tables; 4 ref. English. (AGRI 95-084200).

4119 Mahdi, GS. (1995) BARLEY AS HIGH-CHROMIUM FOOD. Journal of the American Dietetic Association. 95(7):749. English. [UNIV LONDON KINGS COLL SCH LIFE BASIC MED & HLTH SCI DEPT NUTR & DIETET LONDON ENGLAND].

4120 Mertz, W. (1995) BARLEY AS HIGH-CHROMIUM FOOD - REPLY. Journal of the American Dietetic Association. 95(7):749. English.

4121 Meyer, D. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Zwingelberg, H. (1994) [About the quality of 1993 admitted new wheat cultivars]. Ueber die Qualitaet 1993 neu zugelassener Weizen. Muehle + Mischfuettertechnik (Germany) v. 131(38) p. 500, 503-504. 1 graph, 9 tables; 1 ref. German. (AGRI 95-084202).

4122 Miraglia, M.; Onori, R.; Faraoni, I.; Corneli, S. (Istituto Superiore di Sanita, Rome (Italy)) (1994) [Lipid composition of durum wheat of Italian origin. 1: Evaluation of semolina obtained from different geographical areas]. Composizione lipidica del frumento duro di

produzione nazionale. 1: Valutazione di semole ottenute da varietà diverse. *Rivista di Scienza dell'Alimentazione (Italy)* v. 23(4) p. 453-459. 1 table; 2 graphs; 21 ref. Italian. (AGRI 95-094479).

A study was carried out for the quantification of total lipids in semolina from durum wheats and for the determination of the major classes of acyl lipids. A comparison was performed among varieties cultivated in different geographical areas. Two different degermination procedures (manual vs industrial) resulted in a slight increase in lipids from semola obtained by industrial procedure.

4123 Narziss, L.; Miedaner, H.; Krottenthaler, M. (1994) Development of a selection method suitable for serial application for improving the quality of the beer and the quality parameters of barley which influence the taste of beer. Part 2: Statistical research into the interrelationships between analytical data and the taste of beer. Development d'une methode de selection en serie pour l'amelioration de la qualite de la biere et des parametres de qualite de l'orge qui influencent le gout de la biere. 2eme partie: Enquete statistique sur les relations des donnees analytiques et le gout de la biere. Entwicklung einer Selektionsmethode mit Serienlegung zur Anhebung der Bierqualitaet und der den Biergeschmack beeinflussenden Qualitätsparameter der Gerste. Teil 2: Statistische Erhebungen ueber die Zusammenhaenge von Analysendaten und Biergeschmack. *Monatsschrift fuer Brauwissenschaft (Germany)* v. 47(12) p. 399-403. 4 ill., 6 tables; 5 ref. German. (AGRI 95-094610).

4124 Nierle, W. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Kersting, H.J.; Buermann, I. (1994) 5th International Workshop on Gluten Proteins 1993 in Detmold. Physical properties of gluten-starch systems as a function of preparation single components. 5th International Workshop on Gluten Proteins 1993; Detmold (Germany); 7-9 Jun 1993. *Gluten Proteins 1993, Detmold (Germany); Association of Cereal Research* p. 190-197. 8 graphs, 1 table; 8 ref. English. (AGRI 95-084185).

4125 Nilsson, G.; List, N. (1994) [The gluten-index - a method for rapid gluten quality measurement]. Der Gluten-Index - eine Methode zur schnellen Kleberqualitätsbestimmung. *Muehle + Mischfuttertechnik (Germany)* v. 131(23) p. 316-318. 2 ill., 5 graphs; 7 ref. German. (AGRI 95-084184).

4126 Osborne, B.G. (FMBRA Flour Milling and Baking Research Association, Chorleywood (United Kingdom)); Salmon, S.; Curtis, P.S. (1994) [Quality assessment of new wheat varieties in the United Kingdom]. Qualitätsbeurteilung von neuen englischen Weizensorten. *Getreide Mehl und Brot (Germany)* v. 48(5) p. 4-7. 2 graphs, 1 table; 11 ref. German. (AGRI 95-084199).

4127 Park, M.W.; Kim, Y.G.; Lee, C.K. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station); Chae, J.C. (Dankook University, Cheonan (Korea Republic). College of Agriculture) (1994) Starch content and its associated grain characters in naked barley. *Korean Journal of Crop Science (Korea Republic)* v. 39(1) p. 55-62. 6 illus.; 9 tables; 12 ref. Korean. (AGRI 95-094369).

4128 Rabe, E. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) [Discussion of the results of ring tests]. Diskussion der Ergebnisse von Gemeinschaftsuntersuchungen. *Getreide Mehl und Brot (Germany)* v. 48(5) p. 34-42. 1 graph, 11 tables; 6 ref. German. (AGRI 95-084282).

4129 Rayasduarte, P.; Robinson, S.F.; Freeman, T.P. (1995) INSITU LOCATION OF A STARCH GRANULE PROTEIN IN DURUM WHEAT ENDOSPERM BY IMMUNOCYTOCHEMISTRY. *Cereal Chemistry*. 72(3):269-274. English. [N DAKOTA STATE UNIV DEPT CEREAL SCI & FOOD TECHNOL FARGO, ND 58105 USA].

Starch granule protein (SGP) was extracted with 0.1 N NaCl from starch isolated from durum wheat *Triticum turgidum* cv. Vic flour (53% extraction). Ultrafiltered and lyophilized SGP was analyzed by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE). A 32-kDa SGP was identified, excised from the gel, and used as an antigen to

produce polyclonal antibodies. Western blotting confirmed antibody production. The antibodies were used in a gold label transmission electron study of wheat endosperm tissue seven days after anthesis. Significance was determined using stereological techniques and nonparametric one-way analysis of variance. The number of gold particles per μm^2 area for starch (8.92), cell wall (0.53), and cytoplasm (0.04) differed significantly ($P < 0.01$). Labeling occurred throughout the starch, indicating that the 32-kDa starch granule protein is inherent to starch and is not localized on the granule surface. [References: 29].

4130 Saleh, A.L.; El Faham, S.Y.; Abd El Haleem, A.K. (National Research Center, Cairo (Egypt). Soil Science and Water Use Dept.) (1993) Mineral composition of wheat grains as affected by N and P fertilizers and irrigation. *Journal of Agricultural Sciences, Mansoura Univ. (Egypt)* v. 18(9) p. 2505-2511. 2 tables; 24 ref. English. (AGRI 95-094382).

4131 Schmieder, W. (1994) [A possibility for complex valuation of processing quality of wheat]. Eine Moeglichkeit zur komplexen Einschaeztung des Verarbeitungswertes von Weizen. *Muehle + Mischfuttertechnik (Germany)* v. 131(38) p. 499-500. 2 graphs, 1 table. German. (AGRI 95-084201).

4132 Schramm, W. (Paderborn Univ. (Germany). FB 6); Bitsch, R. (1993) [Vitamin B(6) in plant products]. Vitamin B(6) in pflanzlichen Produkten. Derivatisierung und Bindungsform. *VitaMinSpur (Germany)* v. 8(3) p. 122-124. 1 ill., 2 tables; 2 ref. German. (AGRI 95-094444).

4133 Schuler, S.F.; Bacon, R.K.; Finney, P.L.; Gbur, E.E. (1995) RELATIONSHIP OF TEST WEIGHT AND KERNEL PROPERTIES TO MILLING AND BAKING QUALITY IN SOFT RED WINTER WHEAT. *Crop Science*. 35(4):949-953. English. [UNIV ARKANSAS DEPT AGRON FAYETTEVILLE, AR 72701 USA].

Although test weight is used as a grading criterion and an indication of quality in wheat (*Triticum aestivum* L.), its relationship to specific quality parameters in soft wheat is not well documented. Seed characteristics, flour yield, and baking quality were studied in 24 soft red winter wheat (SRWW) genotypes grown in six environments to determine their relationship to test weight. Flour yield, hour protein, alkaline water retention capacity (AWRC), and softness equivalent (SEQ) were evaluated by the micro-procedures of the USDA-ARS soft wheat early-generation milling and baking quality evaluation program. Despite removal of shriveled kernels prior to evaluation, environmental effects had a significant impact on quality parameters, ranging from 68% of total variability (SEQ) to 5% (AWRC). Test weight was not correlated with flour yield, but was significantly correlated with flour protein content ($r = 0.54$, $P < 0.05$) as was kernel density ($r = 0.49$). Thousand-kernel weight, diversity of seed size, proportion of large seed, and average kernel length and width were not correlated with flour yield or other quality parameters. Test weight did not predict flour yield in SRWW when shriveling was absent, but it was related to flour protein content, which is associated with baking quality. Kernel size or size distribution did not affect end-use quality. The best predictive model based on the characters above explained little of the total variation in flour yield ($R^2 = 0.22$). [References: 28].

4134 Seibel, W. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Gerstenkorn, P. (1994) [Processing quality of German durum wheat from crop years 1990-1993]. Verarbeitungsqualitaet von deutschem Durumweizen der Ernten 1990-1993. *Getreide Mehl und Brot (Germany)* v. 48(5) p. 8-10. 7 tables; 7 ref. German. (AGRI 95-084189).

4135 Seibel, W. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Gerstenkorn, P. (1994) [Processing quality of German durum wheat of crops from 1990 to 1993]. Verarbeitungsqualitaet von deutschem Durumweizen der Ernten 1990-1993. *Muehle + Mischfuttertechnik (Germany)* v. 131(24) p. 329-330. 8 tables; 7 ref. German. (AGRI 95-084188).

4136 Shewry, P.R. (1995) PLANT STORAGE PROTEINS [Review]. *Biological Reviews of the Cambridge Philosophical Society*. 70(3):375-426.

4137 Shurtleff, W.; Aoyagi, A. (1992) **Bibliography and sourcebook on Seventh-Day Adventists' work with soyfoods, vegetarianism, and wheat gluten, 1866-1992: detailed information on 835 published documents (bibliographic), 602 commercial food products, 207 unpublished archival documents, 158 original, interviews (many full text) and overviews. Bibliographies and sourcebooks on soya series (USA) 407 p.** Soyfoods Center. indexes. English. (AGRI 95-084265).

This is the most comprehensive book ever published on the work of Seventh-day Adventists with soyfoods, vegetarianism, or wheat gluten. The scope of this book includes all known publications, commercial food products, and archival documents, plus many original interviews, from earliest times to the present, worldwide. Includes details on 602 commercial food products containing soya or wheat gluten, including the product name, date of introduction, manufacturer's name, address and phone number, and in many cases ingredients, weight, packaging and price, storage requirements, nutritional composition, and a description of the label.

4138 Song, H.S. (Rural Development Administration, Suwon (Korea Republic). Crop Experimental Station); Lee, H.S. (Seoul National University, Suwon (Korea Republic). College of Agriculture and Life Science); Chung, T.Y. (Rural Development Administration, Suwon (Korea Republic). Agricultural Biotechnology Institute) (1994) **Cooking and milling characteristics of several barley starch isogenic lines. Korean Journal of Crop Science (Korea Republic) v. 39(1) p. 63-72. 4 illus.; 7 tables; 18 ref.** Korean. (AGRI 95-094370).

4139 Suhasini, A.W.; Malleshi, N.G. (1995) **INFLUENCE OF MALTING CONDITIONS ON AMYLASE ACTIVITY, PHYSICAL CHARACTERISTICS AND NUTRIENT COMPOSITION OF WHEAT MALT. Journal of Food Science & Technology-Mysore. 32(2):98-103. English. [CENT FOOD TECHNOL RES INST DEPT GRAIN SCI & TECHNOL MYSORE 570013 KARNATAKA INDIA].**

Wheat germinated at 25 degrees C exhibited higher levels of amylase activity than that germinated at 15, 20, 30 and 35 degrees C for any given period up to 120 h germination. Malting loss increased proportionately with temperature and duration of germination. Kilning the green malt of 12% moisture content at 65 degrees C produced the malt of desirable aroma, colour and retained 75% of its amylase activity. Germination led to 13.7 and 45.0% decrease in 1000 kernel weight and hardness, respectively, along with 12% loss in starch content at 72 h. Although there was no appreciable change in protein content on malting, the malt protein contained slightly higher proportion of lysine, while the malt rootlets contained 22% proteins and 1.3% lysine. Malting enhanced the acid extractable minerals, ascorbic acid, riboflavin and niacin, with a concomitant reduction in the dietary bulk (viscosity) of the malt slurry.

4140 Weber, C.W.; Kohlhepp, E.A.; Idouraine, A.; Ochoa, L.J. (1993) **Nutritional composition of tamales and corn and wheat tortillas. Journal of food composition and analysis: an official publication of the United Nations University, International Network of Food Data Systems (USA) v. 6(4) p. 324-335. references. English. (AGRI 95-084271).**

Tamales and corn and wheat tortillas were purchased from various sources in Tucson, Arizona, U.S.A. in 1988 and 1989. A total of 16 tamales and 10 corn and 11 wheat tortillas from different sources were analyzed for proximate composition and mineral content. Corn tortillas averaged 5.9% protein, 2.3% lipid, and 240 kcal/100 g, while the wheat tortillas averaged 8.3% protein, 7.1% lipid, and 328 kcal/100 g. The tamales averaged 5.4% protein, 11.2% lipid, and 215 kcal/100 g. The tamales were divided into two classes of either "green corn" or beef. The green corn tamales averaged 4.9% protein, 11.9% lipid, and 221 kcal/100 g, while the beef tamales averaged 6.0% protein, 10.6% lipid, and 206 kcal/100 g. Corn tortillas had mineral concentrations for calcium of 214 mg/100 g, phosphorus of 71 mg/100 g, iron of 1.7 mg/100 g, and zinc of 1.5 mg/100 g, while wheat tortillas had values for calcium of 70 mg/100 g, phosphorus of 50 mg/100 g, iron of 6.8 mg/100 g, and zinc of 0.7 mg/100 g. Tamales had values of calcium of 82.3 mg/100 g, phosphorus of 83 mg/100 g, iron of 2.9 mg/100

g, and zinc of 1.5 mg/100 g. All composition data are expressed on a wet weight basis.

4141 Weinard, W. (1994) **[Hagberg test for determination of alpha-amylase in grain and flour]. Hagberg-Test zur Bestimmung der Alpha-Amylase in Getreide und Mehl. Muehle + Mischfuttertechnik (Germany) v. 131(23) p. 319. 2 ill., 2 graphs. German. (AGRI 95-084197).**

4142 Weinard, W. (1994) **[Measurements of whole grain by infrared transmission]. Messungen am ganzen Getreidekorn mit Infrarottransmission. Muehle + Mischfuttertechnik (Germany) v. 131(23) p. 311-312, 315. 1 ill., 9 graphs, 2 tables. German. (AGRI 95-084187).**

4143 Weipert, D. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1994) **[Description of the visco-elastic properties of wheat proteins]. Zur Beschreibung der viskoelastischen Eigenschaften der Weizenproteine. Getreide Mehl und Brot (Germany) v. 48(5) p. 53-58. 12 graphs; 19 ref. German. (AGRI 95-084286).**

Q05 FOOD ADDITIVES

4144 Friend, C.P.; Ross, R.G.; Waniska, R.D.; Rooney, L.W. (1995) **EFFECTS OF ADDITIVES IN WHEAT FLOUR TORTILLAS. Cereal Foods World. 40(7):494-497. English. [INAGRA CINCINNATI, OH USA].**

Varied levels of acids, antimicrobial agents, reducing agent, and emulsifiers were evaluated in hot-press, wheat flour tortillas prepared using all-purpose (10.7% protein) and bread (11.8% protein) flours. Tortilla dough was easier to mix and machine between pH 5.8 and 6.4. Good antimicrobial activity (shelf life >14 days) was observed at dough pH 5.5 for calcium propionate and at dough pH 5.8 for potassium sorbate. Cysteine decreased mixing and resting times of tortilla doughs and rollabilities of baked tortillas during storage. Emulsifiers slightly improved processing and product qualities. Dough prepared from 10.7% protein flour had a decreased mixing tolerance. Initial tortilla qualities were similar; but tortillas prepared from 11.8% protein flour had improved rollabilities during storage compared with tortillas prepared from 10.7% protein flour. [References: 16].

4145 Schneider, E.; Usleber, E.; Martlbauer, E.; Dietrich, R.; Terplan, G. (1995) **MULTIMYCOTOXIN DIPSTICK ENZYME IMMUNOASSAY APPLIED TO WHEAT. Food Additives & Contaminants. 12(3):387-393. English. [UNIV MUNICH FAC VET INST HYG & TECHNOL FOOD ANIM ORIGIN SCHELLINGSTR 10 D-80799 MUNICH GERMANY].**

A membrane-based visual dipstick enzyme immunoassay for the simultaneous detection of up to five mycotoxins was developed. Multiple dots of the respective antibodies against aflatoxin B-1 (AFB(1)), T-2 toxin (T-2), 3-acetyldeoxynivalenol (3-AcDON), rosidin A (RA), and zearalenone (ZEA) were applied onto a dipstick membrane. The competitive immunoreactions were performed by incubation of the dipstick in a test tube containing sample solution and a mixture of the respective toxin-horseradish peroxidase conjugates. After a second incubation in enzyme substrate/chromogen solution, a complete suppression of the (blue) colour development of the respective dot was scored positive. Visual detection limits for AFB(1), T-2, 3-AcDON, RA, and ZEA in buffer solution were 2 ng/ml, 5 ng/ml, 50 ng/ml, 30 ng/ml, and 5 ng/ml respectively. Using a simple extraction procedure, the detection limits of the multimycotoxin assay in artificially contaminated wheat samples were 30 ng/g, 100 ng/g, 600 ng/g, 500 ng/g, and 60 ng/g, respectively.

Q51 FEED TECHNOLOGY

4146 Mihok, S. (Agricultural University of Debrecen, PO Box 36, Debrecen 4015 (Hungary)) (1992) **Nutritious weeds for feeding broiler goose. Proceedings 9th International Symposium on Waterfowl, Pisa, Italy, 16-18 September 1992. p. 165-167. World's Poultry Science Association. English. (AGRI 95-094623).**

Q52 FEED PROCESSING AND PRESERVATION

4147 Schneider, G. (1994) [Development and testing of low price conservation methods of moist grain]. *Entwicklung und Erprobung kostengünstiger Konservierungsverfahren fuer Feuchtgetreide*. Hohenheim Univ., Stuttgart (Germany). Inst. fuer Agrartechnik. Fachgebiet Verfahrenstechnik in der Tierproduktion und Landwirtschaftliches Bauwesen. 27 ill., 26 tables. Bibliography 123 ref. 151 p. German. (AGRI 95-094633).

Q53 FEED CONTAMINATION AND TOXICOLOGY

4148 Modi, R. (1993) [Ergosterine content, mycotoxin content and toxicity of feedstuff components]. *Ergosterinegehalt, Mykotoxingehalt und Toxizität von Futtermittelkomponenten*. Hohenheim Univ., Stuttgart (Germany). 56 ill., 25 tables. Bibliography 313 ref. 194 p. German. (AGRI 95-094663).

4149 Thalmann, A. (Staatliche Landwirtschaftliche Untersuchungs und Forschungsanstalt Augustenberg, Karlsruhe (Germany)) (1994) [Microbiology of feedstuffs]. *Die Mikrobiologie von Futtermitteln*. DLG-Tagung Grenzwerte fuer umweltrelevante Spurenstoffe; Suhl (Germany); 7-8 Sep 1993. *Uebersichten zur Tierernaehrung (Germany)* v. 22(1) p. 129-133. 2 tables; 3 ref. German. (AGRI 95-094649).

4150 Wagner, F. (1994) [Actual aspects from animal nutrition and knowledge of feeds. 6. Mycotoxin contamination of grain and feed as a part in food hygiene]. *Aktuelles aus Tierernaehrung und Futtermittelkunde*. 6. Mykotoxinbesatz an Getreide und Futtermitteln als Teil der Lebensmittelhygiene. *Muehle + Mischfuettertechnik (Germany)* v. 131(31) p. 411-412. 2 tables. German. (AGRI 95-084414).

Q54 FEED COMPOSITION

4151 Anon. (1993) [Quality of raw matters for animal feeding: chemical composition and energy value of French sorghum, results of survey; variability of trypsin inhibiting activity of peas grown in France; variability of phosphorus phytates in wheat, barley and peas]. *Qualite des matieres premieres pour l'alimentation animale: composition chimique et valeur energetique des sorghos francais, resultats de 4 annees d'enquete; variabilite de l'activite antitrypsique des pois recoltes en France; variabilite de la teneur en phosphore phytique du ble, de l'orge et du pois*. [Use of cereals and protein crops by animals. Report of the 1992 experiments by the "Service Valorisation Animale (ITCF [Technical institute for cereals and forages])]. *Valorisation animale des cereales et proteagineux. Compte rendu des experimentations 1992 du Service Valorisation Animale (ITCF [Institut technique des cereales et fourrages])*. Institut Technique des Cereales et des Fourrages, Paris (France) p. 11-16. ITCF. French. (AGRI 95-094691).

4152 Anon. (1993) [Trials of digestibility in pigs]. *Essais digestibilite porcs (Vendome)*. [Use of cereals and protein crops by animals. Report of the 1992 experiments by the "Service Valorisation Animale" (ITCF [Technical institute for cereals and forages])]. *Valorisation animale des cereales et proteagineux. Compte rendu des experimentations 1992 du Service Valorisation Animale (ITCF [Institut technique des cereales et fourrages])*. Institut Technique des Cereales et des Fourrages, Paris (France) p. 21-32. ITCF. 7 tableaux. French. (AGRI 95-094680).

Results of the following trials. Feeding value in pigs of one batch of red sorghum and one batch of white sorghum. Duration of the adaptation period and the collection period for total digestibility trials in pigs. Relationship between nitrogen intake and nitrogen excreted in growing finishing pigs. Effect of the introduction of spring pea in the diet of growing finishing pigs on their N excretion. Feeding value of four wheat varieties in pigs. Feeding value of two varieties of triticale in pigs.

4153 Borsting, CF.; Knudsen, KEB.; Steinfeldt, S.; Mejbom, H.; Eggum, BO. (1995) **THE NUTRITIVE VALUE OF DECORTICATED MILL**

FRACTIONS OF WHEAT. 3. DIGESTIBILITY EXPERIMENTS WITH BOILED AND ENZYME TREATED FRACTIONS FED TO MINK. *Animal Feed Science & Technology*. 53(3-4):317-336. English. [NATL INST ANIM SCI RES CTR FOULUM DEPT SMALL FARM ANIM POB 39 DK-8830 TJELE DENMARK].

The nutritive value of boiled and enzyme treated whole grain wheat and six mill fractions prepared by successive decortication of wheat kernels was studied in 15 digestibility trials with mink. The decortication process yielded mill fractions varying considerably in morphological and in chemical composition. The whole kernels (WK) and each of the six mill fractions (F1-F6) were provided to five adult black male mink either raw (only WK), boiled with water (15 min) or after treatment with cell wall degrading and proteolytic enzymes and mixed into complete diets to comprise 450-500 g wheat dry matter (DM) kg⁻¹ DM. Diet composition was (g kg⁻¹): cod meat 750, wheat fractions 190, lard 40, soy oil 10, vitamin mixture 5 and mineral mixture 5. The amount of starch in the diets based on boiled fractions ranged from 85 g kg⁻¹ DM in the diet prepared from the outer fraction enriched in pericarp/testa (F1) to 300 g kg⁻¹ DM in the diet containing the endosperm enriched inner fraction (F6). Total non-starch polysaccharides (NSP) ran conversely, constituting 213 g kg⁻¹ DM in diet F1 vs. 50 g kg⁻¹ DM in diet F6. Enzyme treatment resulted in a significant depolymerisation and solubilisation of cell wall NSP and of starch. The digestibility of energy was significantly higher (similar to 3 absolute units) in the diets with enzyme treated wheat fractions compared to the corresponding diets with boiled products in which energy digestibilities ranged from 70.7% to 90.6%. These differences were mainly due to higher digestibility of the carbohydrates and to a lesser extent to higher protein digestibility in the enzyme treated fractions. The digestibility of crude carbohydrates (calculated by difference) was consistently higher in enzyme treated fractions compared to boiled fractions, the differences varying from 13.4 absolute units (37.4% vs. 24.0%) in F1 to 5.4 absolute units (80.7% vs. 75.3%) in F6. Starch digestibility was about 90% for both boiled and enzyme treated fractions showing slightly, but significantly lower values in enzyme treated diets. Therefore, the higher digestibility of crude carbohydrates in enzyme treated fractions could not be ascribed to higher starch digestibility but to depolymerisation of NSP and to higher digestibility of the remaining NSP in enzyme treated fractions (28.1-34.9%) compared with boiled fractions (12.4-25.3%). A significant positive digestibility of NSP in both boiled and enzyme treated fractions combined with substantial amounts of short-chain fatty acids in faecal material suggest that microbial degradation of cell wall NSP can occur in mink despite the high rate of passage and the relatively low microbial activity in the gastrointestinal tract. [References: 31].

4154 Fike, GD.; Simms, DD.; Cochran, RC.; Vanzant, ES.; Kuhl, GL.; Brandt, RT. (1995) **PROTEIN SUPPLEMENTATION OF AMMONIATED WHEAT STRAW - EFFECT ON PERFORMANCE AND FORAGE UTILIZATION OF BEEF CATTLE**. *Journal of Animal Science*. 73(6):1595-1601. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT ANIM SCI & IND MANHATTAN, KS 66506 USA].

We studied the effects of supplement CP concentration on performance and forage use of cattle allowed ad libitum access to ammoniated wheat straw. During two consecutive winters, crossbred beef cows in late gestation (n = 87 in 1990-1991, n = 84 in 1991-1992) were used in a randomized complete block design with three pens per treatment. Cows were stratified by weight, body condition score (BCS), age, and breed and randomly assigned within strata to 1) control (C, no supplement), or 2 kg/d of 2) low-protein (LP) supplement (12% CP), 3) moderate-protein (MP) supplement (20.1% CP), or 4) high-protein (HP) supplement (31.7% CP) (DM basis). The feeding period was 84 d in 1990-1991 and 60 d in 1991-1992. Supplementation (C vs LP, MP, or HP) increased (P < .01) cow weight gains (32.7 vs 60.7, 62.8, and 72.4 kg, respectively) and improved (P < .01) BCS. Calf birth weights, weaning weights, and ADG were not affected by treatment (P greater than or equal to .20). Average calving date, percentage of cows cycling at the start of the breeding season and percentage pregnant after a 60-d breeding season were also similar (P > .20) among treatments. Sixteen ruminally fistulated steers (482 kg, four steers per treatment) were blocked by weight and assigned to the same four supplements in a 30-d digestion trial. Supplementation increased (P < .01) digestible DMI and forage DMI (P less than or equal to .04) and tended (P = .09) to increase digestible NDF intake but did not alter (P greater than

or equal to .15) apparent DM: or NDF digestibility. However, DM and NDF digestibilities increased (P less than or equal to .03) with increasing CP concentration. Ruminant NH₃ N concentration was increased (P = .04) by supplementation and, among supplemented steers, the increase was linear (P < .01) with increased protein concentration. All other fermentation characteristics measured, except butyrate proportion, responded significantly to increasing protein concentration in the supplement. In conclusion, although forage consumption, cow weight, and body condition increased with increasing CP concentration in supplement, the response was not sufficient to affect subsequent reproduction or calf gain. [References: 30].

4155 Gabel, M. (Rostock Univ. (Germany). Inst. fuer umweltgerechte Tierhaltung); Hackl, W. (1994) [Situation of protein evaluation in cattle and pig]. *Stand der Proteinbewertung bei Rind und Schwein*. Wilhelm-Stahl-Symposium: Umweltvertraegliche und qualitaetsbewusste Erzeugung tierischer Produkte; Rostock (Germany); 17-18 May 1994. *Archiv fuer Tierzucht (Germany)* v. 37(Spec.no.) p. 73-80. 1 ill., 3 tables; 35 ref. German. (AGRI 95-094676).

Q55 FEED ADDITIVES

4156 Kristensen, V.F.; Ohlsson, C. (1995) [Urea as additive for whole-crop wheat silage]. *Urea som additiv ved ensilering af hvedehelsaet*. *Beretning fra Faellesudvalget for Statens Planteavlssorsoeg og Husdyrbrugsforsoeg (Denmark)*; no. 22 17 p. SP. 8 tables; 37 ref. Danish. (AGRI 95-094709).

Q60 PROCESSING OF NON-FOOD OR NON-FEED AGRICULTURAL PRODUCTS

4157 Gueguen, J. (Institut National de la Recherche Agronomique, Nantes (France). Centre de Nantes, Biochimie et Technologie des Proteines); Berot, S.; Popineau, Y.; Schwenke, K.D. (1995) [Functionalization of plant proteins by chemical way [deamidation of wheat gliadines, succinylation of 11S pea protein]]. *Fonctionnalisation de proteines vegetales par voie chimique [desamidation des gliadines du ble, succinylation de la proteine 11S du pois]*. *Colloques de l'INRA (France)*; no. 71 p. 87-93. INRA. 7 ref., 6 graph. p. 87-93. French. (AGRI 95-094749).

4158 Kersting, H.J. (Bundesanstalt fuer Getreide, Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Lindhauer, M.G.; Bergthaller, W. (1994) *Application of wheat gluten in non food industries*. 5th International Workshop on Gluten Proteins; Detmold (Germany); 7-9 Jun 1993. *Gluten Proteins 1993, Detmold (Germany)*; Association of Cereal Research p. 414-428. 4 graphs, 3 tables; 36 ref. English. (AGRI 95-084467).

4159 Renard, C. (Institut National de la Recherche Agronomique, Nantes (France). Centre de Nantes, Biochimie et Technologie des Glucides); Crepeau, M.J.; Thibault, J.F. (1995) [Water retention by sugarbeet and wheat bran fibres]. *Retention d'eau par les fibres de betterave et le son de ble*. *Colloques de l'INRA (France)*; no. 71 p. 61-66. INRA. 9 ref. p. 61-66. French. (AGRI 95-094764).

Q70 PROCESSING OF AGRICULTURAL WASTES

4160 Maheswari, D.K.; Jahan, H.; Paul, J.; Varma, A. (Department of Botany, Gurukul University, Harwar (India)) (1993) *Wheat straw, a potential substrate for cellulase production using Trichoderma reesei*. *World Journal of Microbiology and Biotechnology (United Kingdom)* v. 9(1) p. 120-121. 5 ref. English. (AGRI 95-094815).

Q80 PACKAGING

4161 Drexler, H.P.; Grund, H.; Koesling, V. (1994) [Kegging system for wheat beer. New equipments: Private brewery Schneider and Son KG, Kelheim]. *Weizenbier-Kegsystem. Neue Anlagen im Blickpunkt*:

Privatbrauerei Schneider und Sohn KG, Kelheim. *Brauwelt (Germany)* v. 134(41) p. 2063-2064. 3 ill. German. (AGRI 95-084539).

T01 POLLUTION

4162 An Lizhe; Wang Xunling (Lanzhou Univ., Gansu (China). Dept. of Biology) (1994) *Effect of ozone on growth of spring wheat and the prevention of rare earth to ozone injury*. *Acta Ecologica Sinica (China)* v. 14(1) p. 95-98. 5 ill., 6 ref. Chinese. (AGRI 95-095254).

4163 Maycock, R.; Butcher, S.; Hastings, M.; Long, T.; Watson, P.; Gibson, R.; Lewer, P. (Letcombe Laboratory, DowElanco Europe, Letcombe Regis, Wantage, Oxfordshire OX12 9JT (United Kingdom)) (1993) *Residue profile of metosulam - a new broad-leaf herbicide*. vol. 2. *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993*. p. 843-848. British Crop Protection Council (BCPC). 3 ref. English. (AGRI 95-095322).

4164 Nicholls, P.H.; Evans, A.A.; Bromilow, R.H.; Howse, K.R.; Harris, G.L.; Rose, S.C.; Pepper, T.J.; Mason, D.J. (Rothamsted Experimental Station, AFRC Institute of Arable Crops Research, Harpenden, Hertfordshire AL5 2JQ (United Kingdom)) (1993) *Persistence and leaching of isoproturon and mecoprop in the Brimstone Farm plots*. vol. 2. *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993*. p. 849-854. British Crop Protection Council (BCPC). 5 ref. English. (AGRI 95-095318).

4165 Steveninck, R.F.M. van (Trobe Univ., Bundoora, Victoria (Australia). School of Agriculture); Babare, A.; Fernando, D.R.; Steveninck, M.E. van (1994) *The binding of zinc, but not cadmium, by phytic acid in roots of crop plants*. *Plant and Soil (Netherlands)* v. 167(1) p. 157-164. 21 ref. English. (AGRI 95-084777).

4166 Traub Eberhard, U.; Kordel, W.; Klein, W. (Fraunhofer Institut fur Umweltchemie und Okotoxikologie, 57392 Schmallenberg Grafschaft (Germany)) (1993) *Monitoring pesticide movement into subsurface drains*. vol. 2. *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993*. p. 885-892. British Crop Protection Council (BCPC). 8 ref. English. (AGRI 95-095327).

U10 MATHEMATICAL AND STATISTICAL METHODS

4167 Bacsi, Z.; Zemankovics, F. (1995) *VALIDATION - AN OBJECTIVE OR A TOOL - RESULTS ON A WINTER WHEAT SIMULATION MODEL APPLICATION*. *Ecological Modelling*. 81(1-3):251-263. English. [PANNON UNIV AGR SCI GEORGIKON FAC AGRON KESZTHELY DEPT AGR EXTENS DEAK F U 57 H-8360 KESZTHELY HUNGARY].

The present paper describes a validation exercise for the CERES-Wheat simulation model using the SCP 179 data set provided by the research team of Technical University of Braunschweig (Germany). The data set used is a common data set to facilitate the performance of different crop growth simulation models. The present paper carries out a validation exercise with the aim of illustrating the capabilities of CERES-Wheat in a West European scenario, and, on the other hand, to illustrate the use of some statistical methods in model validation. Four simulation scenarios are set up with altogether two different soil types and two weather data sets for a winter wheat variety called Kanzler. The goodness of fit between model outputs and field observations is assessed for anthesis and maturity dates, biomass and grain production, leaf area index development and soil water and nutrient balance. A sensitivity analysis is included to illustrate the model's special facility to make distinctions between wheat varieties of different characteristics. Full validation was not possible to be carried out due to the relatively limited number of observations available, thus the paper is an exercise in validation methodology rather than a complete assessment of the model's performance and validity. [References: 6].

4168 Mohamed, T.A. (Ministry of Agriculture, Cairo (Egypt). Central Laboratory for Design and Statistical Analysis) (1994) *Multivariate*

analysis of yield and the relative contributions of variables to its variations in barley (*Hordeum vulgare*). *Journal of Agricultural Science, Mansoura Univ. (Egypt)* v. 19(7) p. 2145-2150. 3 tables; 6 ref. English. (AGRIS 95-095443).

4169 Recio, B. (Universidad Politecnica de Madrid (Espana). Escuela Tecnica Superior de Ingenieros Agronomos) (1994) **A global crop production decision support system for wheat in Navarra**. Investigacion Agraria. Produccion y Proteccion Vegetales (Espana); Fuera de serie no. 1 p. 61-71. INIA. 1 tab., 2 fig. p. 61-71. English. (AGRIS 95-095421).

U30 RESEARCH METHODS

4170 Glaeser, M. (Institut fuer Agrartechnik, Potsdam (Germany)); Kuhn, E.; Ilte, T. (1994) **[Calibration of radiometric backscatter probes. Density measuring of agricultural materials]. Kalibrierung radiometrischer Rueckstreu-Sonden. Dichtemessung an landwirtschaftlichen Guetern** *JLandtechnik* (Germany) v. 49(4) p. 226-227 ill., 1 table. German. (AGRIS 95-095453).

Density is a significant parameter for characterizing agricultural materials. For density measuring, radiometric backscatter probes can be used. Because these probes measure the density indirectly, their calibration is a time consuming procedure. In this paper, methods for attaining proven and reliable calibration curves for the user are shown. For the first time, the relationships found in the experiments are described mathematically.

AUTHOR INDEX

- Abad, MS. 3736
 Abbas, A.M. 3995
 Abbate, PE. 3774
 Abd El Aal, A.M. 3473
 Abd El Haleem, A.K. 4130
 Abd El Maged, A.A. 3455
 Abd El Magid, A.A. 3488
 Abd El Malak, M.S. 3995
 Abd El Rahman, M.M. 3502
 Abd El Zaher, M.T. 3336
 Abdallah, AE. 3445
 Abokassem, E. 3775
 Abou Deya, I.B. 3519
 Abrams, SR. 3832
 Absar, N. 4011
 Abu El Azm, Y.Z. 4097
 Acharya, CL. 3507
 Adams, MJ. 3930
 Adams, N.J. 3993
 Adeoti, AA. 3913
 Adlmissen, J. 4083
 Aggarwal, R. 3867
 Agnessens, R. 4067
 Agret, S. 3849
 Aidara, S. 3849
 Akatova, LZ. 3437
 Akhtar, J. 3949
 Akin, DE. 3776
 Al Gaby, A.M. 3488
 Al Muslum, I.S. 3538
 Alagusundaram, K. 3985
 Alamgir, ANM. 3777
 Albertini, L. 3868, 3938
 Albrechtsen, RS. 3316
 Alcantargonzalez, G. 3765
 Aldridge, WG. 3317
 Aledo, R. 3539
 Ali, NM. 3540
 Alihaimoud, DE. 3938
 Alizadeh, A. 3868
 Aljaloud, AA. 3381
 Alkaddoussi, A.R. 3541, 3562
 Allam, M.A. 4097
 Allen, GJ. 3693
 Almustafa, WA. 3445
 Alonso, V. 3737
 Alvarez, JB. 4070
 Aly, R.M. 3353, 3427
 Amanuel Gorfu 3419
 Amato, M. 3499
 Amatya, R.K. 3354
 Ameenuddin, N. 3858
 Amer, M.M.A. 4106
 An Lizhe 4162
 Andrade, FH. 3774
 Andrews, DC. 4059, 4060
 Anema, PK. 3892
 Anger, H. M. 4098
 Annicchiarico, P. 3635, 3636
 Anon. 3311, 3355, 3356, 3357, 3996, 3997, 3998, 3999, 4071, 4151, 4152
 Antoniow, JF. 3930
 Aoyagi, A. 4137
 Apostolakos, P. 3722
 Aragues, R. 3495
 Araki, S. 3729
 Araus, JL. 3742
 Araya, Jaime E. 3840, 3841
 Argandona, V.H. 3699
 Arijia, I. 3994
 Armentano, LE. 4002
 Arriaga, HO. 4070
 Arshad, MA. 3509
 Arshad, Y. 3678
 Arz, MC. 3778
 Asakawa, S. 3510
 Ashry, A.M. 3336
 Asir, R. 3642
 Aslam, M. 3738
 Asmar, F. 4022
 Aspegren, K. 3739
 Assmus, B. 4037
 Atanassov, A. 3830
 Atherton, JG. 3787
 Atzorn, R. 3823, 3902
 Aujla, SS. 3890
 Auranen, M. 3779
 Awaad, H.A. 3370
 Awad, F. 3740
 Azzam, A.M. 3335
 Babare, A. 4165
 Bachi, PR. 3514
 Back, W. 4099
 Bacon, RK. 3793, 4133
 Bacsi, Z. 4167
 Badamchian, M. 4100
 Baek, H.J. 3780
 Baenziger, M. 3446
 Baenziger, PS. 3328, 3629, 3943
 Baeumer, K. 3450
 Bai Huaifen 3869
 Bai, Q.Y. 4039
 Bailey, KL. 3598
 Bailey, LD. 3494, 3785
 Baitinger, A. 4090
 Baker, JM. 3733
 Bali, AS. 3487
 Balkemaboomstra, AG. 3620, 3741
 Ballesteros, J. 4070
 Balyan, RS. 3428, 3959
 Balyan, RS. 3980
 Banyasz, I. 4108
 Barabas, Z. 3879
 Barbarick, KA. 4040
 Barbaro, N.O. 3449
 Barker, JHA. 3578
 Barnabas, B. 3593
 Baroncelli, S. 3831
 Barrault, G. 3868, 3938
 Barrova, S.R. 3456
 Bartels, D. 3697
 Bartlett, RJ. 3950
 Barua, U.M. 3661
 Barzilai, A. 3953
 Basha, H.A. 3371, 3447
 Basso, F. 3503
 Bateman, GL. 3870, 3871
 Batista, MD. 3930
 Batra, VIP. 3798
 Baumer, M. 3358, 3359, 3650
 Bavec, M. 3360
 Beale, MH. 3700
 Bebeli, PJ. 3361
 Beck, T. 4039
 Becker, D. 3684
 Bedoe, Z. 3593
 Beese, F. 4039
 Begum, S. 3542
 Bekele, N.A. 3582
 Bekes, F. 3687
 Beleia, AP. 4061
 Benalaya, A. 3694
 Benamer, IM. 3543
 Benard, M. 4101
 Bender, J. 3966
 Benedek, A. 3695
 Benhammouda, M. 3696
 Beniwal, MS. 3890
 Berecz, K. 3448
 Bergthaller, W. 4158
 Bernard, M. 3546, 3602
 Bernicot, M.H. 3544
 Bernier, CC. 3903
 Berot, S. 4157
 Bezzola, L. 3449
 Bhardwaj, SK. 3484
 Bhargava, M. 3490
 Bhatt, GN. 3487
 Bhattarai, M. 3331
 Bhuiyan, AKMS. 3777
 Bi Yunqing 3545, 3640
 Bicanin, V. 3475
 Bieblova, J. 3438
 Bindra, AD. 3490
 Bitsch, R. 4132
 Black, I.D. 3975
 Blake, TK. 3733
 Blomback, K. 3781
 Blouet, A. 3811, 3825
 Blumenthal, C. 3690
 Blundell, C. 3790
 Bochev, B. 3791
 Bocheva, N. 3791
 Bodart, C. 4000
 Bode, W. 4037
 Bodson, B. 3506, 3523, 3878, 4057
 Boeva, NP. 3817
 Bogdanova, ED. 3756
 Boila, RJ. 3784
 Bollen, L. 4067
 Bonafaccia, G. 3511
 Bonhomme, A. 3546
 Bonnefoy, M. 3872
 Boonwiroj, S. 3312
 Bordes, J.P. 3362
 Borja, R. 3737
 Borner, A. 3543, 3637
 Borsa, J. 3931
 Borsting, CF. 4153
 Bort, J. 3742
 Bory, E. 3477
 Bosch, OJH. 4023
 Boskovic, J. 3547
 Boskovic, M. 3547
 Bostwick, DE. 3317
 Botha, CEJ. 3746
 Boursereau, J. 3872
 Bouthier, A. 3701
 Bouzerzour, H. 3548
 Boyadjiev, P. 3830
 Brand, O. 4099
 Brand, TS. 4001
 Brandt, RT. 4154
 Bregitzer, P. 3782
 Breiman, A. 3835
 Brenes, A. 3994
 Brettschneider, R. 3684
 Briffaux, G. 3568
 Briggs, KG. 3958
 Britel, A. 3335
 Broek, A. vande 4032
 Bromand, B. 3851, 3852
 Bromilow, R.H. 4164
 Brooking, IR. 3783
 Brower, JH. 3863
 Brown, AH. 3709
 Brown, B.D. 3363, 3421, 3491, 3645
 Brown, RH. 3742
 Bruemmer, J. M. 4072
 Brunn, S. 4042
 Bucag, M.T. 3528
 Buckee, GK. 4101
 Budak, N. 3678
 Budhathoki, C.B. 3591
 Buechley, G. 3317
 Buermann, I. 4124
 Burlando, B. 3846
 Burrup, D.E. 3645
 Burrup, DE. 3321
 Bushuk, W. 4116
 Butcher, S. 4163
 Butenko, RG. 3437
 Cabal, J. 3849
 Cabrera, G. 4061
 Cachola, F.B. 3364
 Cai Shibin 3549
 Cairney, J. 3743
 Calderini, DF. 3550
 Caldwell, RA. 4059, 4060
 Caldwell, SP. 3325, 3328
 Camachocasas, MA. 3873
 Camberato, JJ. 3373, 3706
 Campanini, L. 4051
 Campbell, LD. 3784
 Campbell, WH. 3755
 Canales, R. 3994
 Canteromartinez, C. 3512
 Cao Weixian 3530
 Cao Xin 3677
 Cao Yang 3549, 3551, 3676
 Cappelloni, M. 3574
 Caproni, E. 3511
 Caron, D. 3874
 Carr, PM. 3513
 Carrillo, JM. 3646
 Carrouee, B. 3337
 Carson, M. 3953
 Carvalho, MTV. 4105
 Carver, BF. 3594
 Casabianca, H. 3701
 Catizone, P. 4052
 Cattivelli, L. 3697, 3716
 Cavallini, A. 3831
 Cavellier, M. 3875
 Ceccarelli, S. 3621
 Cellier, P. 3723
 Cenkowski, S. 3990
 Cervi, C. 3929
 Cha, S.H. 3901
 Chae, J.C. 4127
 Chahal, S.S. 3957
 Chaillet, I. 3337
 Chaisattapagon, C. 3984
 Chalmers, K.J. 3661
 Chambers, E. 4102
 Champigny, M.L. 3744
 Chandler, PM. 3724
 Chandra, AK. 3804
 Chang, CY. 4102
 Chang, SJ. 3743
 Chapman, DK. 3709
 Chastain, TG. 3365
 Chaudhary, B.D. 3634
 Chaudhary, HK. 3552
 Chaudhuri, P. 3553
 Chauhan, RS. 3876, 3877
 Chawla, V. 3611
 Chen Bing Huey 3840
 Chen Jixian 3554
 Chen Peiyuan 3483
 Chen Ruhai 3680
 Chen, Bing Huey 3841
 Chen, FQ. 3664
 Chen, HP. 4014
 Chen, THH. 3664
 Chen, WZ. 4103
 Chen, YR. 3703, 4062
 Chesneau, R. 3872
 Chino, M. 3954
 Chinoy, CN. 3555
 Chipde, SJ. 3480
 Chirkova, TV. 3745
 Chiusa, G. 3929
 Choi, W.Y. 3780
 Choo, TM. 3719
 Choudhary, M. 3785
 Chrispeels, MJ. 3858
 Christ, BJ. 3318
 Chun, J.U. 3786
 Chung, D.H. 3708, 3786
 Chung, T.Y. 4138
 Cionini, G. 3831
 Citron, G. 3979
 Clark, RT. 3334

Clarke, JM. 3313
 Clarke, PJ. 3323, 3324
 Claupain, W. 3450
 Claus, S. 3698, 3753
 Clay, SA. 3968
 Close, TJ. 3664
 Coady, SA. 3334
 Cochran, RC. 4154
 Cochran, VL. 3527
 Cofie Agblor, R. 3986
 Cofieagblor, R. 3987
 Coleman, K. 4044
 Colin, CS. 4018
 Conn, JS. 3969
 Connell, J. 3312
 Connery, J. 3847
 Connor, DJ. 3512
 Conry, MJ. 3366, 3451
 Cook, RJ. 3622
 Cooper, A. 3670
 Corcuera, L.J. 3699
 Corneli, S. 4122
 Coutinot, D. 3849
 Couvreur, L. 3457, 3808, 3875, 3878
 Cowan, AK. 3746
 Cowles, S. 3343
 Cox, TS. 3314, 3315, 3581
 Coy, GR. 3509
 Craig, J.P. 3500
 Craigon, J. 3787
 Crepeau, M.J. 4159
 Croker, SJ. 3700
 Cross, RHM. 3746
 Crous, PW. 3911
 Crowley, DE. 4042
 Csonka, K. 4073
 Csosz, M. 3879
 Cuello, J. 3788
 Cui Guangquan 3686
 Culot, JP. 3774
 Cuming, AC. 3724
 Cunin, C. 4074
 Curtis, P.S. 4126
 Dabire, R. 3849
 Daemmgen, U. 4056
 Dahab, M.H. 3400, 3921
 Damato, F. 3831
 Daniel, G. 3650
 Daoang, E.U. 3528
 Dar, W.D. 3367
 Dardenne, P. 3808
 Davidson, JGN. 3323, 3324
 Dawa, T. 3727
 De Marchi, F. 4104
 De Pous, M. 3368
 Deb, D.L. 3763
 Deck, RE. 3969
 Defrancischi, MLP. 4105
 Dekhili, M. 3548
 Delcour, J.A. 4084
 Deleens, E. 3701
 Deleon, JLD. 3429
 Delogu, G. 3891
 Delrot, S. 3713
 Delwiche, S.R. 3702
 Delwiche, SR. 3703, 4062
 Demchenko, N.P. 3691, 3789

Dencic, S. 3665
 Deneufbourg, F. 3860
 Dennert, J. 3478
 Depauw, RM. 3313, 3623
 Depies, KK. 4002
 Deponte, R. 4065
 Derbyshire, E. 4105
 Deshmukh, PS. 3960
 Desiderio, E. 3574
 Desmarchelier, JM. 3962
 Devos, KM. 3555
 Dewey, W. 3316
 Dexter, JE. 4107
 Dhanoa, MS. 3670
 Dhindsa, GS. 3617
 Dhital, B.K. 3385
 Diaz, M. 3842
 Dietrich, R. 4145
 Difonzo, N. 3716
 Ding Hongjian 3556, 3856
 Djambova, G. 3430, 3791
 Djillanov, D. 3830
 Djokic, D. 3452, 3557
 Dmitrieva, VV. 3766
 Dofing, SM. 3323
 Doheim, M.A. 4106
 Donahaye, E. 3991
 Donald, WW. 3501
 Dong Yanqing 3369
 Dong Yingcai 3843
 Dong Yuchen 3683
 Doussinault, G. 3880
 Dovidio, R. 3558
 Dreccer, MF. 3550
 Drexler, H.P. 4161
 Drozdowicz, YM. 3704
 Duan Shangke 3907
 Duan shuangke 3881
 Dubcovsky, J. 3555
 Dubsky, G. 3698
 Duefelsiek, U. 4003
 Duffus, CM. 3431
 Dunsmore, KM. 3892
 Durance, T. 4079
 Durieux, RP. 3950
 Durnin, D. 3832
 Dutoit, F. 3844
 Duveiller, E. 3882
 Dvorak, J. 3555
 Eagles, H.A. 3687
 Easson, DL. 3845
 Eckersten, H. 3781
 Eder, MG. 3332
 Eggum, BO. 4153
 Ehrendorfer, K. 3332
 Ehsanullah, MD. 3526
 Eissa, M.M. 3370, 3541, 3559, 3560, 3561, 3562
 El Attar, W.M. 3488
 El Bana, A.Y.A. 3353, 3371, 3447
 El Banna, E.B. 3502
 El Faham, S.Y. 4130
 El Hamdi, K.F. 4021
 El Saadany, M.A. 3502
 El Shami, M.M. 3374
 Elings, A. 3563
 Ellis, PR. 4064
 Ellis, R.P. 3564, 3659, 3661
 Elmore, CD. 3970

Elshall, AA. 3445
 Endo, TR. 3625
 Engelhardt, G. 3762
 Engels, J.M.M. 3565
 Engerer, K.H. 4004
 Entz, T. 3886
 Ermont, J. 3345
 Escano, C.R. 3566
 Escher, F. 4074
 Evans, A.A. 4164
 Evans, LT. 3790
 Every, D. 4063
 Evett, SR. 3710
 Fahmy, F.A. 3336
 Fajardo, JE. 4107
 Fajersson, F. 3567
 Falco, E. de 3503, 3505
 Falisse, A. 3504, 3506, 3523
 Fan Lu 3577
 Fang, RJ. 4014
 Faraoni, I. 4122
 Faris, DG. 3324
 Faust, H. 3482
 Fautrier, AG. 3599
 Fava, A. 3846
 Favret, EA. 3648
 Fayed, M.A.M. 3883
 Fayed, M.N. 3453
 Feher, G. 4108
 Feil, B. 3446
 Felix, I. 3568
 Feller, U. 3813
 Felsenstein, FG. 3612
 Fenwick, R. 3569
 Ferguson, T. 3719
 Fernandez, E. 4015
 Fernando, D.R. 4165
 Feuillet, C. 3649
 Feussner, I. 3823
 Fiez, TE. 3372
 Fike, GD. 4154
 Finck, M. 3458
 Finney, PL. 4133
 Fischbeck, G. 3478
 Fischer, R.A. 3705
 Fischer, RA. 3820
 Flavell, RB. 3628
 Flint, HJ. 4018
 Flintham, J.E. 3570
 Flood, RG. 3794
 Foda, EA. 3775
 Foerstel, H. 3482
 Forssell, F. 4091
 Forster, B.P. 3571, 3661
 Forster, R.L. 3884
 Foster, John E. 3840, 3841
 Frampton, G. 3837
 Franchi, A.S. de 3503
 Francis, GS. 3792
 Franken, H. 4025
 Frankenberger, W.T. Jr. 3752
 Frederick, JR. 3373, 3706
 Freeman, TP. 4129
 Friebe, B. 3314, 3315, 3572, 3624
 Friedrich, S. 4054
 Friend, CP. 4144
 Fritzer, H. 3347
 Fu Jie 3673

Fuentesdavia, G. 3666
 Fujimoto, DK. 3622
 Fujiwara, N. 3836
 Funkhouser, EA. 3743
 Furutsu, YN. 3836
 Gabel, M. 4155
 Gaber, E.M.A. 3473
 Gabr, S.A. 4109
 Gaffney, JF. 3968
 GAHOONIA. 4022
 Gaillard, C. 3713
 Gaj, M. 3620
 Galatis, B. 3722
 Gale, MD. 3546, 3555
 Galiba, G. 3573
 Galterio, G. 3574
 Gambhir, P.N. 3957
 Gan, Z. 4064
 Ganeva, G. 3430, 3657, 3791
 Gao Jiyan 3951
 Gao Xiang 3707
 Gao, JG. 3885
 Gardi, C. 4051
 Gardner, EA. 3529
 Gardner, JC. 3513
 Gareis, M. 4016
 Garibaldimeza, C. 3429
 Gaskin, P. 3700
 Gaspari, N. 4051
 Gate, P. 3362, 3701
 Gaudet, DA. 3886, 3887
 Gbur, EE. 3793, 4133
 Gebeyehu, G. 4041
 Geiger, HH. 3621, 3626
 Geleto, T. 4041
 Genaidy, S. 3454, 3455
 Genc, I. 3425
 Genette, S. 3917
 Gerlach, M. 4092
 Gerstenkorn, P. 4134, 4135
 Ges', D.K. 3888
 Ghaemi, M. 3575
 Ghanem, A.M. 4106, 4109
 Ghanem, S.A.I. 3427
 Ghosh, PD. 3553
 Ghoslan, M.S. 4109
 Gibbard, CL. 3399
 Gibson, R. 4163
 Giles, LC. 3607
 Gill, BS. 3314, 3315, 3572, 3581, 3624, 3625
 Gill, KS. 3509
 Giller, PS. 3847
 Gillet, J.P. 3368
 Gilmore, EC. 3326, 3327
 Gilpin, MJ. 4063
 Girard, C. 3368
 Gisi, U. 3436
 Glaeser, M. 4170
 Gland, A. 3621
 Glenz, H. 3889
 Goates, BJ. 3320, 3322
 Godoy B, Roberto 4036
 Goel, LB. 3890
 Goffart, J.P. 3457
 Gold, CM. 3431
 Goldstein, AL. 4100
 Gomaa, A.F.A. 3427

Gomez, M. 3912
 Gomez, MH. 3329
 Gong Ming 3952
 Gonzalezdeleon, D. 3833
 Gorham, J. 3636, 3949
 Goswami, J. 3456
 Gouda, M.A. 3374
 Gouet, J.P. 3362
 Goulding, KWT. 4031
 Govedarica, M. 3475
 Goydani, BM. 3333
 Graham, RD. 4028
 Grambow, HJ. 3778
 Grant, CA. 3494, 3785
 Grant, RF. 4033
 Gras, PW. 3607
 Grattan, S.R. 3495
 Graur, D. 3835
 Graybosch, R.A. 3688, 4075
 Graybosch, RA. 3629, 3651
 Graziano, F.S. 3505
 Gregory, PJ. 3819
 Greig-Smith, P. 3837
 Grewal, AS. 3890
 Gries, D. 4042
 Griffiths, B.S. 4034, 4035
 Grimanelli, D. 3833
 Grospietsch, M. 3438
 Grossmann, MVE. 4061
 Gruen, M. 4024
 Grunberger, Y. 3829
 Grund, H. 4161
 Grunes, DL. 4043
 Guaiquil, Victor H. 4036
 Guan Jianping 3951
 Guckert, A. 3811, 3825
 Gueguen, J. 4157
 Guiot, J. 3457
 Guldán, SJ. 3513
 Gupta, AK. 3576
 Gupta, S. 3576
 Gurung, G.B. 3591
 Gurung, H.B. 3423
 Gustafson, JP. 3628
 Guy, S.O. 3375
 Gyori, Z. 3695
 Hackl, W. 4155
 Hadquet, J. 3338
 Hadjichristodoulou, A. 3376
 Haegi, A. 3891
 Hagiwara, H. 4100
 Hagiwara, Y. 4100
 Halford, NG. 3578
 Halloran, GM. 3794, 3795
 Halperin, SJ. 3953
 Hamada, A.A. 3647
 Hamblin, J. 3801
 Han Jinghua 3577
 Han, K.H. 3708
 Handschin, S. 4074
 Hannachi, P. 3701
 Hannappel, U. 3578
 Hansen, M.S. 3852, 3971
 Hansen, P.F. 3377
 Hanus, H. 3458
 Hap, I. 4110
 Harder, DE. 3892
 Hardy, A. 3837

- Harkness, DD. 4044
 Harren, F. 3806
 Harris, G.L. 4164
 Harrison, RM. 4031
 Hartley, BJ. 3746
 Hartmann, A. 4037
 Harwood, JL. 3761
 Hassanein, S.S.M. 3848
 Hastings, M. 4163
 Haugen, L.E. 4029
 Haugerud, N. 3330
 Hauner, M. 4076
 Hawke, BG. 3522
 Hayano, K. 3510
 Hayes, PM. 3587, 3588, 3664
 He Congfen 3579
 He Minyun 3992
 He Yizhe 3459
 He, LH. 4014
 Heathcote, DG. 3709
 Heatherly, LG. 3970
 Hebbe, Y. 3440
 Hebrard, J.P. 3460
 Heck, H. 4093
 Hegazy, M.H. 3455
 Heldt, HW. 3718
 Helm, JH. 3383
 Hendrix, DL. 3754
 Heneen, WK. 4114
 Hennessy, K.J. 4055
 Henry, RJ. 3638
 Hergert, GW. 3334
 Herman, J.L. 3808, 3878
 Hernandez, J.E. 3580
 Hershman, DE. 3514
 Hertel, K.A. 3378
 Hertstein, U. 4056
 Hesser, J.M. 4077
 Hetrick, BAD. 3581
 Hicks, S. 3343
 Higuchi, K. 3954
 Hill, RD. 3832
 Ho, KM. 3719
 Hoeppner, P. 3379
 Hoevelmann, L. 4025
 Hoffmann, M. 4111
 Holappa, LD. 3747
 Hole, DJ. 3316
 Holubova, K. 3582
 Holz, G. 3911
 Hong, H.D. 4082
 Hooshmand, H. 4078
 Hopper, KR. 3849
 Horimoto, Y. 4079
 Hosenev, RC. 4103
 Hoshino, T. 4112
 Hossain, A.H.M.S. 3402, 3921
 Hou Gaoli 3461
 Howell, TA. 3710
 Howse, K.R. 4164
 Hradecka, D. 3582
 Hruschka, WR. 3703, 4062
 Hsam, SLK. 3675
 Hu Jianwei 3861
 Hua Tianmao 3462
 Huang Henglu 3583
 Huang Peizhong 3613
 Huang, J. 3748
- Huang, JW. 4043
 Huebner, G. 3380
 Huffaker, RC. 3738
 Humphray, S.J. 3570
 Hussain, G. 3381
 Hussons, G. 3339
 Huvet, D. 3382
 Hvelplund, T. 4006
 Ibrahim, K.I.M. 3584
 Idouraine, A. 4140
 Ignacio, D.D. 3463, 3464, 3465, 3515, 3585, 3850
 Ikonen, JP. 4058
 Ilte, T. 4170
 Inagaki, M. 3586
 Ingemarsson, B. 3755
 Ippolito, JA. 4040
 Irudayaraj, J. 4117
 Irwin, JAG. 3638
 Ito, S. 4112
 Ito, T. 3711
 Ivlev, AA. 3712
 Iwabuchi, M. 3828
 Iyamabo, OE. 3587, 3588
 Jack, P. 3661
 Jackson, K.E. 3893
 Jacobi, V. 3930
 Jacobsen, O.H. 3516
 Jaeger, H. J. 4056
 Jahan, H. 4160
 Jahier, J. 3546
 Jahn Deesbach, W. 4093
 Jahne, A. 3432
 Jain, J.M. 3758
 Jaiswal, J.P. 3354
 Jamai, A. 3713
 Jamieson, PD. 3783, 3792
 Janse, BJH. 3911
 Janzen, HH. 3517
 Jarak, M. 3475
 Jarosch, B. 3902
 Jauhar, PP. 3589, 3590
 Jayas, DS. 3985, 3990
 Jedel, PE. 3383
 Jelenic, S. 3692
 Jenkins, PD. 3905
 Jenkinson, DS. 4044
 Jenkyn, JF. 3824
 Jensen, L.S. 4045
 Jensen, P.E. 3851, 3852, 3853, 3894, 3895, 3971, 3972
 Jensen, S.E. 3714
 Jepson, P.C. 3838
 Jeroch, H. 4004
 Jia Xu 3433
 Jiang, J. 3624
 Jin, Y. 3656
 Jing Penyan 3654
 Jing Xiangtian 3384
 Joergensen, L.N. 3851, 3852, 3853, 3894, 3895, 3971, 3972
 Johanides, V. 4065
 Johansson, E. 4113, 4114
 Johnston, AM. 3517
 Johnston, RP. 3638
 Jolankai, M. 4068
 Jones, DR. 3896
 Jones, MJ. 3518
 Jones, RGW. 3693
- Jones, RL. 3704
 Joppa, LR. 3644
 Jorgensen, JA. 3715
 Joshi, K.D. 3591
 Jouy, L. 3979
 Jovanovic, B. 3685
 Jui, P. 3719
 Kadayat, K.B. 3385
 Kaetterer, T. 3466
 Kahmann, U. 4118
 Kajdi, F. 3897
 Kaltsikes, PJ. 3361
 Kaminskaya, L.M. 3592
 Kamula, S.A. 3898
 Kanatani, R. 3660, 3674
 Kanazawa, K. 3954
 Kandil, A.A. 3519
 Kang Zhensheng 3899
 Kao, K. 3656
 Kapoor, AS. 3552
 Kapur, OC. 3507
 Karadimova, M. 3430, 3791
 Karasev, GS. 3720
 Karjalainen, R. 3926
 Karsai, I. 3593
 Karwasra, SS. 3890
 Kasai, M. 3961
 Kashta, F. 3386
 Kastori, R. 3467
 Kato, K. 3836
 Katzhammer, M. 3612
 Kaufmann, B. 4115
 Kaul, S. 3484
 Kauppinen, V. 3739
 Keck, B. 4080
 Keener, TK. 3900
 Keller, B. 3649, 3672
 Kelley, KW. 3468
 Kelly, JT. 3793
 Kennedy, AC. 4046
 Kennedy, T. 3847
 Kernich, GC. 3794, 3795
 Kersting, H.J. 4118, 4124, 4158
 Kertesz, Z. 3879
 Ketterer, M. 4099
 Kevresan, S. 3665
 Khalaf, S.A. 3988
 Khalil, IA. 3796
 Khalil, IH. 3594
 Kiba, A. 3836
 Kim, C.H. 3708
 Kim, H.B. 3387
 Kim, HR. 4116
 Kim, J.C. 3901
 Kim, J.K. 3439
 Kim, K.T. 4082
 Kim, S.S. 4082
 Kim, Y.G. 4127
 Kimball, BA. 3754
 King, RW. 3790
 Kirchhof, G. 4037
 Kirk, G. 3849
 Kissimon, J. 3448
 Kjaer, B.J. 3595
 Klein, JD. 3440
 Klein, W. 4166
 Kling, C. 3940
 Kling, CI. 3920
 Kljajic, P. 3989
- Klocke, NL. 3334
 Klockiewiczaminska, E. 4081
 Klopfenstein, CF. 4078
 Knappe, S. 3482
 Knezevic, D. 3557
 Knudsen, KEB. 4153
 Knyazev, DA. 3712
 Kochian, LV. 4043
 Koebner, RMD. 3546, 3637, 3956
 Koerschens, M. 3470
 Koesling, V. 4161
 Kogel, KH. 3902
 Kohler, JM. 3725
 Kohler, P. 4080
 Kohlhepp, E.A. 4140
 Kolev, K. 3942
 Koleva, A. 3749
 Kolmer, JA. 3596
 Kondratev, MN. 3797
 Kong, D. 3719
 Koppel, LA. 3437
 Koran, L.V. 3592
 Kordel, W. 4166
 Korzun, V. 3637
 Koshino, S. 3632, 3729
 Kostic, M. 3557
 Kostic, M.A. 3452
 Kostyanovskii, RG. 3812
 Kota, E. 3467
 Kotwica, K. 3524
 Kovacs, G. 3593
 Kozaczenco, H. 3973
 Kozub, GC. 3887
 Kramer, KJ. 3858
 Kremer, RJ. 3696
 Krippel, E. 3933
 Kristensen, K. 3388
 Kristensen, V.F. 4156
 Kronemann, H. 4024
 Kronstad, WE. 3330, 3873
 Krottenthaler, M. 4123
 Kruk, M. 3320
 Kuburovic, M. 3627
 Kuhl, GL. 4154
 Kuhn, E. 4170
 Kuhn, M. 4115
 Kulikova, AL. 3437
 Kumar, A. 3389
 Kumar, D. 3798
 Kumar, J. 3597
 Kumpawat, BS. 3469
 Kurten, U. 3739
 Kusaba, M. 3836
 Kutcher, HR. 3598
 Labios, R.V. 3367
 Lacerenza, NG. 3716
 Laerke, PE. 3750
 Lajoux, P. 3508
 Lamadji, S. 3599
 Lamari, L. 3903
 Lamb, N. 3832
 Landau, S. 3870
 Landi, G. 3499
 Lang, W. 4117
 Linguasco, L. 3929
 Larsen, NG. 4063
 Larsson, CM. 3755, 3757, 3764
- Larsson, M. 3757
 Lauber, U. 4094
 Lauver, M. 3330
 Lawlor, DW. 3399
 Layaoen, H.L. 3390, 3600
 Lazar, MD. 3325, 3329, 3799
 Lea, V. 3661
 Leaver, CJ. 3761
 Lebedinskaya, SO. 3797
 Lebert, M. 4027
 Leblanc, O. 3833
 Leconte, C. 3601
 Lecorre, V. 3602
 Ledent, J.F. 3603
 Lee, C.D. 3412
 Lee, C.K. 3802, 4127
 Lee, D.S. 3708
 Lee, H.S. 4138
 Lee, I.W. 3901
 Lee, Y.T. 4082
 Leech, RM. 3761
 Leffler, S. 3745
 Legge, WG. 3598
 Legouis, J. 3904
 Lei Yongchang 3391
 Leigh, RA. 3693
 Leisle, D. 3785
 Leitch, MH. 3905
 Lemser, A. 4009
 Lenton, JR. 3700
 Lenz, W. 3358, 3359
 Leopold, J. 3823
 Lercari, B. 3831
 Lesieux, C. 3849
 Leung, H. 3910
 Lew, H. 4095
 Lewer, P. 4163
 Lewis, BE. 3855
 Lezovic, P. 3470
 Li Changwei 3462
 Li Deyang 3965
 Li Fujiang 3392
 Li Gang 3906
 Li Mingli 3869
 Li Weiping 3604
 Li Yan 3955
 Li Yilin 3668
 Li Ying 3483
 Li Yiping 3605
 Li Zhang 3459
 Li Zheqi 3899
 Li Zhongkuan 3982
 Liang, C. 3858
 Liboon, S.P. 3520
 Liebert, F. 4017
 Lind, H. 3764
 Lindhauer, M.G. 4118, 4158
 Lindsay, JG. 3761
 Lippold, H. 3476
 List, N. 4125
 Littleboy, M. 3529
 Liu Binghua 3606
 Liu Changhong 3907
 Liu Guangtian 3667
 Liu Hawen 3945
 Liu Mandao 3393, 3531
 Liu Shaoyou 3992
 Liu Shengfang 3493
 Liu Siheng 3908

- Liu Wancai 3909
Liu Weiqun 3680
Liu Xuezhong 3717
Liu, CT. 3330
Liu, CY. 3607, 3608
Liu, JH. 3832
Loewy, T. 3471
Lohaus, G. 3718
Long, SP. 3754
Long, T. 4163
Longchamps, J.Y. 3337
Loomis, P. 3910
Lopez, S. 3449
Lorz, H. 3432, 3684
Lott, J.N.A. 3732
Lou Guozheng 3864
Louw, JP. 3911
Lu Ping 3583
Lukaszewski, AJ. 3609, 3610
Lukow, OM. 4079
Lundborg, T. 3757
Luqui, A.B. 3912
Luthra, O.P. 3597, 3611
Lutz, J. 3612
Lynch, J. 3953
Ma Jnhu 3613
Ma Qiang 3686
Ma, H. 3614
Ma, ZQ. 3615
Machelett, B. 4024
Magdoff, FR. 3950
Maguire, J. 3931
Mahalakshmi, V. 3800, 3801
Mahapatra, B.S. 3472
Mahaut, T. 3854
Mahdi, GS. 4119
Maheswari, D.K. 4160
Maidl, FX. 3478
Maina, M.P. 3419
Maletic, R. 3685
Malik, R.K. 3428, 3959
Malik, RK. 3980
Malkanathi, DRR. 3751
Malleshi, NG. 4139
Mamluk, OF. 3616
Mamo, T. 4041
Manev, M. 3767
Mangat, GS. 3617
Mann, C.E. 3394
Mannonen, L. 3739
Marais, GF. 3844
Maraitte, H. 3882
Maramba, F.K. Jr. 3618
Maric, V. 4065
Markovic, I. 4065
Markowski, M. 4019
Marley, PS. 3913
Marschner, H. 3740, 3769
Marshall, D. 3914
Marshall, DS. 3325, 3328, 3329
Marshall, E.J.P. 3974
Mart, PK. 3956
Martens, D.A. 3752
Martig, J.M. 3339
Martin, A. 3737
Martin, G. 3362, 3619
Martin, LM. 4070
Martin, M. 4024
Martin, RJ. 3792
Martin, TJ. 3315
Martinezizquierdo, JA. 3539
Martinoia, E. 3713
Martlbauer, E. 4145
Masci, S. 3558
Mason, D.J. 4164
Masse, J. 3481
Massie, D.R. 3702
Mastebroek, HD. 3620, 3741
Mathre, DE. 3900
Matic, R. 3975
Matijevic, D. 3915, 3916
Matsuda, Y. 3826, 3827
Matsumoto, H. 3961
Matuz, J. 3879
Maufras, J.Y. 3917
Maumene, C. 3917
Mautner, J. 3395, 3396, 3397
May, KW. 3719
Maycock, R. 4163
Mayer, M. 3621
Mayfield, C.I. 3898
Mazzola, M. 3622
McCaig, TN. 3313, 3623
Mcdaniel, ME. 3325, 3326, 3327, 3329
Mcdonald, HJ. 3522
McGregor, B.A. 4005
Mcintosh, RA. 3624
McLeod, JG. 3313
Mcneil, DL. 3599
McNiven, MA. 4006
McNutt, R. 3993
McTaggart, I.P. 4047
Mcvey, DV. 3629
Mehier, C. 3340
Mejborn, H. 4153
Melandar, B. 3516, 3976
Merckx, R. 3815
Mertz, W. 4120
Messmer, MM. 3649
Metwally, I.O.E. 3473
Meyer, D. 4121
Mickelsonyoung, L. 3625
Miedaner, H. 4123
Miedaner, T. 3626
Miguel, V. 3398, 3474
Mihok, S. 4146
Miklovicova, M. 3933
Milberg, P. 3862
Miletic, N.M. 3918
Milevoj, L. 3919
Miller, AJ. 3730
Miller, BC. 3372
Miller, JD. 3643, 3644
Milosev, D. 3475
Milovanovic, M. 3627
Min, K.S. 3786
Minaeva, SV. 3817
Minkov, I. 3749
Minor, HC. 3696
Miraglia, M. 4122
Mirschel, G. 4056
Mirschel, W. 3834, 4020
Mitchell, RAC. 3399
Mitchell, VJ. 3399
Mladenov, N. 3685
Mladenova, V. 3657
Modaihsh, AS. 3445
Modak, S.B. 3521
Modi, R. 4148
Moe, T. 4083
Mohamed, T.A. 4168
Mohammad, MJ. 4046
Molina Cano, J.L. 3659
Molnar, I. 3475
Moloney, AP. 4007
Moncur, L. 3821, 3822
Monfort, A. 3539
Monfort, B. 3506, 3523
Monte, JV. 3628
Montfort, B. 3504
Moon, CE. 3855
Morais, F. 3693
Morenosevilla, B. 3629
Morgan, TD. 3858
Morgounov, A. 3573
Mori, S. 3954
Morishita, D.W. 3977
Moritsugu, M. 3751
Mosaad, MG. 3800, 3801
Mouchova, H. 3476
Mrhar, M. 4026
Mueller, H.M. 3940, 4094
Muhle, H. 3753
Muir, S. 3693
Muir, W.E. 3986
Muir, WE. 3985, 3987, 3990
Mujeebkazi, A. 3586, 3614, 3666, 3671
Muller, J. 3753
Muller, R. 3478
Munnery, IC. 3871
Murai, K. 3630
Murphy, D.P.L. 3400
Murray, G.A. 3401
Murray, L. 3855
Myers, M.D.M. 3344
Nachit, MM. 3616
Nagao, S. 4066
Nagarajan, S. 3957
Nakai, S. 4079
Nakamura, T. 3836
Nakayama, T. 3828
Nam, J.H. 3802
Naranjo, T. 3631
Narasimhalu, P. 3719
Narziss, L. 4099, 4123
Nassuth, A. 3885
Nath, K.K. 3957
Navarro, S. 3991
Negusie Tadesse 3419
Nelson, LR. 3329
Nemeth, I. 3477
Netsvetaev, VP. 3812
Neumann, H. 4072
Newton, RJ. 3743
Nguyen, HT. 3715
Ni Hanxiang 3556, 3856
Nicholls, P.H. 4164
Nicolas, P. 3546
Nie, GY. 3754
Nielsen, B.J. 3895
Nielsen, NE. 4022
Nierle, W. 4118, 4124
Nilsson, G. 4125
Ning Kun 3707
Nirenberg, HI. 3920
Nirmal, S.C. 3597
Nishio, T. 3711
Nishizawa, N.K. 3954
Noda, T. 3836
Noguchi, H. 3836
Novitskaya, GV. 3720
Novitskaya, LO. 3745
Nowicki, TW. 4107
O'Callaghan, J.R. 3400, 3402, 3921
Obenauf, S. 4056
Obien, S.R. 3403
Obst, A. 3922
Ochoa, L.J. 4140
Ockenden, I. 3732
Oger, R. 4057
Ohlen, E. 3755, 3764
Ohlsson, C. 4156
Ohm, Herb W. 3840, 3841
Ohm, HW. 3317
Okada, Y. 3632
Okieley, P. 4007
Oku, T. 3711
Okuda, T. 3826, 3827
Olckers, RC. 4001
Oleary, GJ. 3512
Olimpieri, G. 3511
Oliver, J. 3690
Olsson, S. 3923
Omarova, EI. 3756
Ona, B.D. 3580
Onori, R. 4122
Oppitz, K. 3612
Orlando, D. 3978, 3979
Ortel, B. 3902
Ortizferrara, G. 3800, 3801
Osborne, B.G. 4126
Oscarson, P. 3757
Otto, WM. 4023
Owuoche, JO. 3958
Oyanagi, A. 3803
Ozkan, H. 3425
Padu, EK. 3721
Pageau, D. 3924
Pal, AR. 3480
Pan, WL. 4046
Pang Chunming 3633
Pankhurst, CE. 3522
Pannase, SK. 3333
Pannu, R.K. 3634
Panozzo, J.F. 3687
Panse, A. 3478
Panteris, E. 3722
Panwar, R.S. 3959
Panwar, RS. 3980
Papes, D. 3692
Pardo, A. 3499
Parihar, GN. 3404
Park, A.R. 3901
Park, H.H. 3802
Park, K.H. 3708
Park, M.W. 3802, 4127
Parker, DR. 4042
Parthier, B. 3823
Patel, K.P. 3758
Pati, BR. 3804
Patil, R.G. 4050
Patrick, JW. 3822
Patterson, FL. 3317
Patterson, LM. 3932
Patterson, P.E. 3417
Paul, J. 4160
Pearson, JN. 3759, 3760
Pecetti, L. 3635, 3636
Pecsi, S. 3897
Peculi, V. 3386
Peltonen, S. 3925, 3926
Peng Yongkang 3805
Penney, DC. 3958
Pepper, T.J. 4164
Peric, I. 3989
Peric, Z. 3989
Perrissinfabert, D. 3811
Pescio, F. 3348
Petersen, J. 3479
Peterson, C.A. 3898
Peterson, C.J. 3688, 4075
Peterson, CJ. 3328, 3629, 3651
Petroczy, I. 3937
Petrovic, M. 3467
Petrucelli, L. 3806
Philis, J. 3857
Piaseckakwiatkowska, D. 4081
Pich, A. 3769
Pichlmaier, K. 3358, 3359
Pichuzhkin, VI. 3712
Pigla, U. 3698
Plaha, P. 3727
Plaschke, J. 3637
Plesnik, S. 3933
Plueng, N.S. 3312
Podlesak, W. 4024
Poelaert, J. 3506, 3523, 4057
Pogna, N.E. 3574
Poitrat, E. 3481
Poje, T. 4026
Polimbetova, FA. 3756
Popineau, Y. 4157
Porceddu, E. 3558
Porta Puglia, A. 3891
Porter, DR. 3319
Porter, JR. 3399, 3783
Porter, KB. 3326, 3327, 3329
Postiglione, L. 3503
Poulsen, DME. 3638
Poulson, M. 3782
Powell, C. 3405
Powell, W. 3661
Power, IL. 3771
Pradhanang, PM. 3927
Prasad, R. 3525
Pratt, P.W. 3893
Prevot, J.P. 3568
Prodanovic, S. 3685
Puchalski, BJ. 3886
Puchalski, BL. 3887
Pueyo, JJ. 3858
Puigdomenech, P. 3539
Punia, SS. 3980
Puupponenpimia, R. 3739
Puyaoan, M. 3406
Qafoku, N. 3407
Qi Zhongzhan 3805
Qian Xi 3981

- Quaglietta Chiaranda, F. 3505
 Quail, KJ. 4059, 4060
 Quarrie, SA. 3573
 Qureshi, R.H. 3949
 Rabe, E. 4128
 Rackwitz, R. 4039
 Rademacher, W. 3823
 Ragasits, I. 3448
 Rahimian, H. 3868
 Rahman, S. 3639
 Rai, R.K. 3521
 Rajkovic, S. 3916
 Ramo, T. 3659
 Ran Yun 3545, 3640
 Rana, G. 3723
 Rao Weiwei 3545
 Rasco, E.T. Jr. 3641
 Rasmussen, I. 3388
 Rasmussen, JB. 3656
 Ratcliffe, RH. 3317
 Rathi, SS. 3980
 Rathjen, AJ. 3607
 Rathore, AL. 3480
 Rathore, SS. 3469
 Rauch, H.W. 4010
 Rawson, HM. 3809
 Rayasduarte, P. 4129
 Raymundo, A.D. 3928
 Raz, R. 3539
 Recio, B. 4169
 Reddy, VRK. 3642
 Redmann, RE. 3748
 Reeck, GR. 3858
 Rees, R.M. 4047
 Rees, RG. 3638
 Reichert, S. 3849
 Remuauux, M. 3337
 Renard, C. 4159
 Rengel, Z. 3759, 3760, 4028
 Reuss, J. 3806
 Richter, G. 4008, 4009
 Richter, O. 3807
 Riede, CR. 3643, 3644
 Riens, B. 3718
 Rikiishi, K. 3434
 Risius, ML. 3318
 Ristic, M. 4010
 Ritala, A. 3739
 Ritchie, JT. 3820
 Ritz, K. 4035
 Rivero, C. 3726
 Robert, D. 3481
 Roberts, C. 3953
 Robertson, EJ. 3761
 Robertson, L.D. 3408, 3409, 3422, 3645
 Robertson, M. 3724
 Robinson, D. 4034
 Robinson, SF. 4129
 Rocca, M. 3831
 Roder, MS. 3650
 Roels, S.P. 4084
 Roemheld, V. 3740
 Rogasik, J. 4056
 Roisin, C. 3506
 Romheld, V. 3769
 Ron, MM. 3471
 Rooney, LW. 3326, 3327, 4144
- Roscoe, MM. 4107
 Rose, S.C. 4164
 Rosenberger, CA. 3736
 Rosenzweig, C. 3818
 Ross, A.R.J. 3655
 Ross, RG. 4144
 Rossberg, R. 3410
 Rossi Pisa, P. 4051, 4052
 Rossi, V. 3929
 Rossnagel, BG. 3598, 3656
 Rouxhet, F. 3457
 Royo, A. 3495
 Rozema, J. 3775
 Rubio, A. 3659
 Ruckenbauer, P. 3332
 Rudnicki, F. 3524
 Ruetter, A. 3411
 Rugel, H. 3650
 Ruhland, M. 3762
 Ruiz, M. 3646
 Ruland, W. 3411
 Ruppel, H.G. 4118
 Russow, R. 3482
 Rutledge, SS. 3943
 Ryan, B. 3847
 Ryan, R. 3310
 Rybalka, AJ. 3812
 Rydahl, P. 3972
 Ryu, Y.H. 3412
 Saadalla, M.M. 3647
 Sabater, B. 3788
 Sacco, F. 3648
 Sachdev, M.S. 3763
 Sachdev, P. 3763
 Sacher, B. 4099
 Sagi, L. 3663
 Sagisaka, S. 3826, 3827
 Sahara, H. 3632, 3729
 Saharan, R.P. 3611
 Saini, RG. 3576
 Saione, HA. 3648
 Sairam, RK. 3960
 Salama, S.M. 3541, 3562
 Saleh, A.L. 4130
 Saleh, H.H. 4021
 Salgado, JM. 4105
 Salisbury, CD. 3799
 Salmenkalliomarttila, M. 3739
 Salmon, S. 4126
 Saluzzi, L. 4018
 Samuelson, ME. 3764
 Sanchez, M.D. 3788
 Sanderson, SM. 3855
 Sandovalvilla, M. 3765
 Sandvol, L.E. 3859
 Sangwan, V.P. 3634
 Sapirstein, HD. 3725
 Sarkar, M.C. 4050
 Sarker, A.A. 4011
 Sarrafi, A. 3575, 3868
 Sarwar, M. 3696
 Sasaki, M. 3961
 Sato, A. 4112
 Savidan, Y. 3833
 Sawarkar, SD. 3333
 Schachermayr, GM. 3649
 Schaefer, W. 3762
 Scharen, AL. 3873
 Schatz, BG. 3513
- Schenk, PM. 3930
 Schiffer, R. 3902
 Schildbach, R. 3413, 3414
 Schipper, A. 4093
 Schlöter, M. 4037
 Schmid, J.E. 3446
 Schmidt, B. 3726
 Schmidt, JW. 3328
 Schmieder, W. 4131
 Schmitzelsheer, H. 3920
 Schneekloth, JP. 3334
 Schneider, AD. 3710
 Schneider, E. 4145
 Schneider, G. 4147
 Schneider, J. 4024
 Schofield, JD. 4064
 Scholz, G. 3769
 Schramm, W. 4132
 Schroder, U. 3807
 Schuler, SF. 4133
 Schulman, A.H. 3662
 Schulthess, U. 3820
 Schultz, A. 3834
 Schultz, TR. 3931
 Schulz, A. 4020
 Schulz, H. 3852
 Schwappach, P. 3415
 Schweizer, GF. 3650
 Schwenke, K.D. 4157
 Sebesta, EE. 3319
 Secher, J.M. 3853
 Sedcole, JR. 3599
 Seguin, B. 3860
 Seibel, W. 4085, 4134, 4135
 Seitz, LM. 4102
 Seiwert, C. 4012
 Sengupta, RK. 3553
 Sengupta, S. 3804
 Seo, YW. 3651
 Seog, H.M. 4082
 Sernasaldivar, S. 3325
 Sesek, S. 3435
 Sethi, GS. 3728
 Sevov, V. 3942
 Shaaya, E. 3962
 Shadchina, TM. 3766
 Shah, DM. 3736
 Shaner, G. 3317
 Shang Hongsheng 3899
 Shangguan Zhouping 3483
 Shao Zhengrun 3909
 Sharafeldin, A. 3775
 Sharma, CM. 3484
 Sharma, DK. 3389
 Sharma, G.L. 3472
 Sharma, HC. 3389
 Sharma, KN. 3485
 Sharma, S.K. 3652
 Sharma, SN. 3525
 Sharma, TR. 3727
 Sharma, VK. 3507
 Sharobeem, S.F. 4106, 4109
 Sharshar, M.S. 3374
 Shaw, A. 3832
 Shaykewich, CF. 3689
 Shehab El Din, T.M. 3416, 3486
 Shelton, D.R. 3688, 4075
- Shelton, DR. 3651
 Shepherd, KW. 3607, 3608
 Shewry, PR. 3578, 4136
 Shi Sixin 3441
 Shi Xiaoyang 3392
 Shields, P. 3529
 Shinawatra, B. 3312
 Shukla, DS. 3960
 Shurtleff, W. 4137
 Sibbesen, E. 4053
 Simmen, U. 3436
 Simms, DD. 4154
 Sindic, M. 4067
 Singh, A. 3890
 Singh, AK. 3526
 Singh, B.R. 4029
 Singh, BK. 3526
 Singh, BM. 3876, 3877
 Singh, D.P. 3634
 Singh, D.V. 3867
 Singh, DP. 3890
 Singh, H. 3485
 Singh, I. 3652, 3653
 Singh, K.N. 3489
 Singh, KN. 3487
 Singh, M. 3518, 3816
 Singh, P. 3634
 Singh, R. 3404
 Singh, RP. 3614
 Singh, S. 3525, 3728, 3959
 Singh, SS. 3526
 Singh, T. 3487, 4022
 Singh, Y.P. 3653
 Sinha, M.N. 3521
 Sinha, R.N. 3986
 Sinha, RN. 3985, 3987
 Sinha, VC. 3890
 Sinicio, R. 3990
 Sinnaeve, G. 3808
 Sitohy, M.Z. 3488
 Sittton, JW. 3931
 Skala, J. 4069
 Skaloud, V. 3767
 Slafer, GA. 3550, 3795, 3809
 Slaski, J.J. 3963
 Smathers, R.L. 3417
 Smiley, RW. 3932
 Smith, A. 4018
 Smith, EG. 3517
 Smith, EL. 3594
 Smith, K.A. 4047
 Smith, RE. 3810
 Smith, SJ. 3730
 Snape, JW. 3573
 Sobovljevic, R. 3685
 Sokhansanj, S. 4117
 Solari, RM. 3648
 Soldatov, SE. 3817
 Soliman, A.Z. 3995
 Soltesrak, E. 3665
 Song Jiabao 3418
 Song Ziren 3654
 Song, H.S. 3802, 4138
 Sood, AK. 3877
 Sood, RD. 3490
 Sorrells, ME. 3615
 Sosulski, F.W. 4117
 South, J.B. 3655
 Souza, E. 3320, 3322
 Spangelo, BL. 4100
- Sparrow, EB. 3527
 Sparrow, SD. 3527
 Spiekers, H. 4013
 Springob, G. 4027
 Sreec, S. 3692
 Srivastava, K.D. 3867
 Stahli, D. 3811
 Stahli, M. 3781
 Stamp, P. 3446
 Stanko, AD. 3812
 Stanko, SA. 3812
 Starcevic, Lj. 3467
 Stark, J.C. 3408, 3491, 3496
 Steinfeldt, S. 4153
 Steffenson, BJ. 3656
 Stehno, Z. 3767
 Steinbiss, HH. 3930
 Steiner, JL. 3710
 Stephan, U. 3612, 3675
 Steveninck, M.E. van 4165
 Steveninck, R.F.M. van 4165
 Sthapit, BR. 3927
 Stich, S. 4099
 Stieger, P.A. 3813
 Stockdale, E.A. 4047
 Stoilova, T. 3657
 Stoltz, R.L. 3859
 Stothers, SC. 3784
 Stougaard, RN. 3900
 Streibig, JC. 3750
 Su Jingrui 3556
 Suarez, EY. 3648
 Subedi, K.D. 3591
 Sucksdorff, Y. 4058
 Suhasini, AW. 4139
 Sun Jingrui 3856
 Sun Qixin 3658
 Sun Shumei 3861
 Sun Yanhao 3424
 Sun Zhemin 3604
 Sunderman, DW. 3320, 3322
 Sutka, J. 3573
 Sutton, RL. 3914
 Suvorova, TA. 3720
 Svensson, G. 4113, 4114
 Svihra, J. 3814
 Swanston, J.S. 3564, 3659, 3661
 Swarup, A. 3489
 Sweet, N. 3787
 Swinnen, J. 3815
 Syarova, Z.Ya. 3888
 Sykora, M. 3933
 Szakal, M. 3937
 Szunics, L. 3934, 3935
 Taguiam, F.C. 3528
 Taha, A.A. 4021
 Takashio, M. 3729
 Takeda, K. 3434, 3660, 3674
 Talanova, VV. 3817
 Talapka, S. 3814
 Tan, ZL. 4014
 Tang Guoshun 3682
 Tang Zhongming 3982
 Tanner, DG. 4041
 Tanner, Douglas G. 3419
 Tanskanen, J. 3662
 Taoka, KI. 3828

- Tattari, S. 4058
Tausch, H. 3420
Taylor, G.J. 3958
Taylor, Paige L. 3840, 3841
Teeri, T.H. 3662
Teeri, TH. 3739
Terplan, G. 4145
Tewari, SK. 3816
Thakur, RC. 3490
Thakuria, K. 3456
Thalmann, A. 4149
The, D. 3624
Theobald, O. 3481
Therrien, MC. 3719
Thibault, J.F. 4159
Thiede, B. 3726
Thielemans, M.F. 4000
Thiessen, LL. 3313
Thill, D.C. 3977
Thomas, EC. 3529
Thomas, W.T.B. 3564, 3661
Thomashow, LS. 3622
Thow, D. 3346
Thylin, J. 3936
Tindall, T.A. 3375, 3421, 3491
Tiradotorres, JL. 3765
Titov, AF. 3817
Tiwari, AN. 3890
Tiwari, P.N. 3957
Toneva, V. 3749
Tong, Y. 4028
Tortuero, F. 4015
Tosa, Y. 3836
Toth, A. 3937
Toth, Z. 4086
Toubiarahme, H. 3938
Touzeau, J. 3939
Trajer, J. 4019
Traub Eberhard, U. 4166
Travis, RL. 3738
Trissler, R. 3940
Trochard, R. 3508
Tronchetti, F. 3849
Trunova, TI. 3720
Tsuchiya, Y. 3729
Tsunewaki, K. 3630
Tubiello, FN. 3818
Tuladhar, J.K. 3768
Tuleen, NA. 3314, 3572
Tuomi, T. 3662
Turkina, MV. 3437
Tyagunenko, A.V. 3349
- Tyynela, J. 3662
Ueyama, H. 4100
Uhlen, G. 4029
Uribe, T. 3659
Uslar S, Dietter Hans 4048
Usleber, E. 4145
Vach, M. 3492, 4069
Vallega, V. 3313
Van Keulen, H. 3563
Van Vuuren, M.M.I. 4034
Vancampenhout, S. 3663
Vandermerwe, JP. 4001
Vanderstappen, J. 3663
Vannacci, G. 3891
Vanzant, ES. 4154
Vanzee, K. 3664
Vapa, L. 3665
Varaku, H. 3941
Varma, A. 4160
Varnava, A. 3991
Vassilev, V. 3942, 3944
Veen, J.A. van 3815
Velten, K. 3807
Ventura, F. 4051
Veseth, R.J. 3421, 3422
Viadva, A.K. 3423
Vicari, A. 4052
Vicentecarbajosa, J. 3578
Vicient, CM. 3539
Victor, D. 3911
Vida, G. 4068
Vidal, J. 3849
Vig, AC. 3485
Villareal, RL. 3666
Viswanathan, P. 3642
Viveros, A. 3994
Volckaert, G. 3663
Volk, T. 3818
Vonreichenbach, HG. 4027
Vrebos, D. 3808
Vrkoc, F. 3492, 4069
Vuksa, P.V. 3918
Wagner, F. 4150
Wahbi, A. 3819
Walker, DJ. 3730
Walkersimmons, MK. 3747
Wallin, E. 3862
Wallnoefer, P. 3762
Walter, A. 3769
Walter, G. 3745
Walther, P. 4074
Wang Bao Tong 3881
Wang Caibin 3424
- Wang Chengshe 3493
Wang Jianshe 3667
Wang Jufang 3530
Wang Kaixi 3965
Wang Mingzhen 3951
Wang Shize 3843
Wang Shuan 3770
Wang Weiling 3369
Wang Xianying 3392
Wang Xiaoming 3668
Wang Xiuling 3686
Wang Xunling 4162
Wang Yaru 3493
Wang Youliang 3418
Wang Yueguang 3669
Wang Zhenyi 3735
Wang Zhenying 3964
Wang Zhimin 3770
Wang, SY. 3820
Wang, XB. 3494
Waniska, RD. 4144
Warchalewski, JR. 4081
Ward, KJ. 3365
Ward, RW. 3820
Wardlaw, IF. 3821, 3822
Wasternack, C. 3823, 3902
Watanabe, Y. 3773
Watkins, JE. 3943
Watson, P. 4163
Waugh, R. 3661
Wauthy, JM. 3924
Webber, AN. 3754
Weber, C.W. 4140
Webster, CP. 4031
Webster, JA. 3319
Wecke, C. 4017
Wei Liulan 3965
Weigel, H. J. 3966
Weil, R.R. 3500
Weinard, W. 4141, 4142
Weipert, D. 4143
Weisbjerg, MR. 4006
Welham, SJ. 3870
Weller, RF. 3670
Wen, BR. 3863
Wernecke, P. 3698, 3753
Werner, WE. 3731
Wesenberg, D.M. 3409, 3645
Wesenberg, DM. 3321
Wesley, RA. 3970
Wessels, WG. 3844
West, M.M. 3732
Westfall, DG. 4040
Wheatley, R.E. 4035
- Wheeler, D.M. 3967
Wheeler, DM. 3771
White, EM. 3399
White, N. 3824
White, NDG. 3985
Whitmore, J. 3320
Whitmore, J.C. 3645
Whitmore, JC. 3321
Wieser, H. 4080, 4091
Wiles, J.A. 3838
William, MDHM. 3671
Williams, M. 3761
Williams, ND. 3643, 3644
Wilson, DL. 3315
Wilson, GWT. 3581
Windes, JM. 3320, 3322
Winks, R.G. 3310
Winter, H. 3718
Winzeler, H. 3649, 3672
Winzeler, M. 3649, 3672
Wolfe, RI. 3323, 3324
Wolff, J. 4118
Wong, M. 3825
Wootton, M. 3687
Worland, AJ. 3543
Worrall, WD. 3325, 3326, 3327, 3328, 3329, 3799
Wrage, LJ. 3968
Wraith, JM. 3733
Wrigley, C.W. 3690
Wu Jinsui 3772
Wu Junxiang 3992
Wu Shenglong 3418
Wu Yaowu 3673
Wu, J. 3674
Wyseure, G.C.L. 3400, 3402, 3921
Wysocki, DJ. 3365
Xia, XC. 3675
Xiang Jianye 3864
Xin, JF. 3494
Xing, TX. 4014
Xiong Enhui 3676
Xiu Yian 3583
Xu Zhuling 4030
Xu, XT. 3610
Xue Gang 3735
Yadav, B. 3611
Yagbasanlar, T. 3425
Yamai, M. 3711
Yamamoto, S. 3773
Yamamoto, Y. 3961
Yamanaka, A. 3826, 3827
Yamulki, S. 4031
Yan Changshou 3640
- Yan Zhen De 3426
Yang Hun 3945
Yang Li 3606
Yang Yucang 3983
Yang Yufeng 3677
Yang, P. 3828
Yang, TM. 3675
Yangling 3864
Yasuda, S. 3434
Yildirim, MB. 3678
Yokoyama, K. 3751
Yoon, H.J. 3901
Yoshigi, N. 3632
Young, HC. 3319
Young, IM. 3734
Yuan Baoxiang 3393, 3531
Yukawa, T. 3773
Zagal, E. 4038
Zagorska, N. 3830
Zaharieva, M. 3942, 3944
Zamecnik, J. 3438
Zamski, E. 3829
Zeidan, E.M. 3427
Zeissler, A. 4049
Zeller, FJ. 3612, 3675
Zelles, L. 4039
Zemankovics, F. 4167
Zemetra, RS. 3330
Zeng Zherong 3679
Zhang Aiguo 3654
Zhang Jitao 3369
Zhang Qinfeng 3864
Zhang Rongping 3735
Zhang Sui 3680
Zhang Zhongjun 3681
Zhang, N. 3984
Zhao Boshan 3462
Zhao Xiaoming 3945
Zhao Xulan 3554
Zheng Diansheng 3683
Zhong Peihe 3946
Zhong Qinfeng 3947
Zhou Ronghua 3668
Zhu Lieceng 3682
Zhu Wei 3549, 3676
Zhu Xiangsan 3947
Zhuang Qiaosheng 3683
Ziegler, DE. 3626
Zimny, J. 3684
Zozikova, E. 3791
Zuniga, G.E. 3699
Zwingelberg, H. 4087, 4088, 4089, 4121
Zwinger, SW. 3513

KEYWORD INDEX

1000 KERNEL MASS 3879
 1BL/1RS 3651
 2 POPULATIONS 3596
 2, 4 DIACETYLPHTHOROGLUCINOL 3622
 3, 4 DICHLOROANILINE 3726
 A GLIADIN 4091
 A1 3751
 ABSCISIC ACID 3704, 3716, 3724, 3823
 ABSORPTION 3495, 3732, 3965, 4034
 ABSORPTION
 MICROSPECTROPHOTOMETRY 3776
 ACCLIMATION 3664, 3754
 ACCUMULATION 3445, 3749
 ACETYL COA CARBOXYLASE 3578
 ACHLOROPHYLLOUS MUTANT 3746
 ACID 3527, 3713, 3719, 3902
 ACQUIRED RESISTANCE 3902
 ACQUISITION 4046
 ACTIN 3437
 ACTIN BINDING PROTEINS 3437
 ACTINOMYCETALES 3936
 ADAPTATION 3583, 3697
 ADDITIVE GENE ACTION AND
 CORRELATION 3678
 ADDITIVES 3750
 ADENOSINE TRIPHOSPHATASE 3805
 ADENOSINE TRIPHOSPHATASE (ATPASE)
 3693
 ADIABATIC 3987
 ADIPOSE TISSUES 4010
 ADSORPTION AND DESORPTION
 ISOTHERMS 3485
 ADULT PLANT RESISTANCE 3614, 3824
 AEGILOPS 3835, 3944
 AEGILOPS CRASSA 3630
 AEGILOPS LONGISSIMA 3631
 AEGILOPS SEARSII 3572
 AEGILOPS SPELTOIDES 3609
 AEGILOPS SQUARROSA 3614
 AEGILOPS VENTRICOSA 3546, 3672
 AERATION 3990
 AEROBIOSES 4156
 AESTIVUM 3572, 3631
 AFLATOXIN 4145
 AFLATOXIN PRODUCTION 3931
 AFLATOXINS 4092, 4150
 AGAVE DESERTI 3733
 AGE 3967, 3998
 AGING 3936
 AGRARIAN REFORM 3349
 AGRICULTURAL CHEMICALS 3343, 3569
 AGRICULTURAL DEVELOPMENT 3349
 AGRICULTURAL ECONOMICS 3342
 AGRICULTURAL POLICIES 3349, 3423, 3569
 AGRICULTURAL SITUATION 3346
 AGRICULTURAL SOILS 3466, 3923
 AGRICULTURAL STRUCTURE 3349
 AGROCLIMATIC ZONES 3340, 3382, 3533,
 3534, 3535, 3537, 3544, 3866
 AGRONOMIC CHARACTERS 3371, 3385,
 3416, 3447, 3520, 3533, 3534, 3535, 3537, 3561,
 3580, 3583, 3584, 3591, 3645, 3682, 3686, 3802,
 4127
 AGROPYRON 3433, 3681, 3712
 AGROPYRON ELONGATUM 3649, 3672
 AGROPYRON JUNCUM 3671

AGROSTIS 3976
 AIR FLOW 3723
 AIR FLOW DIRECTION 3985
 AIR POLLUTION 4162
 AIR TEMPERATURE 3689, 4057
 AL STRESS 3961
 ALASKA 3527
 ALBOSTRIANS 3746
 ALCOHOLIC FERMENTATION 4123
 ALEURONE LAYERS 3724
 ALFALFA 3696, 3710
 ALIEN DISOMIC ADDITIONS 3671
 ALIEN GENE TRANSFER 3589
 ALIEN GENES 3642
 ALIEN TRANSLOCATION LINES 3624
 ALKALI METALS 3956
 ALKYLRESORCINOLS 4001
 ALLELES 3638
 ALLELIC TEST 3576
 ALLELIC VARIATION 3663, 3671
 ALLELISM 3643
 ALOPECURUS MYOSUROIDES 3974
 ALPHA AMYLASE 3431, 3671, 3832, 4141
 ALPHA AMYLASE INHIBITOR 3704
 ALPHA TOCOPHEROL SUCCINATE 4100
 ALPHA TROPOMYOSIN 3437
 ALTERNARIA SPP 3920
 ALTERNATIVE FARMING 3388, 4111
 ALTITUDE 3565, 3583
 ALUMINIUM 3593, 3771, 3950, 3963, 3967,
 4023
 ALUMINIUM TOXICITY 4043
 ALUMINUM TOXICITY 3751
 AMARANTHUS 4146
 AMINES 4092
 AMINO ACID 3704, 3718
 AMINO ACID SEQUENCE 4091, 4136
 AMINO ACID TRANSPORT 3738
 AMINO ACIDS 3467, 3744, 3955, 4000, 4139,
 4155
 AMMONIA 3459, 4092
 AMMONIA VOLATILIZATION 3478
 AMMONIATED FEEDS 4154
 AMMONIUM 3764
 AMMONIUM NITRATE 3476
 AMPHIPLOID 4070
 AMYLASE 3812
 AMYLASE ACTIVITY 4139
 AMYLASE INHIBITOR 3858
 ANABOLISM 3554, 3752
 ANALYTICAL METHODS 3386, 3407, 3574,
 3595, 3708, 3735, 3945, 4016, 4082, 4098, 4104,
 4111, 4123, 4128, 4141
 ANALYZER MA 30 3767
 ANATOMY 3733
 ANCESTORS 3581
 ANDROGENESIS 3830
 ANEUPLOID 3644
 ANILINES 3726
 ANIMAL FEEDING 3997, 3999, 4004, 4005,
 4011, 4146, 4152
 ANIMAL GROWTH PROMOTERS 3993
 ANIMAL HUSBANDRY 3342
 ANIMAL NUTRITION 4024
 ANIMAL PRODUCTS 3342
 ANISOPTEROMALUS CALANDRAE 3863

ANNUALS 3516
 ANOXIA 3745, 3949
 ANSER FABALIS 3862
 ANTAGONISM 3936
 ANTHUR CULTURE 3433, 3593, 3782, 3830
 ANTHUR CULTURE RESPONSE 3830
 ANTHUR CULTURE/ QUALITY 3661
 ANTHESES 3575
 ANTHESIS 3801, 3829
 ANTIBODIES 3739
 APEX 4043
 APEX DEVELOPMENT 3794
 APHANOMYCES 3936
 APHIDIDAE 3498, 3699, 3839, 3865
 APHIDOIDEA 3851
 APICES 3950
 APOPLAST 3718
 APPEARANCE 3800, 3801
 APPLICATION RATES 3343, 3443, 3457, 3462,
 3467, 3491, 3853, 3866, 3894, 3907, 3916, 3971,
 3972, 4029
 APPLICATION STAGE 3825
 APPLIED CATTLE SLURRY 3478
 AQUACULTURE EFFLUENT 3381
 AQUATIC WEEDS 3959
 ARABIDOPSIS 3747
 ARABIDOPSIS THALIANA 3664, 3697, 3718,
 3755, 3828
 ARABINOSE 3711
 ARABLE SOILS 4047
 ARACHIS HYPOGAEA 3424
 ARGENTINA 3348, 3912, 4077
 ARID ZONES 3563
 ARIZONA 4140
 ARM 3625
 ARRAYS 3722
 ARTHROPODS 3847
 ARTIFICIAL INOCULATION 3879
 ASCORBATE OXIDASE 4063
 ASCORBIC ACID 4063
 ASH 4112
 ASPARAGUS OFFICINALIS 3898
 ASPERGILLUS NIGER 3936
 ASSAY 3437
 ASSIMILATION 4033
 ATMOSPHERE 3966, 4031
 ATMOSPHERIC DISTURBANCES 3723
 ATOMIC ABSORPTION SPECTROMETRY
 3965
 ATPASES 3693
 ATROFACIENS 3942
 ATTRIBUTES 4113
 AUREOFACIENS 3622
 AUSTRALIA 3310, 4055, 4077
 AUTUMN 3458
 AUXIN 3791
 AUXINS 3752
 AVAILABILITY 3445
 AVAILABLE MANGANESE 4028
 AVENA 3342, 3428, 3444
 AVENA FATUA 3974, 3982
 AVENA SATIVA 3377, 3378, 3405, 3534, 3972,
 3983, 4163
 AVENAE F HEMIPTERA 3847
 AZOSPIRILLUM 4036
 AZOSPIRILLUM BRASILIENSE 4032

B GENOME 3572
 BACILLUS THURINGIENSIS 3851
 BACTERIA 3923, 4018, 4035, 4149
 BACTERICIDES 3907
 BADEN WUERTTEMBERG 3420
 BAKERY ADDITIVES 4085, 4115
 BAKERY PRODUCTS 4072, 4140
 BAKING 4072, 4097, 4107
 BAKING ABSORPTION 4064
 BAKING CHARACTERISTICS 3339, 3345, 3567, 3619, 3688, 3690, 4075, 4087, 4096, 4110, 4121, 4125, 4126, 4131, 4143
 BAKING QUALITY 3558, 4069, 4114
 BANGLADESH 3402
 BARLEY 3323, 3324, 3347, 3430, 3434, 3522, 3539, 3542, 3571, 3590, 3638, 3649, 3659, 3662, 3689, 3700, 3716, 3719, 3724, 3729, 3732, 3742, 3746, 3764, 3773, 3784, 3791, 3794, 3796, 3798, 3800, 3819, 3823, 3824, 3862, 3868, 3870, 3924, 3927, 3931, 3933, 3985, 3991, 3994, 3995, 4004, 4012, 4013, 4015, 4016, 4024, 4054, 4071, 4076, 4082, 4085, 4092, 4098, 4099, 4111, 4127, 4138, 4142, 4146, 4147, 4148, 4149, 4151, 4153, 4163, 4166
 BARLEY ANTHRAX CULTURE 3432
 BARLEY CULTIVARS 4022
 BARLEY HORDEUM VULGARE 3555, 3573, 3615, 4136
 BARLEY MILD MOSAIC VIRUS 3930
 BARLEY PERICARP 3742
 BARLEY ROOTS 3693, 3961
 BARLEY YELLOW DWARF LUTEOVIRUS 3497, 3839, 3865
 BARLEY YELLOW DWARF VIRUS RESISTANCE 3589
 BARLEY YELLOW MOSAIC VIRUS 3930
 BARLEY/ EXPORTS 3569
 BARLEY/ GENETIC VARIATION 3655
 BASE TEMPERATURE 3809
 BASES 3871
 BASILICATA 3503
 BAVARIA 3358, 3359
 BAYMV 3930
 BEERS 4123, 4161
 BEETLES 3858, 3987
 BEIJING 3679
 BELGIUM 3342, 3443, 3444, 3457, 3497, 3498, 3523, 3808, 3854, 3878, 4000, 4057, 4067
 BENOMYL RESISTANCE 3870
 BETA 3852
 BETA AMYLASE 3708, 3780
 BETA GLUCAN 3719
 BETA GLUCANASE 4015
 BETA GLUCURONIDASE 3684
 BETA VULGARIS 3342, 3450, 3457, 3470, 3508, 3851, 3971, 3972, 4166
 BETA VULGARIS L 3693, 3718
 BEVERAGES 4083
 BICOLOR 3696
 BIENNIALS 3516
 BIOASSAYS 3696, 4148
 BIOCHEMICAL FRACTIONS 3712
 BIOCHEMICAL MODEL 4033
 BIOCHEMICAL VARIATION 3599
 BIOCONTROL AGENT 3622
 BIODEGRADATION 4034
 BIOENERGETICS 3987
 BIOFUELS 3481
 BIOLOGICAL ACTIVITIES 4081
 BIOLOGICAL ADDITIVES 4015

BIOLOGICAL CONTAMINATION 4094, 4095, 4149
 BIOLOGICAL CONTROL 3849, 3863
 BIOLOGICAL DEVELOPMENT 3393, 3531, 3679, 3992, 4011, 4020, 4056
 BIOLOGICAL PROPERTIES 3864, 3981
 BIOLOGICAL REGULATORS 3812
 BIOMASS 3381, 3425, 3550, 3707, 3768, 4020, 4037, 4045
 BIOPESTICIDES 3936
 BIOSYNTHESIS 3436, 3749, 3769, 3823, 4132
 BIOSYNTHESIS/ CARBOHYDRATE METABOLISM 3662
 BIOSYNTHETIC ENZYMES 3926
 BIOTYPES 3840, 3841
 BIRD CONTROL 3860
 BLACK CHERNOZEM 3517
 BLOTCH 3905
 BLUE LIGHT ABSORBING PHOTORECEPTOR 3831
 BLUESTEM RANGE FORAGE 4154
 BLUMERIA GRAMINIS F SP HORDEI 3656
 BOEOTICUM 3602
 BOMBYX MORI 4011
 BONE MEAL 4155
 BORON 3771
 BOX 3724
 BRACTS 3742
 BRAN 4011, 4013, 4148, 4149, 4155, 4159
 BRASSICA NAPUS 3354, 3508, 3830, 3837, 3851, 3971, 3972, 4038, 4117, 4165
 BRASSICA OLERACEA BOTRYTIS 3768
 BRASSICA OLERACEA CAPITATA 4165
 BREAD 4070, 4079, 4085, 4107
 BREAD DOUGH 4064
 BREAD MAKING QUALITY 3607, 4070, 4113, 4114
 BREAD WHEAT 3546, 3590, 3672, 3692
 BREADMAKING 4084, 4085
 BREADMAKING QUALITY 3607
 BREEDING 3779, 3799
 BREEDING METHODS 3398, 3604
 BREEDING PROGRESS 3794
 BREEDING VALUE 3585
 BREEDS 4005
 BRENT GEESE 3862
 BREWERS DRIED GRAINS 4015
 BREWING 3355, 3356, 3380, 3382, 3569, 4071
 BREWING INDUSTRY 3504
 BROILER CHICK DIETS 3719
 BROILER CHICKENS 3311, 3994, 4003, 4008
 BROMUS 3974, 3976
 BUCKWHEAT 4085
 BUDGETS 3417
 BUFFERED NUTRIENT SOLUTION 3759
 BUFFERED NUTRIENT SOLUTIONS 4042
 BUILDING MATERIALS 4147
 BULBOSUM METHOD 3830
 BULK DENSITY 3734
 BULK SEGREGANT ANALYSIS 3638, 3833
 BULLOCKS 3993
 BUNKER 3991
 BURNED WHEAT STUBBLE 3970
 BUTYRIC ACID 4156
 BYPRODUCTS 3999, 4155
 C BANDING 3572, 3610, 3624, 3631
 C BANDS 3625
 CA²⁺ 3961
 CADMIUM 3785, 3965, 4024, 4040, 4093, 4165
 CAFFEINE 3964
 CAJANUS CAJAN 3521

CALCIUM 3693, 3751, 3950, 3961, 4021, 4024
 CALCIUM CHANNEL 4043
 CALCIUM HYDROXIDE 4092
 CALCIUM UPTAKE 4043
 CALDESMON 3437
 CALLUS 3433, 3435, 3543, 3782, 3791
 CALLUS CULTURE 3437
 CALLUS CULTURES 3430
 CALORIMETER 3987
 CANADA 3596, 3943, 4077
 CANADA GEESE 3862
 CANADIAN ERGOT 4107
 CANONICAL CORRELATION 3361
 CANOPY 3679, 3717
 CANOPY PHOTOSYNTHESIS 4033
 CAP 3504, 3569
 CARABIDAE 3854
 CARBOHYDRATE METABOLISM 3697
 CARBOHYDRATES 3488, 3708, 3770, 4153
 CARBON 3701, 3815, 3834, 4032, 4033, 4038, 4045
 CARBON 13 4044
 CARBON DIOXIDE 3754, 3761, 3818
 CARBON DIOXIDE EXCHANGE 3706
 CARBON ISOTOPE COMPOSITION 3712
 CARBON ISOTOPE DISCRIMINATION 3742
 CARBON ISOTOPE FRACTIONATION 4044
 CARCASS COMPOSITION 4008, 4012
 CAROTENOID 3796
 CAROTENOID CONTENT 3746
 CARROT 3787
 CARROTS 3762
 CASH CROPS 3342
 CATCH CROPPING 4053
 CATECHOL OXIDASE 3680
 CATIONS 3751
 CATTLE 3342, 4006, 4007, 4024, 4155
 CD 3785
 CDNA 3747, 4080
 CELIAC ACTIVE PEPTIDES 4091
 CELL COUNTING 4149
 CELL CULTURE 3762
 CELL CULTURES 3823, 3832, 3902
 CELL MEMBRANES 3788, 4162
 CELL RESPIRATION 3986
 CELL STRUCTURE 3679, 3888
 CELL WALLS 3659, 3776, 3925
 CELLS 3437, 3684, 3961
 CELLULASE 4008, 4160
 CELLULOLYSIS 4160
 CELLULOSES 4011
 CELLULOSIC PULP 3737
 CENTRAL SASKATCHEWAN 3517
 CENTRALLY PLANNED ECONOMIES 3349
 CENTRE (FRANCE) 3337, 3568
 CEREAL 3429, 3625
 CEREAL APHIDS 3849
 CEREAL CROPS 3337, 3352, 3362, 3368, 3378, 3382, 3442, 3446, 3460, 3466, 3481, 3495, 3508, 3523, 3533, 3534, 3535, 3536, 3537, 3544, 3563, 3568, 3601, 3619, 3627, 3701, 3714, 3744, 3839, 3842, 3860, 3865, 3866, 3872, 3874, 3880, 3904, 3917, 3939, 3948, 3973, 3978, 3979, 4029
 CEREAL FLOURS 4128
 CEREAL GRAINS 3784, 4006
 CEREAL PRODUCTS 4140
 CEREAL PROTEIN 3655, 4084
 CEREAL SILAGE 4007
 CEREALS 3432, 3569, 3684, 3742, 3942, 3958, 4019, 4046, 4056, 4128, 4142
 CHAMPAGNE ARDENNES 3568

CHANNEL 3738
 CHANNELS 3730
 CHARA CORALLINA 3738
 CHELATOR 4042
 CHEMICAL COMPOSITION 3511, 3574, 3659, 3661, 3718, 4067, 4075, 4082, 4122, 4151
 CHEMICAL CONTROL 3368, 3839, 3860, 3865, 3866, 3867, 3874, 3917, 3974, 3977, 3978, 3979, 3982
 CHEMICAL REACTIONS 4124
 CHEMICAL RESISTANCE 3593, 3978
 CHEMICAL STRUCTURE 4084, 4124
 CHEMICOPHYSICAL PROPERTIES 3908, 4021, 4084, 4097, 4108, 4117, 4118, 4138
 CHEMOTAXIS 4032
 CHICKENS 4017
 CHICKS 4009, 4107
 CHILE 4048
 CHINA 3426, 3613, 3668, 3683, 3909, 3947
 CHINESE WHEAT CULTIVARS 3675
 CHLORATES 4032
 CHLORIDAZON 4166
 CHLORIDE 3811
 CHLORIDES 3495
 CHLORMEQUAT CHLORIDE 3811
 CHLOROPHYLL 3746, 3796
 CHLOROPHYLL FLUORESCENCE 3956
 CHLOROPHYLL SYNTHESIS 3749
 CHLOROPHYLLS 3412, 4162
 CHLOROPLAST DEVELOPMENT 3746
 CHLOROPLAST DNA 3835
 CHLOROTHALONIL 3875
 CHOETOSPILA ELEGANS 3863
 CHOLESTEROL 3994
 CHROMATIN SPECIFYING RESISTANCE 3624
 CHROMATOGRAPHY 4018, 4059, 4153
 CHROMIUM 3965, 4024
 CHROMOSOMAL ABERRATIONS 3692
 CHROMOSOMAL LOCATION 3615
 CHROMOSOMAL VARIATIONS 3782
 CHROMOSOME 3430, 3791
 CHROMOSOME 1A 3558
 CHROMOSOME 1B 3607, 3608
 CHROMOSOME 5 3620
 CHROMOSOME 7D 3672
 CHROMOSOME ENDOREPLICATION 3831
 CHROMOSOME MAP 3625
 CHROMOSOME SPECIFIC PRIMERS 3663
 CHROMOSOMES 3441, 3571, 3572, 3575, 3577, 3590, 3595, 3649, 3681, 3833
 CINNAMIC ACID 3926
 CIRCULATION 4058
 CIS ACTING ELEMENT 3828
 CIS REGULATORY SEQUENCES 3828
 CITRULLUS LANATUS 3530
 CL 3738
 CLADOSPORIUM SPP 3920
 CLASSIFICATION 3686, 3703, 3936, 4096, 4121
 CLAY SOILS 3466, 3503, 3505
 CLEANING 3311
 CLIMATE 3710, 3808, 3818, 4031, 4056
 CLIMATE CHANGE 3399
 CLIMATIC CHANGE 4054, 4055, 4056
 CLIMATIC FACTORS 3852, 4055, 4075
 CLONES 3673
 CLONING 3632, 3662, 3663, 3664, 3716
 CLOSTRIDIUM 4156
 CO2 COMPENSATION CONCENTRATION 3742

CO2 CONCENTRATION 3753
 CO2 ENRICHMENT 3399
 CO2 EXCHANGE 3753
 CO2 X TEMPERATURE 3399
 COCCINELLA SEPTEMPUNCTATA 3843
 COCKS 3997
 COLD 3697, 3805
 COLD ACCLIMATION 3826
 COLD HARDENING 3720
 COLD HARDINESS 3573
 COLEOPTERA 3858
 COLEOPTILES 3387
 COLLETOTRICHUM LINDEMUTHIANUM 3925
 COLONIZATION 3581
 COLOR 3609
 COLOUR 3570, 4082, 4104, 4134
 COMBINING ABILITY 3551, 3562, 3617
 COMMERCIAL CULTIVARS 3612
 COMMUNION 4087, 4088, 4089
 COMMODITY MARKETS 4090
 COMMON AND DWARF BUNT FUNGI 3910
 COMMON WHEAT 3425, 3608, 3609, 3631
 COMPACTION 4033
 COMPARATIVE 3637
 COMPETITIVE PARASITISM 3863
 COMPONENTS 4091
 COMPOSITION 3784
 COMPOSTS 3449
 COMPOUND FEEDS 4003, 4011, 4092
 COMPOUND FERTILIZERS 3493
 COMPUTER APPLICATIONS 3889, 4169
 COMPUTER SOFTWARE 3853, 3889, 3939, 3972, 4169
 CONCRETE 4147
 CONDUCTANCE 3733
 CONSTITUENTS 3784, 4006
 CONSTRUCTION 3615, 3650, 3656, 3739
 CONSUMPTION 4077
 CONTAMINATION 4016, 4024, 4093, 4147
 CONTRACT FARMING 3346
 CONTROLLED ATMOSPHERE 3985
 CONVENTIONAL TILLAGE 3514
 CONVERSION 3822
 COOKING 4104, 4132, 4134, 4138
 COOKING QUALITY 3646
 COORDINATION 3783, 3820
 COPPER 3771, 3955, 3958, 4024, 4028, 4042
 CORN 3990
 CORN COBS 4002
 CORN GROWTH RESPONSE 3689
 CORRELATED RESPONSE 3548
 COST ANALYSIS 3390
 COST ANALYSIS/ BARLEY 3335
 COST BENEFIT ANALYSIS 3417, 3418, 3528, 3530
 COSTS 3347, 3889, 4003, 4147
 COTTON SEEDLINGS 3622
 COVER PLANTS 4051, 4052
 COWS 4154
 CRACKING CLAY SOILS 3529
 CROP 3596, 3818, 4070
 CROP COEFFICIENT 3710
 CROP COEFFICIENTS 3710
 CROP DAMAGE 3862
 CROP INJURY 3968
 CROP LOSSES 3375, 3423, 3981
 CROP MANAGEMENT 3339, 3368, 3375, 3382, 3444, 3504, 3535
 CROP RESIDUES 3421, 3467, 4034
 CROP ROTATION 3517, 3920

CROP SIMULATION MODEL VALIDATION 3399
 CROP SIMULATION MODELING 3710
 CROP WATER USE 3710
 CROP YIELD 3337, 3339, 3340, 3341, 3344, 3353, 3358, 3359, 3360, 3362, 3368, 3370, 3371, 3374, 3377, 3378, 3379, 3382, 3390, 3392, 3395, 3396, 3397, 3400, 3402, 3407, 3412, 3415, 3418, 3424, 3426, 3427, 3428, 3444, 3455, 3458, 3459, 3461, 3465, 3470, 3473, 3474, 3475, 3477, 3479, 3489, 3493, 3495, 3498, 3505, 3508, 3515, 3520, 3523, 3524, 3528, 3530, 3533, 3535, 3537, 3538, 3541, 3544, 3559, 3562, 3568, 3574, 3582, 3583, 3584, 3585, 3595, 3597, 3604, 3627, 3661, 3705, 3802, 3808, 3893, 3917, 3923, 3975, 4029, 4048
 CROPPING PATTERNS 3424, 3567
 CROPPING SYSTEM 3525
 CROPPING SYSTEMS 3856
 CROPPING SYSTEMS MODELS MARANOVA 3529
 CROPS 3350, 3399, 3662, 3809, 3871
 CROSS 3588
 CROSS LINKING 4064
 CROSSABILITY 3590
 CROSSING OVER 3555
 CRUDE FIBRE 4013, 4110
 CRUDE PROTEIN 4156
 CRUDE PROTEIN, EXTRACT 3814
 CRUST 4102
 CUCUMIS SATIVUS 3817
 CUCURBITA MAXIMA 3700
 CUCURBITA MOSCHATA DUCH 3749
 CULM ELONGATION 3794
 CULTIVAR DESCRIPTION 3323, 3324
 CULTIVAR MIXTURE 3927
 CULTIVAR MIXTURES 3596
 CULTIVARS 3550, 3581, 3646, 3696, 3712, 3757, 3799, 4114
 CULTIVATED LAND 4053
 CULTIVATION 3339, 3348, 3355, 3356, 3369, 3380, 3384, 3391, 3406, 3410, 3411, 3413, 3414, 3418, 3420, 3574, 3603, 3857, 4056
 CULTURAL BEHAVIOUR 3603
 CULTURAL CONTROL 3977
 CULTURAL METHODS 3426, 3857
 CULTURAL VALUES 3603
 CULTURE 3436, 4100
 CULTURE MEDIA 3433, 3786, 3891
 CULTURE TECHNIQUES 3936
 CULTURES 3764
 CUMINUM 3972
 CURCULIONIDAE 3846
 CUTICLES 3750
 CYCLING 4045
 CYCLOHEXIMIDE 3720
 CYDIA NIGRICANA 3851
 CYPRUS 3857
 CYSTEINE 3858
 CYTOGENETIC RELATIONSHIP 3631
 CYTOGENETICS 3610, 3644
 CYTOKININS 3435
 CYTOLOGICAL MARKERS 3671
 CYTOMORPHOGENESIS 3437
 CYTOPLASM 3579, 3654, 3658
 CYTOPLASMIC MALE STERILITY 3654
 CYTOPLASMIC PH 3730
 CYTOPLASMIC POLY(A) RIBONUCLEOPROTEIN 3827
 CYTOSKELETON 3437
 D GENOME 3607
 DACTYLIS GLOMERATA 4036

DAIRY CATTLE 4006
 DAIRY COWS 4002, 4156
 DAMAGE 3862
 DARK RESPIRATION 3753
 DARKNESS 3745
 DATA ANALYSIS 3344
 DATA COLLECTION 3341
 DATABASES 3889
 DATES 3809
 DAYLENGTH 3795
 DAYLIGHT 3393, 3531, 3909
 DECISION MAKING 3939
 DEFICIENCY 4046
 DEFICIENT BARLEY 3769
 DEFOLIATION 3520
 DEGRADABILITY 4006
 DEGRADATION 3421, 3713, 3776, 4045, 4164
 DEHYDRIN 3724
 DEHYDROASCORBIC ACID 4063
 DELETION MAPPING 3625
 DELTA C 13 3712
 DELTAMETHRIN 3838
 DENATURATION 3655
 DENITRIFICATION 4031, 4045
 DENMARK 3377, 3479, 3516, 3851, 3852, 3853,
 3894, 3895, 3971, 3972, 3976, 4053
 DENSITY 4170
 DEPENDENCY 3581
 DEPOSITION 3822
 DESICCANTS 3634, 3971
 DESICCATION 3747
 DETOXIFICATION 4092
 DEVELOPING ENDOSPERM 3798
 DEVELOPING MESOPHYLL 3437
 DEVELOPING PUMPKIN COTYLEDONS
 4136
 DEVELOPMENT 3429
 DEVELOPMENTAL STAGES 3850
 DIALLEL 3678
 DIALLEL ANALYSIS 3660
 DIALLEL CROSS 3617
 DIALLEL CROSSING 3562
 DIAZOTROPHS 3804
 DICHLORTOLURON 3692
 DICLOBUTRAZOL 3796
 DIET 3995, 4017
 DIETARY FIBER 4153
 DIETARY FIBRES 3574
 DIETS 4154
 DIFENZOQUAT 3983
 DIFFERENT RELATIVE RATES 3757
 DIFFERENTIATION 3437
 DIGESTIBILITY 3776, 3998, 4006, 4147, 4154,
 4155
 DIGESTION 4154
 DIGESTIVE ABSORPTION 4017
 DIGESTIVE JUICES 4017
 DIGITAL IMAGE ANALYSIS 3703, 3725
 DIHAPLOIDY 3830
 DILATOMETRY 4143
 DIPLOSPORY 3833
 DIPSTICK 4145
 DISCRIMINATION 3703, 3712
 DISEASE CONTROL 3368, 3382, 3408, 3497,
 3498, 3504, 3837, 3853, 3864, 3866, 3869, 3881,
 3884, 3895, 3907, 3918, 3936, 3939, 3946
 DISEASE FREQUENCY 3920
 DISEASE RESISTANCE 3497, 3533, 3534, 3535,
 3537, 3544, 3545, 3547, 3564, 3579, 3613, 3614,
 3640, 3668, 3676, 3680, 3681, 3872, 3878, 3880,

3891, 3894, 3899, 3904, 3908, 3919, 3926, 3928,
 3940, 3945
 DISEASE TRANSMISSION 3864, 3891, 3947
 DISEASES 3905
 DISINFECTION 3311
 DISTICHUM THUNB LOVE 3672
 DISTRIBUTION 3759
 DISULFIDE BONDS 4080
 DIURAPHIS NOXIA 3844, 3849, 3855
 DIVERSITY 3602, 3835, 3911
 DIVISION SITE 3722
 DNA 3570, 3572, 3638, 3684, 3789, 3883
 DNA MARKERS 3649
 DNA RFLP 3665
 DNA SEQUENCE ALIGNMENT 3628
 DNA SEQUENCES 3663
 DODECYL SULFATE 3731
 DOMESTIC MARKETS 3348
 DORMANCY 3570, 3659
 DOUBLE CROPPING 3510
 DOUBLED HAPLOID PLANTS 3432
 DOUBLED HAPLOIDS 3587, 3588, 3621, 3656
 DOUGH PROPERTIES 4116
 DOUGHS 3690, 4063, 4072, 4104, 4115, 4124,
 4143
 DRECHSLERA 3894, 3895
 DRECHSLERA SOROKINIANA 3920
 DRIVING VARIABLES 3755
 DROSOPHILA MELANOGASTER 3628
 DROUGHT 3799, 3800
 DROUGHT INDUCED GENES 3716
 DROUGHT RESISTANCE 3634, 3756, 3957
 DROUGHT RESPONSE 3792
 DROUGHT STRESS 3621, 3635, 3716, 3717
 DROUGHT TOLERANCE 4046
 DRY MATTER 3785, 3822, 4027
 DRY MATTER CONTENT 3557, 3582
 DRY MATTER K 4027
 DRY MATTER OF SEEDS 3767
 DRY SEASON 3402, 3474, 3580
 DRYERS 4019
 DRYING 4019, 4076, 4077, 4149
 DURATION 3710, 3794, 3838, 4115
 DURATIONS 3783
 DURUM 3663
 DURUM QUALITY 3646
 DURUM WHEAT 3608, 3635, 3636, 3716, 3757,
 3785
 DWARF 3774
 DWARF BUNT 3931
 DWARFING GENE 3637
 DWARFISM 3606, 3661
 DWARFS 3549
 DYE MARKERS 4037
 DYNAMICS 3781, 3863
 EAR 3829
 EAR CULTURE 3431
 EAR DEVELOPMENT 3794
 EAR EMERGENCE TIME 3573
 EARLINESS 3534, 3595, 3682
 EARLY MATURITY 3323, 3324
 EARS 3742
 EAST AFRICA 3419
 ECHINOCHLOA 3745
 ECOLOGY 4018, 4020, 4035
 ECONOMETRICS 3331
 ECONOMIC ANALYSIS 3384
 ECONOMIC DEPRESSION 3569
 ECONOMIC GEOGRAPHY 3344
 ECOPHYSIOLOGICAL
 CHARACTERIZATION 3753

ECOSYSTEMS 3966, 4020
 ECOTYPES 3797
 EFFECT OF TEMPERATURE 4139
 EFFICIENCY 3610, 3701, 3774, 3874, 3889,
 3917, 3948, 4073
 EGG AGGREGATION 3846
 EGG PRODUCTION 3995
 EGYPT 3336, 3351, 3371, 3453
 ELASTICITY 4124, 4143
 ELECTRON TRANSPORT 3745
 ELECTROPHORESIS 3646, 3805, 3826, 3847,
 4106
 ELEMENTS 3772
 ELEVATED TEMPERATURE 3821, 3822
 ELICITOR 3778
 EMBRYO CULTURE 3429, 3434, 3586, 3673,
 3786
 EMBRYOGENESIS 3832
 EMBRYOGENIC CELL SUSPENSIONS 3432
 EMBRYONIC DEVELOPMENT 3673, 3786,
 3789
 EMBRYOS 3782
 EMERGENCE 3783, 3787
 EMILIA ROMAGNA 4051, 4052
 EMISSIONS 4031
 ENDOGENOUS GIBBERELLINS 3790
 ENDOGLUCANASE I 3739
 ENDOPEPTIDASE 3672
 ENDOSPERM 3608, 3659, 3704, 3776, 3821,
 3822, 4126
 ENDOXYLANASE 3925
 ENERGY 3784, 3997, 4154
 ENERGY BALANCE 3481
 ENERGY FLOW 4033
 ENERGY VALUE 4001, 4151
 ENGLAND 3896, 4126
 ENRICHMENT 3761, 3818
 ENT KAURENE 3700
 ENT KAURENOLS 3700
 ENVIRONMENT 3712
 ENVIRONMENTAL FACTORS 3690, 3808,
 3842, 4075, 4093, 4122
 ENVIRONMENTAL IMPACT 3837
 ENVIRONMENTAL PROTECTION 3357
 ENVIRONMENTAL TEMPERATURE 3531
 ENVIRONMENTS 3621
 ENZYMIC AMPLIFICATION 3558, 3663
 ENZYME ACTIVITIES 3742
 ENZYME IMMUNOASSAY 4145
 ENZYME PREPARATIONS 3311, 4008
 ENZYME PREPARATIONS/ SUPPLEMENTS
 4004
 ENZYME RELEASE 3704
 ENZYMES 3662, 3745, 3936, 3954, 3994, 4017,
 4110, 4160
 ENZYMIC ACTIVITY 3441, 3735, 4141
 EPICOCUM SPP 3920
 EPICOTYL 3749
 EPIDEMICS 3906, 3909
 EPIDEMIOLOGY 3928
 EPOXIDASE 3436
 EQUATIONS 3990
 EQUIPMENT 4170
 ERGOSTEROL 3940, 4148, 4149
 ERGOT 3924
 EROSION 3503, 3529, 4052, 4053
 ERYSIPHE 3902, 3941
 ERYSIPHE GRAMINIS 3620
 ERYSIPHE GRAMINIS 3668, 3824, 3836, 3880,
 3894, 3907, 3918
 ERYSIPHE GRAMINIS F SP HORDEI 3741

ESCAPE PROTEIN 4006
 ESCHERICHIA COLI 3755
 ESTERASES 3680
 ETHANOL 3481
 ETHIOPIA 3565
 ETHYLENE 3747
 ETHYLENE/ SEEDS 3806
 EUROPE 3395, 3396, 3966, 4077
 EUROPEAN COMMUNITIES 3346, 4056, 4077
 EVALUATION 3912, 4089, 4096, 4104, 4121, 4122, 4125, 4131, 4134, 4135
 EVAPORATION 3710, 3714
 EVAPOTRANSPIRATION 3694, 3710, 3714, 3723, 4029, 4030
 EVOLUTION 3558, 3628
 EXCISED ROOTS 3751
 EXCLUSION 3863
 EXCRETA 4000, 4008, 4009
 EXCRETION 3997
 EXHIBITIONS 3410
 EXOGENOUS AUXINS 3430
 EXOGENOUS ENZYMES 4153
 EXOTIC GENOTYPES 3542
 EXPERIMENTAL VERIFICATION 4033
 EXPERIMENTATION 3444, 3457, 3523, 4000, 4019
 EXPORTS 3566
 EXPRESSION 3664, 3684, 3715, 3718, 3724, 3736, 3739, 3754, 3812, 3832, 3902
 EXSEROHILUM ROSTRATUM 3913
 EXTENSION ACTIVITIES 3311, 3312, 3354, 3364, 3566
 EXTRACELLULAR ENZYME 4022
 EXTRACT VISCOSITY 3719
 EXTRACTS 4124
 EXUDATES 3740
 EXUDATION 3732
 EYESPOT 3870, 3875, 3896
 F ACTIN 3722
 F SP GLYCINEA 3926
 F SP TRITICI 3649, 3672, 3778
 F1 HYBRIDS 3557, 3575, 3580
 F2 HYBRIDS 3557
 FABA BEANS 4012
 FABACEAE 3726
 FALLOW 3457, 3516, 3523, 3854
 FALLOW SYSTEMS 3516, 4053
 FAMILY 3578
 FARM AREA 3341, 3343
 FARM INCOME 3342
 FARM INPUTS 3339
 FARM MANAGEMENT 3343, 3417, 3423
 FARM STRUCTURE 3342
 FARM SURVEYS/ CULTIVATED LAND 3341
 FARMERS 3312
 FARMING SYSTEMS 3472
 FARMS 3339, 3354, 3385
 FARMYARD MANURE 3470, 3477, 3489, 3523, 4035
 FAT 4002
 FATS 4110
 FATTENING 4003, 4012, 4013, 4152
 FATTY ACID 4018
 FATTY ACIDS 3720, 4039
 FAUNA 3854
 FEED ADDITIVES 3311, 4008, 4012, 4017, 4156
 FEED CEREALS 4147, 4155
 FEED CONVERSION EFFICIENCY 4008, 4009, 4012
 FEED CROPS 4017
 FEED INTAKE 4004, 4009

FEED LEGUMES 3500
 FEEDING 4008
 FEEDS 3993, 4024, 4150, 4151, 4155, 4156
 FERMENTATION 4002, 4115, 4156
 FERTILE 3782
 FERTILITY RESTORING GENE 3630
 FERTILIZER 3381, 3517
 FERTILIZER APPLICATION 3341, 3354, 3368, 3382, 3392, 3406, 3442, 3450, 3459, 3460, 3461, 3462, 3463, 3464, 3466, 3474, 3476, 3481, 3511, 3619, 3758, 3848, 3869, 4049
 FERTILIZERS 3408, 3491
 FERULIC ACID 3776, 4103
 FESTUCA RUBRA 3972
 FIBER 3696
 FIELD 3753, 3819
 FIELD EVALUATION 3494
 FIELD EXPERIMENTATION 3466, 3495, 3524, 3851, 3852, 3894, 3895, 3923, 3971, 3972, 3973
 FIELD GROWN WHEAT 3712
 FIELDS 4056
 FINANCE 3343
 FIRMNESS 4104, 4115, 4126
 FISH MEAL 4149, 4155
 FISTULATION 4155
 FLAG LEAF 3742, 3811
 FLAG LEAF AREA 3801
 FLAVOUR 4123
 FLOUR 4103
 FLOUR COLOR 4112
 FLOURS 3348, 4086, 4110
 FLOWERING 3595
 FOLIAR APPLICATION 3482, 3488, 3848, 3893
 FOOD ADDITIVES 3569
 FOOD CHAINS 4024
 FOOD FERMENTATION 4083
 FOOD INDUSTRY 4067
 FOOD INDUSTRY EQUIPMENT 4071, 4076
 FOOD PRODUCTION 3394, 3618, 4077
 FOOD SUPPLY 3349
 FOOD TECHNOLOGY 4122
 FOODS 3349, 3639, 4132
 FORECASTING 3362, 3694, 3861, 4055
 FORECROP 3492
 FORECROPS 4069
 FOREST SOILS 3477
 FORMA SPECIALIS 3836
 FORMALDEHYDE TREATED BARLEY 4006
 FORMICIDAE 3842
 FORMULATIONS 3971
 FRACTIONATION 3712, 4067, 4116, 4124
 FRAGMENT LENGTH POLYMORPHISM 3649
 FRAGMENT LENGTH POLYMORPHISMS 3911
 FRANCE 3345, 3382, 3481, 3533, 3534, 3535, 3536, 3537, 3544, 3601, 3866, 3904, 3917, 3939, 4151, 4163
 FREEZE RESISTANCE 3720
 FREEZING 4072
 FREEZING TOLERANCE 3664, 3747, 3826
 FRENCH BREAD 4102
 FRESH WT 3553
 FROST RESISTANCE 3573
 FRUCTAN 3773
 FRUCTAN HYDROLASE 3773
 FRUCTOSE 3945
 FUEL CROPS 3481
 FUMIGATION 3310, 3962
 FUNCTIONAL PROPERTIES 4064
 FUNGAL 3436

FUNGAL DISEASES 3544, 3866, 3869, 3874, 3880, 3888, 3889, 3891, 3917, 3923, 3940, 3988
 FUNGAL ELICITOR 3778
 FUNGI 3581
 FUNGICIDE 3870
 FUNGICIDE RESISTANCE 3870
 FUNGICIDE SENSITIVITY 3933
 FUNGICIDES 3350, 3860, 3866, 3867, 3874, 3878, 3889, 3893, 3894, 3895, 3896, 3915, 3916, 3917, 3918, 3939, 3946
 FUNGUS 3596
 FUSARIUM 3898, 3901, 3912, 3929, 3937, 3940, 3941, 3988, 4095
 FUSARIUM CULMORUM 3626, 3874
 FUSARIUM EQUISETI 3913
 FUSARIUM OXYSPORUM 3936
 GA 3549, 3829
 GA(3) INSENSITIVITY 3637
 GAEUMANNOMYCES GRAMINIS 3936
 GALIUM 3974
 GALLIUM 3771
 GAMETOCIDAL GENES 3609
 GAMETOCIDE 3825
 GAMMA GLIADIN GENES 4080
 GAMMA IRRADIATION 3931, 3988, 4078
 GAMMA RADIATION 3553
 GANSU 3418, 3906
 GAS CELLS 4064
 GAS EXCHANGE 3799
 GAS EXCHANGE CHARACTERISTICS 3742
 GAS RETENTION 4064
 GEESE 4004, 4010, 4146
 GEL ELECTROPHORESIS 3715
 GEL MOBILITY SHIFT ASSAY 3828
 GENE 3628, 3632, 3743, 3747
 GENE BANKS 3403
 GENE EXPRESSION 3578, 3823, 3828, 4032
 GENE FAMILY 3578
 GENE INTERACTION 3545
 GENE INTRODUCTION 3620
 GENE LOCATION 3571
 GENE POOLS 3603
 GENE PROMOTER 3724
 GENE TRANSFER 3590, 3662, 3684
 GENERATIVE GROWTH 3757
 GENES 3399, 3545, 3549, 3564, 3570, 3571, 3577, 3592, 3595, 3605, 3606, 3613, 3625, 3638, 3656, 3661, 3668, 3676, 3731, 3832, 3833
 GENETIC ANALYSIS 3608, 3620, 3656
 GENETIC CONTROL 3559, 3671, 3812
 GENETIC CORRELATION 3560, 3652, 3667, 3674, 3682
 GENETIC ENGINEERING 3639
 GENETIC GAIN 3594
 GENETIC IMPROVEMENT 3550
 GENETIC INHERITANCE 3597, 3605, 3647, 3658, 3667
 GENETIC LINKAGE 3607
 GENETIC LINKAGE MAP 3602, 3625
 GENETIC MAP 3555
 GENETIC MAPS 3595
 GENETIC MARKERS 3564, 3595, 4037
 GENETIC PARAMETERS 3541
 GENETIC RESOURCES 3563
 GENETIC STABILITY 3681
 GENETIC VARIABILITY 3542, 3599
 GENETIC VARIATION 3559, 3561, 3565, 3571, 3575, 3577, 4168
 GENETICS 3570, 3595, 4114
 GENOME 3539, 3555, 3573, 3587, 3615, 3625, 3779, 3835, 4080

GENOME SIMILARITY 3833
 GENOMES 3575, 3595
 GENOMIC IN SITU HYBRIDIZATION 3624
 GENOMIC ORGANIZATION 3828
 GENOTYPE 3712, 3821
 GENOTYPE BY ENVIRONMENT
 INTERACTION 3621
 GENOTYPE ENVIRONMENT INTERACTION
 3563, 3659, 3688
 GENOTYPE X ENVIRONMENT
 INTERACTIONS 3617
 GENOTYPES 3386, 3446, 3538, 3548, 3574,
 3575, 3592, 3604, 3611, 3634, 3637, 3679, 3751,
 3770, 3803, 3820, 3840, 3841, 3934, 3940
 GENUS ZEN 3539
 GEOGRAPHICAL DIFFERENTIATION 3434
 GERMANY 3311, 3358, 3359, 3397, 3415, 4054,
 4096, 4121, 4134, 4135, 4163, 4166
 GERMINABILITY 3441, 3549, 3982
 GERMINATION 3439, 3493, 3777, 3779, 3780,
 3802, 3806, 3964, 4076, 4139
 GERMPLASM 3394, 3398, 3583, 3676, 3904
 GERMPLASM EVALUATION 3635
 GIBBERELLA 3881, 3919
 GIBBERELLIC ACID 3704, 3724, 3829, 3831
 GIBBERELLIC ACID INSENSITIVITY 3637
 GIBBERELLIN BIOSYNTHESIS 3700
 GLASSHOUSE 3819
 GLI 1 LOCI 3608
 GLIADIN ELECTROPHOREGRAMS 3607,
 3646
 GLIADIN PEPTIDES 4091
 GLIADINS 3608
 GLU 3 LOCI 3608
 GLUCANS 3659
 GLUCOSE 3945
 GLUCOSE REPRESSION 3578
 GLUCOSIDASES 4132
 GLUCOSIDES 4132
 GLUMES 3412
 GLUTAMATE PYRUVATE TRANSAMINASE
 3798
 GLUTEN 4060, 4077, 4084, 4110, 4115, 4116,
 4118, 4124, 4125, 4128, 4137, 4143, 4158
 GLUTEN STRENGTH 3607, 3646
 GLUTENIN 3651, 4116
 GLUTENIN SUBUNIT COMPOSITION 3646
 GLUTENIN SUBUNITS 3540
 GLUTENINS 3608, 4084
 GLYCINE MAX 3439, 3500, 3520, 3726, 3732,
 3762, 4165
 GLYCOSIDASES 4004, 4008
 GLYCOSIDES 4016
 GLYPHOSATE ACID 3750
 GLYPHOSATE MONOAMMONIUM 3750
 GOATS 4005
 GOSSYPPIUM 3393, 3455, 3531
 GRADING 3345, 4134
 GRAIN 3310, 3349, 3353, 3360, 3376, 3479, 3488,
 3582, 3604, 3655, 3667, 3669, 3704, 3779, 3784,
 3842, 3937, 3988, 3989, 3990, 4024, 4069, 4081,
 4117, 4127, 4128, 4130, 4138, 4142, 4150, 4170
 GRAIN AVAILABILITY 3846
 GRAIN DEVELOPMENT 3760, 3822
 GRAIN DRYING RATE 3431
 GRAIN FILLING 3811
 GRAIN INFESTATION 3846
 GRAIN MASS 3792, 3829
 GRAIN NUMBER 3792, 3829
 GRAIN PROTEIN 3757
 GRAIN PROTEIN COMPOSITION 4113

GRAIN QUALITY 3660
 GRAIN SIZE 3674
 GRAIN SORPTION 3990
 GRAIN YIELD 3381, 3425, 3540, 3550, 3689,
 3741, 3793, 3800, 3821, 3829, 4041
 GRAIN YIELD AND QUALITY 3366, 3451
 GRAINS 3920
 GRAMINEAE 3411, 3523, 3700
 GRAMINEARUM 3626
 GRAPEVINES 3857
 GRASSES 3714, 3971, 3972, 3976
 GRASSLANDS 4039
 GRAZING 3862, 3993, 4010
 GREAT BRITAIN 4126
 GREEN BARLEY LEAF EXTRACT 4100
 GREEN MANURE 3527
 GREEN MANURES 3523
 GREEN MANURING 3525
 GROSS MARGINS 3339
 GROUNDNUTS 4092
 GROUNDWATER TABLE 3500
 GROWN SPRING BARLEY 4027
 GROWTH 3383, 3387, 3393, 3399, 3400, 3429,
 3436, 3440, 3466, 3473, 3499, 3505, 3519, 3522,
 3531, 3538, 3550, 3563, 3577, 3654, 3691, 3700,
 3733, 3748, 3751, 3774, 3781, 3783, 3789, 3790,
 3794, 3795, 3800, 3803, 3805, 3809, 3810, 3817,
 3820, 3829, 3845, 3849, 3858, 3862, 3905, 3923,
 3949, 3956, 3958, 3964, 4001, 4009, 4021, 4036,
 4046, 4162
 GROWTH ACTIVITIES 3777
 GROWTH ANALYSIS 3775
 GROWTH INDICATORS 3814
 GROWTH INHIBITORS 4017
 GROWTH PERIOD 3967
 GROWTH RATE 3843
 GROWTH REGULATORS 3830
 GROWTH RESPONSE 3581
 GROWTH SUBSTANCE 3804
 GUARD MOTHER CELLS 3722
 GUS 3724
 GYNOGENESIS 3830
 GYPSUM 3489
 H 4 GENES 3828
 H+ 3950
 H+ PUMP 3961
 HALOPHYTES 3748
 HAPLOID 3586
 HAPLOIDY 3571, 3654, 3661, 3786, 3830
 HARD RED WINTER WHEAT 3858
 HARD WHEAT 3335, 3338, 4104, 4122, 4134,
 4135, 4142
 HARDNESS 4112, 4133
 HARROWING 3506
 HARVEST INDEX 3425, 3550, 3557, 3652, 3653,
 3678, 3707
 HARVESTING 3395, 3396, 3397, 3406, 3413,
 3414, 3415, 3422
 HARVESTING LOSSES 3422
 HAY 3517
 HBP 1A 3828
 HBP 1B 3828
 HEAT 3658, 3986, 3989
 HEAT PRODUCTION 3987
 HEAT SHOCK RESPONSE 3715
 HEAT STRESS 3647, 3697
 HEAT TREATMENT 4092, 4097, 4149
 HEAVY METALS 3445, 3817, 4165
 HEBEI 3633, 4030
 HECTOLITRE WEIGHT 3623

HEIGHT 3387, 3550, 3565, 3623, 3633, 3661,
 3829
 HELIANTHUS ANNUUS 3508
 HELMINTHOSPORIUM 3390, 3403, 3528,
 3544, 3888, 3917, 3928
 HEMIPTERA 3699
 HEN DAY EGG PRODUCTION 4015
 HERBICIDE RESISTANCE 3684
 HERBICIDES 3368, 3374, 3692, 3749, 3837,
 3971, 3973, 3974, 3975, 3978, 3979, 3983, 3984,
 4052, 4163, 4164, 4166
 HERITABILITY 3425, 3548, 3595, 3669, 3674
 HERMETIC 3991
 HESSIAN FLY RESISTANCE 3624
 HETEROBASIDIUM ANNOSUM 3925
 HETEROCHROMATIN 3539
 HETERODERA AENAE 3532
 HETEROLOGOUS EXPRESSION 3739
 HETEROSIS 3604
 HEXAPLOID BREAD WHEAT 3558, 3731, 4080
 HEXAPLOID TRITICALE 3361
 HEXAPLOID WHEAT 3671
 HEXAPLOIDY 3575
 HGCL2 3777
 HIGH ATMOSPHERIC CO2 3754
 HIGH MOLECULAR WEIGHT GLUTENIN
 3540
 HIGH PRESSURE LIQUID
 CHROMATOGRAPHY 3762, 4094
 HIGH TEMPERATURE 3614
 HIGH YIELDING VARIETIES 3369, 3554, 3627,
 3679
 HIGHER PLANT CELLS 3722
 HIGHER PLANTS 3578, 3745
 HIGHLANDS 3354, 3385, 3423, 3503, 3591,
 3723, 4052
 HILL 3587, 3588
 HILL PLOTS 3587
 HISTOCHEMISTRY 3776
 HISTORY 3310, 3603
 HMW 4080
 HMW GLUTENIN GENES 3558
 HMW GLUTENIN SUBUNIT 3558
 HMW GLUTENINS 3665
 HOLCUS 4036
 HOMOELOGOUS CHROMOSOME
 PAIRING 3590
 HOMOELOGOUS PAIRING 3589, 3631
 HOMOELOGOUS RELATIONSHIPS 3631
 HOMOELOGY 3572, 3631
 HOMOLOGOUS SERIES 3962
 HOPS 4098
 HORDEUM 3342, 3405, 3413, 3414, 3443, 3444,
 3457, 3470, 3479, 3497, 3504, 3564, 3565, 3569,
 3571, 3755, 3842, 3954
 HORDEUM (LEAVES) 3718
 HORDEUM BULBOSUM 3590, 3786
 HORDEUM SATIVUM 3795
 HORDEUM SPONTANEUM 3571, 3620, 3794
 HORDEUM VULGARE CULTIVARS 3719
 HORDEUM VULGARE L 3432, 3553, 3650,
 3759, 3798, 3830
 HORDEUM VULGARE L INULINASE 3773
 HOST PATHOGEN RELATIONS 3921
 HOST PLANT NUTRITION 3855
 HOSTS 3640, 3947
 HOUSEHOLDS 4072
 HULL CRACKED GRAIN 3660, 3674
 HULLESS BARLEY 3719
 HUMIDITY 3439, 3523
 HUMUS 3477, 3523, 4049

HUNGARY 3477, 3593, 3897, 3934, 3937, 4073, 4086, 4108
 HYBRID WHEAT 3825
 HYBRIDIZATION 3370, 3433, 3560, 3584, 3681
 HYBRIDS 3426, 3433, 3577, 3593, 3604, 3631, 3669, 3919
 HYDRAULIC CONDUCTIVITY 3733
 HYDROLASES 3662
 HYDROLOGY 3723
 HYDROPONICS 4042
 HYDROXAMIC ACIDS/ ALKALOIDS 3699
 HYGIENE 4150
 HYGROSCOPICITY 4159
 HYMENOPTERA 3847
 HYPERSENSITIVE LIGNIFICATION RESPONSE 3778
 HYPOCOTYL 3749
 HYV 3777
 IAA 3752
 ICE 3438
 IDAHO 3408, 3409, 3417, 3491, 3496, 3645, 3884
 IDENTIFICATION 3437, 3555, 3556, 3578, 3595, 3607, 3628, 3631, 3638, 3650, 3726, 3729, 3823, 3833, 3911, 3936, 3984
 IDENTITY 3911
 IMAGE PROCESSING 3984
 IMAZAQUIN 3811
 IMMATURE EMBRYOS 3820
 IMMUNOFLUORESCENCE MICROSCOPY 3722
 IMPACT 3529
 IMPROVED PLANT REGENERATION 3432
 IMPROVEMENT 3594, 3623, 4015
 IN SITU HYBRIDIZATION 3539, 3628, 3671
 IN VITRO EXPERIMENTATION 3891, 4016, 4109
 IN VITRO REGENERATION 3435
 IN VIVO EXPERIMENTATION 3891, 4016
 INCLUSIONS 3885
 INCORPORATION 4045
 INDOLES 3699
 INDUCED MUTATION 3659
 INDUCTION 3755, 3764, 3832, 3925, 3926
 INDUSTRIAL CROPS 3508
 INFECTION 3581, 3626, 3905
 INFERTILITY 3423
 INFESTATION 3840, 4150
 INFRARED RADIATION 4142
 INGESTION TOXICITY 4095, 4148
 INHERITANCE 3552, 3608, 3643, 3644, 3879, 4114
 INHIBITION 3436, 3961, 4100, 4151
 INHIBITION BY TETCYCLACIS 3823
 INITIATION 3783, 3809, 3827
 INNOVATION ADOPTION 3312
 INOCULATION METHODS 4036
 INOCULUM DENSITY 3522
 INORGANIC FERTILIZERS 3458, 3479, 4093
 INOSITOL 1, 4, 5 TRISPHOSPHATE 3778
 INPUT LEVELS 3332
 INSECT CONTROL 3839
 INSECTICIDES 3838, 3853, 3856, 3859, 3860, 3865, 3989
 INSECTS 3858, 3985
 INSITU HYBRIDIZATION 3539, 3624
 INSOLATION 4057
 INSTABILITY 3609
 INTEGRATED CONTROL 3856, 3981
 INTEGRATED PLANT PRODUCTION 3357
 INTERCROPPING 3393, 3418, 3500, 3519, 3520, 3528, 3530, 3600

INTERGENERIC CROSS 3586
 INTERGENERIC HYBRID 3590
 INTERGENERIC HYBRIDS 3589, 3833
 INTERIOR EGG QUALITY 4015
 INTERMEDIATE PHOTOSYNTHESIS 3742
 INTERNODES 3776, 3829
 INTERSPECIFIC HYBRIDIZATION 3575, 3577, 3949
 INTESTINES 4016, 4017, 4155
 INTRODUCED NATURAL ENEMIES 3863
 INTROGRESSION 3624
 INVERSION 3555
 INVESTMENT 3342
 IODIDES 3634
 ION TRANSPORT 3693
 IONS 3751
 IRON 3740, 3771, 3954, 4028, 4042
 IRRADIANCE 3753, 3819
 IRRADIATED POLLEN 3830
 IRRADIATION 3788
 IRRIGATED FARMING 3384
 IRRIGATED RICE 3474, 3520
 IRRIGATED WHEAT 3821
 IRRIGATION 3392, 3406, 3408, 3466, 3710, 3792, 3897, 4029, 4130
 IRRIGATION RATES 3694
 IRRIGATION SCHEDULING 3496, 3710
 IRRIGATION SYSTEMS 3496
 IRRIGATION WATER 4021
 ISOELECTRIC FOCUSING 3571
 ISOENZYMES 3680, 3721, 3805, 3964
 ISOLATED POLLEN 3432
 ISOLEUCINE 4012
 ISONICOTINIC ACID 3902
 ISOPROTURON 4166
 ISOPROTURON/ SOIL 4164
 ISOTHIOCYANATES 3962
 ISOTOPES 3701, 3744
 ISOZYME 3587, 3650, 3779
 ISOZYME MARKER 3672
 ISOZYMES 3555, 3671
 ISRAEL 3620, 3794
 ITALY 3574, 4004, 4010, 4104, 4122, 4146, 4163
 JAPAN 4077
 JASMONATES 3823, 3902
 JIANGSU 3676, 3981
 JIP GENE EXPRESSION 3823
 JOINT SEGREGATION ANALYSIS 3576
 K+ 3961
 K+ EFFLUX 3961
 KARNAL BUNT 3666
 KEEPING QUALITY 3504, 4117, 4147
 KERNEL MORPHOLOGICAL VARIATION 3703
 KERNEL NUMBER 3623
 KERNEL WEIGHT 3623
 KERNELS 3702, 3937, 4082, 4118
 KIDNEYS 4024
 KINETICS 3738, 3755
 KOREA REPUBLIC 3901
 L CV IGRI 3432
 LABORATORIES 4128
 LABORATORY EQUIPMENT 4125, 4142
 LABORATORY EXPERIMENTATION 3780, 3888
 LABOUR PRODUCTIVITY 3342
 LAND EVALUATION 3529
 LAND LEVELLING 3502
 LAND MANAGEMENT 4049
 LAND USE 4045
 LAND VARIETIES 3563

LANTHANUM 3771
 LARGE INTESTINE 4153
 LARVAE 3843, 3863, 4011
 LATENT HEAT FLUX 4058
 LATERAL ROOTS 3733
 LAYER CHICKENS 3995, 4009
 LAYING PERFORMANCE 3995
 LEACHING 3458, 3476, 3500, 3516, 4029, 4048, 4164, 4166
 LEAD 3817, 4024
 LEAF 3753, 3794, 3829, 3905
 LEAF AREA 3477, 3582, 3768, 3818
 LEAF BLOTCH 3873
 LEAF DISKS 3718
 LEAF EMERGENCE 3689, 3795, 3800
 LEAF INSERTION 3753
 LEAF NUMBER 3794, 3820
 LEAF ROLLING 3756
 LEAF RUST 3572, 3649, 3672, 3876
 LEAF RUST RESISTANCE 3546, 3576, 3590
 LEAF SURFACE BACTERIA 3804
 LEAF TEMPERATURE 3753
 LEAF THIONIN 3902
 LEAKAGE 3730
 LEAVES 3412, 3495, 3551, 3712, 3735, 3744, 3749, 3753, 3754, 3766, 3788, 3811, 3813, 3823, 3824, 3826, 3838, 3902, 3922, 3945, 3955, 3961, 4162
 LEGUMES 3513, 4157
 LEGUMIN LIKE PROTEINS 4136
 LENGTH 3582, 3967
 LENGTH POLYMORPHISM MAP 3656
 LENS CULINARIS 3354
 LEYS 3972
 LIGATION 3663
 LIGHT 3735, 3774, 3788, 3831
 LIGNIN 3721, 3776
 LINES 3588, 3620, 3715
 LINKAGE 3555, 3588, 3608, 3625, 3646
 LINKAGE MAP 3615
 LINUM USITATISSIMUM 3972
 LIPID ACYL HYDROLASE 4136
 LIPID CONTENT 4064, 4122
 LIPIDS 3720, 3735, 4124
 LIPOPOLYSACCHARIDES 4039
 LIPOXYGENASE GENE 3823
 LIQUID FERTILIZERS 3482
 LIQUID FILM 4064
 LIQUID NITROGEN 3441
 LMW GLUTENIN 3663
 LMW SUBUNITS 3608
 LOAF VOLUME 4064, 4079
 LOAM SOILS 3714
 LOCALIZATION 3761
 LOCATION 3546, 3573, 3609, 3637, 3671, 3672
 LOCUS 3648, 3649, 3650
 LOCUS ANALYSIS 3663
 LODGING 3375, 3497, 3498, 3685, 3948
 LOESS SOILS 3450, 3462, 3470, 4025
 LOLIUM 3854
 LOLIUM MULTIFLORUM 4036
 LOLIUM PERENNE 4034, 4036, 4038, 4053
 LONG TERM EXPOSURE 3754
 LONG TERM FERTILIZATION 3485
 LORRAINE 3339
 LOSSES 3732, 3815
 LOW MOLECULAR WEIGHT 4136
 LOW PH 3751, 3961
 LOW TEMPERATURE 3664
 LOWER SAXONY 3450
 LOX PATHWAY 3823

LUCERNE MEAL 4013
 LUPINUS 3405, 4165
 LUPINUS LUTEUS 3524
 LYCOPERSICON ESCULENTUM 3697, 3762, 3805, 4165
 LYSIMETERS 3710, 4029
 LYSINE 3996, 4012
 MACHINE VISION 3984
 MAIZE 3344, 3715, 3724, 3732, 3734, 3766, 3950, 3995, 4013, 4033, 4056, 4085, 4095, 4140, 4142, 4163, 4166
 MAIZE CHROMOSOME LOCALIZATION 3539
 MAIZE MICROSPORES 3432
 MAIZE PLANTS 3684
 MAIZE ROOTS 3738
 MAIZE WHEAT SEQUENCE 3485
 MAJOR CONSTITUENTS 4153
 MAKING QUALITY 3558
 MALE INFERTILITY 3579, 3606
 MALE STERILITY 3825
 MALT 3347, 3355, 3356, 3357, 3380, 3413, 3414, 3415, 3420, 3719, 4071, 4076, 4098, 4099, 4123, 4148
 MALT, ADJUNCT RATIO 4083
 MALTING 3739
 MALTING BARELY 3366, 3451
 MALTING BARLEY 3382, 3409, 3660
 MANAGEMENT 3383, 3471, 3522, 3939, 4090
 MANAGEMENT PRACTICES 3373
 MANGANESE 3759, 3760, 3771, 4042
 MANITOBA 3784
 MANURE 3478, 3517
 MAP 3588, 3624, 3650, 3779
 MAPPING 3637
 MAPS 3573
 MARCHAL 3933
 MARCHANTIA PALEACEA 3722
 MARGIN 3332
 MARKER 3672
 MARKERS 3573, 3587, 3602, 3656
 MARKETING 3336, 3348, 3367, 3566, 3618
 MARKETS 3346, 3413, 3414
 MARYLAND 3500
 MASHING 3739
 MATHEMATICAL MODELS 3343, 3384, 3418, 3483, 3714, 3861, 4019, 4073
 MATRIC POTENTIAL 3734
 MATURATION 3633, 3682
 MAYETIOLA DESTRUCTOR 3840, 3841
 MEASUREMENT 3442, 3457, 3460, 4047, 4115, 4141, 4142, 4143, 4170
 MEASURING INSTRUMENTS 3460, 4108, 4115, 4125, 4141, 4142, 4143
 MEAT YIELD 3994
 MECHANISM 4043
 MECHANIZATION 3388
 MEDICAGO SATIVA 4165
 MEDITERRANEAN ZONE 4048
 MELANOMA CELLS 4100
 MELIGETHES AENEUS 3851
 MEMBRANE 3713
 MEMBRANE POTENTIAL CHANGES 3738
 MENDELIAN GENETICS 3715
 MERCURY 4024
 MESSENGER RIBONUCLEOPROTEIN 3826
 MESSENGER RNA 3704, 3754, 3755, 3764, 3826
 MESSENGER RNA STABILITY 3827
 MESSENGER RNAs 3828
 METABOLIC REGULATION 3578
 METABOLIC WATER 4008, 4009

METABOLISM 3482, 3578, 3726, 3745, 3747, 3748, 3762, 3764, 3788, 3806, 3832, 4015, 4016
 METABOLITES 3762
 METAMITRON 4166
 METEOROLOGICAL OBSERVATIONS 3503, 4057
 METEOROLOGICAL STATIONS 3694, 4057
 METHANE FERMENTATION 3881
 METHANOGENIC BACTERIAL POPULATION 3510
 METHIONINE 3769, 4012
 METHODS 3567, 3571, 3966, 4047, 4077, 4087, 4088, 4089, 4141, 4164
 METHYL JASMONATE 3823
 METOPOLOPHIUM DIRHODUM 3839
 METRIBUZIN 3726
 MICE 3532
 MICRO ELECTRODES 3730
 MICROBIAL ECOLOGY 3936
 MICROBIAL FLORA 3752, 4016, 4039, 4149
 MICROBIOLOGICAL ANALYSIS 3897, 3936, 4037
 MICROELECTRODE 4043
 MICROGRAVITY 3709
 MICRONUTRIENT FERTILIZERS 3768
 MICROORGANISMS 3923, 4037, 4038, 4045, 4160
 MICROPROJECTILE BOMBARDMENT 3684, 3782
 MICROSCOPY 3776, 3952
 MICROSPORE 3830
 MICROSPORE CULTURE 3432, 3830
 MICROSPORE DERIVED PLANTS 3650, 3656
 MICROTUBULE ORGANIZING CENTRES 3722
 MICROTUBULES 3722
 MICROWAVE COOKING 3655, 4132
 MICROWAVE TREATMENT 3655
 MILDEW RESISTANCE 3650
 MILDEWS 3564, 3668, 3676, 3894, 3897, 3909
 MILK 3342, 4002
 MILK PRODUCTS 3342
 MILK YIELD 4156
 MILLET PENNISETUM TYPHOIDES 3809
 MILLETS 4085
 MILLING 4073, 4087, 4088, 4089, 4121, 4131, 4138
 MILLING BYPRODUCTS 4013
 MILLING YIELD 4112
 MILLS 3348, 4086, 4090
 MINERAL AVAILABILITY 4139
 MINERAL CONTENT 4088, 4089, 4128, 4130
 MINERAL NUTRIENTS 3759
 MINERALIZATION 4034, 4038, 4047
 MINERALS 3994
 MINIMUM TILLAGE 3508
 MINK 4153
 MITOCHONDRIAL DNA 3835, 3911
 MITOSIS 3964
 MITOTIC INDEX 3692
 MITOTIC SPINDLE 3722
 MIXED CROPPING 3524, 3531
 MIXOGRAPH 3607, 3646, 4144
 MIXTURES 3596
 MOBILIZATION 3769
 MODEL 3781, 3783, 3792, 3809
 MODELLING 3689, 3820
 MODELS 3388, 3476, 3694, 3889, 3972, 4056, 4164, 4169
 MOISTURE 4058

MOISTURE CONTENT 3655, 3734, 4019, 4086, 4097, 4126, 4142, 4147
 MOLASSES 4013
 MOLECULAR CLONING 3828
 MOLECULAR GENETICS 3697, 4032
 MOLECULAR WEIGHT 4109
 MOLECULAR WEIGHT SUBUNITS 3558
 MONITORING 4128
 MONOCOCCUM 3602
 MONOCULTURE 3923
 MONOGRAPHELLA NIVALIS 3874
 MONOSOMIC ANALYSIS 3624
 MONOSOMICS 3644
 MOROCCO 3335
 MORPHOLOGY 3870, 3911
 MORTALITY 3838, 3985, 4009
 MOULDS 4148
 MOVEMENT 4032, 4163, 4164, 4166
 MOWING 3523
 MUD 3475
 MUGINEIC ACID 3769, 4042
 MULTIGENE FAMILIES 3558
 MULTIPLE DISEASE RESISTANCE 3656
 MULTIVARIATE ANALYSIS OF VARIANCE 3361
 MULTIVARIATE STATISTICS 3361
 MUNG BEANS 3528
 MUNGBEAN 3525
 MUSCIDIFURAX ZARAPTOR 3863
 MUSCLES 4024
 MUTAGENS 4148
 MUTANT 3540, 3631
 MUTANTS 3605, 3662, 3677, 4032
 MUTATION 3659, 3662
 MUTATIONS 3953
 MYCOPLASMA LIKE ORGANISMS 3947
 MYCOTOXIN 4145
 MYCOTOXINS 3891, 3912, 3920, 3937, 4092, 4094, 4095, 4148, 4149, 4150
 MYCOTOXINS IN GRAINS 4078
 MYZUS PERSICAE 3847, 3851
 N (N BUTYL) THIOPHOSPHORIC TRIAMIDE 3494
 N APPLICATION RATES 3492
 N GLUCOSYLTRANSFERASE 3726
 N LIMITED BARLEY 3757
 N MALONYLTRANSFERASE 3726
 NAFTIFINE 3436
 NAOH 4007
 NASTIC CURVATURES 3709
 NATURAL DISTRIBUTION 3565, 3613, 3981, 3982
 NATURAL ENEMIES 3856
 NATURAL ENEMY EXCLUSION 3849
 NEAR ISOGENIC LINES 3943
 NEMATODA 4034
 NEMATODE 3514
 NEMATODE CONTROL 3857
 NEPAL 3331, 3385, 3423, 3591
 NEPHOTETIX VIRESCENS 3850
 NET PHOTOSYNTHETIC RATE 3775
 NEURAL NETWORK 4079
 NEW SOUTH WALES 3378, 3405, 3821
 NICKEL 3763, 4024
 NICOTIANA TABACUM 3528, 3600
 NILAPARVATA LUGENS 3850
 NITRATE 3721, 3764, 3765, 3950
 NITRATE CONCENTRATIONS 3730
 NITRATE REDUCTASE (ACTIVITY, MRNA) 3755
 NITRATE REDUCTASE ACTIVITY 3764, 3797

NITRATE REDUCTASE TRANSCRIPT 3764
 NITRATE UPTAKE 3738, 3764
 NITRATE UPTAKE (N 15 LABELLING) 3755
 NITRATES 3442, 3460, 3500, 3744, 4052
 NITRIC OXIDE 4031
 NITRITE 3755
 NITROGEN 3366, 3368, 3381, 3382, 3442, 3446, 3450, 3460, 3472, 3479, 3481, 3489, 3500, 3513, 3516, 3522, 3527, 3619, 3659, 3661, 3698, 3744, 3758, 3801, 3810, 3819, 3834, 4029, 4033, 4034, 4038, 4045, 4047, 4048, 4049, 4050, 4152
 NITROGEN CONTENT 3407, 3452, 3557, 3595, 3996, 4000
 NITROGEN ECONOMY 3525
 NITROGEN FERTILIZATION 4044, 4069
 NITROGEN FERTILIZERS 3353, 3360, 3367, 3427, 3442, 3443, 3444, 3446, 3447, 3457, 3458, 3459, 3460, 3464, 3465, 3466, 3467, 3473, 3475, 3481, 3482, 3483, 3486, 3497, 3498, 3504, 3511, 3519, 3520, 3619, 3758, 4029, 4093, 4130
 NITROGEN FIXATION 4032
 NITROGEN FIXING BACTERIA 4032, 4036
 NITROGEN METABOLISM 3466, 3797, 3883, 3955
 NITROGEN TIMING 3451
 NITROGEN UTILIZATION 3755
 NITROUS OXIDE 4031
 NITROUS OXIDE PRODUCTION 4031
 NMR SPECTROSCOPY 3708, 3711, 3957
 NO₃ 3764
 NODAL AXES 3819
 NODE 3800
 NODORUM 3905
 NON FOOD INDUSTRIES 4158
 NONFORAGE FIBER SOURCES 4002
 NONSTRUCTURAL CARBOHYDRATE 3773
 NORD PAS DE CALAIS 3568
 NORMALIZING FACTOR 3769
 NORTHEASTERN UNITED STATES 4031
 NOXIOUS ANIMALS 3842, 4054
 NOXIOUS BIRDS 3842
 NPK FERTILIZERS 3452, 3453, 3463, 3465, 3470, 3477
 NUCLEAR 3746, 3754
 NUCLEASES 3888
 NUCLEOTIDE 3731
 NUCLEOTIDE SEQUENCE 3558, 3632, 4080
 NUCLEOTIDE SEQUENCES 3828
 NUCLEUS 3579
 NUMBER 3399
 NUMBER OF LEAVES 3801
 NUTRIENT ABSORPTION 3751
 NUTRIENT AVAILABILITY 3479, 3772, 3838, 4045, 4132
 NUTRIENT CONCENTRATIONS 3771
 NUTRIENT CONTENT 4069
 NUTRIENT SOLUTIONS 4032
 NUTRIENT TRANSPORT 3760, 3770, 3772
 NUTRIENT UPTAKE 3446, 3450, 3476, 3482, 3516, 3740, 3744, 3763, 3772, 4017, 4021, 4038
 NUTRIENTS 4056
 NUTRITION 3429, 3764, 3765, 3958, 4046
 NUTRITION PHYSIOLOGY 4104
 NUTRITIONAL REQUIREMENTS 3442, 3460, 4012, 4013, 4155
 NUTRITIVE VALUE 3784, 3997, 4110, 4140, 4152
 NUTRITIVE VALUE, STRAW 4014
 OAT FRACTIONS 4153
 OAT LEAVES 3926
 OATS 3824, 4010, 4085, 4095, 4149, 4163

OCHRATOXIN 3762, 4092, 4150
 OIDIUM 3878
 OILSEED CAKES 4013, 4092
 OKLAHOMA 3893
 OLD 3550, 3794
 OLIGO(DT) BINDING PROTEIN 3826, 3827
 OLIGOSACCHARIDES 3711
 ONTOGENY 3753
 OPERATING COSTS 3339
 OPTIMIZATION 4079
 OPTIMIZATION METHODS 3369, 3384
 OPTIMUM TEMPERATURE 3809
 ORGANIC COMPOUNDS 3758
 ORGANIC FARMING 3411, 3511
 ORGANIC FERTILIZERS 3453, 3454
 ORGANIC MATTER 4045, 4047
 ORGANIC NITROGEN COMPOUNDS 3699, 4045
 ORGANIC PHOSPHORUS 4022
 ORGANOLEPTIC PROPERTIES 3574, 4085, 4104
 ORIGIN 3835
 ORTHO PHOSPHATE DIKINASE 3742
 ORYZA 3473
 ORYZA SATIVA 3392, 3426, 3439, 3456, 3472, 3489, 3745, 3758, 3772, 3992
 OSCINELLA 3854
 OSMOTIC ADJUSTMENT 3748
 OVENS 4072
 OVIPOSITION 3846
 OXIDASE 4063
 OXIDATION 3735
 OXIDOREDUCTASES 3439
 OXYGEN 4032
 OZONE 3966, 4162
 PACIFIC NORTHWEST 3522
 PACKAGING 4161
 PACLOBUTRAZOL 3700, 3796
 PADDY FIELD SOIL 3510
 PADDY SOILS 4050
 PAPAVER 3972
 PAPILLA FORMATION 3902
 PARASITES 3850
 PARASITOID 3863
 PARASITIDS 3849
 PARENTS 3549, 3657
 PARTIAL ADULT PLANT RESISTANCE 3944
 PARTIAL CORRELATION 3361
 PARTIAL PURIFICATION 3778
 PARTIAL RESISTANCE 3741
 PARTICLE SIZE 3997, 4104, 4147
 PASTA 3574, 4104, 4134
 PASTA INDUSTRY 3338
 PASTURES 3405
 PATHOGEN INTERACTIONS 3778
 PATHOGENESIS 3581
 PATHOGENIC FUNGI 3544, 3874, 3880, 3894, 3917, 3936
 PATHOGENICITY 3522, 3870, 3899, 3911, 3919
 PATHOGENS 3640, 3899, 3928
 PATHOGENS/ PHYSICAL CONTROL 3388
 PATHOTYPE 3911
 PAYS DE LA LOIRE 3368
 PCR 3632, 3729
 PCR PRODUCTS 3663
 PEA 3513, 3715
 PEAS 3732, 3996, 3997, 4151, 4152, 4155
 PEAT 4170
 PENDIMETHALIN 4166
 PENETRATION 3750
 PENICILLIUM 4094

PENNISETUM GLAUCUM 3586
 PEPTIDASES 4065
 PEPTIDES 3687
 PERENNIALS 3516
 PERFECT 3529
 PERFORMANCE 3999, 4000, 4011, 4015, 4107, 4152
 PERFORMANCE LIQUID CHROMATOGRAPHY 3558, 3607, 4080, 4091, 4136
 PERMEABILITY 3788, 4162
 PEROXIDASE 3721
 PEROXIDASES 3680, 3964
 PEROXIDE SCAVENGING SYSTEMS 3826
 PEST CONTROL 3382, 3406, 3408, 3474, 3837, 3851, 3853, 3860, 3864
 PEST INSECTS 3408, 3585, 3699, 3840, 3841, 3842, 3843, 3859, 3861
 PEST RESISTANCE 3444, 3556, 3699, 3840, 3841
 PESTICIDES 3310, 3810, 3847, 3851, 3941
 PESTS OF PLANTS 3388, 3842, 3851, 3852, 3853, 3860
 PH 3523, 4017, 4022, 4023, 4083
 PHASEOLUS VULGARIS 3457, 3732, 3858
 PHASIC DEVELOPMENT 3809
 PHENOLIC ACIDS 3696
 PHENOLOGY 3689, 3783, 3969, 4056
 PHENOTYPIC ABNORMALITIES 3692
 PHENOTYPIC ADAPTABILITY 3599
 PHENOTYPIC STABILITY 3599
 PHENYLALANINE AMMONIA LYASE 3721, 3778
 PHILIPPINES 3364, 3367, 3390, 3394, 3398, 3403, 3406, 3463, 3464, 3465, 3474, 3515, 3520, 3528, 3566, 3580, 3585, 3600, 3618, 3641, 3850, 3928
 PHLEINASE 3773
 PHLOEM TRANSPORT 3718
 PHOSPHATASE 3704, 4022
 PHOSPHATASE ACTIVITIES 3693
 PHOSPHATE ADSORPTION AND DESORPTION 3485
 PHOSPHATE FERTILIZERS 3449, 3454, 3456, 3462, 3511, 3519, 4130
 PHOSPHINOETHYLACETYLTRANSFERASE 3684
 PHOSPHOENOLPYRUVATE CARBOXYLASE 3742
 PHOSPHOLIPASE C 3778
 PHOSPHOLIPIDS 4039
 PHOSPHORUS 3456, 3521, 3595, 3732, 4017, 4046, 4053, 4110, 4151
 PHOSPHORYLATION 3578, 3747
 PHOTODYNAMIC HERBICIDES 3749
 PHOTOPERIOD 3689, 3783, 3787, 3790, 3809, 3820, 3824
 PHOTOPERIOD INSENSITIVE PHASES 3783
 PHOTOPERIOD SENSITIVE CYTOPLASMIC MALE STERILITY 3630
 PHOTOSYNTHESIS 3399, 3554, 3705, 3741, 3745, 3753, 3761, 3774, 3811, 3818
 PHOTOSYNTHETIC METABOLISM 3742
 PHOTOSYSTEM 2 3956
 PHYLLCHRON 3689, 3800, 3801
 PHYLLOTRETA 3851
 PHYLOGENIES 3628
 PHYLOGENY 3602, 3835
 PHYSICAL CONTROL 3976
 PHYSICAL MAP 3555, 3609, 3625
 PHYSICAL PROPERTIES 4064

PHYSIOGRAPHIC FEATURES 3723
 PHYSIOGRAPHIC SOIL TYPES 3500
 PHYSIOLOGICAL ATTRIBUTES 3550
 PHYSIOLOGICAL SPECIALIZATION 3649, 3943
 PHYSIOLOGY 3832, 4043
 PHYTATES 4017, 4151
 PHYTIC ACID 4165
 PHYTIC ACID/ SOYBEANS 3732
 PHYTOALEXIN SYNTHESIS 3778
 PHYTOCHROME 3831
 PHYTOPHTHORA 3911
 PHYTOPHTHORA INFESTANS 4054
 PHYTOSIDEROPHORE 4042
 PHYTOTOXICITY 3696, 3750, 3751, 3891, 3963, 3967
 PICARDY 3568
 PIG 4001
 PIGLETS 3999, 4013
 PIGMENTATION 4134
 PIGMENTS 3488
 PIGS 4153
 PISUM SATIVUM 3337, 3405, 3732, 3806, 3831, 3851, 3936, 3971, 3972
 PISUM SATIVUM L 4136
 PLANT 3810
 PLANT AGE 3820
 PLANT ANATOMY 3691, 4138
 PLANT ANIMAL RELATIONS 3842
 PLANT BIOTECHNOLOGY 3564
 PLANT BIOTECHNOLOGY/ ABA 3697
 PLANT BREEDING 3532, 3554, 3564, 3567, 3574, 3575, 3591, 3593, 3601, 3683, 3707
 PLANT CANOPIES 3710
 PLANT CELLS 3693, 3713, 3730
 PLANT COVER 3523
 PLANT DEVELOPMENT 3926
 PLANT DEVELOPMENTAL STAGES 3387, 3401, 3407, 3443, 3444, 3516, 3592, 3691, 3701, 3786, 3808, 3815, 3936, 3952, 3979, 4030, 4057, 4118
 PLANT DISEASES 3532, 3852, 3860, 3884, 3893, 3894, 3922, 3936, 3971, 4054
 PLANT ECOLOGY 3686
 PLANT EMBRYOS 3786
 PLANT ESTABLISHMENT 3516
 PLANT GROWTH 3818
 PLANT GROWTH SUBSTANCES 3375, 3379, 3439, 3497, 3806, 3948, 3971
 PLANT IDENTIFICATION 3984
 PLANT INTRODUCTION 3603, 3683, 3786
 PLANT NEMATODES 4035
 PLANT NITROGEN 3781
 PLANT NUTRITION 4042
 PLANT PHYSIOLOGY 3386, 3611
 PLANT POPULATION 3391
 PLANT PRODUCTION 3339, 3351, 3364, 3367, 3390, 3394, 3398, 3403, 3408, 3410, 3419, 3463, 3641, 4169
 PLANT PRODUCTS 4132, 4163
 PLANT PROPAGATION 3438
 PLANT PROTECTION 3368, 3444, 3450, 3853, 3922, 4054
 PLANT PROTEIN 4157
 PLANT REGENERATION 3684, 3782
 PLANT REPRODUCTIVE ORGANS 3701
 PLANT REQUIREMENTS 3408, 3442, 3458, 3460, 3491
 PLANT RESISTANCE 3858
 PLANT RESPONSE 3919
 PLANT ROOTS 3734

PLANT SOIL RELATIONS 3466, 3923
 PLANT TISSUE 3785
 PLANT VEGETATIVE ORGANS 3701
 PLANT VIRUSES 3504, 3613, 3839, 3865, 3872, 3904
 PLANT WATER RELATIONS 3701
 PLANTING 3374
 PLANTS 3436, 3539, 3664, 3712, 3738, 3748, 3765, 3769, 3836, 3966, 4022, 4024, 4042, 4046
 PLASMA MEMBRANE 3693, 3778
 PLASMA MEMBRANE VESICLES 4043
 PLASMALOGEN 4018
 PLASMIDS 4032
 PLASTIC FILM COVERS 3530
 PLASTICS 3991
 PLOUGHING 3506, 3976
 POA PRATENSIS 3972
 POACEAE 3709, 3726, 4042
 POITOU CHARENTES 3338
 POLAND 3593
 POLLEN 3575
 POLLUTANTS 4162
 POLY(A) 3827
 POLY(A) BINDING PROTEIN 3827
 POLY(A) BINDING PROTEINS 3826
 POLY(A)(+) BINDING PROTEIN 3827
 POLY(A)(+)RNA BINDING PROTEIN 3827
 POLY(A)+ 3826
 POLYACRYLAMIDE GEL ELECTROPHORESIS 3731
 POLYADENYLATE BINDING PROTEIN 3827
 POLYGALACTURONASE 3925
 POLYMERASE CHAIN REACTION 3638, 3663
 POLYMERASE CHAIN REACTION (PCR) 3558, 3663
 POLYMERIZATION 3662
 POLYMERS 4084
 POLYMORPHISM 3555, 3570, 3661, 3715
 POLYMYXA 3497
 POLYMYXA GRAMINIS 3930
 POLYPHOSPHOINOSITIDE METABOLISM 3778
 POLYPLOID WHEATS 3835
 POLYPLOIDY 3831
 POLYSACCHARIDES 3776, 3925, 4153
 POPULATION 3855
 POPULATION DENSITY 3391, 3843
 POPULATION DYNAMICS 3514, 3856, 3861, 4034
 POPULATION PARAMETER 3626
 POPULATIONS 3522, 3847, 3849, 3870, 3871
 POPULUS 3697
 POT EXPERIMENTATION 3768
 POTASH FERTILIZERS 3461
 POTASSIUM 3634, 3748, 4027
 POTATO TUBEROUS ROOTS 4136
 POTATOES 4024, 4132
 POTENTIAL IMPORTANCE 4070
 POULTRY HOUSING 3311
 POWDERS 3983, 4011
 POWDERY MILDEW 3612, 3615, 3675, 3933
 POWDERY MILDEW FUNGUS 3836
 POWDERY MILDEW RESISTANCE 3638, 3649, 3656
 PRAIRIE ENVIRONMENT 3689
 PRECIPITATION 3344, 3694, 3852, 4051, 4056, 4057
 PREDATION 3843
 PREDATORS 3843
 PREPROPHASE MICROTUBULE BAND 3722
 PRESERVATION 3310, 4147

PRESERVATIVES 4147, 4149
 PRICE POLICIES 3331, 3335
 PRICES 3331, 3340, 3345, 3346, 3618, 4013
 PRIMARY LATERAL ROOTS 3819
 PRINCIPAL COMPONENT REGRESSION 4079
 PROBES 3624
 PROCESSING 3655, 4077, 4110, 4121, 4131, 4134, 4135, 4157, 4158
 PROCHLORAZ 3870, 3875, 3894, 3896
 PRODUCER PRICES 3338
 PRODUCTION 3338, 3349, 4160
 PRODUCTION COSTS 3337, 3339, 3340, 3342, 3368, 3390, 3408, 3417
 PRODUCTION DATA 3341, 3386
 PRODUCTION ECONOMICS 3336
 PRODUCTIVITY 3757, 3818
 PRODUCTS 3962
 PROFILES 3730
 PROFITABILITY 3337, 3342, 3348, 3368, 3382, 3523, 3568, 4003, 4158
 PROGENIES 3657
 PROGENY 3677
 PROLACTIN 4100
 PROLAMIN GENES 3608
 PROLAMINES 3574, 3659, 4084
 PROLAMINS 3646
 PROLIFERATION 4100
 PROLINE ACCUMULATION 3748
 PROMOTER ANALYSIS 3724
 PROPIONIC ACID 4147
 PROTEASE INHIBITOR 3858
 PROTEIN 3540, 3724, 3828, 4041, 4112
 PROTEIN CONTENT 3360, 3511, 3574, 3619, 3702, 4000, 4012, 4077, 4086, 4088, 4107, 4110, 4126, 4128, 4134, 4142
 PROTEIN ISOZYME MARKERS 3671
 PROTEIN METABOLISM 4000, 4106
 PROTEIN PLANTS 3337
 PROTEIN QUALITY 4106
 PROTEIN SUBUNITS 4114
 PROTEINACEOUS INHIBITORS 3858
 PROTEINS 3441, 3655, 3713, 3720, 3731, 3739, 3813, 3832, 3902, 3930, 3951, 4059, 4075, 4109, 4118, 4124, 4143, 4155
 PROTEINS/ CHLOROPHYLLS 3788
 PROTEINS/ SEEDS 3571
 PROTEOLYTIC ACTIVITY 3797
 PROTOCHLOROPHYLLIDE 3749
 PROTON SUCROSE SYMPORT 3718
 PROTOPLASTS 3739
 PROTOZOA 4034
 PROXIMATE COMPOSITION 4085, 4140
 PSEUDOCERCOSPORELLA HERPOTRICHOIDES 3672, 3870, 3896, 3936
 PSEUDOMONAS 3936
 PSEUDOMONAS SYRINGAE 3942
 PSEUDOMONS SYRINGAE PATHOVAR ATROFACIENS 3944
 PSYLLIOIDES CHRYSOCEPHALA 3851
 PUCCINIA 3899, 3917, 3941
 PUCCINIA GRAMINIS 3643, 3644
 PUCCINIA GRAMINIS F SP TRITICI 3656
 PUCCINIA GRAMINIS TRITICI 3879
 PUCCINIA HORDEI 3638, 3656, 3894
 PUCCINIA RECONDITA 3547, 3640, 3649, 3672, 3883
 PUCCINIA RECONDITA F SP TRITICI 3576
 PUCCINIA STRIFORMIS 3545, 3614, 3894, 3906
 PUPAE 3863

PURCHASING 4090
 PURIFICATION 3437, 3826, 3858
 PURIFICATION PROCEDURE 3737
 PURITY 3338
 PV CEREALIS 3868
 PYRENOPHORA 3891, 3915
 PYRIDOXINE 4132
 PYTHIUM 3923
 PYTHIUM ULTIMUM 3622, 3936
 QINGHAI 3554
 QLD 3529
 QUALITY 3332, 3338, 3339, 3345, 3349, 3355, 3356, 3358, 3359, 3360, 3379, 3380, 3388, 3497, 3498, 3504, 3511, 3517, 3530, 3540, 3564, 3567, 3569, 3619, 3627, 3629, 3639, 3641, 3655, 3662, 3667, 3669, 3802, 3808, 3973, 3995, 4056, 4067, 4070, 4072, 4074, 4079, 4084, 4085, 4089, 4090, 4096, 4099, 4104, 4107, 4111, 4121, 4125, 4126, 4131, 4134, 4135, 4142, 4156
 QUALITY CONTROLS 4090
 QUANTITATIVE 3529
 QUANTITATIVE ANALYSIS 4037
 QUANTITATIVE RESISTANCE 3626
 QUANTITATIVE TRAIT LOCI 3573, 3615
 QUANTITATIVE TRAIT LOCUS 3587
 RACE COMPOSITION 3935
 RADICLE 3789
 RAIN 3503, 3869, 3906, 3909
 RAIN FED FARMING 3520
 RAINFALL 3920
 RAPD 3649
 RAPD MARKER 3650
 RAPHANUS SATIVUS 4165
 RARE EARTH ELEMENTS 4162
 RATES 3783
 RATIONS 3994, 3996, 3998, 3999
 RATS 4024
 RAW MATERIALS 4098, 4151
 RBCS 3399
 REALIZED HERITABILITY 3594
 RECLAIMED SOILS 3453, 4025
 RECLAMATION 4025
 RECOMBINATION 3555, 3560, 3588
 RED KIDNEY BEAN 3858
 RED WINTER WHEAT 3757
 REDUCTASE ACTIVITY 3757
 REFRIGERATED STORAGE 3441
 REFRIGERATION 4072, 4149
 REGENERANTS 3876
 REGENERATION 3543, 3553
 REGIONAL ACCOUNTING 3342
 REGIONS 3733
 REGISTRATION 3614, 3629
 RELATIVE ADDITION RATE 3755
 RELATIVE EXTENSION RATES 3819
 RELATIVE HUMIDITY 3992
 RELATIVE MULTIPLICATION RATES 3819
 REPEATED DNA SEQUENCES 3539
 REPEATED NUCLEOTIDE SEQUENCES 3835
 REPEATED SEQUENCES 3539
 REPEATING STRUCTURE 3827
 REPEATS 3628
 REPELLENTS 3860
 REPLACEABLE SIEVING MATRIX 3731
 REPORTER GENE 3739
 REPRODUCTIVE GROWTH 3821, 3822
 REPRODUCTIVE PERFORMANCE 3992
 REQUIREMENT 3573
 RESEARCH 3364, 3419, 3600
 RESEARCH PROJECTS 3351, 3837
 RESIDUAL EFFECTS 3456, 3472

RESIDUAL LEGUME EFFECTS 3527
 RESIDUE 3525
 RESIDUES 3457, 3838, 3962, 4024, 4163, 4164, 4166
 RESISTANCE 3572, 3620, 3648, 3666, 3823, 3824, 3833, 3836, 3858, 3871, 3887, 3942, 3985
 RESISTANCE BREEDING 3935
 RESISTANCE GENE 3615
 RESISTANCE GENE RH2 3650
 RESISTANCE GENES 3612, 3638, 3675
 RESISTANCE SELECTION 3626
 RESISTANCE TO INJURIOUS FACTORS 4032
 RESPIRATION 3761, 3987
 RESPIRATORY QUOTIENT 3780
 RESPONSES 3820, 3824
 RESPONSIVE PROMOTER 3724, 3743
 RESPONSIVENESS 3637
 RESTRICTION FRAGMENT LENGTH 3555
 RESTRICTION FRAGMENT LENGTH POLYMORPHISM (RFLP) 3650
 RETARDANT (E) 1 (4 CHLOROPHENYL) 4, 4 DIMETHYL 2 (1, 2, 4 TRIAZOL 1 YL) 1 PENTEN 3 3700
 RETENTION 3985
 RETROTRANSPOSON 3628
 RETROVIRUSES 3628
 RFLP 3602, 3637, 3649, 3833
 RFLP ANALYSIS 3546
 RFLP MAPPING 3573
 RFLP MARKERS 3615, 3638, 3649
 RHEOLOGICAL PROPERTIES 3511, 4067, 4115, 4121, 4124, 4125, 4126, 4128, 4143
 RHINELAND PALATINATE 3380
 RHIZOCTONIA 3869
 RHIZOCTONIA SOLANI 3622, 3680, 3928, 3936
 RHIZOSHEATH 3734
 RHIZOSPHERE 3622, 3740, 3923, 3936, 4037, 4038, 4045
 RHOPALOSIPHUM 3848
 RHOPALOSIPHUM PADI 3839, 3843, 3861, 3865
 RHT GENES 3431
 RHYNCHOSPORIUM 3544, 3917
 RHYNCHOSPORIUM SECALIS 3324, 3650
 RHYZOPERTHA DOMINICA 3986
 RIBONUCLEOPROTEIN 3827
 RIBOSOMAL RNA 3539
 RIBOSOME DEFICIENT PLASTIDS 3746
 RIBULOSE 1, 5 BISPHTHOSPHATE CARBOXYLASE OXYGENASE 3754
 RICE 3525, 3724, 3858, 4056, 4085
 RICE ORYZA SATIVA 3432
 RICE PLANTS 3684
 RICE WEEVIL 3863
 RICH 4153
 RIVERS 4053
 RNA 3746, 3883
 RNA BINDING PROTEIN 3826
 RNA BINDING PROTEINS 3826
 ROASTING 4082
 RODENTS 3842
 ROOT 3749
 ROOT CAP 3963
 ROOT DIFFERENTIATION 3434
 ROOT GROWTH 4033
 ROOT MUCILAGE 3734
 ROOT NODULATION 4032
 ROOT PATHOGENS 3622
 ROOT ROT 3929
 ROOT ROTS 3923

ROOT SYSTEMS 4025
 ROOT WATER UPTAKE 3733
 ROOTING 3493, 3499
 ROOTS 3438, 3499, 3685, 3691, 3740, 3744, 3752, 3759, 3764, 3785, 3803, 3805, 3815, 3898, 3922, 3923, 3936, 3950, 3954, 3967, 4022, 4024, 4042, 4165
 ROTATION 3517
 ROTATIONAL CROPPING 3337, 3363, 3450, 3499, 3500, 3503, 3505, 3508, 3516, 3524, 3857, 3923, 3976
 ROTS 3585
 ROUGHAGES 4154
 ROW PLOTS 3587, 3588
 RT PCR 3930
 RUMEN POPULATION 4018
 RUMINAL FERMENTATION 4154
 RUMINANTS 4006
 RUMINOCOCCUS FLAVEFACIENS 4018
 RUNOFF 4051, 4052, 4053
 RUSSIAN FEDERATION 3349
 RUSSIAN WHEAT APHID 3855
 RUST RESISTANCE 3614, 3642, 3650
 RUSTS 3423, 3547, 3640, 3681, 3878, 3906
 RYE 3546, 3555, 3572, 3573, 3625, 3631, 4001, 4008, 4013, 4096, 4128, 4141, 4149, 4163
 RYE NONSTARCH POLYSACCHARIDES 4064
 S GENOME 3572
 SACCHAROMYCES CEREVISIAE 3578
 SALICYLIC ACID 3902
 SALINE SODIC SOILS 4021
 SALINE SOILS 3454
 SALINE WATER 3495, 3538
 SALINITY 3636, 3949
 SALT EFFECT 3429
 SALT TOLERANCE 3671, 3748, 3951, 3952
 SAMPLING 4051
 SANDY SOILS 3353, 3371, 3416, 3447, 3453, 3486, 3519, 3714
 SAP 3442, 3460
 SAXONY ANHALT 3470, 4049
 SCABS 3908
 SCALD 3324, 3650
 SCANDIUM 3771
 SCHIZAPHIS GRAMINUM 3699, 3861
 SCLEROTIUM ROLFII 3928
 SCORZONERA 3972
 SCOTLAND 4035
 SCOTLAND/ PROTEINS 3659
 SDS PAGE 3540, 3731
 SDS PAGE ELECTROPHORESIS 3665
 SDS SEDIMENTATION 3607, 3646
 SE HPLC 3607
 SEASONAL VARIATION 3694, 3852, 4045
 SECALE CEREALE 3387, 3438, 3444, 3534, 3592, 3626, 3637, 3728, 3852, 3872, 3895, 3963, 3972, 4163
 SECALE CEREALE L 3637
 SECRETION 3739, 3925, 4100
 SEDIMENTATION TEST 4070
 SEDIMENTATION VALUE 4112
 SEED 3439, 3574, 3580, 3641
 SEED DORMANCY 3779
 SEED DRESSING 3493, 3860, 3865, 3907, 3946
 SEED FILLING 3412, 3483, 3654, 3701
 SEED LONGEVITY 3439, 3441
 SEED PATHOLOGY 3895
 SEED PRODUCTION 3976
 SEED SIZE 3655, 3659
 SEED STORAGE 3441

SEED STORAGE PROTEINS 3607
 SEED TESTING 3569
 SEED TREATMENT 3806, 3895
 SEED TREATMENT CHEMICALS 3913
 SEEDBED PREPARATION 3352, 3506
 SEEDBORNE ORGANISMS 3895
 SEEDING DATE 3924
 SEEDING RATE 3924
 SEEDLINGS 3755, 3764, 3790, 3823, 3951, 3964, 4032, 4148
 SEEDS 3570, 3633, 3655, 3659, 3661, 3732, 3802, 3858, 3964, 4081
 SEGREGATION 3588, 3643
 SEGREGATION DISTORTION 3637
 SELECTION 3398, 3548, 3593, 3594, 3601, 3606, 3613, 3634, 3635, 3636, 3674, 3677, 3782, 3957
 SELECTION CRITERIA 3601, 3653
 SEMINAL AXES 3819
 SEMOLINA 3338, 4087, 4089, 4104, 4122
 SENESCENCE 3746, 3788, 3797, 3813, 3815
 SEPARATING 4077
 SEPARATION 3731
 SEPTORIA 3878, 3894, 3917, 3921, 3941
 SEPTORIA TRITICI 3875
 SEQUENCE 3628, 3716, 3827
 SEQUENCES 3555, 3671
 SEQUENTIAL CROPPING 3426, 3456, 3473, 3521, 3758
 SESBANIA 3472, 4050
 SESBANIA ACULEATA L 3525
 SEWAGE 3965
 SEWAGE SLUDGE 3763
 SEX RATIO 3863
 SHAANXI 3369
 SHADING 3400, 3520
 SHANDONG 3686, 3869
 SHEEP 4018, 4024
 SHOOT 3749, 3800
 SHOOT GROWTH 3819
 SHOOTS 3716
 SIDE EFFECTS 3838
 SIDEROPHORES 3740
 SIEVING 4087, 4134
 SIGNAL TRANSDUCTION 3778
 SILAGE 3409
 SILAGE MAKING 4147
 SILICON 3953
 SILKWORMS 4011
 SILTY SOILS 3503, 3505
 SIMULATED FOODS 4158
 SIMULATION 3529, 4019
 SIMULATION MODELS 3400, 3402, 3466, 3563, 3921, 4019, 4020, 4049
 SINES 3539
 SINK STRENGTH 3829
 SITE 3492, 4069
 SITE FACTORS 3411
 SITES 3578
 SITOBION AVENAE 3839, 3843, 3847, 3861
 SITODIPLOSI MOSCELLANA 3556, 3856
 SITOPHILUS GRANARIUS 3846, 3986, 3989
 SITOPHILUS ORYZAE 3863, 3986
 SITOPHILUS ORYZAE COLEOPTERA 3863
 SITOTROGA CEREALELLA 3992
 SLOPING LAND 3499, 3505, 3723, 4051, 4052
 SLUDGE 4040
 SLUGS 3854
 SLURRY 3458, 3479
 SMALL INTESTINE 4006
 SMUTS 3423
 SNF1 3747

SNF4 PROTEIN 3578
 SNOW TOLERANCE 3773
 SODIC SOILS 3489
 SODIUM 3495, 3748
 SODIUM CHLORIDE 3951, 4116
 SOFT WHEAT 3335, 3339, 3511
 SOIL 3445, 3522, 4024, 4026, 4042, 4045, 4050, 4053, 4163, 4166
 SOIL ACIDITY 4023
 SOIL AMENDMENTS 4050
 SOIL BIOLOGY 4034, 4035, 4037, 4045, 4047, 4093
 SOIL CHEMICOPHYSICAL PROPERTIES 4026, 4045
 SOIL CHEMISTRY 4093
 SOIL COMPACTION 4045
 SOIL CONSERVATION 3505
 SOIL CROP SYSTEM 4033
 SOIL EXCHANGEABLE K 4027
 SOIL FAUNA 4034
 SOIL FERTILITY 3393, 3450, 3476, 3758, 4045, 4049
 SOIL MECHANICS 4026
 SOIL MORPHOLOGICAL FEATURES 4025
 SOIL NITROGEN 3512
 SOIL ORGANISMS 3923, 4045
 SOIL PROFILES 3457
 SOIL ROOT INTERFACE 4022
 SOIL SCARIFICATION 3392
 SOIL STRUCTURE 4025, 4053
 SOIL TEMPERATURE 3466
 SOIL TRANSPORT PROCESSES 4024, 4049
 SOIL TYPES 3511, 4045
 SOIL WATER 3483, 3496, 3512, 3710, 4164
 SOIL WATER CONTENT 3393, 3466, 3483, 3531, 4020, 4030, 4051
 SOIL WATER DEFICIT 3733
 SOIL WATER REGIMES 4029
 SOILBORNE ORGANISMS 3923
 SOILS 3785, 3810
 SOLANUM 3603
 SOLANUM TUBEROSUM 3342, 3354, 3457, 3470, 3762, 3852, 3971, 3972, 4024, 4039
 SOLANUM TUBEROSUM L 3830
 SOLAR ENERGY 3705
 SOLAR RADIATION 3399
 SOLE CROPPING 3524
 SOLUBILITY 3571
 SOLUBLE STARCH SYNTHASE 3822
 SOMACLONAL VARIATION 3782, 3876
 SOMATIC EMBRYOGENESIS 3684
 SOMATIC EMBRYOS 3673
 SORBITOL INDUCED JASMONATE SYNTHESIS 3823
 SORGHUM 3833
 SORGHUM BICOLOR 3586
 SORGHUM BICOLOR L MOENCH 3696
 SORGHUM GRAIN 3997, 4151, 4152
 SORPTION 3962, 4164, 4166
 SOUTH AFRICA 4077
 SOWING 3360, 3497, 3498, 3869
 SOWING DATE 3352, 3366, 3377, 3530, 3562, 3795, 3821, 3824, 3895
 SOWING DEPTH 3387
 SOWING RATES 3352, 3360, 3374, 3377, 3416, 3427, 3428, 3474, 3515
 SOWS 4013
 SOYBEAN 3726
 SOYBEAN HYPOCOTYLS 3926
 SOYBEAN MEAL 3996, 4012, 4155
 SOYBEAN PRODUCTS 4017

SOYBEAN YIELD 3970
 SOYBEANS 3344, 4056
 SOYFOODS 4137
 SPACING 3371, 3427, 3515, 3982
 SPAGHETTI 4107
 SPAIN 3659, 3842, 4169
 SPARSE CROPS 3710
 SPECIES 3516, 3859, 3936
 SPECIFIC WEIGHT 3793
 SPECTROMETRY 3702, 3744, 4142
 SPECTROPHOTOMETRIC ASSAY 4063
 SPECTROSCOPY 3776
 SPELTODES 3590
 SPICES 3931
 SPIKE 3809
 SPIKE STERILITY 3692
 SPIKELET 3829
 SPIKELET INITIATION 3794
 SPIKELET NUMBER 3795
 SPIKELETS 3604
 SPIKES 3423, 3673, 3874, 3922
 SPINACIA (LEAVES) 3718
 SPRAYING 3379, 3907
 SPRING BARLEY 3814
 SPRING CROPS 3384, 3435, 3446, 3470, 3479, 3504, 3516, 3524, 3534, 3537, 3544, 3554, 3647, 3805, 3851, 3852, 3853, 3894, 3895, 3971, 3972, 3973, 4162
 SPRING WHEAT 3399, 3471, 3517, 3550, 3689, 3706, 3774, 3800, 3801, 3809
 SPRING WHEATS 3820
 SPRING WINTER TRITICALE 3617
 SPRINKLER IRRIGATION 3495
 STABLE TRANSFORMATION 3684
 STANDARD KARYOTYPE 3631
 STANDARDIZING 4090, 4128, 4170
 STAPHYLINIDAE 3854
 STARCH 3639, 3754, 3784, 4006, 4077, 4088, 4118, 4124, 4127, 4138
 STARCH DIGESTION 4006
 STARCH SYNTHESIS 3821
 STATISTICAL ANALYSIS 3369, 3370, 3387, 3391, 3418, 3459, 3461, 3462, 3483, 3493, 3551, 3565, 3577, 3633, 3658, 3661, 3667, 3669, 3682, 3694, 3717, 3770, 3802, 3897, 3992, 4020, 4030, 4108, 4123, 4127, 4138, 4168
 STATISTICAL CORRELATIONS 4113
 STATISTICAL EVALUATION 3646
 STEERS 4154
 STELLARIA 3974
 STEM ELONGATION 3878
 STEM RESERVES 3829
 STEM RUST 3638, 3656, 3926
 STEMS 3438, 3442, 3460, 3582, 3595, 3685, 3770
 STERYL ESTER 3436
 STICKINESS 4103
 STOMATAL CONDUCTANCE 3753, 3775, 4058
 STOMATAL FREQUENCY AND SIZE 3728
 STOMATAL GUARD CELLS 3730
 STORAGE 3379, 3422, 3985, 3986, 3991, 4086, 4094, 4132, 4147, 4149, 4150
 STORAGE PROTEINS 3608, 3663, 4113, 4114
 STORAGE ROOTS 3693
 STORED PRODUCTS 3858
 STORED PRODUCTS PESTS 3310
 STORED WHEAT 3863, 3985
 STOREHOUSES 4117
 STRAINS 3870
 STRAW 3350, 3477, 3523, 3595, 4024, 4045, 4170
 STRENGTH 3608, 3646

STRESS 3381, 3636, 3687, 3697, 3715, 3733, 3777, 3799, 3951
 STRESS PROTEINS 3715
 STRESS RESPONSE 4042
 STRESSED BARLEY 3748
 STRIPE RUST 3614, 3876
 STRUCTURAL TIMBER 4147
 STUBBLE RETENTION 3512
 SUBARCTIC 3527
 SUBSIDIES 3335
 SUBSTITUTION LINES 3543, 3572
 SUBUNIT COMPOSITION 4116
 SUBUNITS 3607, 3663, 4080, 4116
 SUCCESSIVE CROPS 3870
 SUCKING INSECTS 3856
 SUCROSE CONCENTRATION 3718
 SUGAR 4170
 SUGAR BEET 3718, 4170
 SUGAR BEET BYPRODUCTS 4159
 SUGARS 3680, 3822
 SUMMER 3395, 3396, 3397
 SUMMERFALLOW 3517
 SUNFLOWER 3769
 SUNFLOWER SEED 4132
 SUPPLEMENTARY FEEDING 4003
 SUPPLEMENTATION 4153
 SUPPLEMENTS 3311, 3994, 4000, 4003, 4010
 SUPPLY 3331
 SUPPRESSION 3622, 3863
 SUPPRESSOR 3778
 SURFACE 3522, 4129
 SURFACE FLUXES 4031
 SURFACTANTS 3750
 SURVEYS 3343, 3423, 4135
 SURVIVAL 3774
 SUSCEPTIBILITY 3887
 SUSCEPTIBILITY INDEX 3799
 SUSPENSION CULTURE 3726
 SUSPENSION CULTURES 3778
 SUSTAINABILITY 3419
 SWEDEN 3466, 3862, 3923
 SWINE 3342, 3479, 3996, 4000, 4012, 4013, 4016, 4147, 4152, 4155
 SWISS CHARD 4040
 SYNTHASE 4129
 SYNTHETIC FIBRES 4147
 SYNTHETIC HEXAPLOID 3614
 SYNTHETIC HEXAPLOIDS 3666
 SYRIA 3376, 3563
 SYRINGAE 3942
 SYSTEM 3833
 SYSTEMS 3819
 T AESTIVUM 3555, 3572
 T MONOCOCCUM 3555
 T MONOCOCCUM SSP BOEOTICUM 3602
 T MONOCOCCUM SSP MONOCOCCUM 3602
 T TAUSCHII 3666
 T TURGIDUM 3666
 T URARTU 3602
 TALL 3637
 TAUSCHII 3602
 TAXOL 3722
 TAXONOMY 3936, 4037, 4095
 TCK 3900
 TECHNICAL PROPERTIES 3345, 3382, 3444, 3497, 3498, 3511, 3533, 3619, 4067, 4084, 4122, 4157
 TECHNOLOGY TRANSFER 3312, 3367, 3398, 3474, 3566, 3641
 TELOMERIC HETEROCHROMATIN 3361

TELOSOMIC ANALYSIS 3844
 TEMPERATE FOREST SOILS 4031
 TEMPERATURE 3689, 3698, 3710, 3717, 3723, 3753, 3774, 3783, 3787, 3795, 3800, 3801, 3819, 3905, 3906, 3909, 3920, 3992, 4033, 4054, 4056, 4058, 4072, 4082, 4107, 4117
 TEMPERATURE RESISTANCE 3658
 TERBINAFINE 3436
 TERES 3911
 TEST WEIGHT 3594, 3784, 3793
 TESTA 3570, 3711
 TESTING 3851, 3894, 3895, 3971, 4148
 TESTS 3646
 TETRAPLOID WHEAT 3625
 TETRAPLOIDY 3575
 TEXAS 3914
 TEXTURAL SOIL TYPES 3838
 TGGE 3729
 THAILAND 3312
 THALIANA L HEYNH 3664
 THERMAL PROPERTIES 3655
 THERMAL TIME 3794, 3809
 THERMAL UNITS 3689
 THERMOSTABLE (1 |3, 1 |4) BETA GLUCANASE 3739
 THERMOTOLERANCE 3715
 THIN LAYER 3990
 THINOPYRUM BESSARABICUM 3671
 THIONIN 3902
 THREONINE 4012
 THRIPS (GENUS) 3851
 TIBET 3583
 TILLAGE 3471, 3499, 3500, 3503, 3505, 3512, 3520, 4025, 4026
 TILLAGE EQUIPMENT 3506
 TILLERING 3582
 TILLETIA CARIES 3895, 3916
 TILLETIA CONTROVERSA 3910
 TILLETIA FOETIDA 3934
 TILLETIA INDICA 3666
 TILLETIA TRITICI 3910
 TIME DOMAIN REFLECTOMETRY 3733
 TIME OF APPLICATION 3969
 TIMING 3464, 3515
 TIP CELLS 3722
 TIPULA PALUDOSA 3851
 TISSUE ANALYSIS 3958
 TISSUE CULTURE 3641
 TISSUE CULTURE RESPONSE 3543
 TISSUE WATER K 4027
 TO PHLOEM TRANSFER 3769
 TOBACCO 3739
 TOLERANCE 3745, 3799, 3822, 3950
 TOMATO 3716, 3726
 TOMATO MUTANT CHLORONERVA 3769
 TONOPLAST 3713, 3730
 TOXICITY 3771, 3838, 4043, 4091
 TOXINS 3912
 TRACE ELEMENT DEFICIENCIES 3740, 3954, 3955
 TRACE ELEMENTS 3455, 3488, 3493, 3763, 3768
 TRACER TECHNIQUES 3482, 3521, 3701, 3744, 3815, 4038, 4050
 TRACHEARY 3721
 TRADE 3346, 3347
 TRADE BARRIERS 3569
 TRADITIONAL FARMING 3511
 TRAINING 3312, 3394
 TRANSCRIPTION FACTORS 3828
 TRANSFORMATION 3432, 3684, 3739

TRANSGENIC BARLEY 3739
 TRANSGENIC TOBACCO PLANTS 3828
 TRANSLATION 3827, 3930
 TRANSLOCATION 3555, 3672, 3759, 4043
 TRANSLOCATION LINES 3651
 TRANSLOCATION PEAK 3751
 TRANSLOCATIONS 3546, 3833
 TRANSMISSION 3930
 TRANSPIRATION 3698, 3717
 TRANSPIRATION RATE 3756
 TRANSPLANTATION 3993
 TRANSPORT 3704, 3730, 3733, 3751, 3953, 3961
 TRANSPOSABLE ELEMENT 3628
 TRANSPOSABLE ELEMENTS 3539
 TREATMENT DATE 3443, 3491, 3865, 3866, 3979
 TRIADIMEFON 3796
 TRIAL METHODS 3312, 4056
 TRIBOLIUM CASTANEUM 3986
 TRIBOLIUM CONFUSUM 3986
 TRICHODERMA LONGIBRACHIATUM 4160
 TRICHODERMA REESEI 3739
 TRICHOTHECENES 3901, 4095, 4145
 TRIFLURALIN INJURY 3968
 TRIFOLIUM 3523, 3854, 3971
 TRIFOLIUM ALEXANDRINUM 3519
 TRIFOLIUM PRATENSE 3972
 TRITICALE 3599, 3617, 4001
 TRITICALE (GRAMINEAE) 3438, 3444, 3524, 3534, 3536, 3592, 3593, 3872, 3948
 TRITICALES (PRODUCT) 4008, 4009, 4152
 TRITICEAE 3628
 TRITICI 3905
 TRITICUM SEARSII 3572
 TRITICUM AESTIVUM (WHEAT) 3693
 TRITICUM AESTIVUM L 3399, 3432, 3437, 3517, 3543, 3558, 3589, 3648, 3749, 3753, 3820, 3829, 3950, 4080
 TRITICUM DICOCCUM 3574
 TRITICUM DURUM 3386, 3499, 3503, 3505, 3533, 3534, 3563, 3576, 3582, 3607, 3688, 3742, 3806, 3831, 3860, 3872, 3920, 3948, 4122
 TRITICUM LONGISSIMUM 3631
 TRITICUM SPELTA 3543, 4110
 TRITICUM TAUSCHII 3614
 TRITICUM TURGIDUM 3574, 3575, 3614, 3646, 3722
 TRITICUM TURGIDUM CONV DURUM 3635, 3636
 TRITICUM TURGIDUM VAR DURUM 3801
 TRITICUM TURGIDUM VAR DURUM AND T DICOCCOIDES 3608
 TRITORDEUM 4070
 TROPISMS 3803
 TROPOMYOSIN 3437
 TRYPSIN 4017, 4151
 TRYPTOPHAN 3752, 4012
 TUNISIA 3694
 TURKEYS 3311, 3998
 TWO DIMENSIONAL ELECTROPHORESIS 3715
 ULTRASTRUCTURE 3746
 ULTRAVIOLET RADIATION 3788
 UNIFORMITY MEASUREMENT 3725
 UNITED KINGDOM 3350, 3837, 4163, 4164
 UNITED KINGDOM/ BRASSICA NAPUS 3974
 UNITED STATES 3785, 3943
 UNPREDICTABLE ENVIRONMENTS 3548
 UNRESTRICTED FEEDING 4000, 4156
 URARTU 3602

UREA 3472, 3525, 4007, 4050, 4156
 UROCYSTIS 3895
 URTICA / MAIZE 4146
 USA 3340, 3344, 3594, 3688, 4075, 4077
 USEFUL INSECTS 3838
 USES 3521
 USTILAGO 3867, 3946
 UV ABSORPTION 3776
 VACUOLAR MEMBRANE (TONOPLAST) 3693
 VALIDATION 4033, 4167
 VANADATE 3693
 VAR TRITICI 3622
 VARIABILITY 3602, 3715, 4031, 4107
 VARIETAL VARIATION 3434
 VARIETIES 3338, 3345, 3353, 3358, 3359, 3360, 3379, 3382, 3387, 3411, 3416, 3444, 3473, 3497, 3498, 3504, 3528, 3532, 3533, 3534, 3535, 3536, 3537, 3544, 3545, 3556, 3559, 3561, 3567, 3568, 3580, 3582, 3585, 3592, 3595, 3600, 3605, 3613, 3618, 3619, 3633, 3640, 3641, 3645, 3647, 3673, 3680, 3682, 3683, 3686, 3699, 3707, 3735, 3808, 3814, 3840, 3841, 3848, 3856, 3872, 3880, 3891, 3899, 3904, 3940, 3945, 3957, 3966, 3997, 4093, 4096, 4106, 4114, 4121, 4122, 4126, 4127, 4131, 4134, 4135, 4152
 VARIETY TRIALS 3354, 3378, 3385, 3394, 3405, 3498, 3533, 3535, 3537, 3544, 3566, 3569, 3591, 3878, 4122
 VASCULAR SYSTEM 3829
 VASCULAR TISSUES 4032
 VECTORS 3839, 3857, 3865
 VEGETABLES 4024
 VEGETARIANS 4137
 VEGETATION 4058
 VEGETATIVE GROWTH 3759
 VERNALISATION 3824
 VERNALIZATION 3783, 3795, 3809, 3820, 3824
 VERNALIZATION RESPONSE 3573
 VERONICA 3974
 VESICLES 3693, 3961
 VESICULAR ARBUSCULAR MYCORRHIZAE 3581
 VICIA 3500
 VICIA FABA 3499, 3503, 3505, 3718, 3971, 3972
 VICTORIA 3532
 VIGNA MUNGO 3528
 VIGNA RADIATA RADIATA 3528
 VIROSES 3497, 3839, 3857, 3864, 3945
 VIRULENCE 3672, 3925, 3935
 VIRUS MOVEMENT 3930
 VISCOELASTIC PROPERTIES 3646
 VISCOSITY 4017, 4115, 4124, 4143
 VISCOSITY, 4139
 VITAMIN E 4100
 VITAMINS 4139
 VITREOUSNESS 3646
 VOLATILE FATTY ACIDS 3994
 VOLES 3854
 VOLUNTEER PLANTS 3516
 VULGARE L 3902
 W TYPE 3870
 WALES 3896
 WALL BOUND THIONINS 3902

WALL DEGRADING ENZYMES 3925
 WASTE DISPOSAL 3350
 WASTE LAND 4051
 WASTEWATER 3737, 3881
 WATER 4170
 WATER BALANCE 3710
 WATER DEFICIT 3800
 WATER DYNAMICS 3781, 3810, 3834, 4033
 WATER EROSION 4051
 WATER MANAGEMENT 3694
 WATER POTENTIAL 3701, 3780
 WATER QUALITY 4052
 WATER REQUIREMENTS 3694, 4030
 WATER SOLUBLE PENTOSANS 4064
 WATER STRESS 3716, 3799
 WATER TOLERANCE 3551
 WATER UPTAKE 3659, 4089, 4126
 WATER USE 3496, 3502, 3819
 WATER USE EFFICIENCY 3381, 3712, 3775
 WATERLOGGING 3813
 WAXY BLOOM 3552
 WEATHER 3344
 WEED CONTROL 3354, 3368, 3382, 3388, 3403, 3408, 3410, 3428, 3444, 3497, 3498, 3504, 3506, 3837, 3852, 3959, 3971, 3972, 3974, 3975, 3976, 3977, 3978, 3979, 3982, 3983
 WEED COVER 3970
 WEEDS 3388, 3516, 3523, 3837, 3852, 3971, 3972, 3974, 3976, 3981, 3984, 4146
 WEEVIL 3858
 WEIGHT 3582, 3633, 3821
 WEIGHT GAIN 3993, 3999, 4004, 4009, 4012, 4156
 WEIGHT METHOD 3767
 WEIGHT YIELD COMPONENTS 3550
 WHEAT (TRITICUM AESTIVUM) 3750
 WHEAT BREEDING LINES 4114
 WHEAT CROPS 3905
 WHEAT CULTIVARS 3794, 4114
 WHEAT FIELD 4031
 WHEAT FLOUR 3345, 3367, 3390, 3618, 3619, 4061, 4072, 4075, 4079, 4084, 4087, 4088, 4089, 4097, 4115, 4121, 4125, 4131, 4143
 WHEAT FLOUR PROTEINS 3607
 WHEAT GRADING 3725
 WHEAT GROWTH AND YIELD 3512
 WHEAT H2B GENES 3828
 WHEAT LEAF RUST 3596, 3943
 WHEAT MIDDINGS 4002
 WHEAT PHYLLOSPHERE 3804
 WHEAT POWDERY MILDEW 3935
 WHEAT QUALITY 4061
 WHEAT RYE AMPHIPLOID 3728
 WHEAT SPROUTING 4061
 WHEAT STRAW 3737, 4014, 4050, 4154
 WHEAT STRAW / USES 4160
 WHEAT TISSUE CULTURE 3876
 WHEAT TRITICUM AESTIVUM 3731, 3795, 3830, 4136
 WHEAT YIELD 3970
 WHEAT, DIGESTIBILITY 4153
 WHITE MUSTARD (SINAPSIS ALBA) 3750
 WHOLE CROP SILAGE 4156
 WHOLEMEAL FLOUR 4064

WILD PLANTS 3668, 3983
 WINDS 3723
 WINTER 4045, 4154
 WINTER BARLEY 3829, 3830
 WINTER CROPS 3354, 3369, 3438, 3443, 3444, 3450, 3452, 3458, 3466, 3470, 3476, 3482, 3498, 3500, 3504, 3516, 3524, 3533, 3534, 3535, 3537, 3567, 3633, 3717, 3808, 3851, 3852, 3853, 3864, 3894, 3895, 3897, 3921, 3937, 3940, 3947, 3971, 3972, 3974, 3976, 4020, 4025, 4026, 4048, 4049, 4053
 WINTER WHEAT 3332, 3381, 3471, 3492, 3550, 3741, 3774, 3795, 3799, 3800, 3811, 3820, 3826, 3827, 3849, 3871, 3896, 4027, 4033, 4044, 4046, 4064, 4069
 WINTER WHEAT GERMPLASM 3614
 WINTER WHEAT ROOTS 3819
 WORKING GROUP 3847
 WORLD 3413, 3414
 WORLD MARKETS 3382, 4077
 WORT 4098
 XANTHOMONAS CAMPESTRIS PV HORDEI 3868
 XENOBIOTICS 3726
 XENOPUS LAEVIS 3826
 XIPHINEMA INDEX 3857
 XYLANS 3711, 4017
 XYLEM 3759
 YEAR 3492, 4069
 YEAST 3578, 3747
 YEAST DERIVED INVERTASE 3718
 YEASTS 4115
 YELLOW RUST 3614, 3927
 YIELD 3332, 3381, 3383, 3399, 3445, 3527, 3548, 3594, 3710, 3774, 3781, 3814, 3818, 3862, 3905, 3924
 YIELD COMPONENTS 3362, 3374, 3383, 3391, 3412, 3424, 3427, 3461, 3541, 3554, 3559, 3562, 3565, 3597, 3629, 3647, 3652, 3659, 3667, 3679, 3770
 YIELD FORECASTING 3344
 YIELD LOSS 3875, 3896, 3968
 YIELD STABILITY 3621
 YIELD TRIAL 3594
 YIELDS 3385, 3388, 3423, 3517, 3519, 3591, 3647, 3768, 3853, 3854, 3894, 3915, 3973, 3982, 4056, 4135, 4168
 YOUNG ANIMALS 3998, 4009
 YOUNGEST FULLY EMERGED LEAVES 3958
 YUGOSLAVIA 3627
 ZAIRE 3341
 ZEA DIPLOPERENNIS 3539
 ZEA MAYS 3387, 3418, 3457, 3459, 3467, 3473, 3500, 3502, 3508, 3520, 3528, 3586, 3603, 3722, 3732, 3762, 3833, 3898, 3901, 3919, 3965, 3971, 3972, 4024, 4036, 4051, 4052, 4163, 4164, 4165, 4166
 ZEARALENONE 3901, 3988, 4016, 4092, 4095, 4145, 4148
 ZERO TILLAGE 3392, 3500
 ZINC 3759, 3760, 3771, 3785, 4024, 4028, 4042, 4046, 4165
 ZN 3785

How to obtain the full texts of documents

1. Recommendations to scientists:

First determine whether your local library or another library in your country can provide you with a copy of the document you want.

Most authors keep small stocks of reprints of their own publications, and they are usually prepared to respond to a polite request from a fellow scientist. This can be sent on a postcard with a return (institutional) address. In addition, many of the AGRIS input centers have a document delivery service. Your librarian may write and request a photocopy, for which you will often be charged the direct photocopy and mailing cost.

If your librarian is unable to find the document you want, you could send us the document delivery coupon which is included in each copy of *Literature Update on Wheat, Barley and Triticale*. This coupon enables you to ask the CIMMYT or ICARDA library to supply one or two items for your personal research or study. CIMMYT and ICARDA make no charge for this limited service, but the coupons should be used only as a last resort:

Because of copyright regulations, photocopies of entire publications (eg., complete books) cannot be provided.

see Document Delivery Coupon, last page

2. Recommendations to librarians:

Make any effort to get access to, as well as collaborate in, *Union Catalogs of Serials*, covering the journal holdings of the libraries in your country or region.

Order a copy of the *Union Catalog of Serials in International Agricultural Research Centers* (available in electronic format from ICRISAT-India^{1/}).

Establish good working relationships with other librarians and be as helpful as possible in providing document delivery services from the collection you hold.

Make your managers aware of the importance of having your own collection effectively organized, with back copies available for document delivery, with access to a photocopy machine and some funds to provide requested copies of your documents.

Contact the AGRIS input center of your country to make sure that relevant publications of your institution are registered in AGRIS, as well as in your national or regional agricultural database.

Obtain the addresses of all AGRIS input centers and AGLINET libraries (CIMMYT or ICARDA may provide these on request).

There are other useful reference tools that help you to locate the addresses of institutions, such as *Agricultural Information Resource Centers: A World Directory*, published by IAALD^{2/} and CTA^{3/}; the *Tropical Agriculture Information Sources* published by CTA.

^{1/} International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh 502324, India

^{2/} International Association of Agricultural Information Specialists (IAALD)

^{3/} Technical Centre for Agricultural and Rural Cooperation, P.O. B. 380, 6700 AJ Wageningen, Netherlands

CIMMYT ADDRESSES

(January 1995)

Headquarters

CIMMYT
Lisboa 27
Apdo. Postal 6-641
06600 México, D.F.
MEXICO
Internet: cimmyt@cimmyt.mx
Telex: 1772023 CIMTME
Telefax: INTL (52595)54425
Telefax: NATL(91595)54425
(52-5) 726-75-59/726-75-58

Other CIMMYT Offices

CIMMYT
P.O. Box 6057, Gulshan
Dhaka-1212
BANGLADESH
Internet: c.meisner@cgnet.com
Dialcom: 157: CGI425
Telefax: 880-2-883516

CIMMYT
c/o ANAPO
Casilla 2305
Santa Cruz
BOLIVIA
Internet: cimmyt@ugrm.bo
Telefax: (591-3) 427194

CIMMYT
c/o CIAT
Apdo. Aéreo 67-13 Cali **COLOMBIA**
Internet: ciat@cgnet.com
s.pandey@cgnet.com
Telex: 5769 CIATCO
Telefax: (57-23) 4450273

CIMMYT
Apartado 55
2200 Coronado
San José,
COSTA RICA
Internet: cim-costarica@cgnet.com
gsain@iica.ac.cr
Dialcom: 157:CGI066
Telex: 2144 IICA
Telefax: (506) 229-2457

CIMMYT
c/o IITA 01 B. P. 2559
Bouake.01
COTE D'IVOIRE
Internet: a.o.diallo@cgnet.com
Dialcom: 157:CGI125 (WARDA)
Telex: 69138 ADRAOCI
Telefax: (225) 634714

CIMMYT
P. O. Box 5689
Addis Ababa
ETHIOPIA
Internet:
cimmyt-ethiopia@padis.
gn.apc.org
d.g.tanner@padis.gn.apc.org
w.mwangi@padis.gn.apc.org
Dialcom: 157:CGI070 (ILCA)
Telex: 21207 ILCA ET
Telefax: (251-1) 611 892

CIMMYT
Crops Research Institute
c/o Canadian High Commission
Box 1639 , Accra
GHANA
Internet:
fax+23321772562@cgnet.com
r.soza@cgnet.com
Telex: 2024 DOMCAN GH
(Canadian High Commission in
Ghana)
Telefax: (233-21) 772562 (CIDA)

CIMMYT
12 Calle 1-25 Zona 10
Torre Norte 16 Nivel, Of. 1606
Apdo. Postal 231-A
GUATEMALA
Internet:
cimmyt-guatemala@cgnet.com
j.bolanos@cgnet.com
Dialcom: 157:CGI080
Telex: 6215 (ANAVI GU)
Telefax: (502) (2) 353407

CIMMYT
P.O. Box 25171
Nairobi
KENYA
Internet:
cimmyt-kenya@cgnet.com
j.ransom@cgnet.com
hassanr@ilnd.msm.cgnet.com
Telex: 33075
Telefax: (254-2) 631499/630164

CIMMYT
P.O. Box 677
Njoro
KENYA
Internet: cimmyt-kenya@cgnet.com
a.palmer@cgnet.com
Telefax: (254-37) 61145

CIMMYT
P. O. Box 5186
Kathmandu
NEPAL
Internet: cimmyt-nepal@cgnet.com
e.saari@cgnet.com
p.hobbs@cgnet.com
Dialcom: 157:CGI089
Telex: 2276 HOSANG NP
Telefax: Shangri La Hotel
977 (1) 414184 -
Att'n. CIMMYT

CIMMYT
Cereal Improvement Program
c/o ICARDA
P. O. Box 5466
Aleppo
SYRIA
Internet: icarda-fax@cgnet.com
Telex: 331206 ICARDA SY
Telefax: (963-21) 213490

CIMMYT
P.O. Box 9-188
Bangkok 10900
THAILAND
Internet: bangkok@cimmyt.mx
mmorris@cimmyt.mx
cdeleon@cimmyt.mx
jlothrop@cimmyt.mx
Dialcom: 157:CGI205
Telex: 84478 INTERAG TH
Telefax: (66-2) 561-4057

CIMMYT
P. K. 39 Emek
Ankara
TURKEY
Internet: cimmyt-turkey@cgnet.com
h.j.braun@cgnet.com
a.morgunov@cgnet.com
Dialcom 157:CGI071
Telex: 42994 CIMMY TR
Telefax: (90-312) 287-8955

CIMMYT
c/o IICA
CC 1217
Montevideo
URUGUAY
Internet: cimmyt@chasque.apc.org
Telex: IICA UY 22571
Telefax: (598-2)928522

CIMMYT
P. O. Box MP163
Mount Pleasant
Harare
ZIMBABWE
Internet:
cimmyt-zimbabwe@cgnet.com
d.jewell@cgnet.com
s.waddington@cgnet.com
k.pixley@cgnet.com
l.payne@cgnet.com
b.zambesi@cgnet.com
Dialcom 157:CGI237
Telex: 22462 CIMMYT ZW
Telefax: 263-479-0393/435-559

ICARDA ADDRESSES

(January 1995)

Headquarters

ICARDA
P.O. Box 5466
Aleppo
SYRIA
Telex: 331206/331208 ICARDA SY
Phone: (963-21) 213433/213477

ICARDA
c/o CIMMYT
P.O. Box 6-641
06600 Mexico, D.F.
MEXICO
Internet: cimmyt@cimmyt.mx
Phone: (52-5) 7269091,
(52-595) 54400/54410
Fax: (52-5) 7267559
(52-595) 54425

Regional Offices

ICARDA
15 G. Radwan Ibn El-Tabib Giza
11th Floor
P.O. Box 2416
Cairo
EGYPT
Email: ICARDA-Cairo@CGNET.COM
M.SLH@CGNET.COM
Phone: (20-2) 5724358/5725785/5735829
Telex: (091) 21741 ICARD UN
Fax: (20-2) 5728099

ICARDA
Immeuble STB
1st Floor
Appartment No. 1
Tunis
TUNISIA
Phone: (216-1) 232488
Telex: (409) 14066 ICARDA TN
Fax: (216-1) 751666

ICARDA
P.O. Box 950764
Amman 11195
JORDAN
Phone: (962-6) 825750
Telex: (493) 232781 ICARDA JO
Fax: (962-6) 825930

ICARDA
P.O. Box 39 Emek
06511 Ankara
TURKEY
Email: CG1450
Phone: (90-312) 2873595
Telex: (607) 44561 CIMY TR
Fax: (90-312) 2878955

Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information center/library (see "How to obtain the full text of documents" in this publication).

Send your request to either:

CIMMYT-Document Delivery Service, Lisboa 27, Apdo. 6-641, 06600 Mexico, D.F., MEXICO, or

ICARDA-Rachis Document Delivery Service, P.O. Box 5466, Aleppo, SYRIA

Please send me a reprint/photocopy of the following document listed in *Literature Update on Wheat, Barley, and Triticale* for purposes of personal study or research:

Volume No./Year _____ Entry Number _____ Author _____

Title _____

Source _____

Year _____ Pages _____ AGRIS Number (if available) _____

Write your name/address on the reverse of this coupon.

Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information center/library (see "How to obtain the full text of documents" in this publication).

Send your request to either:

CIMMYT-Document Delivery Service, Lisboa 27, Apdo. 6-641, 06600 Mexico, D.F., MEXICO, or

ICARDA-Rachis Document Delivery Service, P.O. Box 5466, Aleppo, SYRIA

Please send me a reprint/photocopy of the following document listed in *Literature Update on Wheat, Barley, and Triticale* for purposes of personal study or research:

Volume No./Year _____ Entry Number _____ Author _____

Title _____

Source _____

Year _____ Pages _____ AGRIS Number (if available) _____

Write your name/address on the reverse of this coupon.

Document Delivery Coupon

Please use this coupon only as a last resort after having tried to obtain the document you need from your own library or a national or regional information center/library (see "How to obtain the full text of documents" in this publication).

Send your request to either:

CIMMYT-Document Delivery Service, Lisboa 27, Apdo. 6-641, 06600 Mexico, D.F., MEXICO, or

ICARDA-Rachis Document Delivery Service, P.O. Box 5466, Aleppo, SYRIA

Please send me a reprint/photocopy of the following document listed in *Literature Update on Wheat, Barley, and Triticale* for purposes of personal study or research:

Volume No./Year _____ Entry Number _____ Author _____

Title _____

Source _____

Year _____ Pages _____ AGRIS Number (if available) _____

Write your name/address on the reverse of this coupon.

My name and institutional address are:

Date

Signature

My name and institutional address are:

Date

Signature

My name and institutional address are:

Date

Signature

ISSN 1405-1672