

Literature Update on Wheat, Barley, and Triticale



CIMMYT



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Literature Update on Wheat, Barley, and Triticale

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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
 Investigaciones en Granos y Semillas); Sterling, F.; Herrera, J. (1992) → 3
 4 → [Evaluation of the vigor in maize seeds and its relationship with the
 behaviour in the field]. Evaluacion del vigor en semillas de maiz y su
 relacion con el comportamiento en el campo. *Agroñomia Costarricense* → 6
 (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
 conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.)
 6 → (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).

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

Note to Readers

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

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

A50 AGRICULTURAL RESEARCH

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

2 Rodriguez Campos, Enrique (Instituto Nacional de Investigaciones Forestales y Agropecuarias, Campo Experimental Sierra de Artega) (1992) [Wheat improvement in the Northern zone of Mexico: present status, needs and prospects]. El mejoramiento del trigo en la zona norte de Mexico. Estatus, necesidades y tendencias. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 49-53. Centro de Investigacion Regional del Noroeste. Spanish. (AGRS 94-114648).

3 Salazar Gomez, Mario (INIFAP. CIR Noroeste, Ap. Postal 515, 85000 Cd. Obregon, Sonora (Mexico)) (1992) [National research network for small-grain cereals: present organization and future plans]. La red nacional de investigacion en cereales de grano pequeno. Organizacion actual y planes futuros. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 35-47. Centro de Investigacion Regional del Noroeste. Spanish. (AGRS 94-114647).

E10 AGRICULTURAL ECONOMICS AND POLICIES

4 Butault, J.P. (Institut National de la Recherche Agronomique, Nancy (France). Centre de Nancy, Economie et Sociologie Rurales); Delame, N.; Rousselle, J.M. (1994) [Costs of production and income in wheat, fruit, pig and milk sector (RICA: 1979-1991) (France)]. Evolution des couts de production et des revenus pour quelques grands produits de l'agriculture francaise (ble, fruit, porc, lait: RICA 1979-1991). Session de Printemps de la SFER [Societe Francaise d'Economie Rurale]: les revenus agricoles; Montpellier (France); 13-14 Mai 1993. *Economie Rurale (France)* (no 220-221) p. 52-53. French. (AGRS 94-114926).

5 Grillenzoni, M. (Bologna Univ. (Italy). Istituto di Estimo Rurale e Contabilita'); Sarti, D. (1994) [Evolution and perspectives of the profitability for some "great crops" in Emilia Romagna]. Evoluzione e prospettive della redditivita per alcune "grandi colture" in Emilia-Romagna. *Informatore Agrario (Italy)* v. 50(5) p. 21-25. 5 tables; 5 graphs. Italian. (AGRS 94-104926).

6 Hoffman, W.L.; Gardner, B.L.; Just, R.E.; Hueth, B.M. (1994) THE IMPACT OF FOOD AID ON FOOD SUBSIDIES IN RECIPIENT COUNTRIES. *American Journal of Agricultural Economics*. 76(4):733-743. English. [ENVIRONM WORKING GRP WASHINGTON, DC USA].

A model in which policy makers maximize a weighted welfare function of producer, consumer, and taxpayer groups is applied to explain the effects of food aid receipts on food policies in the countries receiving food aid. Consumer subsidies for wheat in nine countries receiving food aid are examined during the 1955-83 period. Econometric results indicate food aid increases domestic food subsidies in the recipient countries, but that other

factors (development, country-specific factors) are more important in determining subsidy level. [References: 15].

7 Mendez, F.; Aldana, F.; Juarez, H. (ICTA, Cd. Guatemala) (1992) [Potential for wheat production in Central America]. La produccion potencial del trigo en Centroamerica. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 55-62. Centro de Investigacion Regional del Noroeste. Spanish. (AGRS 94-114860).

8 Rodriguez, V.J. (AGRIPEFOR, Cerro del Vigilante 166, Mexico, D.F.) (1992) [Importance of wheat in Mexico's food production]. Importancia del trigo en la produccion de alimentos en Mexico. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 9-34. Centro de Investigacion Regional del Noroeste. 5 tables, 3 ref. Spanish. (AGRS 94-114864).

9 Shoeiab, O.M.A. (Ministry of Agriculture, Cairo (Egypt). Agricultural Economy Research Inst.) (1992) Analytical study for factors affecting on production and delivery of wheat in Sohage Governorate. *Assiut Journal of Agricultural Sciences (Egypt)* v. 23(4) p. 423-439. 6 tables; 5 ref. English. (AGRS 94-104895).

E16 PRODUCTION ECONOMICS

10 Vietinghoff, J. (Landesforschungsanstalt fuer Landwirtschaft und Fischerei Mecklenburg Vorpommern, Rostock (Germany)); Makowski, N. (1994) [Malting barley: crop management for obtaining high quality]. Braugerste: Fuehren Sie Ihre Bestaende zu hoher Qualitaet. *Top agrar / Spezial fuer Mecklenburg-Vorpommern, Brandenburg, Sachsen-Anhalt, Sachsen, Thueringen (Germany)* (no.3) p. 12-14. 2 ill., 3 tables. German. (AGRS 94-115209).

E21 AGRO-INDUSTRY

11 Meuser, F. (Technische Univ. Berlin (Germany)); Pahne, N. (1993) [Possible changes in the conceptions of starch extraction]. Moeglichkeiten konzeptioneller Veraenderungen bei der Staerkegewinnung. 2. Symposium Nachwachsende Rohstoffe - Perspektiven fuer die Chemie; Frankfurt am Main (Germany); 5-6 May 1993. (Symposium on "Renewable Resources. Perspectives of Chemistry". Proceedings). Bundesministerium fuer Ernaehrung, Landwirtschaft und Forsten, Bonn (Germany). *Schriftenreihe des Bundesministers fuer Ernaehrung, Landwirtschaft und Forsten, Reihe A: Angewandte Wissenschaft (Germany)*, spec. no. p. 115-144. Landwirtschaftsverlag. 4 ill., 10 graphs, 7 tables; 36 ref. German. (AGRS 94-105286).

12 Rocha Dos Santos, R. (Institut National de la Recherche Agronomique, Ivry (France). ESR. Laboratoire d'Economie Industrielle Agro Alimentaire) (1993) [Brazil: an agro-food system in transition]. Bresil, un systeme agro-alimentaire en transition. Centre de Recherche et de Documentation sur l'Amerique Latine, Paris (France). IHEAL. 232 p. French. (AGRS 94-105301).

E70 TRADE, MARKETING AND DISTRIBUTION

13 [Wheat sector (and minor cereals in Italy and abroad)]. Filiera frumento [e cereali minori in Italia e all'estero] (1993) Istituto per Studi, Ricerche e Informazioni sul Mercato Agricolo (ISMEA), Rome (Italy); Prometeia, Bologna (Italy). Istituto per Studi, Ricerche e Informazioni sul Mercato Agricolo. 101 tables; 75 graphs. 126 p. Italian. (AGRS 94-105561).

14 Blanc, J.C. (Institut National de la Recherche Agronomique, Toulouse (France). ESR. Station d'Economie et Sociologie rurales) (1993) [The organic cereals marketing system : actors' strategies]. La filiere des cereales biologiques : logiques d'acteurs. Ecole Supérieure de Commerce, Toulouse (France); Institut National de la Recherche Agronomique, Toulouse (France). ESR. Station d'Economie et Sociologie rurales. 75 p. French. (AGRI 94-105560).

15 Cruz Doren, M.E.; Farias, C.; Ochagavia, A.; Burgos, H.; Edwards, S.; Amunategui, R. (1993) [Wheat price range in Chile]. La banda de precios del trigo en Chile. FAO, Santiago (Chile). Oficina Regional para America Latina y el Caribe. 103 p. FAO-RLAC-93/21-COEX-49. Spanish. (AGRI 94-105562).

16 Leuschner, H. (1993) [Marketing strategies for local beer - producer cooperative for malting barley without herbicides]. Werbekonzepte fuer heimisches Bier - Landwirte und Brauereien setzen auf kontrolliert erzeugte Braugerste. Bayerisches Landwirtschaftliches Wochenblatt (Germany) v. 183(26) p. 19. 3 ill. German. (AGRI 94-115673).

17 Neugebauer, W. (1993) [Bakeries are advertising with cereals from controlled cultivation (without pesticides)]. Baecker werben mit Getreide aus kontrolliertem Anbau. Bayerisches Landwirtschaftliches Wochenblatt (Germany) v. 183(39) p. 22-24. 1 ill., 1 graph. German. (AGRI 94-115611).

E71 INTERNATIONAL TRADE

18 Patterson, P.M.; Brorsen, B.W. (1993) USDA export sales report: is it news? Review of agricultural economics (USA) v. 15(2) p. 367-378. references. English. (AGRI 94-105690).

This article seeks to determine whether the US. Export Sales report provides new information to the market. Event study methodology is used to evaluate the movement of futures prices on days around the release of the report. Recognizing that the variance of futures prices changes through time, GARCH models are used in evaluating the price movements. The results reveal that the information provided in the report is anticipated by traders. Little evidence was found to suggest that the report provides new information to the market.

19 Wills, R.B.H. (1994) THE WHEAT INDUSTRY - EXPORT PROSPECTS. Food Australia. 46(7):299-302. English. [AUSTRALIAN WHEAT BOARD ACAD GRAIN TECHNOL WERRIBEE VIC 3030 AUSTRALIA].

F01 CROP HUSBANDRY

20 Barasits, T.; Tomcsanyi, A. (1994) CHARACTERIZING THE EFFECT OF DRILLING DENSITY ON THE YIELD OF WINTER AND SPRING BARLEY VARIETIES BY 5 DIFFERENT TYPES OF FUNCTIONS. Növénytermelés. 43(4):341-354. Hungarian. [SZENT MARTON UT 25 H-4700 SZOMBATHELY HUNGARY].

The effect of density on the yield of winter and spring barley varieties was studied in 1988/91 in the range of 25-1200 germ/m². This effect was approached by linear, second order, power, logarithm and hyperbolic functions and it was examined which one of these functions describes the best the effect from agronomical standpoint. The linear correlation seemed to be rather loose in the interval of 25-1200. Therefore it is suitable to characterize the effect of sowing density only as a rough approach. The second order, power, logarithm and hyperbolic functions showed equally a close correlation. Based only on the closeness of the correlation it cannot be judged which type of the functions would be justified for choice. Examining the characteristics of the functions (the slope first and asymptotically horizontal second part of the hyperbola; the gradual increase of power and logarithm functions; the maximum point and the downward branch of the second order function), the hyperbola depicts in general a more informative and exact picture on the effect of drilling density in winter and spring barley varieties. In winter barley varieties, however, weak, increasing and depressing tendencies were observed in some years in the higher plant number range (Figs. 2. and 3), but it could be stated, that the varying tendencies in the upper range eliminated on the average of many years. The lower limit of the optimal drilling density can

be well characterized by the hyperbola. This lower limit was determined in 96% of the maximum value of hyperbola. That was the lowest seed rate, which did not give a considerable yield loss.

21 Bartels, G. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Braunschweig (Germany). Inst. fuer Pflanzenschutz in Ackerbau und Gruenland); Nordmeyer, H.; Kampmann, T. (1994) [The location 'Ahlum']. Versuchesstandort 'Ahlum'. Effects of a long-term application of plant protection products used in different intensities and development of assessment criterions. Bartels, G.; Kampmann, T. (comps.). Mitteilungen aus der Biologischen Bundesanstalt fuer Land-und Forstwirtschaft Berlin-Dahlem (Germany); no. 295 p. 9-43. Blackwell. 10 ill., 14 tables. German. (AGRI 94-116222).

The investigations of the soil protection project (promoted by the Federal Ministry of Research and Technology) were conducted on the area 'Ahlum' of the Federal Biological Research Centre for Agriculture and Forestry (BBA) in the east of the town of Wolfenbuettel. From October to March a positive climatic water balance can be observed, but in the main vegetation period deficiencies up to 100 mm can be found. From 11 soil units the rendzinae, para-brown earths and colluviae (especially at bottom slope) predominate in this location. The properties of the soil are heterogenous altogether. As an exception there is a decomposition of limestone in the surface soil in plot 3. Six years before the investigations started the area had been subdivided into three equal parts of 12 ha each. Sugar beet, winter-wheat and winter-barley were cultivated in this area successively. Each of these crops was cultivated in three, later in four intensities (I0-I3). The agricultural and plant cultivation measurements were conducted on principles of regular and practical agricultural cultivation. The tilled soil, the basic dressing, the seeding as drilling and the technique of seeding were conducted in the intensities in the same way. Whereas the seed density of sugar beet was generally equal, there was a difference of 280 to 450 grains/m² in the cereals according to the intensities. There was a stronger variation between the particular intensities in nitrogen fertilizing and the management of plant protection products. The soil samples were taken in areas which were divided into 40 plots (5 parallel lines with 8 repetitions in each of them). One soil sample was taken in each of these plots and they were united to a mixed sample. In the part-projects of soil zoology the scheduled sampling had to be taken in a different way.

22 Beese, G. (Saechsische Landesanstalt fuer Landwirtschaft (Germany)); Luehe, W. (1994) [Results of the land sort trial 1993 of the new federal states: Malting barley]. Ergebnisse der Landessortenversuche 1993 der neuen Bundeslaender: Braugerste. Neue Landwirtschaft (Germany) (no.1) p. 31-33. 3 tables. German. (AGRI 94-115946).

23 Beese, G.; Luehe, W. (1994) [Variety tests for malting barley: few varieties guarantee yield, quality and resistance]. Landessortenversuch Braugerste: Wenige Sorten bringen Ertrag, Qualitaet und Resistenz. Top agrar / Spezial fuer Mecklenburg-Vorpommern, Brandenburg, Sachsen-Anhalt, Sachsen, Thueringen (Germany) (no.1) p. 36-38. 1 ill., 2 tables. German. (AGRI 94-115989).

24 Belcheva, S.; Nenkova, D.; Ivanova, I. (Baza za Razvitie i Vnedryavane na Biologichno Aktivni Veshchestva pri Selskostopanska Akademuya, Sofia (Bulgaria)); Ivanova, V. (1993) [Variation in the productivity potential of the soft wheat varieties as affected by some growth regulators]. Promeni v produktivnite v'zmozhnosti na sortove meka pshenitsa pod vliyanie na rastezhni regulatori. Selskostopanska Akademuya, Sofia (Bulgaria). Rasteniev'dni Nauki (Bulgaria); Plant Science v. 30(5-6) p. 24-27. 3 tables; 19 ref. Bulgarian. (AGRI 94-105941).

25 Betzholz, T. (1993) [Crop harvesting 1992 in Baden-Wuerttemberg]. Ernte der Feldfruechte 1992. Baden-Wuerttemberg in Wort und Zahl (Germany) v. 41(2) p. 68-74. 6 graphs, 3 tables; 1 ref. German. (AGRI 94-115981).

26 Cabanas Cruz, Bertoldo (INIFAP. C.E. Zacatecas. Ap. Postal 18. Calera. Zac. 98500 (Mexico)) (1992) [Grain yield and dry-matter production in four cereal species grown under critical rainfed conditions]. Rendimiento y materia seca de cuatro especies de cereales bajo temporal critico. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988.

[National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 157-171. Centro de Investigacion Regional del Noroeste. 5 tablas; 9 ref. Spanish. (AGRI 94-116051).

27 Cheleev, D. (D'rzhavna Sortova Komisiya, Sofia (Bulgaria)); Todorov, T.; Belcheva, L. (1993) [Ecological stability of the common winter wheat varieties]. *Ekologichna stabilnost na sortove zimna obiknovena pshenitsa. Selskostopanska Akademiya, Sofia (Bulgaria). Rasteniye'dni Nauki (Bulgaria); Plant Science v. 30(5-6) p. 17-23. 3 tables; 11 ref. Bulgarian. (AGRI 94-105847).*

28 Collaud, J. F.; Fossati, A.; Fossati, D.; Praderwand, J. Cl. (Station federale de recherches agronomiques, Changins (Switzerland)) (1994) [Description of the varieties of cereals in the official list of 1994]. *Description des varietes de cereales de la liste officielle 1994. Revue suisse d'agriculture (Switzerland) v. 26(4) Annex 1-6. 7 tables. French. (AGRI 94-105925).*

29 Cybulska Augustyniak, J.; Shokes, F.M.; Barnett, R.D.; Soffes, A.R. (1992) Reliability of methods for assessing leaf blotch diseases of wheat. *Proceedings (USA) v. 51 p. 90-95. references. Meeting held Sept 25-27, 1991, Orlando, Florida. English. (AGRI 94-105935).*

30 Dennert, J. (Technische Univ. Muenchen, Freising (Germany)). Versuchsstation Roggenstein; Fischbeck, G.; Mueller, R. (1993) [Thin stands of winter wheat are more profitable]. *Duennere Weizenbestaende sind wirtschaftlicher. Bayerisches Landwirtschaftliches Wochenblatt (Germany) v. 183(37) p. 86-88. 2 ill., 2 graphs. German. (AGRI 94-115972).*

31 Dimitrov, L. (Opitna Stantsiya po Sortoizpitvane, s. Kapitanovtsi, Oblast Montana (Bulgaria)) (1993) [Testing foreign winter barley cultivars]. *Izpitvane na chuzhdestranni sortove zimni echemik. Selskostopanska Akademiya, Sofia (Bulgaria). Rasteniye'dni Nauki (Bulgaria); Plant Science v. 30(5-6) p. 35-36. 3 table; 6 ref. Bulgarian. (AGRI 94-105868).*

32 Dimitrov, L. (Opitna Stantsiya po Sortoizpitvane, s. Kapitanovtsi, Oblast Montana (Bulgaria)); Tsankova, D. (1993) [Testing of winter two-rowed barley varieties]. *Izpitvane na sortove zimni dvuredni echemik. Selskostopanska Akademiya, Sofia (Bulgaria). Rasteniye'dni Nauki (Bulgaria); Plant Science v. 30(5-6) p. 32-34. 1 table; 5 ref. Bulgarian. (AGRI 94-105867).*

33 Dmowski, Z. (1993) [Effect of cultivation region, soil and agrotechnology on yield of rye and winter wheat]. *Wplyw rejonu uprawy, gleby i agrotechniki na plonowanie zyla i pszenicy ozimej. Akademia Rolnicza, Wroclaw (Poland). Katedra Rolniczych Podstaw Melioracji. Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rozprawa Habilitacyjna (Poland); no. 114 63 p. Wydawnictwo Akademii Rolniczej we Wroclawiu. 6 fig., 19 tables; 152 ref. Polish. (AGRI 94-105924).*

The participation of the studied factors in yield formulation was (in percent) for rye: forecrops - 8.5-46.5, sowing time - 10.2-19, soil complex - 12.1, sowing density - 10.1, location - 6.3, participation of cereals - 1, fertilization - 0.5-4.3; for wheat: forecrops - 10.5-32, sowing time - 8.3-16.3, sowing density - 13.0, location - 7.8, participation of cereals - 4.4, soil complex - 4.1, fertilization - 1.2-2.

34 Eissa, AM.; Eldin, TMS.; Dawood, AM. (1994) PLANTING DATE IN RELATION TO YIELD AND YIELD COMPONENTS OF WHEAT IN AL-QASSIM REGION. *Arab Gulf Journal of Scientific Research. 12(3):449-464. English. [KING SAUD UNIV AL QASSIM BRANCH COLL AGR & VET MED DEPT AGRON & RANGE SCI POB 1482 BAHRAIN SAUDI ARABIA].*

The present investigation was carried out during the 1990/91 and 1991/92 seasons to determine the optimum planting date for maximizing wheat production under Al-Qassim conditions. The experiments were conducted at the Agricultural experimental Station, College of Agriculture and Veterinary Medicine, King Saud University, Al-Qassim Branch, Saudi Arabia. Two high-yielding spring wheat cultivars, Yecora Rojo and West

Bread, were planted in six dates; November 16, December 1 and 16, January 1 and 16 and February 1. The experiments were set up in a split plot design with four replications. Results revealed that planting dates had significant effects on all studied traits. Significant cultivar x planting date, planting date x season and cultivar x planting date x season interactions existed for grain yield and its components, plant height and days to heading. The best planting date for Yecora Rojo cultivar was January 1st and for West Bread cultivar was December 16 in the first season while the first of December was the best planting date for both cultivars in the second season for maximizing grain yield. Spikes per square meter and kernels per spike significantly increased while kernel weight non-significantly decreased as planting date was delayed from November to December. It could be concluded that the optimum period for planting date in Al-Qassim region lies within the first two weeks of December. Expanding planting to January 1st could be possible, while planting after this period would result in yield reduction.

35 Fixen, P.E. (1993) Crop responses to chloride. *Advances in agronomy (USA) v. 50 p. 107-150. references. English. (AGRI 94-105900).*

36 Gallardo Suarez, A. (INIFAP. C.E. Sur de Tamaulipas. Ap. Postal C 1 Suc. Aereopuerto. Tampico, Tamp. 89120 (Mexico)) (1992) [Wheats for tropical environments]. *Trigos para ambientes tropicales. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 173-181. Centro de Investigacion Regional del Noroeste. 1 tabla; 2 ref. Spanish. (AGRI 94-115918).*

37 Glenz, H. (Giessen Univ. (Germany)). Inst. fuer Landwirtschaftliche Betriebslehre; Kuhlmann, F. (1993) [International collaboration in designing Decision Support Systems (DSS) for cultivation and management of wheat, barley and maize]. *Internationale Zusammenarbeit bei der Entwicklung von DSS fuer den Anbau und die Bestandesfuehrung von Weizen, Gerste und Mais. 14. Jahrestagung der Gesellschaft fuer Informatik in der Land-, Forst- und Ernahrungswirtschaft (GIL); Leipzig (Germany); 4-6 Oct 1993. (Lectures delivered at the 14th Annual Meeting of the GIL, Leipzig (Germany)). 1993. Schulze, E. (Leipzig Univ. (Germany)). Wissenschaftsbereich Agrarökonomie; Petersen, B.; Geidel, H. (eds.). Gesellschaft fuer Informatik in der Land-, Forst- und Ernahrungswirtschaft, Stuttgart (Germany). Berichte der Gesellschaft fuer Informatik in der Land-, Forst- und Ernahrungswirtschaft (Germany); v. 5 p. 285-290. GIL. 2 ill., 2 tables; 5 ref. German. (AGRI 94-105875).*

This report deals with the research of an EC-project for the cooperational development of DSS by using information models for wheat cultivation. It is the target of this project - still being developed - to cooperate internationally concerning the development of DSS-software. We, the German team also aim at constructing models that can be adapted to the national needs of the different EC-countries. At the time being, these models are checked and tried out with the help of different test methods, e.g. field tests. The first test results will be expected by the end of this year. It is the task of the German team to develop a DSS for the cultivation and the field management of winter wheat. Already existing Decision support models for this area are hereby being implemented and adapted to the needs of our project partners. With FUNGI, the model for fungicide choice, we are now able to close a gap concerning the development of the DSS.

38 Hankins, B.J. (1993) Rye and triticale for winter pasture. *FSA (USA), no. 2115 2 p. In subseries: Winter Forage Series. English. (AGRI 94-116052).*

39 Hankins, B.J.; McKirney, N.V.; Jones, B.F.; Cloud, G.L.; Boyd, J.W. (1993) Factors affecting the production of forage wheat. *FSA (USA); no. 2116 2 p. English. (AGRI 94-116058).*

40 Hartman, J.B.; Barnett, R.D.; Soffes, A.R.; Sprengel, R.K. (1992) Hessian fly control in Florida wheat with systemic insecticides. *Proceedings (USA) v. 51 p. 99-102. references. Meeting held Sept 25-27, 1991, Orlando, Florida. English. (AGRI 94-105937).*

41 Jonassen, G.H. (Landvik Forskingsstasjon, Grinstad (Norway)) (1993) [Establishment of cocksfoot (*Dactylis glomerata* L.) seed crops with cereal companion crops]. Saamengder av bygg og hvete som dekkvekst til hundegrasfroeng. *Norsk Landbruksforskning* (Norway); *Norwegian Agricultural Research* v. 7(3-4) p. 321-330. 8 figures; 16 ref. Norwegian. (AGRI 94-116301).

42 Kang, Y.K.; Ko, K.S.; Kang, B.K. (Cheju National University, Cheju (Korea Republic). College of Agriculture) (1993) Effects of temperature on leaf emergence rates and phyllochron of naked and malting barley. *Korean Journal of Crop Science* (Korea Republic) v. 38(5) p. 449-457. 4 illus.; 2 tables; 17 ref. Korean. (AGRI 94-105872).

43 Karabinova, M.; Adamovsky, F.; Prochazkova, M. (1994) THE EFFECT OF SOME INTENSIFICATION FACTORS ON THE WINTER WHEAT YIELD. *Rostlinna Vyroba*. 40(10):925-934. Czech. [VYSOKA SKOLA POLNOHOSPODARSKA A HLINKU 2 CS-94976 NITRA SLOVAKIA].

The polyfactorial field experiments were conducted at the Crop Production Department, Research Base, University of Agriculture, Nitra, during the two time periods, in 1985 to 1990 with the varieties of winter wheat Livia, Roxana, Zdar and in 1991 to 1993 with the varieties Barbara, Blava, Livia, Torysa, Vlada. The aim of the experiments was to discuss an influence of three fertilization combinations: a - zero fertilization control, b - fertilization based on standard designated for the yield of 8 t of above-ground biomass per hectare (in 1991 to 1993 50% of NPK nutrients applied per hectare were in organic form), c - rational fertilization determined according to the soil nutrient dynamics [in 1991 to 1993 according to the methodology by Michalik, Lozek (1985)] at two seed rates (3.5 mil. and 5.5 mil. grains per hectare) and three ways of drilling (coulters drilling, strip drilling and disc drilling) on soil structure and resulted grain yield. The fertilization had statistically significant influence on the yield in both time periods. Varieties Livia and Roxana achieved the maximum yields at the fertilization level based on fixed standard (yield increase of 10.6 and 6.9%, resp.) and variety Zdar at rational fertilization (yield increase of 9.4%). The differences between two fertilization combinations were statistically insignificant (1.1%) and from economical point of view after subtracting fertilizer costs the rational fertilizer dose was more advantageous, what saved 146 kg NPK per hectare and coefficient of economic effectiveness achieved 1.29. In 1991 to 1993 in all tested varieties, except Torysa, the maximum yield at fertilization 50% of NPK per hectare in commercial fertilizers was determined and 50% of NPK per hectare in organic manures, where the yield increase ranged from 8.1% (Vlada) to 16.4% (Barbara) compared to the control. From the economic point of view, the rational fertilization according to the methodology (KEE 2.11) was found to be more advantageous. In 1985 to 1990 trials, the seed rate 5.5 mil. grains per hectare was demonstrated as a definitely more advantageous (statistically significant) and the yield increment ranged from 4.6% (Zdar) to 8.4% (Livia). The influence of various types of drilling (coulters, strip, disc) on the yield was found statistically insignificant, moreover, the way of drilling influenced the yield structure (number of plants, number of spikes and number of grains per square meter) where coulters drilling was the best.

44 Kheiralla, K.A.; Dawood, R.A.; Teama, E.A. (Assiut Univ. (Egypt). Faculty of Agriculture) (1993) Performance of some wheat cultivars for grain yield and excised leaf-water loss as an indicator of drought resistance under different levels of nitrogen. *Assiut Journal of Agricultural Sciences* (Egypt) v. 24(2) p. 293-310. 3 ill. 4 tables; 24 ref. English. (AGRI 94-105946).

45 Lafond, G.P. (1994) EFFECTS OF ROW SPACING, SEEDING RATE AND NITROGEN ON YIELD OF BARLEY AND WHEAT UNDER ZERO-TILL MANAGEMENT. *Canadian Journal of Plant Science*. 74(4):703-711 English. [AGR & AGRIFOOD CANADA INDIAN HEAD EXPTL FARM POB 760 INDIAN HEAD S0G 2K0 SK CANADA].

Adopting water-conserving tillage practices on the Canadian prairies will protect the soil against erosion while conserving soil water. The use of tall-standing stubble to conserve water creates a dilemma for producers because maximum yields can only be obtained with narrow rows, and tall stubble may limit the use of narrow row spacings. A 4-yr study on a thin Black clay soil investigated the effects of three row spacings (10, 20 and 30 cm), six seeding rates (34, 67, 100, 134, 168 and 202 kg ha⁻¹) for wheat and 27, 54, 81, 108, 134 and 161 kg ha⁻¹ for barley and two rates of N (low

and high) in hard red wheat (*Triticum aestivum* L.), durum (*Triticum durum* L.) and barley (*Hordeum vulgare* L.) using a continuous cropping, zero-till production system. The yields of cereals were maintained with 30-cm row spacing over a wide range of growing conditions under zero-till management. Durum had a 5.8% yield advantage and barley a 2.4% advantage for the 30-cm row spacing over the 10-cm row spacing. The number of plants established and the number of spikes produced decreased as row spacing increased for all crops. But wider row spacing resulted in more kernels produced per spike, which, in the case of barley and durum, more than compensated for the lower number of spikes. Increasing seeding rates significantly improved grain yield in all crops and years because more spikes were produced. Grain yield was related to the reciprocal of seeding rate. The few row spacing x seeding rate interactions observed in 2 of 12 cases suggest that seeding rates need not be adjusted for changes in row spacing. The results obtained have important implications for equipment design and the ability to more easily handle high-crop-residue situations. [References: 27].

46 Liu Huashan; Peng Wenbo; Meng Fanting (Henan Agricultural Univ., Zhengzhou (China)) (1993) Effects of S3307 on morphological and some physiological characteristics of wheat seedlings. *Plant Physiology Communications* (China) v. 29(5) p. 354-355. 3 tables, 9 ref. Chinese. (AGRI 94-116062).

47 Logu, G. de (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) [The valid alternative of barley in spring seeding]. La valida alternativa dell'orzo in semina primaverile. *Informatore Agrario* (Italy) v. 50(5) p. 47-49. 2 tables; 4 graphs. Italian. (AGRI 94-105869).

48 Lucas Bueno, C. de; Froud Williams, R.J. (University of Reading (U.K.). School of Plant Sciences) (1993) [Variation in the competitive ability of four cultivars of winter wheat]. Naturaleza de la habilidad competitiva de cuatro variedades de trigo de invierno. Congreso 1993 de la Sociedad Espanola de Malherbologia; Lugo (Espana); 1-3 Dic 1993. [Proceedings of 1993 Meeting of the Spanish Society for Weed Control, Lugo, 1-3 Dec 1993]. *Actas del Congreso 1993 de la Sociedad Espanola de Malherbologia*, Lugo, 1-3 Dic 1993. *Sociedad Espanola de Malherbologia*, Madrid (Espana) P. 303-306. SEM. 3 tab.; 6 ref. Spanish. (AGRI 94-115984).

49 Lukipudis, S. (D'rzhavna Sortova Komisiya, Sofia (Bulgaria)) (1993) [Productivity and variety testing of winter soft wheat under semimountainous conditions]. Sorteizpitvane i produktivnost na zimna meka pshenitsa pri poluplaninski usloviya. Selskostopanska Akademiya, Sofia (Bulgaria). *Rasteniev "dni Nauki* (Bulgaria); *Plant Science* v. 30(5-6) p. 10-13. 3 tables; 7 ref. Bulgarian. (AGRI 94-105939).

50 Lukipudis, S. (D'rzhavna Sortova Komisiya, Sofia (Bulgaria)) (1993) [Winter soft wheat under the conditions of Srednogorie]. Zimna meka pshenitsa pri usloviyata na Srednogoriето. Selskostopanska Akademiya, Sofia (Bulgaria). *Rasteniev "dni Nauki* (Bulgaria); *Plant Science* v. 30(5-6) p. 29-31. 1 table; 13 ref. Bulgarian. (AGRI 94-105942).

51 Mahmood, T.; Gergerich, R.C.; Milus, E.A.; West, C.P. (1993) Barley yellow dwarf virus incidence in wheat and other hosts. *Arkansas farm research* (USA) v. 42(3) p. 12-13. references. English. (AGRI 94-105934).

52 Morales M, A.; Grijalva C, R.L. (INIFAP. C.E. Sierra de Sonora, Ap. Postal 38, Moctezuma, Son. 58560 (Mexico)) (1992) [Evaluation of wheat yield under zero and conventional tillage, taking into account the different amounts of nitrogen and phosphorus fertilization, methods of weed control and harvest dates]. Evaluacion del rendimiento de trigo con diferentes niveles de fertilizacion nitrofosforica, control de maleza y epocas de corte, bajo los sistemas de labranza cero y convencional. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste* (Mexico); no. 4 p. 429-439. Centro de Investigacion Regional del Noroeste. 5 tablas; 16 ref. 2o. tomo. Spanish. (AGRI 94-115919).

53 Ortizmonasterio, J.I.; Dhillon, S.S.; Fischer, R.A. (1994) DATE OF SOWING EFFECTS ON GRAIN YIELD AND YIELD COMPONENTS OF IRRIGATED SPRING WHEAT CULTIVARS AND RELATIONSHIPS WITH RADIATION AND TEMPERATURE IN LUDHIANA, INDIA. *Field Crops Research*. 37(3):169-184. English. [CIMMYT LISBOA 27 APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Date of sowing experiments were established under irrigation in Ludhiana, in the Indian state of Punjab, from 1985 to 1992, using a total of 66 spring wheat (*Triticum aestivum* L.) cultivars and 10 sowing dates. To study interactions among cultivars, sowing dates and years and to estimate losses with delayed sowing for grains m(-2) and grain yield, an orthogonal subset of four years, three cultivars (PBW 34, PBW 154 and PBW 226) and seven sowing dates was used. To study the relationship between temperature and radiation, and yield and yield components, the same three cultivars were used with all the available years and sowing dates for each. The optimum sowing dates for yield were 5 November for PBW 34 (long-season) and 15 November for cultivar PBW 154 (medium-season) and PBW 226 (short-season). The combined effect of pre-heading radiation and temperature, referred to as the photothermal quotient (PTQ), was a better predictor of grains m(-2) than was either variable alone. The sole effect of post-heading temperature was the best predictor of individual kernel weight. Yield and grains m(-2) were maximized for all cultivars when exposed to the highest PTQ between 20 days before to 10 days after heading. Hence, the optimum heading date was the same for all three cultivars and, for the years studied, was in mid-February. After the optimum sowing date, there was a 0.8, 0.7 and 0.7% day(-1) yield reduction for PBW 34, PBW 154 and PBW 226, respectively. The optimum heading date is earlier than observed for several other important areas of irrigated spring wheat. This may be explained by the rapid increase in temperature from February onwards at Ludhiana. We discuss the use of PTQ and temperature to determine optimum heading dates and, therefore, sowing dates for different cultivars. [References: 36].

54 Oskarsen, H. (Kvithamar Forskingsstasjon, Stjoerdal (Norway)) (1992) [Growth regulator and fungicide in barley varieties]. *Vekstregulator og soppmiddel til byggsorter. Norsk Landbruksforskning (Norway); Norwegian Agricultural Research* v. 6(4) p. 331-338. 6 tables; 16 ref. Norwegian. (AGRI 94-115987).

55 Pankov, Zh.; Dzhelepov, K. (Institut po Pshenitsata i Sl'nchogleda "Dobrudzha", Geheal Toshevo (Bulgaria)) (1993) [Effect of gamma irradiation on M1 soft wheat pollen and gametophyte]. *Efekt na v"zdejstvieto na gama-l"chi v"rkhu gametofita i polena na meka pshenitsa v M1. B'lgarska Akademuya na Naukite, Sofia (Bulgaria). Genetika i Selektisiya (Bulgaria); Genetics and Breeding* v. 26(5-6) p. 370-377. 3 tables; 14 ref. Bulgarian. (AGRI 94-105943).

56 Petrov, D. (D'rzhavna Sortova Koznisiya, Sofia (Bulgaria)) (1993) [Productivity of winter soft wheat varieties in 1959-1989]. *Produktivnost na sortove zimna meka pshenitsa prez perioda 1959-1989. Selskostopanska Akademuya, Sofia (Bulgaria). Rasteniev"dni Nauki (Bulgaria); Plant Science* v. 30(5-6) p. 5-9. 3 tables. Bulgarian. (AGRI 94-105938).

57 Robertson, L.D.; Souza, E.J.; Tyler, J.M.; Kruk, M.W.; Brown, B.D. (1992) Vandal: hard red spring wheat. *Current information series (USA); no. 935 2* p. English. (AGRI 94-116066).

58 Robertson, L.D.; Wesenberg, D.M.; Whitmore, J.C.; Brown, B.D.; Burrup, D.E. (1992) Colter: six-row spring feed barley. *Current information series (USA); no. 933 2* p. English. (AGRI 94-115990).

59 Robertson, L.D.; Wesenberg, D.M.; Whitmore, J.C.; Burrup, D.E. (1992) Targhee: two-row spring feed barley. *Current information series (USA); no. 934 2* p. English. (AGRI 94-115991).

60 Rocchetti, G.; Mazzieri, G. (Ente di Sviluppo Agricolo delle Marche, Ancona (Italy)); Porfuri, O. (1994) [The barley in spring seeding in the Marche]. *L'orzo in semina primaverile nelle Marche. Informatore Agrario (Italy)* v. 50(5) p. 67-68. Italian. (AGRI 94-105870).

61 Royo, C.; Insa, J.A.; Boujenna, A.; Ramos, J.M.; Montesinos, E.; Delmoral, L.P.G. (1994) YIELD AND QUALITY OF SPRING TRITICALE USED FOR FORAGE AND GRAIN AS INFLUENCED BY SOWING DATE AND CUTTING STAGE. *Field Crops Research*. 37(3):161-168. English. [CTR UDL IRTA AREA CONREUS EXTENSIVUS ROVIRA ROURE 177 E-25006 LLEIDA SPAIN].

Six held experiments involving two sowing times at each of three sites across Spain were conducted to study the response of three spring triticales to forage removal at early stages. Forage dry matter harvested at the first-node-detectable stage (31) doubled or tripled forage harvested at the pseudostem-erect stage (30). Sowing date affected forage production only when cutting was delayed until stage 31, and had a significant effect on the subsequent grain yield and test weight. Forage quality was not affected by sowing date, and forage removal did not affect grain protein content. Grain yield was reduced by about 16% when forage was removed at stage 30 and by nearly 33% at stage 31. At the two northern sites, grain-yield reductions following forage removal may be attributed to grain-weight decreases caused by a prolonged cycle to anthesis. At the southern site, forage removal did not affect the life cycle, probably due to the longer photoperiods, greater irradiation, and higher temperature during spring. [References: 33].

62 Ruland, W.; Dietzsch, H. (1993) [Only moderate wheat qualities]. *Nur maessige Weizen-Qualitaeten. Landwirtschaftliches Wochenblatt Westfalen-Lippe, Ausgabe A (Germany) v. 150(41) p. 20-21. 1 ill., 3 tables. German. (AGRI 94-115949).*

63 Ryu, Y.H.; Ha, Y.W. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station); Lee, C.D. (Kangwon National University, Chuncheon (Korea Republic). College of Agriculture) (1993) Temperature effects at different growth stages on grain filling in winter barley. *Korean Journal of Crop Science (Korea Republic) v. 38(5) p. 425-431. 2 illus.; 4 tables; 16 ref. Korean. (AGRI 94-105871).*

64 Schoonderbeek, D.; Schoute, J.F.T. (1994) ROOT AND ROOT-SOIL CONTACT OF WINTER WHEAT IN RELATION TO SOIL MACROPOROSITY. *Agriculture Ecosystems & Environment*. 51(1-2):89-98. English. [DLO WINAND STARING CTR INTEGRATED LAND SOIL & WATER R POB 125 6700 AC WAGENINGEN NETHERLANDS].

Large thin sections and image analysis techniques were used to understand the relation between macroporosity and root development in two different farm management systems. Samples of 8 cm X 15 cm were collected at three different depths from two fields, one under a conventional and one under an integrated farm management system. Macroporosity was measured on vertically oriented thin sections, whereas root parameters were quantified on horizontal thin sections. Macroporosity was quantified using porosity photograms. Roots were quantified directly on the thin sections using a microscope with several light sources. The micromorphometric measurements were performed with a Quantimet 970 image analyser. Two hypotheses were tested: (a) different farm management systems are responsible for different soil macroporosity; (b) a relationship exists between macroporosity and root-soil contact in the topsoils of conventional and integrated farm management systems. [References: 25].

65 Sheaffer, C.C.; Rasmusson, D.C.; Simmons, S.R. (1994) FORAGE YIELD AND QUALITY OF SEMIDWARF BARLEY. *Crop Science*. 34(6):1662-1665. English. [UNIV MINNESOTA DEPT AGRON & PLANT GENET ST PAUL, MN 55108 USA].

Semidwarf barley (*Hordeum vulgare* L.) with enhanced lodging resistance has been developed for feed grain production. Its potential as a forage crop has not been evaluated. Our objective was to determine forage yield, forage quality, and grain yield of semidwarf barley compared with conventional barley cultivars developed for malting and feed grain production. Three semidwarf experimental barley lines were compared with two conventional height malting barley cultivars in the field at St. Paul, MN, on a Waukegan silt loam (fine-silty over sandy or sandy-skeletal, mixed, mesic Typic Hapludoll) and at Crookston, MN, on a Wheatville loam (coarse-silty over clayey, frigid Aeric Calcicquoll). Semidwarf barleys averaged 24% less stem and 29% greater inflorescence proportion than conventional barleys. Leaf blade and leaf sheath proportion for semidwarf and conventional height barley were similar. Semidwarf barley averaged 11% less whole plant acid detergent fiber

(ADF), 8% less neutral detergent fiber (NDF), and 8% less acid detergent Lignin (ADL) concentrations than conventional height barley. Whole plant crude protein concentration did not consistently differ for the semidwarf and conventional height barley. Whole plant NDF, ADF, and ADL concentrations were negatively correlated with inflorescence percentage ($r(2) > 0.75$) and grain yield ($r(2) > 0.85$) and positively correlated with stem percentage ($r(2) > 0.48$) and height ($r(2) > 0.98$). Forage and grain yields of semidwarf and conventional height barley were not consistently different. Lodging resistant, semidwarf barley had superior forage quality compared with conventional height barley and thus has good potential as a forage crop when grown alone or as a companion crop for forage establishment. [References: 17].

66 Spielhaus, G. (Landwirtschaftskammer Muenster (Germany)); Remmersmann, T. (1993) [Without plough even on clay soils?]. *Pflugos auch auf Tonboeden? Landwirtschaftliches Wochenblatt Westfalen-Lippe, Ausgabe A (Germany) v. 150(42) p. 22-24. 1 ill., 2 graphs, German. (AGRI 94-115971).*

67 Springob, G. (Hannover Univ. (Germany). Inst. fuer Bodenkunde) (1993) [K-content of plants - A suitable index for judgement of K-supply of soils]. *K-Gehalte von Pflanzen - Ein geeigneter Index zur Beurteilung der K-Versorgung von Boeden? 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 217-220. VDLUFA. 2 ill., 1 table; 5 ref. German. (AGRI 94-105849).*

68 Strass, F. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau Freising Muenchen, Freising (Germany)); Zimmermann, G. (1993) [Cultivation of triticale increases - problems with outgrowth]. *Triticale marschiert weiter - Heuer allerdings erhebliche Probleme mit Auswuchs. Bayerisches Landwirtschaftliches Wochenblatt (Germany) v. 183(37) p. 85. 1 ill., 1 table. German. (AGRI 94-115966).*

69 Strass, F. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau Freising Muenchen, Freising (Germany)); Zimmermann, G. (1993) [Variety trials with spring wheat in Bavaria]. *Lueckenbueesser bewaehrte sich - Sommerweizen kam heuer bis auf 5 dt/ha an Winterweizen heran. Bayerisches Landwirtschaftliches Wochenblatt (Germany) v. 183(51) p. 61. 2 tables. German. (AGRI 94-116059).*

70 Strass, F. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau Freising Muenchen, Freising (Germany)); Zimmermann, G. (1993) [Winter wheat for the harvest year 1994]. *Weizen fuer die Ernte 1994. Bayerisches Landwirtschaftliches Wochenblatt (Germany) v. 183(38) p. 48-50. 2 tables. German. (AGRI 94-115973).*

71 Strutz, M. (1993) [Plant ecosystems - Interactions and influences of biomass accumulation and yield formation]. *Pflanzliche Oekosysteme - Wechselwirkungen und Einflussfaktoren der Stoff- und Ertragsbildung. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 637-640. VDLUFA. 2 ill.; 6 ref. German. (AGRI 94-105876).*

72 Svensson, E.; Danielsson, P.; Laike, M.; Truedsson, B. (1994) [Sowing with shoe coulters and wing coulters and different seed rates]. *Saadd med ving- respektive slaepbill och olika utsaedesmaengder. Serierna D7-180 and D7-480. Meddelande fraan Soedra Jordbruksfoersoksdistriktet - Sveriges Lantbruksuniversitet (Sweden); no. 42 71 p. 5 ref. SLU-SJFD-M-42-SE. Swedish. (AGRI 94-105873).*

73 Swinnen, J. (1994) RHIZODEPOSITION AND TURNOVER OF ROOT-DERIVED ORGANIC MATERIAL IN BARLEY AND WHEAT UNDER CONVENTIONAL AND INTEGRATED MANAGEMENT. *Agriculture Ecosystems & Environment. 51(1-2):115-128. English. [DLO AB AGROBIOL & SOIL FERTIL RES INST POB 14 6700 AA WAGENINGEN NETHERLANDS].*

Carbon fluxes in the rhizosphere of barley (*Hordeum vulgare* L.) and wheat (*Triticum aestivum* L.) were studied under field conditions with conventional management (CONV) and integrated management (INT) using C-14-CO₂ pulse labelling. As estimated by a model rhizodeposition

technique, the bulk of the C-14 soil/root respiration during a 3 week period after pulse labelling originated from root respiration and only a minor part was due to microbial activity. Root C-14 losses during washing from soil were considerable (up to 40%) and were corrected for. Most of the carbon transfer to the roots of barley and wheat occurred in the early developmental stages, with a maximum flux around tillering. Over the entire growing season, this amounted to 52% of the above-ground production. Of the annual root growth, about one-half was found to be decayed by the end of the growing period. Compared with CONV, in INT a lower transfer of carbon to the roots, a lower root growth and a lower total rhizodeposition was found. In winter wheat this was mainly due to a lower overall plant production, and not a different C distribution pattern. Total rhizodeposition constituted 29-50% of the carbon translocated below ground and was 1.5-2.1 times the amount of roots left at crop harvest. Microbial respiration of rhizodeposits was higher in CONV than in INT. [References: 35].

74 Todorov, T. (Opitna Stantsiya po Sortoizpitvane, Dobrich (Bulgaria)); V'ltanov, V. (1993) [Productivity of winter soft wheat cultivars]. *Produktivnost na sortove zimna meka pshenitsa. Selskostopanska Akademiya, Sofia (Bulgaria). Rastenio "dni Nauki (Bulgaria); Plant Science v. 30(5-6) p. 14-16. 2 tables; 6 ref. Bulgarian. (AGRI 94-105940).*

75 Vaculova, K.; Heger, J.; Spunar, J.; Spunarova, M. (1994) FEEDING VALUE AND GRAIN PRODUCTION OF DIFFERENT BARLEY CULTIVARS. *Rostlinna Vyroba. 40(10):935-948. Czech. [VYZKUMNY USTAV OBILNARSKY HAVLICKOVA 2787 CS-76741 KROMERIZ CZECH REPUBLIC].*

Based on results of small-plot experiments and balance feeding tests with laboratory rats, a level of the feeding value and grain production in 14 released cultivars and new breeding lines of spring and two-row winter barley grown in the Czech Republic were studied. The results showed significant differences for the values of all parameters regardless of the growth habit (winter-spring) in individual entries. The parameters which characterize the grain protein value (coefficient of true protein digestibility K_S, protein biological value BHB, net protein utilization NPU, and protein unsable content UP) showed up to three-times higher variability as compared to energetic ones (coefficient of energy digestibility K_{SE} and digestible energy content SE - Tab. I). The best level of digestible energy was assessed in the two-row winter barley cultivar Marinka (89.2%) which differed highly significantly from the other entries evaluated. In feeding the grain of this cultivar the highest values of K_S (86.8%) were also determined, while considering the parameters of protein quality the best entry was the line of non-malting barley KM 1628 (BHV = 80.0 and NPU = 65.9). Among malting cultivars, Jarek and Ladik were much better than the control cultivar Akcent in these parameters (Tab. II). A number of significant relationships were found among the balance parameters investigated (Tab. IV). UP values were dependent on protein content ($r = 0.68xx$) which positively correlated with a level of K_S ($r = 0.53xx$). A highly significant correlation was also found between SE and K_S ($r = 0.74xx$), protein content and BHV ($r = 0.85xxx$) and NPU ($r = 0.73xx$). The entries tested differed not only in the content and feeding value of grain nutrients, but they also reached different levels of productivity (Tab. III). Considering grain yield as one of agronomic value parameters actual levels of feeding value parameters were partially confused (Figs 2 to 4) especially in high-yielding cultivars (Novum and Akcent). However, the grain yield itself within the whole set of entries evaluated did not significantly correlate with any of the parameters studied. The results obtained enabled us to screen the set of barleys depending on different purposes of their utilization. Fig. 1 illustrates the entries showing the best protein content and nutritional value which are suitable for special feeding diets. Taking into account both feeding value and grain productivity the best cultivar was winter barley Marinka. Ladik cultivar, malting spring barley, is expected to contribute to the combination of yield and grain energetic value. Jarek, Orbit and Sladko cultivars were intermediate in most parameters investigated. In contrast, cultivars of malting spring barley, Rubin and Perun, and new breeding lines of winter barley, KM 770 and KM 1490, showed the lowest level. The results confirmed the necessity and rightfulness of evaluating grain feeding value even in currently grown spring and winter barleys for effective differentiating the commercial end use of grain production.

76 Vannoordwijk, M.; Brouwer, G.; Koning, H.; Meijboom, F.W.; Grzebisz, W. (1994) PRODUCTION AND DECAY OF STRUCTURAL ROOT MATERIAL OF WINTER WHEAT AND SUGAR BEET IN CONVENTIONAL AND INTEGRATED CROPPING SYSTEMS. *Agriculture Ecosystems & Environment*. 51(1-2):99-113. English. [ICRAF SE ASIA POB 161 BOGOR 16001 INDONESIA].

Production of structural root material of sugar beet and winter wheat was quantified by analysis of root growth and decay in a time series of minirhizotron images, combined with a single auger sampling. Cumulative root production of winter wheat was about 1700 kg ha⁻¹ for conventional crop management and 1960 kg ha⁻¹ for integrated (less pesticides and mineral fertilizer, less intensive soil tillage and more organic manure) crop management; in 1990 the difference between the two management systems was statistically significant. At harvest time 85% and 68% (in 1986 and 1990, respectively) of this structural root production remained as intact roots in the soil in both management systems. For sugar beet total fine root production was estimated at 1150 kg ha⁻¹ in 1987 and 1989, with a significantly lower amount on the field on which minimum tillage was introduced in 1986; on average 47% of total root production remained as intact roots at harvest. Winter wheat root decay was studied with litter pots after crop harvest and in the following growing season. Initially, the N concentration in remaining roots increased while dry weight decreased. No net immobilisation or mineralisation of N and P during autumn was evident. During the next growing season net mineralisation was proportional to loss of root weight in an exponential decay with a half-life of 600 degree days (daily temperature sum). This N release pattern during the next growing period thus contributes to the synchrony between N demand and supply, but no difference between the two management systems was found. [References: 34].

77 Wang Fahong; Zhao Junshi (Shandong Provincial Academy of Agricultural Sciences, Jinan (China). Inst. of Crops); Qin Yueqiu (1993) Effect of density of winter wheat basic seedling on grain yield in condition of chemical manipulation. *Journal of Laiyang Agricultural College (China)* v. 10(3) p. 183-187. 2 tables, 10 ref. Chinese. (AGRI 94-115969).

78 Wang Wenhan; Peng Wenbo; Wang Xiangyang (Henan Agricultural Univ., Zhengzhou (China)) (1993) Effects of PP333 and its mixture with mineral elements on the resistance of lodging and the content of grain protein of winter wheat. *Plant Physiology Communications (China)* v. 29(5) p. 347-349. 4 tables, 8 ref. Chinese. (AGRI 94-115970).

79 Weber, Z.; Berger, D.A.; Shokes, F.M.; Barnett, R.D.; Wright, D.L. (1992) Mycoflora of seed from advanced wheat breeding lines in north Florida. *Proceedings (USA)* v. 51 p. 96-99. references. Meeting held Sept 25-27, 1991, Orlando, Florida. English. (AGRI 94-105936).

80 Winzeler, H.; Weilenmann, F.; Saurer, W.; Keller, B.; Winzeler, B. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Reckenholz (Switzerland)); Jaquiere, R. (Schweiz. Saatzuchtverband, Delley (Switzerland)) (1994) [Hubel, a new Swiss spelt variety (*Triticum spelta*)]. Hubel, eine neue schweizerische Dinkelsorte. *Agrar Forschung (Switzerland)* v. 1(7) p. 323-325. 4 tables, 1 photograph. German. (AGRI 94-105949).

81 Xie Zhuxin; Ding Shouren; Huang Jirong (Zhejiang Agricultural Univ., Hangzhou (China). Dept. of Agronomy) (1993) Selection of growth regulator formulations for stem growth manipulation in winter barley (*Hordeum sativum*). *Acta Agriculturae Zhejiangensis (China)* v. 5(4) p. 220-224. 1 ill., 3 tables, 6 ref. English. (AGRI 94-115988).

82 Zandstra, B.H.; Warncke, D.D. (1993) Interplanted barley and rye in carrots and onions. *HortTechnology (USA)* v. 3(2) p. 214-218. references. English. (AGRI 94-106160).

83 Zhang Guoping; Wang Zhongqi (Zhejiang Agricultural Univ., Hangzhou (China). Dept. of Agronomy) (1993) Studies on the cultural passway of increasing effective tiller percentage and single ear productivity in wheat. *Journal of Zhejiang Agricultural University (China)* v. 19(4) p. 373-377. 5 tables, 4 ref. Chinese. (AGRI 94-116061).

84 Zhao Guangcai (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Crop Breeding and Cultivation) (1993) Studies on plant

characters of main stem and tillers and tillers to rational use in winter wheat. *Journal of Laiyang Agricultural College (China)* v. 10(1) p. 5-11. 10 tables, 7 ref. Chinese. (AGRI 94-115968).

85 Zimmermann, G. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau, Freising Muenchen, Freising (Germany)); Strass, F. (1993) [Take care of production costs of wheat - Worthwhile intensification of cultivation not with every cultivar]. Denken Sie an die Kosten - Intensiver Anbau lohnt sich nicht mit jeder Weizensorte. *Bayerisches Landwirtschaftliches Wochenblatt (Germany)* v. 183(40) p. 50-51. 3 graphs. German. (AGRI 94-115974).

86 Zimmermann, H. (Verein zur Foerderung des Braugerstenanbaus Nord Ost e.V. (Germany)) (1994) [Trends of the cropping of malting barley in Germany: Maintain the malting barley market]. Tendenzen der Entwicklung des Braugerstenanbaus in Deutschland: Den Braugerstenmarkt erhalten. *Neue Landwirtschaft (Germany)* (no.1) p. 29-30. 1 ill., 2 tables. German. (AGRI 94-115945).

FO2 PLANT PROPAGATION

87 Chen Jichu; Wang Liufa (Academia Sinica, Shanghai (China). Shanghai Inst. of Plant Physiology) (1993) Some factors effecting isolation and culture of barley mesophyll protoplasts. *Plant Physiology Communications (China)* v. 29(6) p. 433-435. 4 ill., 8 ref. Chinese. (AGRI 94-116394).

88 Dimanov, D. (Institut za Introduksiya na Rastitelnite Genetichni Resursi, Sadovo (Bulgaria)) (1994) [Embryogenic calli induction and plant regeneration in wheat (*Triticum aestivum* L.) and rice (*Oryza sativa* L.) under unified culture conditions]. Embriogenno indutsirane na kalusi i regenerirane na rasteniyata pri pshenitsa (*Triticum aestivum* L.) i oriz (*Oryza sativa* L.) v unifikirani kulturalni usloviya. *Diagnosis Press Ltd., Sofia (Bulgaria). Biotechnologiya and Biotechnika (Bulgaria); Biotechnology and Biotechnological Equipment* v. 8(1) p. 44-49. 6 ill., 2 tables; 10 ref. English. (AGRI 94-106283).

A culture medium, inducing regenerative callus formation (medium 3) by cultures of mature and immature embryos of five wheat genotypes and mature embryos of two rice genotypes has been optimized. An unified culture medium for plant regeneration from callus of both wheat and rice species (medium 13) has been established. An efficient system for regenerative callus induction and subsequent plant regeneration from immature and mature embryos of five wheat genotypes has been developed.

89 Du Yongqin; Chen Rumei (Shanghai Municipal Academy of Agricultural Sciences, Shanghai (China). Inst. of Crop Breeding and Cultivation) (1993) A study on improving the frequency of green pollen plants in barley anther culture. *Journal of Shanghai Agricultural College (China)* v. 11(3) p. 237-242. 5 tables, 5 ref. Chinese. (AGRI 94-116393).

90 He, D.G.; Mouradov, A.; Yang, Y.M.; Mouradova, E.; Scott, K.J. (1994) TRANSFORMATION OF WHEAT (*TRITICUM AESTIVUM* L.) THROUGH ELECTROPORATION OF PROTOPLASTS. *Plant Cell Reports*. 14(2-3):192-196. English. [UNIV QUEENSLAND DEPT BIOCHEM BRISBANE QLD 4072 AUSTRALIA].

Protoplasts isolated from embryogenic suspension cultures of wheat (*Triticum aestivum* cv. Hartog) were electroporated in the presence of plasmid pEmuGN and/or pEmuPAT, which contained the reporter gene gus and selectable marker gene bar, respectively. Under optimized electroporation conditions, up to 0.9% of viable protoplasts displayed gus activity two days after electroporation. To select for phosphinothricin (PPT) resistant colonies, electroporated protoplasts were incubated for six weeks in a medium containing 10 µg/ml PPT. The cells surviving the selection were maintained as individual colonies on solid medium or as suspension cultures. More than 60% of these colonies exhibited tolerance to 40 µg/ml PPT when tested 10 months after initial selection. To date, 57 green plants have been regenerated from these colonies and 24 have been transferred to soil. Southern blot analyses of colonies and plants, using the bar gene sequence as the probe, confirmed transformation of the cells. Positive PAT assays of both regenerated colonies and plants indicated the presence of the bar gene product. These results provide a

basis for the establishment of routine procedures for transformation of wheat by direct gene transfer into protoplasts. [References: 32].

91 Jahne, A.; Becker, D.; Bretschneider, R.; Lorz, H. (1994) REGENERATION OF TRANSGENIC, MICROSPORE DERIVED, FERTILE BARLEY. *Theoretical & Applied Genetics*. 89(4):525-533. English. [UNIV HAMBURG INST ALLGEMEINE BOT OHNHORSTSTR 18 D-22609 HAMBURG GERMANY].

We have developed a system for the biolistic transformation of barley using freshly-isolated microspores as the target tissue. Independent transformation events led, on average, to the recovery of one plant per 1×10^7 bombarded microspores. Putative transformants have been regenerated using phosphinothricin as a selective agent. R(0) plants have been transferred to soil approximately 2 months after bombardment. Integration of the marker genes *bar* and *uidA* has been confirmed by Southern analysis. The marker genes are inherited in all progeny plants confirming the expected homozygous nature of the R(0) plants. [References: 41].

92 Jang, G.W. (Chungshun Junior College, Goksung (Korea Republic)); Min, K.S. (Chonnam National University, Kwangju (Korea Republic). College of Agriculture) (1993) Effects of plant growth substances on variation of chromosome number in callus cells derived from wheat (*Triticum aestivum* L.) leaf. *Korean Journal of Plant Tissue Culture (Korea Republic)* v. 20(2) p. 97-102. 1 illus.; 6 tables; 16 ref. Korean. (AGRI 94-106284).

93 Karabaeu, M.K.; Dzhardemaliev, Z.K. (1994) THE CULTURED CELLS OF WHEAT AND MAIZE - MORPHOGENESIS AND TOLERANCE. *Russian Journal of Plant Physiology*. 41(6):705-711. English. [NATL ACAD SCI KAZAKHSTAN AITKHOZHIN INST MOLEC BIOL & BIOCHEM UL MICHURINA 86 ALMATY 480012 KAZAKHSTAN].

New methodological approaches to culturing the cells of wheat (*Triticum aestivum* L.) and maize (*Zea mays* L.) were advanced. These approaches comprise the alternation of nutrient media differing in hormonal composition and the reduction of the time periods between passages. This allowed considerable prolongation of the ability of long-term cultured calluses to plant regeneration. The production of suspension cultures enriched in embryogenic cells capable of regeneration became possible. From these suspensions the isolated protoplasts of wheat and maize that regenerated whole plants were obtained. A polypeptide characteristic of *in vitro* morphogenesis of cereals was found. An *in vitro* response of wheat cells to space flight was studied. When the flight lasted longer than 10 days, the population was characterized by the predominance of cells tolerant to some stresses, pathotoxin-induced stress in particular. [References: 16].

94 Kromer, S.; Lernmark, U.; Gardstrom, P. (1994) *IN VIVO* MITOCHONDRIAL PYRUVATE DEHYDROGENASE ACTIVITY, STUDIED BY RAPID FRACTIONATION OF BARLEY LEAF PROTOPLASTS. *Journal of Plant Physiology*. 144(4-5):485-490. English. [UMEA UNIV DEPT PLANT PHYSIOL S-90187 UMEA SWEDEN].

Inactivation and activation of mitochondrial and chloroplastic pyruvate dehydrogenase (PDH; EC 1.2.4.1) have been studied in isolated organelles and protoplasts from barley leaves. The pyruvate dehydrogenase complex (PDC) from barley leaf mitochondria was inactivated by ATP (65% at 4 mM ATP) while the chloroplastic PDC was stimulated (75% at 4 mM ATP). $MgCl_2$ inhibited the mitochondrial complex with increasing concentrations while the chloroplastic complex was stimulated. $MnCl_2$ had a stimulatory effect on both PDCs. ATP-inactivated mitochondrial PDC could be reactivated by $MnCl_2$, but not by $MgCl_2$ or $CaCl_2$. The major part of the PDC was located in the chloroplast. The *in vivo* mitochondrial PDC activity could be determined after removal of the chloroplastic isoform by subcellular fractionation. This activity was sensitive to ATP inhibition confirming the mitochondrial origin. The *in vivo* PDC activity as well as the ATP sensitivity did not change when protoplasts were incubated in darkness or illuminated in photorespiratory or non-photorespiratory conditions. This was taken as an indication of an unchanged activation state of the enzyme under the conditions tested. [References: 25].

95 Molnarlang, M.; Sutka, J. (1994) THE EFFECT OF TEMPERATURE ON SEED SET AND EMBRYO DEVELOPMENT IN RECIPROCAL

CROSSES OF WHEAT AND BARLEY. *Euphytica*. 78(1-2):53-58. English. [HUNGARIAN ACAD SCI AGR RES INST POB 19 H-2462 MARTONVASAR HUNGARY].

The effect of temperature on seed set and embryo development in reciprocal crosses of barley and wheat was assessed in crosses involving two spring barley varieties (Betzes, Martonvasari 50) and one wheat variety (Chinese Spring). Detached tillers placed in nutrient solution were pollinated in controlled oiled environments at constant day-night temperature regimes (12, 15, 18 and 21 degrees C) with a light intensity of 30,000 lux and a relative humidity of 80%. When barley was used as the female, lower temperatures (12 and 15 degrees C) produced the maximum seed set, whereas for the reciprocal cross, the highest temperature (21 degrees C) produced the best seed set in the Chinese Spring x Betzes combination. Low temperature retarded the embryo development. The highest numbers of hybrid plants were produced at 18 degrees C and 21 degrees C in the barley x wheat cross and in the wheat x barley cross, respectively. Embryos of about 1.5 mm length in the barley x wheat cross, and of about 1.0 mm length in the wheat x barley cross germinated successfully. The smallest embryo giving rise to hybrid plants was 0.57 mm in the barley x wheat cross and 0.51 mm in the wheat x barley cross. [References: 30].

96 Mouritzen, P.; Holm, P.B. (1994) CHLOROPLAST GENOME BREAKDOWN IN MICROSPORE CULTURES OF BARLEY (*HORDEUM VULGARE* L.) OCCURS PRIMARILY DURING REGENERATION. *Journal of Plant Physiology*. 144(4-5):586-593. English. [CARLSBERG RES LAB 10 GL CARLSBERG VEJ DK-2500 COPENHAGEN DENMARK].

Southern blot analyses of DNA from microspore cultures of the barley variety Alexis suggested that plastid genome deletions/rearrangements causing albinism occur primarily during regeneration. The Alexis variety responded to microspore culture largely by production of ill-defined embryoids and callus from which plants could be regenerated with a low frequency. Only 0.06 green and 0.61 albino plants were regenerated per anther in contrast to the Igri variety, which formed well-defined embryoids that readily regenerated 11.7 green and 0.1 albino plants per anther. In Alexis, the plastid genomes appeared to remain intact during the microspore culture but started to break down in the structures that underwent regeneration. This development accelerated in parallel with differentiation and leaf formation. In Igri microspore cultures, callus and albino plant formation could be induced by elevated temperatures and in particular during the first 10 days of culture and during the regeneration phase. [References: 36].

97 Pauk, J.; Kertesz, Z.; Jenes, B.; Purnhauser, L.; Manninen, O.; Pulli, S.; Barabas, Z.; Dudits, D. (1994) FERTILE WHEAT (*TRITICUM AESTIVUM* L.) REGENERANTS FROM PROTOPLASTS OF EMBRYOGENIC SUSPENSION CULTURE. *Plant Cell Tissue & Organ Culture*. 38(1):1-10. English. [CEREAL RES INST DEPT WHEAT GENET & BREEDING POB 391 H-6701 SZEGED HUNGARY].

We report regeneration of fertile, green plants from wheat (*Triticum aestivum* L. cv. Aura) protoplasts isolated from an embryogenic suspension initiated from somatic early-embryogenic callus. The present approach combines the optimization of protoplast culture conditions with screening for responsive genotypes. In addition to the dominant effect of the culture media, the increase in fresh mass and the embryogenic potential of somatic callus cultures varied considerably between the various genotypes tested. Establishment of suspension cultures with the required characters for protoplast isolation was improved by reduction of the ratio between cells and medium and by less frequent (monthly) transfer into fresh medium. A new washing solution was introduced to avoid the aggregation of protoplasts. However, the influence of the culture medium on cell division was variable in the different genotypes. We could identify cultures from cultivar Aura that showed approximately a 9% cell division frequency and morphogenic response. The protoplast-derived microcolonies formed both early and late-embryogenic callus on regeneration medium and green fertile plants were obtained through somatic embryogenesis. The reproducibility of plant regeneration from protoplast culture based on the cultivar Aura was demonstrated by several independent experiments. The maintenance of regeneration potential in Aura suspension cultures required establishment of new cultures within a 9-month period. [References: 40].

98 Pickering, R.A.; Wallace, A.R. (1994) GIBBERELIC ACID PLUS 2, 4-D IMPROVES SEED QUALITY IN HORDEUM VULGARE L X H. BULBOSUM L CROSSES. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 113(2):174-176. English. [NEW ZEALAND INST CROP & FOOD RES LTD PRIVATE BAG 4704 CHRISTCHURCH NEW ZEALAND].

Doubled haploid production from crosses between barley (*Hordeum vulgare* L.) and *H. bulbosum* L. is a well established technique for inducing homozygosity. One problem which occurs using certain barley cultivars is premature seed degeneration. In this paper, a post-pollination spray of gibberellic acid and 2, 4-dichlorophenoxyacetic acid that delays the onset of senescence is described. The technique improved the number of high quality seeds to more than 75 % of the seed set. This improvement should result in increased survival of embryos for culture and subsequent plant regeneration. [References: 5].

99 Pijnacker, L.P.; Ferwerda, M.A. (1994) SISTER CHROMATID EXCHANGES IN CULTURED IMMATURE EMBRYOS OF WHEAT SPECIES AND REGENERANTS. *Theoretical & Applied Genetics*. 89(2-3):287-292. English. [UNIV GRONINGEN CTR BIOL SCI DEPT GENET POB 14 9750 AA HAREN NETHERLANDS].

Immature embryos of *Triticum aestivum* (ten cultivars and lines), *T. durum*, *T. dicoccum* and *T. monococcum* were cultured in vitro on MS medium supplemented with 1 or 2 mg/l of 2, 4-D and 20 or 30g/l of sucrose for 3 days and processed to score sister chromatid exchanges (SCEs) per chromosome. Media components affect DNA replication from the start of the culture. The SCE frequencies were dependent on the genotype and were not correlated with the degree of ploidy. They increased after doubling of the concentration of 2, 4-D and/or sucrose, except in one cultivar of *T. aestivum*. The mean numbers were lower than observed in root meristems of *T. aestivum* (two cultivars) and *T. dicoccum*. Immature embryos of regenerants of *T. aestivum* (one cultivar) and *T. durum* demonstrated variable SCE frequencies, which may have been caused by mutations in the parental cell cultures. In the *T. aestivum* embryos the lowest frequencies were found in regenerants obtained from explants with the highest frequencies. [References: 33].

100 Wang Junhui; Zheng Yong; Huang Chunong (Hangzhou Univ., Zhejiang (China). Dept. of Biological Science and Biotechnology) (1994) Tissue culture and plantlet regeneration from young roots of *Hordeum vulgare*. *Plant Physiology Communications (China)* v. 30(1) p. 30-31. Chinese. (AGRIS 94-116395).

101 Xiang Youbin; Liu Jing (Zhejiang Provincial Academy of Agricultural Sciences, Hangzhou (China). Biotechnology Research Center); Ruan Yili (1993) Establishment of embryogenic cell suspension culture embryos of barley. *Acta Agriculturae Zhejiangensis (China)* v. 5(4) p. 213-219. 1 ill., 3 tables, 16 ref. Chinese. (AGRIS 94-116392).

102 Zaghmout, OMF. (1994) TRANSFORMATION OF PROTOPLASTS AND INTACT CELLS FROM SLOWLY GROWING EMBRYOGENIC CALLUS OF WHEAT (TRITICUM AESTIVUM L). *Theoretical & Applied Genetics*. 89(5):577-582. English. [USDA ARS BOX 215 ROUTE 3 LUBBOCK, TX 79401 USA].

A procedure for culturing protoplasts from slowly growing embryogenic calli of wheat was developed. The procedure was dependent on the ability to isolate large numbers of culturable protoplasts from slowly growing embryogenic callus. Approximately 68% of the isolated protoplasts divided, and 22% formed colonies; of the latter, 67% continued to proliferate. Plating efficiency was reduced when protoplasts were transformed by polyethylene glycol, electroporation, and/or *Agrobacterium*. Intact cells were also directly transformed by electroporation. Direct electroporation of the *Agrobacterium* binary vector into intact cells resulted in a significant increase of GUS activity over the control. [References: 20].

103 Zhang Genfa (Henan Normal Univ., Xinxiang (China). Dept. of Biology); Huang Baiqu (1993) Regenerated plantlets from the protoplasts of suspension cells in wheat embryo. *Plant Physiology Communications (China)* v. 29(5) p. 344-346. 7 ill., 10 ref. Chinese. (AGRIS 94-116400).

F03 SEED PRODUCTION

104 Gao Shumin; Li Fayu; Fan Xinmin (Shihezi Agricultural Coll., Xinjiang (China). Dept. of Horticulture and Forestry) (1993) Efficiency of three liquid growing media in fungi spawn production of *Pleurotus ostreatus*, *Lentinus edodes* and *Hericium erinaceus*. *Edible Fungi (China)* v. 15(6) p. 17. 2 tables. Chinese. (AGRIS 94-116469).

105 Lira Ibarra, Manuel (Programa Agrícola en el Estado de Sonora. Hermosillo, Sonora (Mexico)) (1992) [Seed certification: its role and essential components]. *Certificación de semillas, su papel y componentes esenciales. Primera conferencia nacional sobre la producción de trigo en México. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en México. (1, 1988, Cd. Obregon, Son.) (Memoria). Publicación Especial. Centro de Investigación Regional del Noroeste (Mexico); no. 4 p. 471-479. Centro de Investigación Regional del Noroeste. 2o. tomo. Spanish. (AGRIS 94-116451).*

106 Palumbo, M.; Boggini, G. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) [Rule of the certified seed on the productivity and quality of hard wheat]. *Ruolo del seme certificato sulla produttività e sulla qualità del frumento duro. Informatore Agrario (Italy)* v. 50(21) p. 27-30. 5 tables. Italian. (AGRIS 94-106369).

107 Schauder, A. (Bonn Univ. (Germany). Inst. fuer Organischen Landbau); Dornbusch, C.; Piort, H.P.; Koepke, U. (1993) [Monitoring of seed quality from winter wheat in organic farming]. *Qualitätsmonitoring von Winterweizen im Organischen Landbau. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 165-168. VDLUFA. 3 ill., 1 table; 5 ref. German. (AGRIS 94-106367).*

108 Singh, D.; Singh, D. (Punjab Agricultural University, Ludhiana (India)) (1992) Effect of seed treatment with aldrin and fertilizer use on growth and yield of rainfed wheat. *Journal of Research Punjab Agricultural University (India)* v. 29(2) p. 187-191. 2 tables; 1 ill., 4 ref. English. (AGRIS 94-106368).

109 Winter, W. (1994) [Seed treatment: progress and prospects]. *Saatgutbehandlung: Fortschritte und Aussichten. Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Reckenholz (Switzerland). Agrar Forschung (Switzerland)* v. 1(7) p. 333-334. 2 photographs. German. (AGRIS 94-106371).

F04 FERTILIZING

110 Aggarwal, G.C.; Sidhu, A.S.; Singh, N.T.; Sur, H.S. (Punjab Agricultural University, Ludhiana (India). Department of Soils) (1992) Effect of urea application method and depth of supplemental presowing irrigation on wheat. *Journal of Research Punjab Agricultural University (India)* v. 29(2) p. 195-197. 2 tables; 5 ref. English. (AGRIS 94-106545).

111 Ahmed, A.A. (Monoufeya Univ., Shebin El Kom (Egypt). Faculty of Agriculture) (1994) Productivity of some wheat cultivars in reclaimed desert land under different N and P fertilization levels. *Monoufeya Journal of Agriculture Research (Egypt)* v. 19(1) p. 125-138. 1 ill., 4 tables; 17 ref. English. (AGRIS 94-106544).

112 Bautista Relloso, J.; Iruretagoyena, A.; Garcia, T.; Ritter, E. (1994) [Agricultural use of sludge from agroindustrial companies]. *Aprovechamiento agrario de lodos procedentes de empresas agroalimentarias. Sustrai (España)* (no. 32) p. 51-53. 2 tab., 2 fig. Spanish. (AGRIS 94-116484).

113 Boettger, W. (Landwirtschaftskammer Hannover, Nienburg (Germany). Pflanzenschutzamt. Bezirksstelle); Kettel, M.; Schumann, A.; Burdorf, D. (1994) [Wheat - What can stop fungal infestation]. *Weizen - Was den Pilzbefall hemmt DLG-Mitteilungen (Germany)* v. 109(4) p. 18-22. 3 ill., 3 tables. German. (AGRIS 94-106492).

114 Bolland, MDA. (1994) RESIDUAL VALUE OF SUPERPHOSPHATE FOR OAT AND BARLEY GROWN ON A VERY SANDY, PHOSPHORUS LEACHING SOIL. *Fertilizer Research*. 38(3):171-181. English. [WESTERN AUSTRALIA DEPT AGR 3 BARON HAY COURT S PERTH WA 6151 AUSTRALIA].

In a field experiment in a Mediterranean climate (474 mm annual rainfall, 325 mm (69%) falling in the May to October growing season) on a deep sandy soil near Kojaneerup, south-western Australia, the residual value of superphosphate was measured relative to freshly-applied superphosphate. The grain yield of five successive crops (1988-1992) was used to measure the residual value: barley (*Hordeum vulgare*), barley, oat (*Avena sativa*), lupin (*Lupinus angustifolius*), and barley. There was no significant yield response to superphosphate applied to the first crop (barley, cv. Moondyne). There was no results for the second crop (barley) due to weeds or the fourth crop (lupin) due to severe wind erosion which damaged the crop. The residual value of superphosphate was measured using grain yields of the third crop (oat, cv. Mortlock) for superphosphate applied one and two years previously, and the fifth crop (barley, cv. Onslow) for superphosphate applied one, two, three and four years previously. In February 1992, before sowing the fifth crop, soil samples were collected to measure bicarbonate-extractable phosphorus (P) (soil test P) which was related to the subsequent grain yields of that crop. This relationship is the soil test P calibration used to estimate the current P status of soils when providing P fertilizer recommendations. The residual value of superphosphate declined markedly. For the third crop (oat), it was 6% as effective as freshly-applied superphosphate one year after application, and 2% as effective two years after application. For the fifth crop (barley), relative to freshly-applied superphosphate, the residual value of superphosphate in successive years after application was 46%, 6%, 3% and 2% as effective. The soil has a very low capacity to sorb P, and P was found to leach down the soil profile. The largest yield for P applied one and two years previously in 1990, and two, three and four years previously in 1992, was 35 to 50% lower than the maximum yield for freshly-applied P. Soil test P was very variable (coefficient of variation was 32%) and mostly less than 8 mg P/g soil. The calibration relating yield (y axis) to soil test P (x axis) differed for soil treated with superphosphate one year previously compared with soil treated two, three and four years previously. The top 10 cm of soil was used for soil P testing, the standard depth. P was leached below this depth but some of the P leached below 10 cm may still have been taken up by plant roots. Consequently soil test P underestimated the P available to plants in the soil profile. The soil test P calibration therefore provided a very crude estimate of the current P status of the soil.

115 Chen Peiyu; Zhang Shunquan (Haining Municipal Station of Soil and Fertilizers, Zhejiang (China)) (1993) A discussion about twice fertilization of barley. *Soils and Fertilizers (China)* (no. 6) p. 34-36. 4 tables. Chinese. (AGRIS 94-116554).

116 Chen Xueliu; Wang Zhifen; Yu Meiyuan (Shandong Provincial Academy of Agricultural Sciences, Jinan (China). Inst. of Atomic Energy) (1993) The effect of application of organic and chemical fertilizers on the translocation and distribution of photosynthetic product and the absorption and utilization of phosphorus for high-yielding wheat. *Soils and Fertilizers (China)* (no. 5) p.8-11, 14. 6 tables. Chinese. (AGRIS 94-116623).

117 Cheng Liqun (Xinxiang Municipal Station of Soil and Fertilizers, Henan (China)) (1993) Effect of K-fertilizer application on wheat growth in Northern Henan, China. *Acta Pedologica Sinica (China)* v. 30(2) p. 217-219. 3 tables. Chinese. (AGRIS 94-116628).

118 Engel, RE.; Eckhoff, J.; Berg, RK. (1994) GRAIN YIELD, KERNEL WEIGHT, AND DISEASE RESPONSES OF WINTER WHEAT CULTIVARS TO CHLORIDE FERTILIZATION. *Agronomy Journal*. 86(5):891-896. English. [MONTANA STATE UNIV SO AGR RES CTR HUNTLEY, MT USA].

Wheat yields in the Great Plains are frequently improved by potash (0-0.60 N-P-K) application on soils with seemingly abundant supplies of available K. The Cl component in this fertilizer may cause many of the observed yield responses. Field research was undertaken to determine the effects of Cl on grain yield, plant Cl, kernel weight and growth rate, and

foliar disease and/or disease-like symptoms of winter wheat cultivars. Two sites with five Cl levels (0, 22, 45, 90, and 135 kg ha⁻¹) and two cultivars (Redwin, Cree) were used in 1988. Seven sites with two Cl levels (0 and 45 kg ha⁻¹) and six cultivars (Redwin, Cree, Weston, Manning, QT542, Neeley) were used from 1991 to 1992. Chloride increased yield by an average of 267 kg ha⁻¹ (7%) at seven responsive sites. Size of yield response to Cl was generally not affected by cultivar selection, but differed greatly with location. Whole-plant Cl analyses were useful in discriminating between yield responsive (less-than-or-equal-to 3.0 g kg⁻¹) and nonresponsive (>3.0 g kg⁻¹) sites to Cl fertilization. Improved Cl nutrition enhanced plant development, increase immature kernel weights, and accelerated kernel growth during the grain-fill period. Fertilizer Cl increased mature kernel weights, up to 17%, at eight sites. Kernel weight was the most important yield component affected by Cl. Physiological leaf spot in Redwin and Manning, flag leaf sequence in Weston and QT542, powdery mildew (*Erysiphe graminis* DC. f. sp. tritici Em. Marchal), and leaf rust (*Puccinia recondita* Roberge ex Desmaz. f. sp. tritici) were suppressed by fertilizer Cl. These phenomena may explain in part the yield responses to Cl; however, yield response to Cl occurred even without foliar disease and disease-like suppression. [References: 19].

119 Gama Danba (Shannan Regional Bureau of Agricultural and Animal Husbandry, Xizang (China)); Kang Yuncheng (1993) The influence of nitrogen fertilizers on the yield of highland barley. *Soils and Fertilizers (China)* (no. 6) p. 18-20. 3 tables. Chinese. (AGRIS 94-116553).

120 Guenther Borstel, O. (Kiel Univ. (Germany). Inst. fuer Pflanzenbau und Pflanzenzuechtung); Finck, M.; Hanus, H. (1993) [N-dynamics in soil and N-uptake from winter wheat, winter barley and winter rape in special consideration of inorganic N-fertilization and slurry fertilization - Test of a balance (results from the Special Research Field 192)]. N-Dynamik im Boden und N-Aufnahme von Winterweizen, Wintergerste und Winterraps unter besonderer Beruecksichtigung von mineralischer Stickstoff- und Guelleduengung - Versuch einer Bilanzierung (Ergebnisse aus dem SFB 192). 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). *VDLUFA-Schriftenreihe (Germany)*; no. 37 p. 125-128. VDLUFA. 2 tables; 5 ref. German. (AGRIS 94-106505).

121 Harris, GH.; Hesterman, OB.; Paul, EA.; Peters, SE.; Janke, RR. (1994) FATE OF LEGUME AND FERTILIZER NITROGEN-15 IN A LONG-TERM CROPPING SYSTEMS EXPERIMENT. *Agronomy Journal*. 86(5):910-915. English. [UNIV GEORGIA POB 1209 TIFTON, GA 31793 USA].

Relying more on biological N₂ fixation has been suggested as a way to meet one of the major challenges of agricultural sustainability. A N-15 study was conducted to compare the fate of applied legume and fertilizer N in a long-term cropping systems experiment. Nitrogen-15-labeled red clover (*Trifolium pratense* L.) and (NH₄)₂SO₄ were applied to microplots within the low-input and conventional cropping systems of the Farming Systems Trial at the Rodale Institute Research Center in Pennsylvania. The N-15 was applied to soil and traced into corn (*Zea mays* L.) in 1987 and 1988. Residual N-15 was also traced into second-year spring barley (*Hordeum vulgare* L.). Legume and fertilizer N-15 remaining in soil was measured and loss of N was calculated by difference. More fertilizer than legume N was recovered by crops (40 vs. 17% of input), more legume than fertilizer N was retained in soil (47 vs. 17% of input), and similar amounts of N from both sources were lost from the cropping systems (39% of input) over the 2-yr period. More fertilizer than legume N was lost during the year of application (38 vs. 18% of input), but more legume than fertilizer N was lost the year after application (17 vs. 4% of input). Residual fertilizer and legume N-15 was distributed similarly among soil fractions. Soil microbial biomass was larger in the legume-based system. A larger, but not necessarily more active, soil microbial biomass was probably responsible for the greater soil N supplying capacity in the legume-based compared with fertilizer-based system. [References: 30].

122 Jin Shaoling; Ma Yongtai (Gansu Provincial Academy of Agricultural Sciences, Lanzhou (China). Inst. of Soil and Fertilizers) (1993) A study on the results of potassium dihydrogen phosphate foliar application for wheat. *Soils and Fertilizers (China)* (no. 3) p. 16-19. 5 tables. Chinese. (AGRIS 94-116620).

123 Justes, E.; Mary, B.; Meynard, J.M.; Machet, J.M.; Thelierhuche, L. (1994) DETERMINATION OF A CRITICAL NITROGEN DILUTION CURVE FOR WINTER WHEAT CROPS. *Annals of Botany*. 74(4):397-407. English. [INRA AGRON STN BP101 F-02004 LAON FRANCE].

A set of N-fertilization field experiments was used to determine the 'critical nitrogen concentration', i.e. the minimal concentration of total N in shoots that produced the maximum aerial dry matter, at a given time and field situation. A unique 'critical nitrogen dilution curve' was obtained by plotting these concentrations N(et) (% DM) vs. accumulated shoot biomass DM (t ha⁻¹). It could be described by the equation: $N(et) = 5.35 DM^{-0.442}$ when shoot biomass was between 1.55 and 12 t ha⁻¹. An excellent fit was obtained between model and data ($r^2 = 0.98$, 15 d.f.). A very close relationship was found using reduced N instead of total N, because the nitrate concentrations in shoots corresponding to critical points were small. The critical curve was rather close to those reported by Greenwood et al. (1990) for C3 plants. However, this equation did not apply when shoot biomass was less than 1.55 t ha⁻¹. In this case, the critical N concentration was independent of shoot biomass: the constant critical value $N(er) = 4.4\%$ is suggested for reduced-N. The model was validated in all the experimental situations, in spite of large differences in growth rate, cultivar, soil and climatic conditions; shoot biomass varying from 0.2 to 14 t ha⁻¹. Plant N concentration was found to vary by a factor of four at a given shoot biomass level. In the heavily fertilized treatments, shoot N concentration could be 60% higher than the critical concentration. Most (on average 80%) of the extra N accumulated was in the form of reduced N. The proportion of nitrate to total N in shoot mainly depended on the crop stage of development. It was independent of the nitrogen level. [References: 47].

124 Kurpjuweit, H. (1994) [A new program for EDP-fertilization advisory]. Ein neues Programm zur EDV-Duengeberatung: Fruchtfolgeduengeplan. *Neue Landwirtschaft (Germany) (no.1)* p. 39-41. 2 tables. German. (AGRIS 94-116555).

125 Liu Wenge (Chinese Academy of Agricultural Sciences, Zhengzhou (China). Inst. of Pomology); Li Zuyin (1993) Effects of morphological transformation of phosphate fertilizer in limy soil and time of its application on fertilizer efficiency. *Chinese Journal of Soil Science (China)* v. 24(4) p. 154-157. 1 ill., 5 tables 14 ref. Chinese. (AGRIS 94-116546).

126 Lonhardbory, E.; Nemeth, I. (1994) EFFECT OF N-FERTILIZATION ON THE SEASONAL DYNAMICS OF LEAF AREA AND YIELD IN WHEAT. *Novenytermeles*. 43(4):317-325. Hungarian. [PANNON UNIV AGR SCI DEAK FERENC U 16 H-8360 KESZTHELY HUNGARY].

The effect of N fertilization on seasonal dynamics of wheat leaf area, LAI, LAD and through these values on the development of yield was studied in 1991 at Keszthely on Ramann's brown forest soil, at Szentgyorgyvölgy on pseudogley brown forest soil. In the experiment four N-levels (87, 174, 261, 348 kg/ha) were included. In addition to the N-doses each plot received basic fertilizer of 140 kg/ha P₂O₅ + 140 kg/ha K₂O active agent. The leaf area was measured by apparatus type LI-3000. The N fertilizer increased significantly the individual leaf area (LA) at each date of measurements. At Keszthely the correlation between the N-dose and the individual leaf area could be characterized by the function $y = a + bx + cx^2$, while at Szentgyorgyvölgy by function $y = a + bx$. Authors assume that these functions can be explained by the different N-demand and different climatic conditions of the two sites. As the N-doses increased there was a parallel rise in LAI and LAD values. A close positive linear correlation was observed between LA(max) and ear mass, LAD and ear mass. At Keszthely the r values of the correlations between LA(max) and ear mass at the four sampling dates were 0, 99***, 0, 96**, 0, 99***, at Szentgyorgyvölgy 0, 94**, 0, 83*, 0, 92*, 0, 86*. The r values of correlation between integrated leaf area (LAD) and ear mass were the followings: at Keszthely 0, 89***, 0, 91, 0, 99, 0, 98***, at Szentgyorgyvölgy 0, 92**, 0, 88*, 0, 94**, 0, 92*.

127 Lorenz, F. (1992) [Effect of slurry application with additional inorganic-N-fertilizer application on achievement optimum yields on the condition of low nitrate loss]. Guelleduengung mit ergaenzenden Mineral-N-Gaben zur Erzielung optimaler Ertraege bei niedrigem Nitrataustrag. *Goettingen Univ. (Germany). Inst. fuer Bodenwissenschaften. Goettinger bodenkundliche Berichte (Germany); no. 99*

172 p. Selbstverlag. 26 ill., 52 tables. Bibliography 158 ref. German. (AGRIS 94-106407).

128 Megalah, S.S.; Abd El Maksoud, M.M.R.; Abd El Nour, A.S. (Ministry of Agriculture, Cairo (Egypt). Soils and Water Research Inst.) (1993) Effect of nitrogen-iron fertilizers, irrigation intervals and soil type on mineral content of wheat. *Menoufiya Journal of Agricultural Research (Egypt)* v. 18(3) p. 1815-1826. 4 tables; 16 ref. English. (AGRIS 94-106496).

129 Peng Zhiyun; Wang Chenglan; Chen Zhiye (Wuwei Regional Station of Soil and Fertilizers, Gansu (China)) (1993) Optimized fertilization pattern for spring wheat in Gansu, China. *Chinese Journal of Soil Science (China)* v. 24(2) p. 71-73. 5 tables, 4 ref. Chinese. (AGRIS 94-116545).

130 Peretzki, F. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau Freising Muenchen, Freising (Germany)) (1994) [Slurry injection into the soil during hoeing]. Guelle beim Hacken einbringen? *DLG-Mitteilungen (Germany)* v. 109(2) p. 21. 1 ill. German. (AGRIS 94-106491).

131 Robinson, D.; Linehan, D.J.; Gordon, D.C. (1994) CAPTURE OF NITRATE FROM SOIL BY WHEAT IN RELATION TO ROOT LENGTH, NITROGEN INFLOW AND AVAILABILITY. *New Phytologist*. 128(2):297-305. English. [SCOTTISH CROP RES INST DEPT CELLULAR & ENVIRONM PHYSIOL SOIL PLANT DYNAM GRP DUNDEE DD2 5DA SCOTLAND].

We studied the interactions between nitrogen (N) inflow (uptake rate per unit root length) and root growth in the capture of nitrate by soil-grown wheat (*Triticum aestivum* L. cv. Wembley). [N-15]-nitrate was applied locally to soil overlying seminal roots of 42-d-old plants that had previously received N fertilizer (N+) or not (N0). [S-35]-sulphate was also applied to check the specificity of the plant's responses to nitrate. N0 plants had exhausted soil nitrate by day 42. Over the next 7 d, inflow was stimulated in soil to which [N-15]-nitrate was supplied in the N0 plants. N0 plants increased their root length densities throughout the root system, not only around the point of [N-15]-nitrate application. Root length density did not change in the N+ plants. N0 plants captured 73 % of the [N-15]-nitrate in 7 d; N+ plants captured only 13 %. There was no evidence that the plants' responses to the localized application of nitrate had an effect on the uptake of sulphate. The dominant influence on the capture of nitrate was inflow, rather than root growth. [References: 28].

132 Scharf, H. (Halle Wittenberg Univ., Halle (Germany). Inst. fuer Allgemeinen Pflanzenbau (Ackerbau)); Klum, S.; Huelsbergen, K. J. (1993) [Effect of combined organic-inorganic fertilization on selected constituents of potatoes, winter wheat and annual ryegrass]. Wirkung kombinierter organisch-mineralischer Duengung auf ausgewaehlte Inhaltsstoffe von Kartoffeln, Winterweizen und Einjaehrigen Weidelgras. 105. VDLUFA-Kongress: Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). *VDLUFA-Schriftenreihe (Germany); no. 37* p. 169-172. VDLUFA. 3 ill., 1 table; 7 ref. German. (AGRIS 94-106550).

133 Singh, B.R. (1994) EFFECT OF SELENIUM-ENRICHED CALCIUM NITRATE, TOP-DRESSED AT DIFFERENT GROWTH STAGES, ON THE SELENIUM CONCENTRATION IN WHEAT. *Fertilizer Research*. 38(3):199-203. English. [AGR UNIV NORWAY DEPT SOIL & WATER SCI POB 28 N-1432 AS NORWAY].

A greenhouse experiment was conducted to evaluate the effect of Se contained in calcium nitrate, top-dressed at different growth stages, on the Se concentration in wheat (*Triticum aestivum* L.). Selenium as sodium selenate was added to Ca (NO₃)₂ and NPK (21-4-10) during the manufacturing process. A silty clay soil with soil pH of 6.1 was used. For selenium treatments incorporated in Ca(NO₃)₂ were top-dressed at both the tillering and heading growth stages at rates of 0, 15, 30, and 45 mg kg⁻¹ of Ca(NO₃)₂ fertilizer equivalent to about 0, 0.003, 0.007, 0.01 mg Se kg⁻¹ soil, respectively. A fifth treatment of 20 mg Se kg⁻¹ of NPK (21-4-10%) equivalent to 0.007 mg Se kg⁻¹ soil was basal dressed at the time of sowing. Calcium nitrate with or without Se was top-dressed at the rate of 35 mg N kg⁻¹. In addition all pots received a basal dose of N at the rate of 70 mg N kg⁻¹ through a NPK(21-4-10) fertilizer. The Se-enriched Ca(NO₃)₂ increased the uptake and concentration of Se in wheat significantly ($\rho > 0.05$) with increasing concentration of Se in the fertilizer applied. The

Se concentration in wheat grain increased from <1.1 to 468 µg Se kg⁻¹ in the first year when the concentration in the Se-enriched Ca (NO₃)₂ was increased from 0 to 45 mg Se kg⁻¹ but the corresponding increase in the second and third year was lower. The Se concentration in the grain was more than twice of that in the straw. The uptake and concentration of Se in wheat, except in the second year, was generally higher when Se was top-dressed at heading as compared to that when it was top-dressed at tillering but the concentration differences between time of application were not statistically significant ($\rho > 0.05$). Basal application of Se-enriched NPK (0.007 mg Se kg⁻¹ soil) was only half as effective as an equivalent rate of Se in top-dressed Se-enriched Ca(NO₃)₂ in increasing the Se concentration in wheat and the concentration levels among these treatments were significantly ($\rho > 0.01$) different. It was concluded that topdressing of Se-enriched Ca(NO₃)₂ at 30 mg Se kg⁻¹ is an effective method of application to increase the Se concentration in wheat grain to a level, > 100 µg kg⁻¹ dry matter, considered adequate for human consumption.

134 Sommer, K. (Bonn Univ. (Germany). Agrikulturchemisches Inst.); Fischer, D. von (1993) [Results from crop rotation studies of 6 years: N-fertilization of sugar beets, winter wheat and winter barley to "CULTAN"-procedure (CULTAN: Controlled Uptake Long Term Ammonium Nutrition)]. Ergebnisse aus 6-jährigen Fruchtfolgeversuchen: Z-Rüben, W-Weizen und W-Gerste bei einer N-Düngung nach dem "CULTAN"-Verfahren. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 75-78. VDLUFA. 4 tables; 4 ref. German. (AGRI 94-106605).

135 Sun Xue (Ningbo Municipal Bureau of Agriculture and Water Conservancy, Zhejiang (China)); Chen Jialong (1994) Study on the effects of fertilizer application on soil fertility and yield increase. *Soils and Fertilizers (China)* (no. 1) p. 20-22. 3 tables. Chinese. (AGRI 94-116604).

136 Tanacs, L.; Matuz, J.; Gero, L.; Kovacs, K. (1994) EFFECT OF NPK FERTILIZATION AND YEAR ON THE VALORIGRAPHIC QUALITY OF WHEAT VARIETIES. *Novenytermeles*. 43(3):195-203. Hungarian. [UNIV HORT & FOOD IND FAC FOOD IND SZEGED HUNGARY].

The valorigraphic parameters (valorigraphic index, water absorption capacity, dough development time, stability, softening, extension) of grain yield of two winter wheat varieties were studied for 2 years in an NPK fertilization experiment set up at the Trial Station of the Cereal Research Institute at Fulopzallas on highly calcareous meadow soil rich in humus. Based on the results the valorigraphic parameters of the wheat varieties depended in different degrees on the weather conditions of the year and the fertilization treatments. The effect of the year was the most remarkable on valorigraphic index, stability, softening and extensibility of dough, it was slight on the water absorption capacity of the flour, and non-significant on the swelling time. The effect of fertilizer treatments frequently varied depending on the variety and year, the interaction of year x variety x fertilizer was strong. The N fertilization without PK in general increased each valorigraphic parameter, apart from softening of dough, which in fact decreased. The highest N dose (240 kg/ha) frequently failed to cause further improvement in quality. The PK treatments without N had a varying effect depending on variety and year. The valorigraphic index, stability, the extensibility of quality wheat GK Kata rose in 1990 as the results of higher PK doses, while the same parameters decreased in 1991 as affected by higher PK doses. The joint application of N and PK fertilizers changed the parameters of GK Csuros to a less extent than those of GK Kata. The highest valorigraphic index was achieved in GK Kata in both years by 240 kg/ha N treatment, in GK Csuros in 1990 by 90 kg P, 180 kg K and 120 kg N, and in 1991 by the treatment of 60 kg P, 120 kg K and 120 kg N active agent/ha.

137 Tanacs, L.; Matuz, J.; Kovacs, K.; Gero, L. (1994) EFFECT OF NPK FERTILIZATION AND YEAR ON THE BAKING QUALITY AND PROTEIN CONTENT OF WHEAT VARIETIES. *Novenytermeles*. 43(4):285-293. Hungarian. [UNIV HORT & FOOD IND FAC FOOD IND MARS TER 7 H-6724 SZEGED HUNGARY].

In the experiment the SDS and Zeleny sedimentation values, falling number, raw protein content and loaf volume of two wheat varieties were tested in 2 years at 16 different fertilizer levels. In each 5 characteristics the

effect of all three factors (year, variety, fertilization) were observed, often even strong interactions (year x variety x fertilization) were found. In general it was observed that the PK fertilization without N fertilizer caused a decrease in sedimentation tests, falling number, protein content and loaf volume. The N fertilization had an improving effect on each characteristics. The joint PK and N fertilizations weakened the contrasting effects mentioned, but the improving effect of N - depending on variety and year - countered the marring effect of PK.

138 Verma, LP.; Sharma, NL. (1994) RESIDUAL EFFECT OF PHOSPHATIC FERTILIZERS APPLIED TO WHEAT (TRITICUM AESTIVUM) ON SUCCEEDING CROP OF GREENGRAM (PHASEOLUS RADIATUS). *Indian Journal of Agronomy*. 39(2):237-240. English. [NARENDRA DEVA UNIV AGR & TECHNOL DEPT SOIL SCI FAIZABAD 224001 UTTAR PRADESH INDIA].

A field investigation was carried out on a sandy-loam soil during summer seasons of 1986-88 to find out the residual effect of different phosphatic fertilizers applied to wheat (*Triticum aestivum* L. emend. Fiori & Paol.) on succeeding crop of greengram (*Phaseolus radiatus* L.). Rock phosphate alone or in combination with cattle-dung did not increase the grain yield of greengram. Superphosphate alone and in combination with pyrite or mixing of rock phosphate with superphosphate showed significant residual response in terms of grain yield and phosphorus uptake. Mixtures of rock phosphate + superphosphate (75% + 25%) and rock phosphate + pyrite (1 : 3) were more effective than other sources at 60 kg and 90 kg doses of P₂O₅/ha respectively for grain yield and net return. Residual effect of various phosphatic fertilizers did not affect the straw yield significantly.

139 Wang Jieyuan; Wang Yingyu; Chen Hongbing (Hebei Agrotechnical Teachers Coll., Changli (China)) (1993) The techniques of balanced fertilization for winter wheat. *Soils and Fertilizers (China)* (no. 1) p. 11-14. 8 tables. Chinese. (AGRI 94-116544).

140 Wang Kuibo; Yu Meiyun; Shen Xiuzhen (Shandong Provincial Academy of Agricultural Sciences, Jinan (China). Inst. of Application of Atomic Energy) (1993) Effect of organic and inorganic nitrogen fertilizer dressing together on wheat nitrogen absorption. *Journal of Laiyang Agricultural College (China)* v. 10(3) p. 188-192. 2 ill., 5 tables, 4 ref. Chinese. (AGRI 94-116547).

141 Wang Zhangsheng (Jinyun County Extension Centre of Agro techniques, Zhejiang (China)) (1993) A study on prevention and control of wheat infertility by use of copper fertilizer on the slopping dryland. *Soils and Fertilizers (China)* (no. 4) p. 36-38. 3 tables. Chinese. (AGRI 94-116622).

142 Xue Jian; Zhao Bingqiang; Li Fengchao (Shandong Agricultural Univ., Taian (China)) (1993) A long term study on direct return of straw to the field. *Soils and Fertilizers (China)* (no. 2) p. 27-29. 2 tables. Chinese. (AGRI 94-116570).

143 Yang Qing (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Soil and Fertilizers) (1993) The influence of different copper levels on wheat yield. *Soils and Fertilizers (China)* (no. 6) p. 25-27. 4 tables, 3 ref. Chinese. (AGRI 94-116624).

144 Yao Yuanxi; Gu Hegao; Cai Qiufang (Laiyang Agricultural Coll., Shandong (China)) (1993) Effectiveness of fertilization to reduce the fluctuation in winter wheat-summer maize yield caused by climatic factors. *Chinese Journal of Soil Science (China)* v. 24(4) p. 167-168. 2 tables, 2 ref. Chinese. (AGRI 94-116573).

145 Zahran, M.; Mosalem, M.E. (Tanta Univ., Kafr El Sheikh (Egypt). Faculty of Agriculture) (1993) Effect of foliar application of some micronutrients under different levels of nitrogen on the productivity of wheat. *Tanta Journal of Agricultural Research (Egypt)* v. 19(1) p. 52-62. 2 ill. 2 tables; 25 ref. English. (AGRI 94-106495).

146 Zhang Muxiang; Zhang Yujie; Zhao Xueyun (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Soil and Fertilizers) (1993) The suitable soil moisture for wheat straws returned to the field. *Soils*

and Fertilizers (China) (no. 6) p. 20-24. 2 ill., 6 tables, 3 ref. Chinese. (AGRIS 94-116578).

147 Zhang Quzhu (Shanxi Provincial Station for Popularizing Agro technical, Taiyuan (China)) (1993) The effects of nitrophosphate upon winter wheat and technique for its application. *Soils and Fertilizers (China)* (no. 1) p. 39-42. 7 tables. Chinese. (AGRIS 94-116543).

148 Zuo Dongfeng (Beijing Agricultural Univ. (China)) (1993) Optimal mixture ratio of trace elements applied by foliage spraying method to winter wheat-summer corn in rotation in saline soil region and its yield increasing effect. *Chinese Journal of Soil Science (China)* v. 24(3) p. 132-134. 4 tables, 10 ref. Chinese. (AGRIS 94-116572).

149 Zuo Dongfeng; Wei Xiumei (Beijing Agricultural Univ. (China)) (1993) The yield increasing effect of iron fertilizer upon the main crops grown on the salt-affected soils in Huan Huai Plain, Hebei (China). *Soils and Fertilizers (China)* (no. 5) p. 18-20. 5 tables, 4 ref. Chinese. (AGRIS 94-116571).

F06 IRRIGATION

150 Dasilveira, PM.; Dasilva, SC.; Dasilva, OF.; Damaceno, MA. (1994) AGRICULTURAL SYSTEM UNDER IRRIGATION. *Pesquisa Agropecuaria Brasileira*. 29(8):1243-1252. Portuguese. [EMBRAPA CTR NACL PESQUISA ARROZ & FEIJAO BOLSISTA CNPQ CX POSTAL 179 BR-74001970 GOIANIA BRAZIL].

A field experiment was conducted at the National Rice and Bean Research Center of EMBRAPA, Goiania-Goias, Brazil, during four consecutive years under sprinkler irrigation using center pivot. The objective of this study was to evaluate effects of plowing at different depths (15 and 30 cm), fertilizer levels (200 and 400 kg ha⁻¹) and crop rotation (R1 = rice-bean; R2 = corn-bean and R3 = rice-wheat-corn-bean) on grain yield, and physical and chemical properties of soil. In general, concentrations of Al, Ca+Mg, P, K and MO in soil decreased during the experimentation period with the agricultural system employed. Under treatment of plowing at 30 cm depth, bulk density at 20 and 30 cm depths were lower as compared to initial values. Plowing treatment at 30 cm depth produced higher grain yield of rice in rotation with wheat-corn and bean as compared to rotation with bean. Bean yield was lower after corn than after rice. Plowing depth had no effect on yield of corn, bean and wheat. Higher yields of rice, corn, bean and wheat were obtained at higher fertilizer level. Agricultural system with highest rentability was corn-bean rotation.

151 El Haddad, E.H.; Amer, M.A. (Monoufeya Univ., Shebin El Kom (Egypt). Faculty of Agriculture); Moustafa, M.A. (1993) Effect of salinity on the growth yield of three wheat cultivars grown in calcareous soil. *Menoufiya Journal of Agricultural Research (Egypt)* v. 18(3) p. 1669-1683. 2 ill. 6 tables; 12 ref. English. (AGRIS 94-106700).

152 Megalah, S.S.; Abd El Maksoud, M.M.R.; Abd El Nour, A.S. (Ministry of Agriculture, Cairo (Egypt). Soils and Water Research Inst.) (1993) Effect of irrigation, preceding crops and fertilization on wheat plants. *Menoufiya Journal of Agricultural Research (Egypt)* v. 18(3) p. 1717-1730. 6 tables; 16 ref. English. (AGRIS 94-106701).

F07 SOIL CULTIVATION

153 Mcandrew, DW.; Fuller, LG.; Wetter, LG. (1994) GRAIN AND STRAW YIELDS OF BARLEY UNDER FOUR TILLAGE SYSTEMS IN NORTHEASTERN ALBERTA. *Canadian Journal of Plant Science*. 74(4):713-722. English. [AGR & AGRIFOOD CANADA MORDEN R6M 1Y5 MB CANADA].

The agronomic feasibility of reduced tillage management for barley (*Hordeum vulgare*) production in northeastern Alberta was evaluated with respect to grain and straw yield. Five sites were established in 1988 and continued until 1992 within the Dark Brown, Black, and Gray soil zones. Four tillage management systems were studied including zero (ZT), minimum (MT), and two conventional systems (C1 and C2). Fungicide (propiconazole) was applied to one-half of the plots to evaluate the need for fungicide in a continuous barley rotation using reduced tillage systems.

Fungicide had no effect on grain and straw yields and no interaction between fungicide and tillage system occurred thus indicating that fungal diseases controllable by propiconazole did not limit yields during this study. Tillage system significantly affected grain and straw yields in approximately one-third of the site-years studied. Grain yields averaged over 5 yr ranged from 2.55 to 4.27, 2.61 to 3.93, 2.51 to 4.08, and 2.63 to 3.99 Mg ha⁻¹ for ZT, MT, C2 and C1, respectively. Straw yields averaged over 5 yr ranged from 2.56 to 4.32, 2.61 to 3.90, 2.48 to 4.08, and 2.59 to 4.87 Mg ha⁻¹ for ZT, MT, C2 and C1, respectively. In general, grain and straw yields of barley under ZT were equal or superior to yields obtained under C1, C2 and MT systems. Straw yields followed closely the trends observed for grain yields. Zero tillage grain yields significantly exceeded those of C1, C2 and MT in 30-50% of the site-years when growing season precipitation was below normal. This is believed to be related to better soil water conservation and greater water use efficiency under ZT compared with other tillage systems in years with below normal precipitation and particularly when June and July precipitation was low. [References: 30].

154 Munn, D.A. (1992) Comparisons of shredded newspaper and wheat straw as crop mulches. *HortTechnology (USA)* v. 2(3) p. 361-366. references. English. (AGRIS 94-106760).

155 Rao, SC.; Dao, TH. (1994) STRAW QUALITY OF 10 WHEAT CULTIVARS UNDER CONVENTIONAL AND NO-TILL SYSTEMS. *Agronomy Journal*. 86(5):833-837. English. [USDA ARS GRAZINGLANDS RES LAB POB 1199 EL RENO, OK 73036 USA].

Straw of small-grain cereal is an important source of feed for maintenance of ruminant livestock. Information on the nutritional quality of wheat (*Triticum aestivum* L.) straw under conservation tillage system is limited. Grain and straw (leaves and stem) samples were obtained from a previous tillage by cultivar field study conducted on a Bethany silt loam (fine, mixed, thermic Pachic Paleustoll) from 1984 to 1987 near El Reno, OK, to determine the straw quality of 10 hard red winter wheat cultivars grown under conventional (moldboard plow) and no-till systems. Straw was analyzed for neutral-detergent fiber (NDF), acid-detergent fiber (ADF), lignin (LIG), crude protein (CP), and in vitro dry matter digestibility (IVDMD). Fiber (ADF and NDF) and LIG concentrations of straw from the early-maturity cultivars were higher (P less-than-or-equal-to 0.05) than medium and late maturity cultivars. Crude protein (5 to 12 g kg⁻¹) and IVDMD (25 to 39 g kg⁻¹) concentrations were lower in early-maturing than in medium- and late-maturing cultivars among years. Neutral-detergent fiber and ADF concentrations of all cultivars were not affected by tillage system; however, LIG of early-maturing cultivars (Chisholm and Vona) grown under a no-till system was 9 to 24 g kg⁻¹ lower in 1985 and 1986 than in conventionally tilled plots. In vitro dry matter digestibility of all cultivars was not consistently affected by tillage system: no significant difference in 1984, while straw IVDMD from no-till plots of all cultivars averaged 9 g kg⁻¹ lower in 1985 and 13 g kg⁻¹ lower in 1986, compared with conventionally tilled plots. Straw quality of the 10 wheat cultivars varied among maturity groups, but the effect of tillage system on straw quality was minimal. [References: 18].

156 Singh, S.; Kumar, R.; Sharma, HC. (1994) RELATIONSHIP OF SEED EMERGENCE AND YIELD OF WHEAT (TRITICUM-AESTIVUM) WITH SOIL CHARACTERISTICS. *Indian Journal of Agricultural Sciences*. 64(11):789-790. English. [CHAUDHARY CHARAN SINGH HARYANA AGR UNIV DEPT AGRON HISAR 125004 INDIA].

F08 CROPPING PATTERNS AND SYSTEMS

157 Apel, B. (Landwirtschaftskammer Rheinland, Bonn (Germany). Referat Allgemeiner Ackerbau und Bodenschutz); Buchner, W. (1994) [New ideas about crop rotation]. *Die Fruchtfolge neu ueberdenken. DLG-Mitteilungen (Germany)* v. 109(2) p. 22, 24-26, 28. 9 ill. German. (AGRIS 94-106774).

158 Billore, SD.; Singh, K.; Singh, KP.; Bargale, M. (1994) ENERGY PRODUCTIVITY OF SORGHUM (SORGHUM BICOLOR) WHEAT (TRITICUM AESTIVUM) SEQUENCE THROUGH LONG-TERM USE OF CHEMICAL FERTILIZERS. *Indian Journal of Agronomy*. 39(2):198-202. English. [JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA RAK COLL AGR SEHORE 466001 MADHYA PRADESH INDIA].

A long-term field experiment was conducted during 1977-78 to 1990-91 on medium black soil to evaluate the effect of continuous sorghum [*Sorghum bicolor* (L.) Moench]-wheat (*Triticum aestivum* L. emend. Fiori and Paol.) cropping and manuring on sustainability. The yield of both the crops, energy output and net returns increased with an increase in level of each nutrient during all the years. The response per unit nutrient applied and benefit : cost ratio drastically declined with increased levels of nutrients. The total energy-use efficiency and energy productivity increased only up to an 80 kg N/ha. However, energy intensiveness showed the reverse trend. Application of P and K decreased the energy-use efficiency and energy productivity but increased the energy intensiveness.

159 Hadjicristodoulou, A. (1994) SELECTION OF DRY PEA (*PISUM-SATIVUM*) VARIETIES AND THEIR PERFORMANCE BY COMPARISON WITH BARLEY AND WHEAT IN MEDITERRANEAN ENVIRONMENTS. *Experimental Agriculture*. 30(4):477-481. English. [AGR RES INST NICOSIA CYPRUS].

The possibility of growing dry peas in the semi-arid areas of Mediterranean countries was assessed by comparing dry pea (*Pisum sativum* L.) varieties with the highest yielding barley and durum wheat varieties under rainfed conditions and with supplementary irrigation in Cyprus. The yield of barley cv. Kantara was greater than that of the best pea variety selected, PS 210713, especially under the driest conditions, but the differences between cereals and dry pea varieties were smaller when grown in areas where there was more rain or where supplementary irrigation was supplied. The protein content of the dry seeds and straw of the peas was higher than those of the cereals. It is concluded that selected varieties of dry peas could be grown in dry Mediterranean areas, particularly in rotation with barley or wheat. [References: 8].

160 Hughes, D.; Butcher, W.; Jaradat, A.; Penaranda, W. (1995) ECONOMIC ANALYSIS OF THE LONG-TERM CONSEQUENCES OF FARMING PRACTICES IN THE BARLEY CROPPING AREA OF JORDAN. *Agricultural Systems*. 47(1):39-58. English. [LOUISIANA STATE UNIV DEPT AGR ECON & AGRIBUSINESS BATON ROUGE, LA 70803 USA].

The sustainability of agricultural practices is an important determinant of the ability to meet the growing food needs of future generations in developing countries. But sustainable agricultural practices will not be adopted by farmers unless current farm income levels are maintained. The Erosion Productivity Impact Model (EPIC), a whole-farm model, and budget analysis are used to evaluate both the short-run profitability and the long-run sustainability of a number of agricultural practices in the Mafrqa region of Jordan. While only a few technologies exceed current practices in terms of short-run benefits, a number of technologies provide long-term benefits due to enhanced soil productivity. A combination of technologies, such as a fertilized barley-vetch rotation (instead of the traditional barley-weedy fallow rotation), may provide the most feasible means of maintaining current farm incomes while also enhancing the sustainability of area agriculture. [References: 13].

161 Jasper, J. (Giessen Univ. (Germany). Inst. fuer Pflanzenbau und Pflanzenzüchtung, Gruenlandwirtschaft und Futterbau) (1993) [Temporary land diversion - effects of green cover grasses and legumes on preceding crops]. Ackerrotationsbrache - Vorfruchteffekte bei differenzierter Begrünung. 37. Jahrestagung der Gesellschaft fuer Pflanzenbauwissenschaften; Giessen (Germany); 30 Sep - 02 Oct 1993. *Mitteilungen der Gesellschaft fuer Pflanzenbauwissenschaften (Germany)* v. 6 p. 345-348. 5 graphs; 3 ref. German. (AGRS 94-116848).

162 Karpenstein Machan, M. (Kassel Univ. (Gesamthochschule), Witzenhausen (Germany). Fachbereich Landwirtschaft); Maschka, R. (1993) [Winter oats in cropping seeds mixture with rye and triticale as protection and compensation from winter killing]. Winterhafer im Gemengeanbau mit Roggen und Triticale zum Schutz und Ausgleich bei Auswinterung. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 265-268. VDLUFA. 3 ill.; 1 ref. German. (AGRS 94-106822).

163 Leterme, P.; Manichon, H.; Rogerstrade, J. (1994) YIELD ANALYSIS OF WHEAT GROWN IN AN ON-FARM FIELD NETWORK IN

THYMERAS (FRANCE). *Agronomie*. 14(6):341-361. French. [INRA BP 29 F-35650 LE RHEU FRANCE].

This paper presents a methodology of analysing yield variations of wheat grown in on-farm fields. The study takes place in 'Thymerais', a region at about 80-100 km in the west of Paris. The wheats studied were grown after 2 groups of previous crops (wheat or non-wheat). The soils are silty and the fields may be stony. In many fields, we can notice an early reduction of crop growth, before spring stem elongation, mainly for sanitary causes. During the stem elongation, the main limiting factor is water nutrition. At present, the environmental effect is more important than that of cropping systems. Nevertheless, the latter exists mainly by its crop rotation component: the sanitary state of the wheat behind wheat is often deficient. Drought prevails in summer, during grain filling, with larger consequences when there are other limiting factors (soil structure, stem and root sanitary states, and lodging). We observe that wheat as a precedent induces higher risks of yield limitation, these risks being increased by late sowings and stony fields. In conclusion, we notice that there is not an exact relationship between yields and cropping systems and/or environment characteristics. However, we can say that these induce different levels of risk, whose exteriorisation depends on weather and sowing date.

164 Li Daqing; Xu Lihua; Zheng Chunling (Jiangsu Provincial Academy of Agricultural Sciences, Nanjing (China). Inst. of Industrial Crops) (1993) Influence of biomass and population leaf area on lint yield in post-barley directly sown cotton. *Jiangsu Journal of Agricultural Sciences (China)* v. 9(4) p. 16-21. 1 ill., 6 tables, 9 ref. Chinese. (AGRS 94-116874).

165 Michel, D. (Halle Wittenberg Univ., Halle (Germany). Inst. fuer Allgemeinen Pflanzenbau (Ackerbau)) (1993) [Preceding crop value alfalfa with regard to yield, mineral nutrients and protein quality of following crops potatoes and winter wheat]. Vorfruchtwert des Luzerneanbaus hinsichtlich Ertrag, Mineralstoffe und Eiweissqualitaet der Nachfruechte Kartoffeln und Winterweizen. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 257-260. VDLUFA. 5 tables. German. (AGRS 94-106843).

166 Moreno Ramos, Oscar Humberto (INIFAP. C.E. Valle del Yaqui. Ap. Postal 515. Cd. Obregon, Son. 85270 (Mexico)) (1992) [Agronomic management: its importance for wheat production in Mexico]. El manejo agronomico: su importancia en la produccion de trigo en Mexico. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p.393-417. Centro de Investigacion Regional del Noroeste. 11 tablas; 8 ref. 2o. tomo. Spanish. (AGRS 94-116836).

167 Murrieta Baldenegro, Fernando (INIFAP. C.E. Mexicali, Ap. Postal 3 1019, Mexicali, B.C. (Mexico)) (1992) [The wheat and grain sorghum production system, with minimum tillage for the sorghum, as an alternative for the Valle de Mexicali]. El sistema de produccion trigo-sorgo de grano como relevo sorgo una alternativa para el Valle de Mexicali. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 419-427. Centro de Investigacion Regional del Noroeste. 4 tablas; 6 ref. 2o. tomo. Spanish. (AGRS 94-116862).

168 Orphanos, Pi.; Metochis, C. (1994) THE WATER RELATIONS OF BARLEY GROWN CONTINUALLY OR AFTER FALLOW UNDER SEMI-ARID CONDITIONS. *Experimental Agriculture* 30(4):431-439. English. [AGR RES INST NICOSIA CYPRUS].

Grain barley was grown either continually or in rotation with fallow in a 12-year experiment. Annual rainfall ranged from 120 to 297 mm. As the water requirement of the crop is 240 mm, growth in most seasons occurred

under water stress. The amount of water conserved under fallow was only significant (75-100 mm) in three of the 12 years and only once did the water conserved increase barley yield in the following year. The total grain yield over the experimental period was twice as high in the barley-barley sequence as in the barley-fallow sequence. [References: 16].

169 Palmer, J.H.; Hood, C.; Wallace, S.U.; Khalilian, A.; Porter, P. (1993) Soybeans: relay intercropping with wheat. *Soybean leaflet (USA)*; no. 10 4 p. references. English. (AGRIS 94-116869).

170 Raguwanshi, R.K.S.; Umat, R. (1994) INTEGRATED NUTRIENT MANAGEMENT IN SORGHUM (SORGHUM BICOLOR) WHEAT (TRITICUM AESTIVUM) CROPPING SYSTEM. *Indian Journal of Agronomy*. 39(2):193-197. English. [JAWAHARLAL NEHRU KRISHI VISHVA VIDYALAYA ALL INDIA COORDINATED AGRON RES PROJECT CROPPING INDORE 452001 MADHYA PRADESH INDIA].

An experiment was conducted during 1987-88 and 1988-89 to investigate the effect of organic and inorganic fertilizers, alone and in combination, on nutrient uptake, yield and the extent to which farmyard manure, crop residue and green organic matter could supplement nitrogen for sorghum [*Sorghum bicolor* (L.) Moench]-wheat (*Triticum aestivum* L. emend. Fiori and Paol.) crop sequence grown on a medium black soil. The results indicated the possibility to save N at least 25-50% by applying farmyard manure or green crop residue or green organic matter to sorghum. For optimum economy, organic manure was applied to rainy-season crop rather than to the winter crop, as their decomposition and assimilation were better during rainy season. Similarly, residual effect of organics was pronounced leading to increased average grain yield of wheat for 2 years (46.95 q/ha) in the treatments receiving 50% of recommended dose through farmyard manure + 50% through chemical fertilizer. Rainy-season treatment of 75% of recommended dose of NPK through fertilizer + 25% N through farmyard manure or through green organic matter gave grain yield of 45.44 or 48.08 q/ha of wheat as compared with 43.77 q/ha through chemical fertilizer applied in both rainy and winter seasons. Treatments where no fertilizer was applied in both seasons by any source of organic and inorganic gave only 14.81 q/ha of sorghum and 18.89 q/ha of wheat grain (average of 2 years) yields.

171 Rathi, K.S.; Prasad, K. (C.S. Azad University of Agriculture and Technology, Uttar Pradesh (India). Department of Agronomy) (1994) Border-ridge technique for intercropping wheat with potato. *Indian Farming (India)* v. 44(1) p.9-10. 2 tables; 1 ill. English. (AGRIS 94-116864).

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

Two cereal cropping systems are described which, through the introduction of a leguminous intercrop, increased productivity, nitrogen output and ground cover of the systems in the absence of added nitrogen fertilizer. Nitrogen-fixing legumes were cultivated between rows of wheat or barley grown at low levels of soil nitrogen, and mostly under rainfed conditions, in Mexico between 1989 and 1992. None of the legumes tested reduced yields of the cereal crop in comparison to controls where cereal yields were in the range of 1-4 t/ha, while the extra total biomass from legumes in some cases more than doubled productivity. Different legume crops were tested to demonstrate the adaptability of the system to the varying needs of farmers. The intercropped legumes achieved dry biomass yields as high as 6.5 t/ha in the case of a sequentially cropped forage crop of hairy vetch, or 1.4 t/ha of dry beans plus 3.5 t/ha of green residue in the case of *Vicia faba*. Total biomass in the intercropped situation gave land equivalent ratios as high as 1.54. Light measurements inside the crop canopies indicated that the intercropped systems intercepted a higher proportion of the incident solar radiation than the cereal monocrop, presumably accounting for the large differences in total biomass produced. In addition, with leaf nitrogen levels of 3.8%, it is assumed that the intercropped legumes fixed considerably more nitrogen than was removed by the wheat crop. The potential of the system to stabilize erodible soils by increasing ground cover as well as by raising inputs of soil organic matter is discussed. [References: 31].

173 Saxena, M.C.; Abd El Moneim, A.M. (ICARDA, Aleppo (Syria)) (1994) Place and role of legumes in livestock production in West Asia and North Africa. Seminar on Livestock in West Asia and North Africa; Aleppo (Syria); 11-12 May 1993. International Center for Agricultural Research in the Dry Areas, Aleppo (Syria). Board of trustees presentation, 11-12 May 1993. International Center for Agricultural Research in the Dry Areas, Aleppo (Syria) p. 60-72. ICARDA. 6 Tables; 1 fig., 36 ref. English. (AGRIS 94-106836).

174 Shapiro, B.I.; Brorsen, B.W.; Doster, D.H. (1992) Adoption of double-cropping soybeans and wheat. *Southern journal of agricultural economics (USA)* v. 24(2) p. 33-40. references. English. (AGRIS 94-116867).

Double-cropping of soybeans and wheat is often promoted by extension personnel. This paper seeks to explain how the decision to adopt double-cropping is made, using a Tobit regression model. Tobit makes use of more of the information in the data set than do logit or probit and explains not only the decision to double-crop but also the rate of adoption. The paper considers factors such as profit and risk perceptions and risk which have not been included in the past models used to explain adoption of technology. The results show that risk perception is important. Contrary to the findings of some other adoption studies, this decision is not influenced by human capital factors. The farmers who double-crop are more highly leveraged and appear to do so both to achieve higher income and as part of a risk diversification strategy. This is consistent with the importance of the location factor, measured as the average number of growing degree days at the farm's location. Growing degree days is a proxy for the actual distribution of returns from double-cropping and is the main factor explaining this decision. Extensive adoption of double-cropping in cooler regions of the Midwest must await technological advances that can increase the profitability of double-cropping by reducing the growing season for wheat and/or beans.

F30 PLANT GENETICS AND BREEDING

175 [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria) (1992) *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 567 p. en 2 tomos. Centro de Investigacion Regional del Noroeste. Spanish. (AGRIS 94-117180).

176 [Varietal choice (results of trials on spring barley in Italy)]. Scelta varietale (risultati di prove su orzo primaverile in Italia) (1994) *Informatore Agrario (Italy)* v. 50(5) p. 55-58. 12 tables. Italian. (AGRIS 94-106985).

177 Andersen, L.; Joergensen, J.H. (Risoe National Laboratory, Roskilde (Denmark). Environmental Science and Technology Dept.) (1992) Mlo aggressiveness of barley powdery mildew. 188. NJF Seminar: Aas (Norway); 11-14 Feb 1991. Disease resistance in agricultural crops. NJF-Seminar no. 188. Elen, O.; Tronsmo, A.M. (eds.). Scandinavian Association of Agricultural Scientists (NJF). *Norwegian Journal of Agricultural Sciences (Norway)*; no. 7(suppl.) p. 77-87. Statens Fagtiene for Landbruket. 1 table, 2 figures; 26 ref. English. (AGRIS 94-117026).

178 Badaeva, E.D.; Filatenko, A.A.; Badaev, N.S. (1994) CYTOGENETIC INVESTIGATION OF TRITICUM TIMOPHEEVII (ZHUK) ZHUK AND RELATED SPECIES USING THE C-BANDING TECHNIQUE. *Theoretical & Applied Genetics*. 89(5):622-628. English. [KANSAS STATE UNIV DEPT PLANT PATHOL CTR WHEAT GENET RESOURCE THROCKMORTON HALL MANHATTAN, KS 66506 USA].

Triticum timopheevii and related species *T. militinae* (2n = 28, A'G) and *T. zhukovskii* (2n = 42, A(m)A(t)G), hybrids *T. kiharae*, *T. muguschovae*, the amphidiploid *T. timopheevii* x *T. tauschii* (all 2n=42, A(t)GD), *T. fungicidum* (ABA(t)G) and *T. timonovum* (2n = 56, A(t)A(t)GG) were analyzed using the C-banding technique. Chromosomes of the A(m) and A(t) genomes in the karyotype of *T. zhukovskii* differed in their C-banding pattern. Partial substitutions of A(t)-genome chromosomes and a complete substitution of the G-genome chromosomes by homoeologous chromosomes of an unidentified tetraploid wheat species with an AB genome composition were found in the *T. timonovum* karyotype. A(t)- and G-genome chromosomes in the karyotypes of all studied species had

similar C-banding patterns and were characterized by a low level of polymorphism. The comparative stability of the A(t) and G genomes is determined by the origin and specificity of cultivation of studied species. [References: 23].

179 Bajaj, R.K.; Bains, K.S.; Chahal, G.S.; Khehra, A.S. (Punjab Agricultural University, Ludhiana (India). Department of Plant Breeding) (1992) Effect of intermating in a three-way cross of barley. *Journal of Research Punjab Agricultural University (India)* v. 29(2) p. 177-181. 2 tables; 11 ref. English. (AGRI 94-106984).

180 Bajchev, V.; Tsvetkov, S. (Institut po Pshenitsata i Sl'nchogleda "Dobrudzha", General Toshevo (Bulgaria)) (1993) [Hybrids between (*Triticum aestivum* L. x *Secale cereale* L.) and *Triticale* (2n=6x=42). III. F3]. *Khibridi mezhdur (Triticum aestivum* L. x *Secale cereale* L.) i *Triticale* (2n=6x=42). III. F3. B'lgarska Akademiya na Naukite, Sofia (Bulgaria). *Genetika i Selektiya (Bulgaria); Genetics and Breeding* v. 26(5-6) p. 337-344. 3 tables; 9 ref. Bulgarian. (AGRI 94-107081).

181 Bajchev, V.; Tsvetkov, S. (Institut po Pshenitsata i Sl'nchogleda "Dobrudzha", General Toshevo (Bulgaria)) (1993) [Hybrids between (*Triticum aestivum* L. x *Secale cereale* L.) and *Triticale* (2n=6x=42). IV. F4-F6]. *Khibridi mezhdur (Triticum aestivum* L. x *Secale cereale* L.) i *Triticale* (2n=6x=42). IV. F4-F6. B'lgarska Akademiya na Naukite, Sofia (Bulgaria). *Genetika i Selektiya (Bulgaria); Genetics and Breeding* v. 26(5-6) p. 355-361. 2 tables; 7 ref. Bulgarian. (AGRI 94-107082).

182 Balyan, H.S.; Singh, O. (1994) PLEIOTROPIC EFFECTS OF GA-INSENSITIVE RHT GENES ON GRAIN YIELD AND ITS COMPONENT CHARACTERS IN WHEAT. *Cereal Research Communications*. 22(3):195-200. English. [MEERUT UNIV DEPT AGR BOT MEERUT 250004 INDIA].

Evaluation of random pairs of near isogenic tall (rht) and dwarf (Rht) lines under late sown conditions indicated that the Rht1, Rht2 and Rht3 dwarfing genes were associated with 22.25%, 14.19% and 26.73% reduction in grain yield, respectively. The negative effect of each of the three Rht genes on grain yield was due to significant reduction in biological yield. In turn, the poor biological yield in Rht1 and Rht2 lines was due mainly to reduced number of lighter tillers while in Rht3 lines it was due to lighter tillers, less number of grains per floret and grains per spike and reduced 100 grain weight. The mechanisms, involved in grain yield reduction in the lines containing different Rht genes were, thus, different. It is suggested that the poor grain yield and biological yield of the Rht lines may arise due to their greater sensitivity to stress factors, particularly warm conditions, associated with late sowings.

183 Bansal, P.; Batra, V.I.P. (Haryana Agricultural University, Hisar (India). Department of Chemistry and Biochemistry) (1992) Accumulation of 14C in starch and protein in low starch low protein barley mutant. *Crop Improvement (India)* v. 19(2) p. 119-123. 1 ill., 11 ref. English. (AGRI 94-117024).

184 Bansal, S.; Chauhan, S.V.S. (1994) SENSITIVITY TO STREPTOMYCIN IN VARIETIES OF BARLEY (HORDEUM-VULGARE). *Indian Journal of Agricultural Sciences*. 64(11):755-759. English. [AGRA UNIV RAJA BALWANT SINGH COLL DEPT BOT AGRA 282002 UTTAR PRADESH INDIA].

An experiment was conducted during 1992 to study the sensitivity of 7 varieties ('IC 79574', 'IC 79596', 'IC 82560', 'IC 82637', 'DL 3', 'DL 100' and 'Ratna') of barley (*Hordeum vulgare* L. sensu lato) to streptomycin. There was a marked reduction in seed germination in different varieties treated with various concentrations of streptomycin. Streptomycin 2 500 ppm caused the maximum reduction in seed germination (61.9%) in 'Ratna', whereas 3 000 ppm showed the minimum reduction (25.1%) in 'DL 100'. Similarly, a significant reduction in the growth of the seedlings (length of root and shoot) was observed, which was directly proportional to the increase in the concentration of streptomycin. 'DL 3' showed the maximum reduction, whereas 'IC 79574' the minimum. Based on the number of chlorophyll mutations (albinos, stripe I and stripe II) in the treated populations, 'DL 100' and 'Ratna' showed maximum resistance, indicating their usefulness as stress-tolerant phenotypes, which may be useful in somatic hybridization for somaclonal selection.

185 Belea, A.; Kissimon, J.; Hassan, A.; Sutka, J. (1994) WHEAT SPECIES COLLECTION IN THE SERVICE OF GENETICISTS AND BREEDERS [Review] [Hungarian]. *Novenytermeles*. 43(4):355-360. Hungarian. [HUNGARIAN ACAD SCI AGR RES INST PF 19 H-2462 MARTONVASAR HUNGARY].

Due to the ever greater requirements which must be satisfied by cultivated plant varieties and hybrids, breeders have made great efforts to incorporate the most efficient genes determining important agronomic properties environmental stress resistance and quality into new genotypes. There is, however, a danger that the wide-ranging use of genetic sources of identical origin will lead to an ever greater similarity between new plant varieties developed in various countries, with a consequent reduction in genetic diversity and a genetic impoverishment of the cultivated varieties. There is thus every justification for the development of a wheat species collection in the Agricultural Research Institute of the Hungarian Academy of Sciences. In recent years, genetic, biochemical and physiological experiments have already been conducted in the institute on species belonging to the *Triticum* genus. Hybridisation using wild species bearing traits useful in wheat breeding also has a long tradition. The institute's gene bank currently contains not only 3150 varieties, but also 1299 wheat genotypes and other cereal species (*Agropyron*, *Hordeum*, *Avena*, *Secale*, *Haynaldia* etc.), together with genetically valuable stocks developed in the institute or obtained for research purposes from foreign gene banks. In addition to collecting and storing gene sources and to identifying and classifying cereal species, the gene bank is involved in the preparation of a catalogue containing the major morphological and economic properties of the species, together with spike photographs and the electrophoretic spectra of the storage proteins.

186 Benitez Riquelme, Ignacio; Rodriguez Perez, Juan E.; Serrano Covarrubias, Luis Manuel (Colegio de Postgraduados, Montecillo, Mex. (Mexico); Instituto Nacional de Investigaciones Forestales y Agropecuarias, Mexico, D.F. (Mexico)) (1992) [Stratified mass selection for grain yield and spike length in wheat I. Genetic advances]. *Selección masal estratificada para rendimiento de grano y longitud de espiga en trigo. I. Avances geneticos. Revista Fitotecnia Mexicana (Mexico)* v. 15(1) p. 30-39. 2 illus; 4 tablas; 21 ref. Spanish. (AGRI 94-117158).

187 Benitez Riquelme, Ignacio; Serrano Covarrubias, Luis Manuel; Molina G, Jose D. (Colegio de Postgraduados, Montecillo, Mex. (Mexico). Centro de Genetica) (1992) [Gridded versus visual mass selection as applied to wheat (*Triticum aestivum* L.)]. *Selección masal estratificada vs selección masal visual en trigo (Triticum aestivum L.)*. Primera conferencia nacional sobre la producción de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicación Especial. Centro de Investigación Regional del Noroeste (Mexico)*; no. 4 p. 215-228. Centro de Investigación Regional del Noroeste. 3 tablas; 14 ref. Spanish. (AGRI 94-117161).

188 Brar, L.S.; Walia, U.S. (Punjab Agricultural University, Ludhiana (India). Department of Agronomy) (1992) Tolerance of wheat cultivars to herbicides. *Journal of Research Punjab Agricultural University (India)* v. 29(2) p. 182-186. 3 tables; 6 ref. English. (AGRI 94-107089).

189 Broennimann, A.; Keller, B.; Winzeler, H. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Reckenholz (Switzerland)) (1994) Prospectives of cereal breeding in Europe. *Symposium on "Prospectives of cereal breeding in Europe"; Landquart (Switzerland)*; 4-7 Sep 1994. FAP. various tables, numerous ref. 194 p. English. (AGRI 94-117007).

190 Brooks, S.W. (Sveriges Lantbruksuniv., Svaloev (Sweden). Inst. foer Vaextfoeraedling) (1993) The isolation and backcrossing of *Puccinia hordei* resistant *Hordeum vulgare* ssp. *spontaneum* lines from Israel in a pre-breeding program. *Sveriges Utsaedesfoerennings Tidskrift (Sweden)* v. 103(3) p. 154-159. 17 ref. English. (AGRI 94-106988).

191 Busch, R.H. (USDA ARS, University of Minnesota, St. Paul); Froberg, R.C. (North Dakota State University, Fargo, ND) (1992) [Breeding for special quality traits in wheats]. [Mejoramiento para calidad especial en trigos]. Primera conferencia nacional sobre la producción de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988.

[National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en México. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicación Especial. Centro de Investigación Regional del Noroeste (México)*; no. 4 p. 133-139. Centro de Investigación Regional del Noroeste. 2 tablas; 7 ref. English. (AGRI 94-116902).

192 Cardenas Ramos, Francisco (INIFAP. C.E. Valle de México. Ap. Postal 10, Chapingo, Mex. 56230 (México)) (1992) [The importance of genetic resources to broaden the available genetic diversity]. La importancia de los recursos genéticos para diversificar la variabilidad genética. Primera conferencia nacional sobre la producción de trigo en México. (Memoria); Cd. Obregon, Sonora (México); 22-25 Mar 1988. [National conference on wheat production in México. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en México. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicación Especial. Centro de Investigación Regional del Noroeste (México)*; no. 4 p. 63-71. Centro de Investigación Regional del Noroeste. 4 ref. Spanish. (AGRI 94-116898).

193 Carver, BF.; Rayburn, AL. (1994) COMPARISON OF RELATED WHEAT STOCKS POSSESSING 1B OR 1RS.1BL CHROMOSOMES - AGRONOMIC PERFORMANCE. *Crop Science*. 34(6):1505-1510. English. [OKLAHOMA STATE UNIV DEPT AGRON STILLWATER, OK 74078 USA].

The 1RS.1BL translocation is widely used by wheat (*Triticum aestivum* L.) breeders to enhance agronomic performance and particularly grain yield. Research is lacking that compares agronomic trait expression in closely related stocks with or without the translocated chromosome arm. Our objective was to determine the effects of 1RS.1BL on means and genetic variances for grain yield and other agronomic traits in two hard red winter wheat populations segregating for the 'Aurora' translocation. Two field experiments were conducted using different genetic materials derived from two crosses, OK83398 x 'Chisholm' and OK83398 x 'Arkan'. In Experiment 1, 25 pairs of F-5-derived near-isolines homozygous for either 1B or 1RS.1BL were evaluated in three environments. In Experiment 2, plants homozygous for either 1B or 1RS.1BL were selected in the F-2, and further subsampled in the F-3; forty F-3(F-2) lines per chromosome type in each cross were evaluated in four environments. The average effect of 1RS.1BL in Experiment 1 was to increase grain yield by 9 to 10%, increase aerial biomass by 11 to 12%, and increase kernel weight by 4 to 6%, depending on the cross. Differences in kernels per spike, harvest index, and test weight were not detected, whereas differences in plant height and the number of spikes per meter squared were inconsistent between crosses or among environments. The magnitude of the effect of 1RS.1BL varied considerably among the paired near-isolines, presumably by the effects of genes present on other wheat chromosomes. Heterogeneity of genetic variance in Experiment 2 was usually caused by larger variance among 1RS.1BL genotypes than 1B genotypes. These results encourage further use of 1RS.1BL to improve agronomic traits of wheat. [References: 22].

194 Castagnaro, A.; Marana, C.; Carbonero, P.; Garciaolmedo, F. (1994) CDNA CLONING AND NUCLEOTIDE SEQUENCES OF ALPHA(1) AND ALPHA(2) THIONINS FROM HEXAPLOID WHEAT ENDOSPERM. *Plant Physiology*. 106(3):1221-1222. English. [UNIV POLITECN MADRID ESCUELA TECN SUPER INGN AGRON BIOQUIM & BIOL MOLEC LAB E-28040 MADRID SPAIN].

195 Castillo Trevino, Rogelio (INIFAP. C.E. Sur de Tamaulipas. Ap. Postal C 1 Suc. Aeropuerto. Tampico, Tamp. 89120 (México)) (1992) [Wheats as an option for the rainfed areas in the North of Tamaulipas]. Trigo, una opción para el temporal del norte de Tamaulipas. Primera conferencia nacional sobre la producción de trigo en México. (Memoria); Cd. Obregon, Sonora (México); 22-25 Mar 1988. [National conference on wheat production in México. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en México. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicación Especial. Centro de Investigación Regional del Noroeste (México)*; no. 4 p. 209-214. Centro de Investigación Regional del Noroeste. Spanish. (AGRI 94-116906).

196 Ceccarelli, S. (1994) SPECIFIC ADAPTATION AND BREEDING FOR MARGINAL CONDITIONS. *Euphytica*. 77(3):205-219. English. [INT CTR AGR RES DRY AREAS POB 5466 ALEPPO SYRIA].

Breeding has been very successful in generating cultivars that in favorable environments, and together with large use of fertilizer and chemical control of weeds, pest and diseases, have increased agricultural production several fold. Today the environmental impact of high input agriculture in more favorable environments causes growing concern. By contrast, the impact of breeding in marginal environments has been elusive. The paper discusses evidence showing that the use of breeding principles developed for, and successfully applied, in favorable environments may be the main reason for the lack of breeding progress in marginal environments. Very little breeding work has actually been done in marginal environments, although the theory of correlated responses to selection indicates that selection conducted in good environments or in well-managed experiment stations is not expected to be very efficient when genotype by environment interactions of a cross-over type exist. The assumptions that heritability is higher under good conditions and that there is a carry-over effect of high yield potential are not supported by experimental evidence. If the target environment is below the cross-over point, selection has to be conducted for specific adaptation to that environment. The concept of wide adaptation has more a geographical than an environmental meaning, and it reduces genetic diversity and increases genetic vulnerability. Eventually the issue of genetic heterogeneity versus genetic uniformity is discussed in relation to specific adaptation to marginal environments. [References: 65].

197 Chen, FQ.; Hayes, PM.; Mulrooney, DM.; Pan, AH. (1994) NUCLEOTIDE SEQUENCE OF A CDNA ENCODING A HEAT-SHOCK PROTEIN (HSP70) FROM BARLEY (*HORDEUM VULGARE* L.). *Plant Physiology*. 106(2):815. English. [OREGON STATE UNIV DEPT CROP & SOIL SCI CORVALLIS, OR 97331 USA].

198 Chen, HB.; Martin, JM.; Lavin, M.; Talbert, LE. (1994) GENETIC DIVERSITY IN HARD RED SPRING WHEAT BASED ON SEQUENCE-TAGGED-SITE PCR MARKERS. *Crop Science*. 34(6):1628-1632. English. [MONTANA STATE UNIV DEPT PLANT SOIL & ENVIRONM SCI BOZEMAN, MT 59717 USA].

Genetic variation among wheat (*Triticum aestivum* L.) parents is necessary to derive superior progeny from crossing and selection. However, crosses are often performed among elite lines with similar agronomic and end-use characteristics. Thus, the potential exists for an undesirable narrowing of the germplasm base for any particular class of wheat. The relative genetic diversity within hard red spring wheat was determined in comparison to a sample of wheat accessions representing an array of types and geographic origins. Three groups of accessions were assayed for the frequencies of DNA polymorphism using a total of 38 sequence-tagged-site primer sets with polymerase chain reaction. Group I contained 10 elite hard red spring wheat cultivars under production in Montana and North Dakota, Group II included 15 hard red spring wheat cultivars and lines from the North American Great Plains, and Group III contained 20 accessions representing a wide range of collection and morphological types. Twenty-four of 38 primer sets (63%) and 31 of 76 primer-enzyme combinations (41%) revealed polymorphisms. The range of genetic similarity estimated by percentage of shared restriction fragments varied from 0.65 to 0.99 among all pairwise comparisons among the 45 lines. Average genetic similarity was 0.81. Genetic similarity among the hard red spring wheats was 0.88, whereas genetic similarity among the broadly based Group III was 0.78. Our results showed that the breeding pool for hexaploid hard red spring wheat is narrow relative to levels of diversity among and within classes in hexaploid wheat. [References: 25].

199 Chen, Q.; Lu, YL.; Jahier, J.; Bernard, M. (1994) IDENTIFICATION OF WHEAT AGROPYRON CRISTATUM MONOSOMIC ADDITION LINES BY RFLP ANALYSIS USING A SET OF ASSIGNED WHEAT DNA PROBES. *Theoretical & Applied Genetics*. 89(1):70-75. English. [NATL INST AGRON RES IMPROVEMENT PLANTS STN BP 29 F-35650 LE RHEU FRANCE].

A non-radioactive digoxigenin-labelled DNA method was used successfully to identify RFLP markers in 54 *Triticum aestivum* cv 'Chinese Spring' - *Agropyron cristatum* (2n=28, genome PPPP) P-genome monosomic addition lines. Southern analysis using a set of 14 DNA probes identifying each homoeologous chromosome arm, combined with two restriction enzymes HindIII and EcoRI, indicated that six A. cristatum chromosomes (1P, 2P, 3P, 4P, 5P and 6P) and five A. cristatum chromosome arms (2PS, 2PL, 5PL, 6PS and 6PL) have been individually

added to the wheat genome. The added chromosomes of three lines were Agropyron translocated chromosomes. It was also found that two addition plants possessed an Agropyron-wheat translocation. These results showed that RFLP analysis using the set of assigned wheat probes was a powerful tool in detecting and establishing homoeology of alien A. cristatum chromosomes, or arms, added to wheat, as well as in screening the alien addition material. The creation of the monosomic addition lines should be useful for the transfer of disease-resistance genes from A. cristatum to wheat. [References: 26].

200 Chen, Z.; Devey, M.; Tuleen, NA.; Hart, GE. (1994) USE OF RECOMBINANT SUBSTITUTION LINES IN THE CONSTRUCTION OF RFLP-BASED GENETIC MAPS OF CHROMOSOMES 6A AND 6B OF TETRAPLOID WHEAT (TRITICUM TURGIDUM L.). *Theoretical & Applied Genetics*. 89(6):703-712. English. [TEXAS A&M UNIV DEPT SOIL & CROP SCI COLLEGE STN, TX 77843 USA].

RFLP-based genetic maps of chromosomes 6A and 6B of *Triticum turgidum* have been constructed using data obtained by the study of *Triticum turgidum* var 'durum' cv 'Langdon'-T. t. var 'dicoccoides' recombinant substitution lines (RSLs) supplemented with data obtained from F-3 families derived from 'Langdon'-dicoccoides 6A and 6B disomic substitution lines. The average RFLP frequencies detected for the two chromosomes in a test of 45 DNA clones with six restriction enzymes were 56% and 53%, respectively, and a subset of 32 clones gave frequencies of 75% and 72%, respectively. Seventeen loci were mapped in 6A and 18 in 6B. With the possible exception of 5 loci in the centromeric region of 6A, all of the mapped 6A and 6B loci are located in the same arm as are homologous loci in hexaploid wheat, and the linear order of the loci is the same in the two chromosomes, except possibly close to the centromere. Major differences in genetic distances exists between homologous loci located in the proximal regions of the 6AL and 6BL linkage groups, however, the distances being much larger in the former than in the latter. The 6B maps that were constructed using data from both the RSL and the F-2 populations and using data from the RSL population alone closely resemble one another, indicating that the 6B RSL population, composed of 85 lines, can be reliably used for genetic mapping. Additional studies must be conducted before the utility of the 6A RSL population, composed of 66 lines, can be adequately assessed. [References: 24].

201 Chong, K.; Wang, LP.; Tan, KH.; Huang, HL.; Liang, HG. (1994) MOLECULAR CLONING AND CHARACTERIZATION OF VERNALIZATION-RELATED (VER) GENES IN WINTER WHEAT. *Physiologia Plantarum*. 92(3):511-515. English. [ACAD SINICA INST BOT BEIJING 100044 PEOPLES REPUBLIC OF CHINA].

The enriched cold-induced cDNA library of 1×10^4 plaque-forming units (pfu), was prepared using cDNAs from cold-induced winter wheat, subtracted with mRNA of the control (non cold-induced). Results of the hybridization in situ of differential screening with probes of the control, the vernalized and devernallized wheat cDNAs showed that *verc17* (*verc*: vernalization-related cDNA clone) is specific for the vernalization. The insert of lambda gt 10 recombinant was subcloned into the sites between *Bam*HI and *Hind*III in a pUC 19 plasmid. Analysis by northern blotting with a probe from *verc17* indicated that the *verc17* has negative signals for the control and the devernallized mRNA, but a positive signal for the mRNA of vernalized wheat at about 1.8 kb. The sequence had 20 restriction sites, covered by 17 enzymes. The *ver17* gene showed some homology with the *P. yeolii* major merozoite surface-antigen gene. [References: 17].

202 Choo, TM.; Martin, RA.; Ho, KM.; Bubar, JS.; Walton, R.; Blatt, R.; Rodd, V. (1994) AC STERLING BARLEY. *Canadian Journal of Plant Science*. 74(4):817-819. English. [AGR & AGRI FOOD CANADA RES STN POB 1210 CHARLOTTETOWN C1A 7M8 PE CANADA].

AC Sterling is a two-row, spring feed barley (*Hordeum vulgare* L.) cultivar developed by the Eastern Canada Barley Breeding Group, Agriculture and Agri-Food Canada. It has high yield, high protein content, low acid detergent fibre content, high 1000-kernel weight, and resistance to powdery mildew. AC Sterling is well adapted to Eastern Canada.

203 Chung, D.H. (Rural Development Administration, Mokpo (Korea Republic). Mokpo Crop Experiment Station); Min, K.S. (Chunnam National University, Kwangju (Korea Republic). College of Agriculture); Chun, J.U. (Sunchon National University, Sunchon (Korea Republic). College of

Agriculture) (1993) Major characteristics of *Hordeum bulbosum* and haploid production of cultivated barley by pollinating with *H. bulbosum* L. *Korean Journal of Crop Science (Korea Republic)* v. 38(6) p. 531-536. 3 illus.; 4 tables; 16 ref. Korean. (AGRI 94-106913).

204 Clarke, JM.; Depauw, RM.; Mcleod, JG.; Mccaig, TN. (1994) VARIATION FOR PREHARVEST SPROUTING RESISTANCE IN DURUM WHEAT. *Crop Science*. 34(6):1632-1635. English. [AGR & AGRI FOOD CANADA BOX 1030 SWIFT CURRENT S9H 3X2 SK CANADA].

Preharvest sprouting may reduce end-use quality and is thus an important grading criterion in all market classes of wheat (*Triticum* spp.). There are few reports in the literature of genetic variation in preharvest sprouting resistance in durum wheat (*T. turgidum* L. var *durum*), and the only apparent attempts to breed sprouting resistant durums have been to transfer resistance from red common wheat (*T. aestivum* L.). Use of resistance sources within the durum species would be easier, so this study was undertaken to assess the variation for sprouting resistance in durum. Sprouting resistance of 185 durum genotypes was evaluated in 1990. Unreplicated samples of 10 spikes from each genotype were evaluated in an artificial rain chamber. Sixty of these genotypes were re-evaluated in a replicated study in 1991. The 1990 study indicated that the durums had a similar range in sprouting score (spikes out of 10 showing visible sprouts) to the common wheat checks. The sprouting scores of the red (5.8 ± 3.7 , $n = 30$) and white (6.5 ± 3.0 , $n = 149$) genotypes were not different ($P < 0.05$). Sprouting score measured in 1991 was correlated with that of 1990 ($r = 0.55$, $n = 60$). We conclude that there is considerable genetic variation in sprouting resistance in durum that can be more easily exploited by durum breeders than common wheat sources of resistance. [References: 26].

205 Cruz Medina, Roberto (Instituto Tecnológico de Sonora. Cd. Obregon, Sonora (Mexico)); Salazar Gomez, Mario; Hernandez Jasso, Arturo (INIFAP. CIR Noroeste, Ap. Postal 515, 85000 Cd. Obregon, Sonora (Mexico)) (1992) [The analysis of genotype-environment interactions in breadwheat]. Consideraciones sobre el analisis de la interaccion genotipo ambiente en trigos harineros. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 251-269. Centro de Investigacion Regional del Noroeste. 7 tablas; 11 ref. 1er. tomo. Spanish. (AGRI 94-117163).

206 D'Antuono, L.F. (Bologna Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee) (1994) [Productive potentiality of spring variety for malt upon office of the seed time (in Italy)]. Potenzialita produttive di varieta primaverili da malto in funzione dell'epoca di semina (nel Lazio). *Informatore Agrario (Italy)* v. 50(5) p. 61-64. 3 tables; 12 graphs. Italian. (AGRI 94-106986).

207 Depauw, RM.; Mcleod, JG.; Clarke, JM.; Mccaig, TN.; Fernandez, MR.; Knox, RE. (1994) AC EATONIA HARD RED SPRING WHEAT. *Canadian Journal of Plant Science*. 74(4):821-823. English. [AGR & AGRI FOOD CANADA RES STN SWIFT CURRENT S9H 3X2 SK CANADA].

AC Eatonia hard red spring wheat (*Triticum aestivum* L.) has several improved traits relative to Leader: increased stem solidness and resistance to cutting by the wheat stem sawfly, resistance to common bunt, common root rot and seed shattering, and higher grain yield potential. It is adapted to the Brown and Dark Brown soil zones. [References: 2].

208 Deverall, BJ.; Saverimuttu, N.; Cantrill, LC.; McIntosh, RA. (1994) GENETIC CONTROL OF RESPONSIVENESS OF WHEAT TO ELICITORS IN INTERCELLULAR WASHING FLUIDS FROM LEAF RUST-INFECTED LEAVES. *Physiological & Molecular Plant Pathology*. 45(3):189-194. English. [UNIV SYDNEY DEPT CROP SCI SYDNEY NSW 2006 AUSTRALIA].

Reciprocal crosses were made between the cv. Cappelle Desprez, which is highly responsive to elicitors in intercellular washing fluids from leaf rust-infected leaves, and the non-responsive cv. Little Club. Analyses of F-2 and F-3 generations showed that responsiveness was conferred by a single dominant gene. Studies of recombinant lines for chromosome 5A and its long arm from Cappelle Desprez indicated that the gene must be

located in the long arm of 5A. It is proposed that the gene encodes for a receptor of the elicitors, which are considered to be glycoprotein(s) from the walls of rust fungi. The action of the gene for expression of resistance is observed when the elicitors are introduced into the intercellular spaces but not during infection by the rust hyphae, suggesting that the elicitors on fungal walls are not presented to the receptor in the normal infection process. [References: 16].

209 Devos, KM.; Chao, S.; Li, QY.; Simonetti, MC.; Gale, MD. (1994) **RELATIONSHIP BETWEEN CHROMOSOME 9 OF MAIZE AND WHEAT HOMEOLOGOUS GROUP 7 CHROMOSOMES.** *Genetics*. 138(4):1287-1292. English. [JOHN INNES CTR PLANT SCI RES NORWICH RES PK NORWICH NR4 7UH NORFOLK ENGLAND].

Comparison of the genetic map of maize chromosome 9 with maps of wheat chromosomes has revealed a high degree of colinearity between maize chromosome 9 and the group 4 and 7 chromosomes of wheat. The order of DNA markers on the short arm and a proximal region of the long arm of the genetic map of maize chromosome 9 is highly conserved with the marker order on the short arm and proximal region of the long arm of the genetic maps of the wheat homeologous group 7 chromosomes. A major part of the long arm of the genetic map of maize chromosome 9 is homeologous with a short segment in the proximal region of the long arm of the genetic map of the wheat group 4 chromosomes. Evidence is also presented that maize chromosome 9 has diverged from the wheat group 7 chromosomes by both a pericentric and a paracentric inversion. The paracentric inversion is probably unique to maize among the major cereal genomes. [References: 24].

210 Donald, R.G.K.; Jackson, A.O. (1994) **THE BARLEY STRIPE MOSAIC VIRUS GAMMA-B GENE ENCODES A MULTIFUNCTIONAL CYSTEINE-RICH PROTEIN THAT AFFECTS PATHOGENESIS.** *Plant Cell*. 6(11):1593-1606. English. [UNIV CALIF BERKELEY DEPT PLANT BIOL BERKELEY, CA 94720 USA].

Barley stripe mosaic virus contains seven genes, one of which specifies a 17-kD cysteine-rich protein, gamma b, that is known to affect virulence. To further characterize the role of gamma b in pathogenesis, we mutagenized sequences encoding amino acids within two clusters of cysteine and histidine residues in the cysteine-rich domain and a group of basic amino acids located between the clusters and determined the effects of these mutations on the symptom phenotype in barley. Three single amino acid substitutions in cluster 1 and two amino acid exchanges in the basic region caused bleached symptoms associated with pronounced elevations in accumulation of gamma b protein. In contrast, three single amino acid substitutions in cluster 2 and a mutation in the basic motif resulted in attenuated ("null") symptoms typical of those produced when the gamma b gene is deleted. Tissue infected with these "null" mutants accumulated slightly elevated amounts of the gamma b protein but significantly lower levels of coat protein and the putative movement protein beta b. Genetic complementation tests revealed that cluster 1 mutations are dominant over the wild-type gamma b gene, whereas those in cluster 2 are recessive. These results highlight the pivotal role of gamma b in pathogenesis and suggest that the two cysteine-rich clusters are functionally distinct and that they affect different aspects of disease development. [References: 43].

211 Dubcovsky, J.; Dvorak, J. (1994) **GENOME ORIGINS OF TRITICUM CYLINDRICUM, TRITICUM TRIUNCIALE, AND TRITICUM VENTRICOSUM (POACEAE) INFERRED FROM VARIATION IN RESTRICTION PATTERNS OF REPEATED NUCLEOTIDE SEQUENCES - A METHODOLOGICAL STUDY.** *American Journal of Botany*. 81(10):1327-1335. English. [LAWRENCE LIVERMORE NATL LAB DEPT AGRON & RANGE SCI DAVIS, CA 95616 USA].

Three methods of phylogenetic inferences on polyploid plants employing variation in restriction sites in repeated nucleotide sequences were compared. Allotetraploid *Triticum* species of well-established origin were used as a model. Methods based on determination of the proportion of restriction fragments shared between a polyploid and its diploid relatives generated biased results because of uneven numbers of restriction fragments among diploid species and presence of common bands in phylogenetically related diploid species. A method employing restriction fragments unique to a diploid species (marker bands) was not affected by either factor and generated results consistent with cytogenetic inferences. It is shown that the latter method can be used to investigate the origin of a

polyploid species even when one of its progenitors is extinct or when the polyploid and its diploid progenitors have diverged. [References: 47].

212 Dyck, PL. (1994) **THE TRANSFER OF LEAF RUST RESISTANCE FROM TRITICUM TURGIDUM SSP DICOCOIDEES TO HEXAPLOID WHEAT.** *Canadian Journal of Plant Science*. 74(4):671-673. English. [AGR & AGRIFOOD CANADA RES STN 195 DAFOE RD WINNIPEG R3T 2M9 MBCANADA].

Accession 8404 of *Triticum turgidum* ssp. *dicoccoides* was shown to have excellent resistance to leaf rust. Genetic analysis of the F-3 of 8404 and RL6089, a leaf rust susceptible durum, indicated that 8404 had three genes for leaf rust resistance. Two of these genes were transferred to hexaploid wheat (Thatcher) by a series of backcrosses. One of the genes transferred was the same as Lr33 (RL6057). The second gene, which gives a fleck reaction to avirulent *P. recondita* races, appears to be fully incorporated into the hexaploid where it segregated to fit a one-gene ratio. Backcross lines with this gene give excellent resistance to leaf rust, although race MBG is virulent to this gene. This may be a previously unidentified leaf rust resistance gene and should increase the genetic diversity available for wheat breeders. [References: 6].

213 Dyck, PL.; Bartos, P. (1994) **ATTEMPTED TRANSFER OF LEAF RUST RESISTANCE FROM TRITICUM MONOCOCCUM AND DURUM WHEAT TO HEXAPLOID WHEAT.** *Canadian Journal of Plant Science*. 74(4):733-736. English. [AGR CANADA RES STN 195 DAFOE RD WINNIPEG R3T 2M9 MB CANADA].

An attempt was made to transfer leaf rust resistance from diploid *Triticum monococcum*, an autotetraploid of the *T. monococcum* accession, and durum cultivars Medora and Stewart to hexaploid wheat cultivars Thatcher and RL6058 (Lr34). A single gene for leaf rust resistance which was the same as Lr33 (RL6057) was transferred from the durum cultivars to hexaploid wheat. The gene transferred in crosses involving autotetraploid *T. monococcum* was also Lr33, but since Lr33 is on chromosome 1B, it was probably not from *T. monococcum*. This gene was not the same as the *T. monococcum*-derived gene in RL6137 (Tc(*6)/TMR5-J14-12-24). Using RL6058 (Lr34) as the recurrent parent appeared to facilitate the interspecific transfer of resistance since resistance was expressed in the first backcross generation involving RL6058 but not Thatcher. [References: 15].

214 Ehdaie, B.; Waines, J.G. (1994) **GROWTH AND TRANSPIRATION EFFICIENCY OF NEAR-ISOGENIC LINES FOR HEIGHT IN A SPRING WHEAT.** *Crop Science*. 34(6):1443-1451. English. [UNIV CALIF RIVERSIDE DEPT BOT & PLANT SCI RIVERSIDE, CA 92521 USA].

The two most commonly used dwarfing genes of bread wheat (*Triticum aestivum* L.) are Rht1 and Rht2. The Rht3 gene is also a potent dwarfing gene. Information in the literature is limited as to the comparative effects of these genes on transpiration efficiency (TE) and water-use efficiency (WUE). Carbon isotope discrimination (Delta) has been proposed as a criterion to select for improved TE. Four near-isogenic lines, RhtRht, Rht1Rht1, Rht2Rht2, and Rht3Rht3, in 'Maringa' bread wheat background and four of their near-isogenic F-1 hybrids derived from crossing the original lines were used to determine the effects of dwarfing genes on plant height, root dry matter, shoot dry matter including grains, grain yield, total dry matter (TDM), TE (TDM/water transpired), WUE (grain yield/water used), and Delta in well-watered and droughted pot experiments in the glasshouse. The near-isogenic lines and their six F-1 hybrids were also grown in well-watered and droughted field conditions. Plant height ranged from 60 to 124 cm and from 53 to 121 cm in well-watered and droughted pot experiments, and it varied from 50 to 94 cm and from 49 to 90 cm in well-watered and droughted field experiments, respectively. Total dry matter, grain yield, TE, and WUE declined with plant height in well-watered glasshouse conditions. No significant relationships were found between plant height and these traits in droughted glasshouse conditions. Carbon isotope discrimination was negatively correlated with TE, but significantly so only in the well-watered pot experiment. Plant height was negatively associated with Delta in both well-watered and droughted pot and field experiments. Grain yield and shoot dry matter also declined with plant height in field conditions. Negative correlations were observed between Delta and grain yield and Delta and shoot dry matter in well-watered field conditions. In most cases, the dwarfing genes reduced shoot dry matter more than grain yield and, therefore, harvest index of the semidwarf and dwarf lines was higher than

that of the tall standard line. The dwarfism caused by Rht1, Rht2, and Rht3 genes had, in general, depressing effects on TE, WUE, TDM, and grain yield. [References: 24].

215 Ekiz, H.; Konzak, C.F. (1994) ANTHR CULTURE RESPONSE OF SOME SPRING BREAD WHEAT (TRITICUM-AESTIVUM L) CULTIVARS, LINES AND F1) CROSSES. *Cereal Research Communications*. 22(3):165-171. English. [BAHRI DAGDAS INT WINTER CEREALS RES CTR POB 325 KONYA TURKEY].

To determine the anther culture response of spring bread wheat, 44 cultivars and lines, and 14 F1s were cultured. Genotypes showed significant differences especially in callus induction and green plant proportion compared to plant regeneration. The results from F1s suggested that additive genetic effects predominated for callus induction. In addition, epistasis and heterosis were also observed in some crosses. Some cultivars had dominant or masking genes suppressing callus induction, which were functional in F1 crosses as well; however, probably because of minor genes or gene interactions their functions were some altered positively in their crosses. On the other hand, additive, epistasis and heterosis genetic effects were observed for plant regeneration and green plant proportion as well. In contrast to callus induction, the genotypes with low green plant proportion did not drastically reduce green plant proportion in their crosses. Insignificant correlation coefficients calculated between anther culture components (callus induction, plant regeneration, and green plant proportion) indicated that these are under the control of different genetic mechanisms.

216 Elen, O.N. (Statens Plantevern, Aas (Norway). Avd. Plantesykdommer) (1992) Resistance to *Septoria nodorum* in Norwegian spring wheat. 188. NJF Seminar; Aas (Norway); 11-14 Feb 1991. Disease resistance in agricultural crops. NJF-Seminar no. 188. Elen, O.; Tronsmo, A.M. (eds.). Scandinavian Association of Agricultural Scientists (NJF). *Norwegian Journal of Agricultural Sciences (Norway)*; no. 7(suppl.) p. 95-98. Statens Fagteneste for Landbruket. 2 tables; 4 ref. English. (AGRI 94-117209).

217 Elovson, R.; Nilsson, C. (Weibullsholm Plant Breeding Inst., Landskrona (Sweden)) (1992) Test for tolerance to grey snow mould (*Typhula* spp.) in winter barley. 188. NJF Seminar; Aas (Norway); 11-14 Feb 1991. Disease resistance in agricultural crops. NJF-Seminar no. 188. Elen, O.; Tronsmo, A.M. (eds.). Scandinavian Association of Agricultural Scientists (NJF). *Norwegian Journal of Agricultural Sciences (Norway)*; no. 7(suppl.) p. 51-54. Statens Fagteneste for Landbruket. 3 tables; 6 ref. English. (AGRI 94-117025).

218 Friebe, B.; Gill, B.S. (1994) C-BAND POLYMORPHISM AND STRUCTURAL REARRANGEMENTS DETECTED IN COMMON WHEAT (TRITICUM AESTIVUM). *Euphytica*. 78(1-2):1-5. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

Giemsa C-banding allows for the identification of all 21 chromosome pairs of hexaploid wheat. However variation in banding patterns of individual chromosomes and structural rearrangements exist between different cultivars making chromosome identification more difficult. The paper summarizes the available data on C-band polymorphism and structural rearrangement present in wheat cultivars and germplasms. [References: 18].

219 Fukui, K.; Kakeda, K. (1994) A CRITICAL ASSESSMENT OF KARYOTYPE ANALYSIS BY IMAGING METHODS. *Japanese Journal of Genetics*. 69(5):537-544. English. [UNIV BIRMINGHAM SCH BIOL SCI POB 363 BIRMINGHAM B15 2TT W MIDLANDS ENGLAND].

A critical evaluation of the digital data of 250 barley metaphase spreads obtained by image analysis revealed the instability of the chromosomal morphology during the mitotic metaphase stage. Both the relative length (RL) and arm ratio (AR) of the chromosomes, which are the two major numerical parameters in karyotype analysis, varied in the different chromosomal spreads. The ranking of the chromosomes for the respective parameters within a complement changed accordingly. The data indicated that karyotype analysis based merely on the numerical parameters RL and AR may lead to the misidentification of chromosomes, causing a misinterpretation of the data from different chromosomes when averaging several data. Thus, most of data of the RL and AR which have so far been

reported may need reexamination except for the cases where chromosomes were identified based on other critical parameters, e.g., banding pattern, condensation pattern, in situ hybridization, etc. Differential condensation between the chromosome arms may be the cause of the instability of the karyotype. [References: 20].

220 Garciasado, G.; Sanchezmonge, R.; Lopezotin, C.; Salcedo, G. (1994) RYE CHROMOSOME ARM 3RS ENCODES A HOMODIMERIC INHIBITOR OF INSECT ALPHA-AMYLASE. *Theoretical & Applied Genetics*. 89(1):60-63. English. [ETS INGN AGRON DEPT BIOQUIM E-28040 MADRID SPAIN].

A new inhibitor of insect alpha-amylase, designated RDAI-1, has been purified from rye (*Secale cereale* L.) endosperm. RDAI-1 is homologous to wheat homodimeric inhibitors. This homology is supported by their similar N-terminal amino-acid sequences, inhibitory activities towards amylases from *Tenebrio molitor* (Coleoptera) and human saliva, and aggregative properties in gel-filtration chromatography. The gene encoding RDAI-1, *IdhAR1*, is located on the short arm of chromosome 3R, which is homoeologous with wheat chromosome arms 3BS and 3DS, where the genes for homodimeric inhibitors have been previously mapped. [References: 16].

221 Gouda, M.A.; El Shami, M.M.; Shehab El Din, T.M. (Ministry of Agriculture, Kafr El Sheikh (Egypt). Sakha Agricultural Research Station) (1993) Inheritance of grain yield and some related morphophysiological traits in wheat. *Tanta Journal of Agricultural Research (Egypt)* v. 19(3) p. 537-546. 5 tables; 13 ref. English. (AGRI 94-106955).

222 Graf, C. (ed.) (1993) [Papers on breeding research on barley, Triticale and soybean. Dedicated to the memory of Prof. em. Dr. habil. Ernst Keppler]. *Beiträge zur Züchtungsforschung bei Gerste, Triticale und Sojabohnen. Dem Gedenken an Prof. em. Dr. habil. Ernst Keppler gewidmet. Landwirtschaftliche Untersuchungs- und Forschungsanstalt Thüringen, Jena (Germany). Fachbereich Pflanzenproduktion; Verband fuer Agrarforschung und -bildung Thüringen, Jena (Germany). Schriftenreihe VAFB Thüringen (Germany); no. 1 69 p. VAFB. ill., graphs; ref. German. (AGRI 94-117023).*

223 Gustafson, J.P.; Dera, A.R. (USDA ARS Dept. of Agronomy, University of Missouri, Columbia, Missouri 65211, U.S.A.) (1992) [Alien manipulation and biotechnology: Present and future impact on wheat]. [Manipulation y biotecnologia genetica: Impacto presente y futuro en trigo]. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 151-156. Centro de Investigacion Regional del Noroeste. 13 ref. English. (AGRI 94-116903).

224 Gyurova, M. (Agraren Universitet, Plovdiv (Bulgaria)); Georgiev, S.; Dimitrov, L.; Spasov, R.; Ivanova, V. (1993) [Agroclimatic parameters of the development rate of triticale and rye]. *Agroklimaticzni pokazateli za skorostta na razviti na tritikale i r'zh. Selskostopanska Akademiya, Sofia (Bulgaria). Rasteniye "dni Nauki (Bulgaria); Plant Science v. 30(5-6) p. 77-79. 3 ill., 3 ref. Bulgarian. (AGRI 94-107072).*

225 Gyurova, M. (Agraren Universitet, Plovdiv (Bulgaria)); Georgiev, S.; Ivanova, V.; Dimitrov, L. (1993) [Agroclimatic zonation of rye and triticale grown for green mass]. *Agroklimaticno rajonirane na r'zh i tritikale za zelena masa. Selskostopanska Akademiya, Sofia (Bulgaria). Rasteniye "dni Nauki (Bulgaria); Plant Science v. 30(5-6) p. 80-83. 2 ill., 1 table; 3 ref. Bulgarian. (AGRI 94-107067).*

226 Hadjichristodoulou, A. (Ministry of Agriculture and Natural Resources, Nicosia (Cyprus). Agricultural Research Inst.) (1992) A new domestication of the 'wild' brittle rachis gene of barley (*Hordeum vulgare* L.). *Plant Genetic Resources Newsletter (IBPGR/FAO); Bulletin des Ressources Genetiques Vegetales (CIRP/FAO); Noticiario de Recursos Geneticos Vegetales (CIRP/FAO) (no.90) p. 46. English. (AGRI 94-106994).*

227 Hadjichristodoulou, A. (Ministry of Agriculture and Natural Resources, Nicosia (Cyprus). Agricultural Research Inst.) (1992) Collecting, evaluation and utilization of *Hordeum vulgare* subsp. *agriocrithon* in Cyprus. *Plant Genetic Resources Newsletter* (IBPGR/FAO); *Bulletin des Ressources Genetiques Vegetales* (CIRP/FAO); *Noticiario de Recursos Geneticos Vegetales* (CIRF/FAO) (no.90) p. 15-18. English. (AGRIS 94-106993).

228 Haroun, S.A. (Tanta Univ., Kafr El Sheikh (Egypt). Faculty of Education); Ali, A.A. (1993) Cytological studies on gamma irradiated wheat (*Triticum aestivum* L.). *Tanta Journal of Agricultural Research* (Egypt) v. 19(3) p. 618-623. 2 fig. 2 tables; 23 ref. English. (AGRIS 94-107087).

229 Hendawy, F.A. (Monoufeya Univ., Shebin El Kom (Egypt). Faculty of Agriculture) (1994) General and specific combining ability estimates in a diallel cross of seven bread wheat varieties. *Monoufeya Journal of Agriculture Research* (Egypt) v. 19(1) p. 76-93. 4 tables; 19 ref. English. (AGRIS 94-106956).

230 Hendawy, F.A.; Dawwam, H.A.; Seleem, S.A.M. (Monoufeya Univ., Shebin El Kom (Egypt). Faculty of Agriculture) (1993) Heterosis and combining ability for yield and its components in common wheat. *Menoufiya Journal of Agricultural Research* (Egypt) v. 18(4 part 1) p. 2349-2383. 6 tables; 20 ref. English. (AGRIS 94-106958).

231 Hendawy, F.A.; Rady, M.S.; Hendawy, H.I. (Monoufeya Univ., Shebin El Kom (Egypt). Faculty of Agriculture) (1993) Breeding for yield and its components in wheat. *Menoufiya Journal of Agricultural Research* (Egypt) v. 18(4 part 1) p. 2235-2260. 5 tables; 21 ref. English. (AGRIS 94-106957).

232 Henry, Y.; Marcotte, J.L.; Debuyser, J. (1994) CHROMOSOMAL LOCATION OF GENES CONTROLLING SHORT-TERM AND LONG-TERM SOMATIC EMBRYOGENESIS IN WHEAT REVEALED BY IMMATURE EMBRYO CULTURE OF ANEUPLOID LINES. *Theoretical & Applied Genetics*. 89(2-3):344-350. English. [UNIV PARIS 11 GENET VEGETALE LAB BT 360 F-91405 ORSAY FRANCE].

The expression of essential genes during somatic embryogenesis can be analysed by inducing aneuploid cells to undergo embryogenesis during immature embryo culture and then determining whether defects occur. *Triticum aestivum* disomic and aneuploid stocks, including 36 ditelosomics and 7 nullitetrasonic 'Chinese Spring' wheats, were compared for their ability to undergo somatic embryogenesis after 2 months of in vitro immature embryo culture. Their regeneration capacity was observed after 4 and 14 months of in vitro culture to determine which chromosome arms influence the process. The large range of variation found among the tested aneuploids suggested that genetic control of the somatic tissue culture ability is polygenic. Our results indicate that genes affecting somatic embryogenesis and regeneration are located in all of the homoeologous chromosome groups. The lack of chromosome arms 1AL (DT 1AS) and 3DL (DT 3DS) practically suppresses somatic embryogenesis, demonstrating that major genes on wheat chromosome arms 1AL and 3DL control regeneration capacity. Results suggest that plants were mainly produced from somatic embryo development. Although the control of somatic embryogenesis and regeneration is polygenic, the genes located on the long arms of homoeologous group 3 chromosomes have a major effect. We also have evidence of chromosome arms that determine the time required for regeneration. [References: 20].

233 Hernandez Sierra, Arturo (INIFAP. C.E. Valle de Mexico. Ap. Postal 10. Chapingo. Mex. 56230 (Mexico)) (1992) [Progress in the genetic improvement of wheat in Mexico]. *Avance en el mejoramiento genetico del trigo en Mexico. Primera conferencia nacional sobre la produccion de trigo en Mexico*. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. *Conferencia nacional sobre la produccion de trigo en Mexico*. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste* (Mexico); no. 4 p. 115-131. Centro de Investigacion Regional del Noroeste. 3 tablas; 13 ref. Spanish. (AGRIS 94-116901).

234 Hess, W.R.; Hoch, B.; Zeltz, P.; Hubschmann, T.; Kossel, H.; Börner, T. (1994) INEFFICIENT RPL2 SPLICING IN BARLEY MUTANTS WITH RIBOSOME-DEFICIENT PLASTIDS. *Plant Cell*. 6(10):1455-1465. English.

[HUMBOLDT UNIV BERLIN INST BIOL INVALIDENSTR 43 D-10115 BERLIN GERMANY].

Analysis of transcript accumulation and splicing in plastids of four nuclear mutants of barley revealed that the ribosomal protein L2 (rpl2) gene transcripts containing a group II intron remained entirely unspliced, whereas the intron of the ribosomal protein L16 (rpl16) gene (linked with the rpl2 gene in the same operon) was removed in the mutant plastids. Also, the transcripts of other genes containing group II introns (ribosomal protein S16 gene, rps16; NADH dehydrogenase ND2 gene, ndhB; cytochrome f gene, petD; and intron-containing reading frame 170, irf170) and of the tRNA for leucine, trnL (UAA), possessing the only chloroplast group I intron, were found to be spliced. The mutants used in this investigation are considered to be nonallelic; this excludes the possibility that a single nuclear gene is responsible for the impaired splicing of rpl2 transcripts. The mutants, however, have a severe deficiency in chloroplast ribosomes in common; this deficiency is evident from the lack of the essential ribosomal protein L2 and from an extremely low steady state level of plastid rRNAs. From these results, we conclude that a functioning translational apparatus of the organelle is a prerequisite for splicing of the chloroplast rpl2 class II intron but not for splicing of at least five other group II intron-containing transcripts. This provides genetic evidence for a chloroplast DNA-encoded component (e.g., a maturase) involved in the splicing of rpl2 pre-mRNA. [References: 51].

235 Hintum, T.J.L. van (Sveriges Lantbruksuniv., Svalöv (Sweden). Inst. för Växtförsäddning) (1994) Drowning in the gene pool. Managing genetic diversity in genebank collections. *Sveriges Lantbruksuniv., Svalöv (Sweden). Sveriges Lantbruksuniv. Bibliography* p. 33-39. A dissertation bound with a collection of 7 reprints. 39 p. English. (AGRIS 94-117027).

236 Hoemmoen, L.M. (Agricultural Research Centre, Jokioinen (Finland). Inst. of Plant Breeding) (1992) Hardening ability of some winter wheat, winter rye and winter barley varieties. Use of conductivity method in evaluating the hardening ability of overwintering crop species. 188. NJF Seminar; Aas (Norway); 11-14 Feb 1991. Disease resistance in agricultural crops. NJF-Seminar no. 188. Elen, O.; Tronsmo, A.M. (eds.). *Scandinavian Association of Agricultural Scientists (NJF). Norwegian Journal of Agricultural Sciences (Norway); no. 7(suppl.)* p. 39-50. Statens Fagteneste for Landbruket. 6 tables, 6 figures; 18 ref. English. (AGRIS 94-117148).

237 Huang Jianhua; Lu Ruiju; Zhang Yuhua (Shanghai Municipal Academy of Agricultural Sciences, Shanghai (China). Inst. of Crop Breeding and Cultivation) (1993) Embryo-like structure formation and green plant regeneration of barley genotypes with low responsiveness to anther culture. *Acta Agriculturae Shanghai (China)* v. 9(4) p. 19-22. 2 ill., 3 tables, 10 ref. Chinese. (AGRIS 94-117022).

238 Hussain, A.; Lukow, O.M. (1994) CHARACTERIZATION OF THE 1B/1R TRANSLOCATION IN WHEAT USING WATER EXTRACTABLE PROTEIN CONCENTRATE. *Euphytica*. 78(1-2):109-113. English. [AGR & AGRIFOOD CANADA RES CTR 195 DAPOE RD WINNIPEG R3T 2M9 MB CANADA].

An electrophoretic procedure was developed to obtain patterns of water soluble proteins from the endosperm halves of seeds to detect the 1B/1R translocation in wheat cultivars. The water soluble proteins were precipitated with Coomassie Brilliant Blue R-250 and separated in a 10% polyacrylamide gel with sodium dodecyl sulfate. This procedure extracted protein bands (Mr 40, 000, 44, 000 and 45, 000) corresponding to the omega-secalins of the rye parent which were present only in the wheat cultivars carrying 1B/1R translocation. By simplifying extract preparation and providing clear band resolution this procedure facilitates large scale screening of wheat lines for the rye translocation. Proteins with properties of overlapping solubilities are also discussed. [References: 18].

239 Hyne, V.; Kearsey, M.J.; Martinez, O.; Gang, W.; Snape, J.W. (1994) A PARTIAL GENOME ASSAY FOR QUANTITATIVE TRAIT LOCI IN WHEAT (*TRITICUM AESTIVUM*) USING DIFFERENT ANALYTICAL TECHNIQUES. *Theoretical & Applied Genetics*. 89(6):735-741. English. [HORT RES INT WELLESBOURNE CV35 9EF WARWICK ENGLAND].

F-1 plants between two intervarietal chromosome substitution lines of European spring wheat varieties, 'Sicco' (Chinese Spring 5B) and 'Highbury' (Chinese Spring 5B), were used to produce 114 doubled

haploid lines, 45 by the *Hordeum bulbosum* technique and 69 by anther culture. These two sets of lines were characterized for variation at a range of morphological, isozyme and RFLP marker loci, and genetic maps were developed with emphasis on chromosomes 6B, 7A, 7B and 7D. A subset of lines, scored for production traits in field trials in 1986 and 1987, were analysed for quantitative trait loci (QTL). The performance of the lines for the quantitative traits studied showed no overall differences due to the method of production of the lines. QTL were located on the linkage map for ear emergence time, height, tiller weight, yield and 50-grain weight using four analytical methods. Many of these effects showed genotype x year interaction. [References: 15].

240 Innes, RL; Kerber, ER. (1994) RESISTANCE TO WHEAT LEAF RUST AND STEM RUST IN TRITICUM TAUSCHII AND INHERITANCE IN HEXAPLOID WHEAT OF RESISTANCE TRANSFERRED FROM T-TAUSCHII. *Genome*. 37(5):813-822. English. [DEKALB CANADA INC RR 2 GLANWORTH NOL 1L0 ON CANADA].

Twelve accessions of *Triticum tauschii* (Coss.) Schmal. were genetically analyzed for resistance to leaf rust (*Puccinia recondita* Rob. ex Desm.) and stem rust (*Puccinia graminis* Pers. f.sp. *tritici* Eriks. and E. Henn.) of common wheat (*Triticum aestivum* L.). Four genes conferring seedling resistance to leaf rust, one gene conferring seedling resistance to stem rust, and one gene conferring adult-plant resistance to stem rust were identified. These genes were genetically distinct from genes previously transferred to common wheat from *T. tauschii* and conferred resistance to a broad spectrum of pathogen races. Two of the four seedling leaf rust resistance genes were not expressed in synthetic hexaploids, produced by combining tetraploid wheat with the resistant *T. tauschii* accessions, probably owing to the action of one or more intergenomic suppressor loci on the A or B genome. The other two seedling leaf rust resistance genes were expressed at the hexaploid level as effectively as in the source diploids. One gene was mapped to the short arm of chromosome 2D more than 50 cM from the centromere and the other was mapped to chromosome 5D. Suppression of seedling resistance to leaf rust in synthetic hexaploids derived from three accessions of *T. tauschii* allowed the detection of three different genes conferring adult-plant resistance to a broad spectrum of leaf rust races. The gene for seedling resistance to stem rust was mapped to chromosome 1D. The degree of expression of this gene at the hexaploid level was dependent on the genetic background in which it occurred and on environmental conditions. The expression of the adult-plant gene for resistance to stem rust was slightly diminished in hexaploids. The production of synthetic hexaploids was determined to be the most efficient and flexible method for transferring genes from *T. tauschii* to *T. aestivum*, but crossing success was determined by the genotypes of both parents. Although more laborious, the direct introgression method of crossing hexaploid wheat with *T. tauschii* has the advantages of enabling selection for maximum expression of resistance in the background hexaploid genotype and gene transfer into an agronomically superior cultivar. [References: 31].

241 Jedel, PE. (1994) INHERITANCE OF VERNALIZATION RESPONSE IN THREE POPULATIONS OF SPRING WHEAT. *Canadian Journal of Plant Science*. 74(4):753-757. English. [ALBERTA AGR CROP RES BAG 47 LACOMBE T0C 150 AB CANADA].

Vernalization responses are known to differ among spring wheat (*Triticum aestivum* L.) genotypes. Three crosses were made to determine the inheritance of vernalization response in the spring wheat cultivars Cajeme 71, Yecora 70, Glenlea, Pitic 62 and Neepawa. Segregation analyses of days to anthesis were made of the F-2 generation in a growth room (25/15 degrees C, 16/8 h). Segregation analysis of the F-2 generation was made in a summer greenhouse. Reciprocal crosses between Neepawa and Pitic 62 indicated an early/late / transgressively late ratio of 12:3:1 in the F-3 generation. The F-3 generation results fitted an early/late / transgressively late / segregating ratio of 4:1:1:10. Based on the segregation of transgressively late types from both crosses, it was concluded that the genes for spring habit in Pitic 62 and Neepawa were different and not maternally inherited. The Glenlea / Pitic 62 cross produced one transgressively late segregant in an F-2 population of 97 plants. The data fitted an early/late / transgressively late ratio of 60:3:1, indicating that Glenlea may differ from Pitic 62 at three *Vrn* loci. Therefore, either Glenlea or Pitic 62 may carry two dominant *Vrn* alleles. The reciprocal crosses between Yecora 70 and Cajeme 71 did not segregate transgressively late types in the F-2 generation. Therefore, those cultivars

had a *Vrn* allele in common. Selection for vernalization response might be useful when introducing exotic germplasm into spring wheat breeding programs and in manipulating maturity responses. [References: 24].

242 Jiang Aidiang (Tianjing Inst. of Crops (China)) (1993) The study on peroxidase isozymes in the progress of male sterility line in wheats. *Acta Agriculturae Universitatis Pekinensis (China)* v. 19(suppl.) p. 44-47. 3 ill., 1 table, 9 ref. Chinese. (AGRIS 94-117200).

243 Jiang, JM.; Gill, BS. (1994) NONISOTOPIC IN SITU HYBRIDIZATION AND PLANT GENOME MAPPING - THE FIRST 10 YEARS [Review]. *Genome*. 37(5):717-725. English. [KANSAS STATE UNIV AGR & APPL SCI WHEAT GENET RESOURCE CTR MANHATTAN, KS 66502 USA].

Nonisotopic in situ hybridization (ISH) was introduced in plants in 1985. Since then the technique has been widely used in various areas of plant genome mapping. ISH has become a routine method for physical mapping of repetitive DNA sequences and multicopy gene families. ISH patterns on somatic metaphase chromosomes using tandemly repeated sequences provide excellent physical markers for chromosome identification. Detection of low or single copy sequences were also reported. Genomic in situ hybridization (GISH) was successfully used to analyze the chromosome structure and evolution of allopolyploid species. GISH also provides a powerful technique for monitoring chromatin introgression during interspecific hybridization. A sequential chromosome banding and ISH technique was developed. The sequential technique is very useful for more precise and efficient mapping as well as cytogenetic determination of genomic affinities of individual chromosomes in allopolyploid species. A critical review is made on the present resolution of the ISH technique and the future outlook of ISH research is discussed. [References: 92].

244 Jovanovic, B. (Faculty of Agriculture, Belgrade (Yugoslavia)); Maletic, R.; Prodanovic, S.; Protic, R.; Jeric, Z. (1993) Estimates of genetic parentage on the pharino-graph's values. *Review of research work at the Faculty of Agriculture (Yugoslavia)* v. 38(1) p. 47-52. 1 graph; 2 tables; 5 ref. English. (AGRIS 94-106962).

In this study cluster analysis was used to estimate the phenotypic diversity in quality components among 17 winter wheat cultivars. The presence of wheat varieties from different quality classes and groups in the same cluster was observed. Also, wheat varieties of the same quality group could be found in different clusters. For breeders these cases mean that crosses among the varieties of the same quality class could give good possibility for recombinations of genes if parents were chosen correctly. High-quality parents from different clusters are expected to increase allelic diversity for hybridization and selection of new wheat lines.

245 Kakeda, K.; Fukui, K. (1994) DYNAMIC CHANGES IN THE MORPHOLOGY OF BARLEY CHROMOSOMES DURING THE MITOTIC METAPHASE STAGE. *Japanese Journal of Genetics*. 69(5):545-554. English. [UNIV BIRMINGHAM SCH BIOL SCI POB 363 BIRMINGHAM B15 2TT W MIDLANDS ENGLAND].

Dynamic changes in the morphology of barley chromosomes during the mitotic metaphase stage were observed and attributed to the differential condensation of the chromosome arms. The mitotic stage of the 250 metaphase spreads was classified into five sub-stages from early metaphase to late metaphase. At each sub-stage, the relative length (RL) and the arm ratio (AR) of the chromosomes were examined and the ranking of the chromosomes for the two parameters was also determined for the respective chromosomal spreads. As a result, the RL and AR values of some of the chromosomes as well as their ranking for the two parameters were found to vary with the progression of the metaphase stage. The dynamic changes in the RL and AR values were closely related to the differences in the condensation rate of the chromosome arm. Factors involved in the differential chromosome condensation are discussed. [References: 11].

246 Kazman, E.; Lelley, T. (1994) RAPID INCORPORATION OF D-GENOME CHROMOSOMES INTO A AND/OR B GENOMES OF HEXAPLOID TRITICALE. *Plant Breeding-Zeitschrift für Pflanzenzüchtung*. 113(2):89-98. English. [UNIV GÖTTINGEN INST ACKERBAU & PFLANZENZÜCHTUNG VON SIEBOLD STR 8 D-37075 GÖTTINGEN GERMANY].

Two series of progenies were developed from hybrids between octoploid (AABBDDRR) and tetraploid triticale ((AB) (AB)RR). One arose from the successive selfing of the F(1)s, while the second was established after one backcross of the F-1 hybrids with the respective 8 x triticale parent. Altogether, 250 F-3 and BC1F2 lines were developed, of which 112 were karyotyped in the F-4/F-5 or in BC1F3/BC1F4 generations using C-banding and SDS-PAGE. The 112 lines represented 61 different karyotypes, of which 39 appeared to be stabilized, having pairs of homologous wheat chromosomes only, while 22 karyotypes exhibited 1-3 heterologous pairs. The frequency of karyotypically stabilized lines originating from the series with one backcrossing was much higher (79.5 %) than those derived from the successive selfing of the F-1 hybrids (51.7 %). Six lines had the pure hexaploid triticale chromosome constitution. The frequency of disomic substitutions of D genome chromosomes for their homoeologous A and/or B genome chromosomes ranged from one to six per line with an average of 1.7. Except for 3B and 6B all possible D(A/B) substitutions were obtained. Chromosomes 1D and 3D substituted for their homoeologues with the highest frequency, while the substitution of chromosome 4D for 4A or for 4B was the least frequent. D(R) substitutions were found in eight lines only. A complete set of 6x triticale lines was established in which chromosome 1D was present in all possible combinations, i.e. single 1D(1A/1B/1R) disomic substitutions as well as disomic 1D addition. [References: 20].

247 Kevresan, S.; Vapa, Lj. (Prirodno matematički fakultet, Novi Sad (Yugoslavia)) (1992) [Molecular and genetic principles for the determination of the technological quality of wheat]. *Molekulske genetičke osnove odredjivanja tehnološkog kvaliteta pšenice*. 34. savetovanje Srpskog hemijskog društva; Beograd (Yugoslavia); 16-18 Jan 1992. [34 th Conference of Serbian Chemical Society, Beograd (Yugoslavia), January 16-18, 1992. Summaries of papers]. Popovic, I.; Blagojevic, N. (eds.) p. 97. Srpsko hemijsko društvo. Serbian. (AGRI 94-107080).

248 Khristov, M. (Institut po Pshenitsa i Sl'nchogleda "Dobrudzha", General Toshevo (Bulgaria)) (1993) [Sources of cytoplasmic male sterility produced at Institute for wheat and sunflower "Dobrudzha"]. *Iztochnitsi na tsitoplazmena m'zhka sterilnost, proizvedeni v Instituta po pshenitsata i sl'nchogleda "Dobrudzha"*. Diagnosis Press Ltd., Sofia (Bulgaria). *Biotehnologiya and Biotehnika (Bulgaria); Biotechnology and Biotechnological Equipment v. 7(4) p. 132-135. 3 tables; 4 ref. English. (AGRI 94-107164).*

Fourteen sources of male sterility (MS) in sunflower are produced at Institute for wheat and sunflower "Dobrudzha", General Toshevo, Bulgaria for the period of 1984-1992. Eight sources originate from hybrid materials produced in hybridization between wild annual species of *Helianthus* and cultivated sunflower. For seven of them it is found that they are of cytoplasmic type. From the investigation regarding the plant fertility restoring in these cytoplasmic male sterility sources are detected and the sterilizing cytoplasm do not exert a negative effect on the morphology and productivity of the hybrid plants.

249 Kimber, G.; McKendry, AL. (1994) THE GENETIC EFFECT OF THE PROXIMAL REGIONS OF WHEAT CHROMOSOMES. *Cereal Research Communications*. 22(3):159-164. English. [UNIV MISSOURI DEPT AGRON COLUMBIA, MO 65211 USA].

The proximal regions of wheat chromosomes rarely undergo recombination and thus it is difficult to determine if some 50 per cent of the DNA of this species has any measureable effect. The genetic effects of the proximal regions of the chromosomes of two cultivars (Chinese Spring and Hope) are investigated using the double-ditelocentrics of Chinese Spring and the Hope substitution series to produce lines in which only the proximal or distal region of a single chromosome is introduced into an otherwise uniform background.

250 King, IP.; Purdie, KA.; Liu, CJ.; Reader, SM.; Pittaway, TS.; Orford, SE.; Miller, TE. (1994) DETECTION OF INTERCHROMOSOMAL TRANSLOCATIONS WITHIN THE TRITICEAE BY RFLP ANALYSIS. *Genomic*. 37(5):882-887. English. [UNIV READING DEPT AGR BOT READING RG6 2AS BERKS ENGLAND].

Twenty-three wheat/alien addition or substitution lines were screened using restriction fragment length polymorphisms for the presence or absence of 4/5 and 4/7 reciprocal translocations in the alien chromosomes. Such translocations have previously been identified in wheat and rye.

Group 4 and group 5 *Aegilops umbellulata*, *Triticum urartu*, and *Thinopyrum bessarabicum* chromosomes were found to carry 4/5 translocations. Evidence for a 4/7 translocation was also found in *Secale montanum*. The presence of the 4/5 translocations in *T. urartu* indicates that the translocation predates the polyploidization of wheat. The implications of these results are discussed. [References: 40].

251 Knox, RE.; Howes, NK. (1994) A MONOCLONAL ANTIBODY CHROMOSOME MARKER ANALYSIS USED TO LOCATE A LOOSE SMUT RESISTANCE GENE IN WHEAT CHROMOSOME 6A. *Theoretical & Applied Genetics*. 89(6):787-793. English. [AGR CANADA RES STN POB 1030 SWIFT CURRENT S9H 3X2 SK CANADA].

Many genes have been located in wheat chromosomes, yet little is known about the location of genes introduction for resistance to *Ustilago tritici*, which causes loose smut. Crosses were made between the loose smut susceptible alien substitution lines Cadet 6Ag(6A) and Rescue 6Ag(6A) (lines in which *Agropyron* chromosome 6 is substituted by wheat chromosome 6A) and four cultivars resistant to *U. tritici* race T19: 'Cadet', 'Kota', 'Thatcher' and 'TD18'. The segregating progeny were tested for reaction to race T19 and for the level of binding with a monoclonal antibody specific to a chromosome GA-coded seed protein. The antibody, which does not bind to seed protein extracts in the absence of the 6A chromosome, was used as a chromosome marker. An association was established between resistance to race T19 and the presence of chromosome 6A for each of the cultivars tested, indicating that resistance to race T19 resides in chromosome 6A. *Ustilago tritici* race T19 resistance in 'Cadet' appears to be located in the short arm of chromosome 6A, based on the evaluation of the Cadet 6A long ditelosomic stock, which was susceptible, and the Cadet 6A-short: 6-*Agropyron*-short alien translocation stock, which was resistant. [References: 28].

252 Kong, D.; Choo, TM.; Jui, P.; Ferguson, T.; Therrien, MC.; Ho, KM.; May, KW.; Narasimhalu, P. (1994) GENETIC VARIATION AND ADAPTATION OF 76 CANADIAN BARLEY CULTIVARS. *Canadian Journal of Plant Science*. 74(4):737-744. English. [AGR & AGRIFOOD CANADA PLANT RES CTR OTTAWA K1A 0C6 ON CANADA].

A study was initiated in 1990 to determine the genetic variation and adaptation of all registered Canadian barley (*Hordeum vulgare* L.) cultivars. Seventy-six cultivars were tested at four locations across Canada (Charlottetown, Ottawa, Brandon, and Bentley) in 1991 and 1992. These cultivars were grouped into 10 classes and classes were compared in five categories: eastern vs. western, doubled-haploid (DH) vs. conventional, feed vs. malting, two-row vs. six-row, and hullless vs. covered. These 76 cultivars showed remarkable variation in yield, test weight, kernel weight, plant height, and maturity and responded differently to the environments. Among them, Albany and Chapais had the highest yield and they also yielded well in both Eastern and Western Canada. Thus, some barley cultivars were widely adapted across the whole country. Two-row cultivars had higher test weight and higher kernel weight than six-row and appeared to be more stable in yield over the environments. Eastern two-row cultivars were superior in yield, test weight, and kernel weight than western two-row. Eastern two-row, in general, performed well across Canada. Several western six-row cultivars performed well in both Western and Eastern Canada. Therefore, greater exchanges of breeding materials between the two regions are recommended in order to fully exploit the genetic potentials of new cultivars. DH cultivars yielded as well as conventional cultivars and responded similarly to the environments. This substantiates that complete homozygosity and homogeneity have very little effect on the performance of DH cultivars. Among the western two-row, feed cultivars yielded either higher than or the same as malting cultivars in the eight environments. Hullless cultivars had lower yield, higher test weight and lower kernel weight than covered cultivars. [References: 10].

253 Kuhlmann, U. (1992) [Regeneration of microspores and investigations into the transformation of barley]. *Mikrosporenregeneration und Untersuchungen zur Transformation bei Gerste*. Technische Univ. Muenchen, Freising (Germany). Lehrstuhl fuer Pflanzenbau und Pflanzenzuechtung. 13 ill., 12 graphs, 21 tables. Bibliography 192 ref. 94 p. German. (AGRI 94-106980).

254 Legana Solano, Juan P.; Munoz Orozco, Abel (Colegio de Postgraduados, Montecillo, Mex. (Mexico)) (1992) [Interaction of wheat

varieties with dry environment at the Mixteca Alta, Oaxaca State]. Interacción de variedades de trigo con ambientes secos de la Mixteca Alta Oaxaqueña. *Revista Fitotecnia Mexicana (Mexico)* v. 15(1) p. 40-50. 2 illus; 5 tablas; 16 ref. Spanish. (AGRS 94-117159).

255 Li Chengdao; Huang Peizhong; Liu Yufang (Shanghai Municipal Academy of Agricultural Sciences, Shanghai (China). Inst. of Crop Breeding and Cultivation) (1993) Analysis of genetic effect and heterosis of internode length in barley. *Acta Agriculturae Zhejiangensis (China)* v. 5(3) p. 158-161. 1 ill., 3 tables, 5 ref. Chinese. (AGRS 94-117021).

256 Li Luxiang (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. for Application of Atomic Energy) (1993) An analysis of heterosis performance of grain yield and seed protein content and superior environment for hybrid wheat. *Acta Agriculturae Universitatis Pekinensis (China)* v. 19(4) p. 107-108. Chinese. (AGRS 94-117201).

257 Lindelaursen, I.; Seberg, O.; Salomon, B. (1994) COMPARISON OF THE GIEMSA C-BANDED AND N-BANDED KARYOTYPES OF 2 ELYMUS SPECIES, E-DENTATUS AND E-GLAUDESCENS (POACEAE, TRITICEAE). *Plant Systematics & Evolution*. 192(3-4):165-176. English. [RISO NATL LAB DEPT ENVIRONM SCI & TECHNOL PLANT GENET SECT POB 49 DK-4000 ROSKILDE DENMARK].

The karyotypes of *Elymus dentatus* from Kashmir and *E. glaucescens* from Tierra del Fuego, both carrying genomes S and H, were investigated by C- and N-banding. Both taxa had $2n = 4x = 28$. The karyotype of *E. dentatus* was symmetrical with large chromosomes. It had 18 metacentric, four submetacentric and six satellited chromosomes. The karyotype of *E. glaucescens* resembled that of *E. dentatus*, but a satellited chromosome pair was replaced by a morphologically similar, non-satellited pair. The C-banding patterns of both species had from one to five conspicuous and a few inconspicuous bands per chromosome. N-banding differentiated the chromosomes of the constituent genomes by producing bands in the H genome only. The S genomes of both species were similar with five metacentric and two satellited chromosomes having most conspicuous C-bands at telomeric and distal positions. They resembled the S genome of the genus *Pseudoroegneria*. The H genomes had four similar metacentric and two submetacentric chromosomes. The seventh H genome chromosome of *E. dentatus* was satellited, that of *E. glaucescens* nonsatellited, but otherwise morphologically similar. The C-bands were distributed at no preferential positions. The H genome of *E. dentatus* resembles the H genomes of some diploid *Hordeum* taxa. [References: 36].

258 Liu, ZW.; Wang, RRC.; Carman, JG. (1994) HYBRIDS AND BACKCROSS PROGENIES BETWEEN WHEAT (TRITICUM AESTIVUM L.) AND APOMICTIC AUSTRALIAN WHEATGRASS. *Theoretical & Applied Genetics*. 89(5):599-605. English. [UTAH STATE UNIV USDA ARS FORAGE & RANGE RES LAB LOGAN, UT 84322 USA].

Wheat (*Triticum aestivum* L., $2n = 6x = 42$, AABBDD) florets were emasculated and pollinated using two apomictic wheatgrass [*Elymus rectisetus* (Nees in Lehm.) A. Love and Connor, $2n = 6x = 42$, SSSYYWW] accessions, one of which produces $2n$ pollen. A $2n = 42$ (B-II) hybrid and four $2n = 63$ (B-III) hybrids were obtained. The spike morphology of the B-II hybrid was intermediate to that of its parents. The pollen mother cells (PMCs) of this hybrid contained on average 38.36 I and 1.62 II, which was consistent with its disparate genome composition (ABDSYW). Its pollen failed to stain and no BC1 progeny was obtained. The B-III hybrids (reduced egg fertilized with unreduced sperm) were grasslike and had a full complement of *E. rectisetus* chromosomes, the synapsis of which was slightly impaired by wheat haplome and/or cytoplasm. Their PMCs contained on average 16.30 II, 25.72 I, and 1.54 multivalents (III plus IV). Pollen stainability in these hybrids was low (<1%), and when they were used as females, one 54- and 60-chromosome BC1 were obtained. A mean of 13.25 II was observed in PMCs of the 54-chromosome BC1 and pollen stainability was 10%. Pollen stainability in the 60-chromosome BC1 was only 5%. The use of $2n$ -pollen-producing *E. rectisetus* accession accelerated hybrid and BC1 formation and may accelerate the ultimate transfer of apomixis to wheat. [References: 18].

259 Lozano del Rio, Alejandro Javier (Universidad Autonoma Agraria Antonio Narro, Buenavista, Coah. (Mexico)) (1992) [Behavior of complete and substituted triticales in four environments of Northern Mexico]. Comportamiento de materiales de triticales completos y substituidos en

cuatro ambientes del norte de Mexico. Primera conferencia nacional sobre la producción de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicación Especial. Centro de Investigación Regional del Noroeste (Mexico)*; no. 4 p. 295-312. Centro de Investigación Regional del Noroeste. 10 tablas; 8 ref. 2o. tomo. Spanish. (AGRS 94-116908).

260 Ma, ZQ.; Sorrells, ME.; Tanksley, SD. (1994) RFLP MARKERS LINKED TO POWDERY MILDEW RESISTANCE GENES PM1, PM2, PM3, AND PM4 IN WHEAT. *Genome*. 37(5):871-875. English. [CORNELL UNIV DEPT PLANT BREEDING & BIOMETRY 252 EMERSON HALL ITHACA, NY 14853 USA].

Near-isogenic lines (NILs) and their recurrent parent Chancellor (Cc) were used to identify restriction fragment length polymorphic markers linked to powdery mildew (*Blumeria graminis* (DC.) E.O. Speer f.sp. tritici) resistance genes Pm1, Pm2, Pm3, and Pm4 in wheat (*Triticum aestivum* L. em. Thell). By mapping these polymorphic markers in F-2 progenies from crosses of the NILs with Cc, it was found that Pm1 cosegregated with a polymorphic locus detected by DNA probe CDO347; Pm2 was linked to a locus detected by probe BCD1871 with a distance of 3.5 cM; Pm3b was linked to a locus detected by probe BCD1434 with a distance of 1.3 cM; Pm4a cosegregated with Xbcd1231-2A(2) and Xcd678-2A, and was closely flanked by Xbcd1231-2A(1) and Xbcd292-2A both with a distance of 1.5 cM. Aneuploid mapping of these markers indicated that locus Xcd347-7A is on 7AL, Xbcd1871-5D on 5DS, Xbcd1434-1A on 1AS, and loci Xbcd292-2A and Xcd678-2A are on 2AL. The same polymorphic fragments detected in the Pm3b NIL by Xbcd1434-1A were found in Pm3a NIL using several enzyme digestions [References: 42].

261 Mac Key, J. (Swedish Univ., Uppsala (Sweden). Dept. of Plant Breeding) (1992) Use of near-isogenic lines in analysing racespecific pathogen interrelations. 188. NJF Seminar; Aas (Norway); 11-14 Feb 1991. Disease resistance in agricultural crops. NJF-Seminar no. 188. Elen, O.; Tronsmo, A.M. (eds.). Scandinavian Association of Agricultural Scientists (NJF). *Norwegian Journal of Agricultural Sciences (Norway)*; no. 7(suppl.) p. 63-76. Statens Fagteneste for Landbruket. 9 tables; 33 ref. English. (AGRS 94-117104).

262 Mangat, G.S.; Dhindsa, G.S.; Sandha, G.S. (Punjab Agricultural University, Ludhiana (India). Department of Plant Breeding) (1992) Combining ability studies in spring X winter triticales crosses. *Crop Improvement (India)* v. 19(2) p. 109-112. 4 tables; 9 ref. English. (AGRS 94-116993).

263 Marko, F. (Vyskumny Ustav Rastlinnej Vyroby, Piestany (Slovak Republic)) (1993) [Results of the research in cereals grown in Eastern Slovakia]. Vysledky vyskumu obilnin VURV Piestany vo Vychodoslovenskom regione. Poľnohospodárstvo Vychodoslovenskej Niziny v Regionalnych Suvislostiach; Michalovce (Slovak Republic); 1-2 Dec 1992. [Regional aspects of the agriculture in the Vychodoslovenska Nizina Lowland, Slovakia. Proceedings of the international conference held in Michalovce, Slovakia, December 1-2, 1992]. *Oblasťny Vyskumny Ustav Agroekologie. Michalovce (Slovak Republic)* p. 89-94. Oblasťny Vyskumny Ustav Agroekologie. 5 tables. Slovak. (AGRS 94-106989).

264 Marthe, F.; Kunzel, G. (1994) LOCALIZATION OF TRANSLOCATION BREAKPOINTS IN SOMATIC METAPHASE CHROMOSOMES OF BARLEY. *Theoretical & Applied Genetics*. 89(2-3):240-248. English. [INST PLANT GENET & CROP PLANT RES D-06466 GATERSLEBEN GERMANY].

Karyotype analyses based on staining by acetocarmine followed by Giemsa N-banding of somatic metaphase chromosomes of *Hordeum vulgare* L. were carried out on 61 reciprocal translocations induced by X-irradiation. By means of computer-based karyotype analyses all of the 122 breakpoints could be localized to defined sites or segments distributed over the seven barley chromosomes. The pre-definition of translocations with respect to their rearranged chromosome arms from other studies rendered it possible to define the break positions even in translocations having exchanged segments equal in size and the breakpoints located distally to any Giemsa band or other cytological marker. The breakpoints were found to be non-randomly spaced along the chromosomes and their

arms. All breaks but one occurred in interband regions of the chromosomes, and none of the breaks was located directly within a centromere. However, short and long chromosome arms recombined at random. An improved tester set of translocations depicting the known break positions of most distal location is presented. [References: 65].

265 Martinez Santana, Jose de Jesus (INIFAP. CIR Noroeste, Ap. Postal 515, 85000 Cd. Obregon, Sonora (Mexico)); Rajaram, S. (CIMMYT); Pfeiffer, W.H. (CIMMYT) (1992) [Uniform wheat trials in Mexico: a useful tool in genetic improvement and for making decisions on the release and recommendation of varieties]. Los ensayos uniformes de trigo en Mexico, una herramienta en el mejoramiento genetico y la toma de decisiones para liberar y recomendar variedades. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 85-104. Centro de Investigacion Regional del Noroeste. 1 illus; 12 tablas; 1 ref. Spanish. (AGRS 94-116899).

266 Martinez Zedillo, Gustavo; Guevara L, E. (Universidad Autonoma Agraria Antonio Narro, Buenavista, Coah. Mexico) (1992) [Variability, correlation and heritability components in wheat varieties (*Triticum aestivum* L.) from CIMMYT germoplasm]. Componentes de variabilidad, correlaciones y heredabilidad en lineas de trigo (*Triticum aestivum* L.) derivadas de germoplasma del CIMMYT. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 229-249. Centro de Investigacion Regional del Noroeste. 9 tablas; 6 ref. Spanish. (AGRS 94-117162).

267 Matzk, F.; Mahn, A. (1994) IMPROVED TECHNIQUES FOR HAPLOID PRODUCTION IN WHEAT USING CHROMOSOME ELIMINATION. *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 113(2):125-129. English. [INST PFLANZENGENET & KULTURPFLANZENFORSCH CORRENSSTR 3 D-06466 GATERSLEBEN GERMANY].

Wheat x maize and wheat x pearl miller crosses have proved efficient for haploid production using various genotypes of wheat: 22 and 27 % of florets produced embryos. In favourable conditions 6-9 haploid plants per spike were produced. The following simplifications or improvements in technique are recommended: 1. Only a single treatment with an aqueous solution of dicamba or 2, 4-D (50-100 ppm) for embryo stimulation in vivo; 2. Application by spraying or dipping the spikes; 3. Application time two to four days after pollination; 4. Embryo rescue 15 to 18 days after pollination; 5. Crosses without emasculation are possible if pollination occurs 1-2 days before anthesis. More than 450 haploids and some doubled haploid (DH) lines (after colchicine treatment in vitro) were produced using these methods. No hybrid plants, chromosome additions or substitutions were found. [References: 17].

268 McDermott, J.M.; Brandle, U.; Dutly, F.; Haemmerli, U.A.; Keller, S.; Muller, K.E.; Wolfe, M.S. (1994) GENETIC VARIATION IN POWDERY MILDEW OF BARLEY - DEVELOPMENT OF RAPD, SCAR, AND VNTR MARKERS. *Phytopathology*. 84(11):1316-1321. English. [SWISS FED INST TECHNOL INST PLANT SCI PHYTOPATHOL GRP UNIV STR 2 LFW CH-8092 ZURICH SWITZERLAND].

Isolates of *Erysiphe graminis* f. sp. *hordei* derived from airborne conidia and progeny of specific crosses were screened for random amplified polymorphic DNA (RAPD) variation detected with 10-base primers. Using two DNA samples, 58 of 76 primers yielded good amplification products. Twenty-seven primers were screened further on a test set of 16 E.g. *hordei* isolates collected from throughout Europe. Approximately 119 resolvable bands were reproducibly amplified, 56 bands were variable, and each primer yielded at least one polymorphism. A subset of 10 of these primers detected 30 polymorphisms in the European test set but only 19 variable bands in 48 isolates collected with a stationary spore trap. In addition to the RAPD markers, we developed six sets of specific primers that detected variation, five of which detected multiple alleles, one detected the

presence and absence of a band, and a seventh was monomorphic. These polymerase chain reaction markers, in conjunction with virulence and fungicide sensitivity, are being used to investigate evolutionary processes and genetic linkage in the barley powdery mildew pathogen. [References: 38].

269 McLeod, J.G.; Townleysmith, T.F.; Depauw, R.M.; Clarke, J.M. (1994) AC COPIA SPRING TRITICALE. *Canadian Journal of Plant Science*. 74(4):811-813. English. [AGR & AGRI FOOD CANADA RES STN SWIFT CURRENT S9H 3X2 SK CANADA].

AC Copia, a cultivar of spring triticales (X *Triticosecale* Wittmack), was developed at the Research Station, Research Branch, Agriculture and Agri-Food Canada, Swift Current, SK. It is widely adapted to the Prairie Provinces of Western Canada. AC Copia represents an improvement in test weight over other currently available Canadian cultivars of triticales. It is very resistant to the prevalent races of leaf rust, stem rust and common bunt, and moderately resistant to common root rot.

270 Miller, T.E.; Reader, S.M.; Purdie, K.A.; King, I.P. (1994) DETERMINATION OF THE FREQUENCY OF WHEAT-RYE CHROMOSOME PAIRING IN WHEAT X RYE HYBRIDS WITH AND WITHOUT CHROMOSOME 5B. *Theoretical & Applied Genetics*. 89(2-3):255-258. English. [JOHN INNES CTR PLANT SCI RES NORWICH NR4 7UJ NORFOLK ENGLAND].

Genomic in-situ hybridization (GISH) was used to determine the amount of wheat-rye chromosome pairing in wheat (*Triticum aestivum*) x rye (*Secale cereale*) hybrids having chromosome 5B present, absent, or replaced by an extra dose of chromosome 5D. The levels of overall chromosome pairing were similar to those reported earlier but the levels of wheat-rye pairing were higher than earlier determinations using C-banding. Significant differences in chromosome pairing were found between the three genotypes studied. Both of the chromosome-5B-deficient hybrid genotypes showed much higher pairing than the euploid wheat hybrid. However, the 5B-deficient hybrid carrying an extra chromosome 5D had significantly less wheat-rye pairing than the simple 5B-deficient genotype, indicating the presence of a suppressing factor on chromosome 5D. Non-homologous/non-homoeologous chromosome pairing was observed in all three hybrid genotypes. The value of GISH for assessing the level of wheat-alien chromosome pairing in wheat/alien hybrids and the effectiveness of wheat genotypes that affect homoeologous chromosome pairing is demonstrated. [References: 18].

271 Miura, H.; Tanii, S.; Nakamura, T.; Watanabe, N. (1994) GENETIC CONTROL OF AMYLOSE CONTENT IN WHEAT ENDOSPERM STARCH AND DIFFERENTIAL EFFECTS OF THREE WX GENES. *Theoretical & Applied Genetics*. 89(2-3):276-280. English. [OBIHIRO UNIV AGR & VET MED DEPT CROP SCI OBIHIRO HOKKAIDO 080 JAPAN].

The endosperm starch of the wheat grain is composed of amylose and amylopectin. Genetic manipulation of the ratio of amylose to amylopectin or the amylose content could bring about improved texture and quality of wheat flour. The chromosomal locations of genes affecting amylose content were investigated using a monosomic series of Chinese Spring (CS) and a set of Cheyenne (CNN) chromosome substitution lines in the CS genetic background. Trials over three seasons revealed that a decrease in amylose content occurred in monosomic 4A and an increase in monosomic 7B. Allelic variation between CS and CNN was suggested for the genes on chromosomes 4A and 7B. To examine the effects of three Waxy (Wx) genes which encode a granule-bound starch synthase (Wx protein), the Wx proteins from CS monosomics of interest were analyzed using SDS-PAGE. The amount of the Wx protein coded by the Wx-B1 gene on chromosome arm 4AL was reduced in monosomic 4A, and thus accounted for its decreased amylose content. The amounts of two other Wx proteins coded by the Wx-A1 and Wx-D1 genes on chromosome arms 7AS and 7DS, respectively, showed low levels of protein in the monosomics but no effect on amylose content. The effect of chromosome 7B on the level of amylose suggested the presence of a regulator gene which suppresses the activities of the Wx genes. [References: 21].

272 Miura, H.; Worland, A.J. (1994) GENETIC CONTROL OF VERNALIZATION, DAY-LENGTH RESPONSE, AND EARLINESS PER SE BY HOMEOLOGOUS GROUP-3 CHROMOSOMES IN WHEAT. *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 113(2):160-169. English. [OBIHIRO UNIV AGR & VET MED OBIHIRO HOKKAIDO 080 JAPAN].

To identify homoeologous group-3 chromosomes that carry genes for vernalization, day-length responses, and earliness per se, a series of aneuploid lines (monosomics and tetrasomics) and chromosome-substitution lines in 'Chinese Spring' (CS) were surveyed under different vernalization and day-length regimes in controlled environments. The results indicated that genes on all three chromosomes of group 3 can have striking effects on ear-emergence time. The replacement of CS 3B by its homologues in 'Lutescens 62' and 'Cheyenne' produced an increased insensitivity to vernalization, while 3B homologues from 'Ceska Presivka' gave CS a remarkable sensitivity to vernalization. This provided evidence for multiple allelism at a new Vrn locus on chromosome 3B. A negative association between gene dosage and day-length response was found in CS 3D which was thought to carry a gene for promoting insensitivity to daylength. The behaviour of CS monosomic 3A and CS (Timstein 3A), in reducing numbers of days to heading independently of environmental stimuli, suggested the presence of earliness per se genes on this chromosome. [References: 31].

273 Mjaerum, J. (Norges Landbrukshegskole, Aas (Norway). Inst. foer Plantekultur) (1992) Development of quality properties in Norwegian wheat. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden. Johansson, H. (ed.) p. 181-186. Svalof AB. 2 ref. English. (AGRIS 94-107092).*

274 Moreno Galvez, Rodolfo (INIFAP. C.E. Valle de Mexico. Ap. Postal 10, Chapingo, Mex. 56230 (Mexico)) (1992) [Breeding wheat varieties for sowing under rainfed conditions]. Obtencion de variedades de trigo para siembras de temporal. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 197-208. Centro de Investigacion Regional del Noroeste. 1 tabla. Spanish. (AGRIS 94-116905).*

275 Morerelepaven, MC.; Debuyser, J.; Henry, Y.; Hartmann, C.; Rode, A. (1994) UNUSUAL INHERITANCE OF THE MITOCHONDRIAL GENOME ORGANIZATION IN THE PROGENY OF RECIPROCAL CROSSES BETWEEN ALLOPLASMIC HEXAPLOID WHEAT REGENERANTS. *Theoretical & Applied Genetics. 89(5):572-576. English. [UNIV PARIS 11 INST BIOTECHNOL PLANTES CNRS URA D1128 BAT 630 F-91405 ORSAY FRANCE].*

The transmission of a structurally-hypervariable fraction of the mitochondrial genome has been studied in 42 F-1 progenies obtained from reciprocal crosses between self-pollinated alloplasmic wheat plants regenerated after long-term somatic embryogenesis. This fraction of the genome is maternally and stoichiometrically inherited. In contrast, some additional restriction fragments specific to regenerated plants display a more complex mode of sexual transmission: one of the additional fragments was stoichiometrically and systematically inherited whereas two others were detected only in certain F-1 hybrids. Assuming that the detection, by Southern analysis, of such a fragment in regenerated plants is due to the amplification of a pre-existing substoichiometric molecule generated by the activation of a rare recombination event, our results suggest that the probability of detecting a novel fragment in the F-1 hybrids could be determined by the length of the repeated sequence at which recombination occurs. [References: 35].

276 Moule, C. (1994) [Grain yield and biomass production in winter wheat. Effects of the selection during the first half of the century]. Rendement en grain et biomasse produite chez le ble tendre d'hiver. Effets de la selection au cours de la premiere moitie du siecle. *Comptes Rendus de l'Academie d'Agriculture de France (France) v. 80(3) p. 135-148. 10 ref. French. (AGRIS 94-117157).*

277 Mouradov, A.; Mouradova, E.; Scott, KJ. (1994) GENE FAMILY ENCODING BASIC PATHOGENESIS-RELATED 1 PROTEINS IN BARLEY. *Plant Molecular Biology. 26(1):503-507. English. [FORBIO PTY LTD BSES LABS 50 MEIERS RD BRISBANE QLD 4068 AUSTRALIA].*

A genomic (prb1) and two cDNA clones (PRb1-2 and PRb1-3) corresponding to two new barley basic PR-1 proteins (prb1-2 and prb1-3)

were isolated from *Hordeum vulgare*. Genomic analysis of DNA suggests that the barley genome contains at least 6 members corresponding to the gene family encoding PR-1 proteins. Expression of these genes was induced in primary leaf tissues of the *H. vulgare* cv. Paaknon 4* (F14) Man. carrying Mlp resistance gene (cv. Mlp) and the near-isogenic susceptible cultivar (cv. mlp) after inoculation with *Erysiphe graminis* f.sp. hordei. [References: 10].

278 Nieto Taladriz M, R.; Bräijich, P.; Amaya, Arnoldo (CIMMYT) (1992) [Dual-purpose durum wheats (pasta and bread making properties)]. Trigos duros de doble proposito. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 271-288. Centro de Investigacion Regional del Noroeste. 7 tablas; 23 ref. 2o. tomo. Spanish. (AGRIS 94-117164).*

279 Odonoughue, LS.; Bennett, MD. (1994) DURUM WHEAT HAPLOID PRODUCTION USING MAIZE WIDE-CROSSING. *Theoretical & Applied Genetics. 89(5):559-566. English. [AGR CANADA RES BRANCH CENT EXPTL FARM BLDG 50 OTTAWA KIA 0C6 ON CANADA].*

While anther culture or pollinations with *Hordeum bulbosum* have provided suitable methods for haploid production in bread wheat, they have been largely unsuccessful in durum wheat. Pollinations with maize were used in an attempt to produce haploid seedlings and, from these, fertile doubled haploids of durum wheats. Moreover, the effect of various concentrations and combinations of a synthetic auxin, 2, 4-dichlorophenoxyacetic acid (2, 4-D), kinetin, and an ethylene inhibitor, silver nitrate (AgNO₃), on embryo recovery were also investigated. Haploid seedlings were recovered from *Triticum turgidum* ssp. *turgidum* cv 'Rampton River' pollinated with maize following in-vivo treatment of ovaries with 2, 4-D for 2 weeks and subsequent embryo culture. The recovery of haploid seedlings from *T. turgidum* ssp. *durum* cv. 'Wakona' pollinated with maize necessitated the addition of AgNO₃ to the 2, 4-D treatment. Overall, haploid seedlings were produced in 1.7% and 3.3% of pollinated florets for 'Rampton River' and 'Wakona' respectively. The success of the present work represents a significant breakthrough for haploid production in durum wheats. Wide hybridization with maize followed by in-vivo treatment of ovaries with 2, 4-D alone, or in combination with AgNO₃, may provide a widely-applicable method of haploid production in tetraploid wheats. [References: 35].

280 Oury, FX.; Rousset, M.; Berard, P.; Pluchard, P.; Doussinault, G. (1994) BREAD-MAKING QUALITY OF WHEAT HYBRIDS THROUGH VARIOUS TECHNOLOGICAL TESTS. *Agronomie. 14(6):377-385. French. [INRA AMELIORAT PLANTES STN DOMAINE CROUELLE F-63039 CLERMONT FERRAND FRANCE].*

Thirty-three winter wheat hybrids produced using a chemical hybridizing agent, and their 27 parents, were compared for bread-making quality. Samples of kernels used for technological tests were obtained in a multilocal experiment, but the 'genotype x environment' interactions appeared negligible for grain hardness, the Pelshenke test and alveograph measurements. Heterosis did not occur, either for these 3 tests or for the protein content, and the F1 was intermediate between the 2 parents. For protein content, this could indicate a 'source-sink' relationship that is more favourable for hybrids than for inbred lines. This is because the protein content was maintained in spite of a significant heterosis for grain yield. In fact, there was a significant heterosis for protein yield. From all these results, it appears that breeding hybrid wheats with good quality characteristics should not be a major problem.

281 Pal, B.; Garg, D.K. (Meerut University, Meerut (India). Department of Agriculture) (1992) Estimation of genetic parameters in three wheat crosses. *Crop Improvement (India) v. 19(2) p. 149-151. 1 table; 6 ref. English. (AGRIS 94-117206).*

282 Pandey, D.K.; Gautam, P.L. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Division of Plant Breeding) (1992) Inheritance of resistance to loose smut (*Ustilago tritici*) of wheat. *Crop Improvement (India) v. 19(2) p. 146-148. 11table; 2 ref. English. (AGRIS 94-117205).*

283 Persaud, R.R.; Lipps, P.E.; Campbell, K.G. (1994) IDENTIFICATION OF POWDERY MILDEW RESISTANCE GENES IN SOFT RED WINTER WHEAT CULTIVARS AND OHIO BREEDING LINES. *Plant Disease*. 78(11):1072-1075. English. [UNIV GUYANA FAC AGR TURKEYEN CAMPUS POB 101110 GEORGETOWN GUYANA].

Eight-day-old seedlings of seven soft red winter wheat cultivars and four elite breeding lines were tested for the presence of powdery mildew resistance genes with 14 isolates of *Blumeria graminis* f. sp. *tritici*. These isolates were characterized for their virulence on differential wheat cultivars and lines with single genes for powdery mildew resistance. Phenotypic reactions of the cultivars and lines to each isolate were assessed 8 days after inoculation. Differential reactions and pedigree information were used to determine the presence of putative powdery mildew resistance genes. The B. g. *tritici* isolates detected powdery mildew resistance gene Pm3a in AGRA brand GR915, and pedigree information indicated that Freedom contained Pm8. No Pm genes were detected in Cardinal, Clark, Dynasty, or Titan. The gene Pm3a was present in breeding lines OH470 and OH493-1, and gene Pm17 was detected in OH464. OH490 contained gene Pm2 or Pm6, or possibly both; the isolates could not differentiate these two genes. [References: 35].

284 Petersen, L.; Ostergard, H.; Giese, H. (1994) GENETIC DIVERSITY AMONG WILD AND CULTIVATED BARLEY AS REVEALED BY RFLP. *Theoretical & Applied Genetics*. 89(6):676-681. English. [RISO NATL LAB DEPT ENVIRONM SCI & TECHNOL PLANT GENET SECT DK-4000 ROSKILDE DENMARK].

Genetic variability of cultivated and wild barley, *Hordeum vulgare* ssp. *vulgare* and *spontaneum*, respectively, was assessed by RFLP analysis. The material consisted of 13 European varieties, single-plant offspring lines of eight land races from Ethiopia and Nepal, and five accessions of ssp. *spontaneum* from Israel, Iran and Turkey. Seventeen out of twenty-one studied cDNA and gDNA probes distributed across all seven barley chromosomes revealed polymorphism when DNA was digested with one of four restriction enzymes. A tree based on genetic distances using frequencies of RFLP banding patterns was estimated and the barley lines clustered into five groups reflecting geographical origin. The geographical groups of land-race lines showed less intragroup variation than the geographical groups of *spontaneum* lines. The group of European varieties, representing large variation in agronomic traits, showed an intermediate level. The proportion of gene diversity residing among geographical groups (F-ST) varied from 0.19 to 0.94 (average 0.54) per RFLP pattern, indicating large diversification between geographical groups. [References: 23].

285 Quarrie, S.A.; Gulli, M.; Calestani, C.; Steed, A.; Marmioli, N. (1994) LOCATION OF A GENE REGULATING DROUGHT-INDUCED ABSCISIC ACID PRODUCTION ON THE LONG ARM OF CHROMOSOME 5A OF WHEAT. *Theoretical & Applied Genetics*. 89(6):794-800. English. [JOHN INNES CTR NORWICH RES PK NORWICH NR4 7UH NORFOLK ENGLAND].

The accumulation of abscisic acid (ABA) by detached and partially dehydrated wheat leaves is known to be inherited in a quantitative manner. The location of genes having a major effect on drought-induced ABA accumulation in wheat was determined using a set of single chromosome substitution lines and populations derived from a cross between a high-ABA- and a low-ABA-producing genotype. Examination of a series of chromosome substitution lines of the high-ABA genotype 'Ciano 67' into the low-ABA recipient 'Chinese Spring' showed that chromosome 5A carries gene(s) that have a major influence on ABA accumulation in a drought test with detached and partially dehydrated leaves (DLT). A similar DLT was used to examine ABA accumulation in a population of F-2 plants and doubled haploid (DH) lines derived from the cross between 'Chinese Spring' (low-ABA) and 'SQ1' (high-ABA) in which the F-2 population (139 plants) and DH lines (96 lines) were also mapped partially with molecular markers. Analysis of variance of ABA accumulation between and within marker allele classes in the F-2 confirmed the location of a gene(s) regulating ABA accumulation on the long arm of chromosome 5A. MAPMAKER-QTL showed the most likely position for the ABA quantitative trait locus (QTL) to be between the loci Xpsr575 and Xpsr426, about 8 cM from Xpsr426. A similar trend for high ABA accumulation was found in DH lines having the 'SQ1' allele at

marker loci in the same region of chromosome 5AL, but the QTL effect was not significant. The function of the QTL is discussed. [References: 34].

286 Rajaram, S.; Pfeiffer, W.H.; Singh, R.P.; Briceno, G.A. (CIMMYT) (1992) [CIMMYT's future breadwheat breeding activities for irrigated areas in Mexico]. Futuras actividades de mejoramiento de trigo harinero del CIMMYT para las regiones de Mexico que cuentan con riego. Primera conferencia nacional sobre la producción de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 73-84. Centro de Investigacion Regional del Noroeste. 7 tablas; 2 ref. Spanish. (AGRIS 94-117160).

287 Reddy, V.R.K. (Bharathiar Univ. (India)); Brahma, R.N.; Asir, R. (1993) Transfer of yellow rust resistance to [Triticum variety] unnath kalyan sona. *Wheat Information Service (Japan) (no.76)* p. 20-22. 1 table. English. (AGRIS 94-116996).

288 Saadalla, M.M. (1994) RESPONSE TO EARLY-GENERATION SELECTION FOR YIELD AND YIELD COMPONENTS IN WHEAT. *Cereal Research Communications*. 22(3):187-193. English. [ALEXANDRIA UNIV COLL AGR DEPT AGRON DAMANHOUR EGYPT].

Several approaches have been recommended to improve the effectiveness of early-generation selection in wheat (*Triticum aestivum* L.). This study was conducted to compare the response to direct early-generation selection for yield and indirect yield selection via its components using Fasoulas (1973) honeycomb design to select among F2 plants in two crosses of spring wheat. A selection intensity of 5% was imposed for each of high and low expressions of each trait among F2 plants and F3 lines. Realized heritabilities (RH) for different traits demonstrated the highest effectiveness for kernel weight (KW) selection and to lesser extent for number of kernels per spike (KS) and grain yield (GY) while the lowest effectiveness was for fertile tillers density (TD). Selection for KW was the most effective indirect selection for yield, while selection for TD was the least effective on yield. Furthermore, response of yield to the selection for KW was greater than direct selection for yield per se. The highest proportion of the high yielding lines in F4 resulted from selection for KW, then GY, KS, and the lowest was for TD. Modified early-generation selection; i.e. using Fasoulas' design to reduce environmental variation among F2 plants and selecting for heavy grains appears to be effective in improving wheat grain yield.

289 Sall, T.; Nilsson, N.O. (1994) CROSSOVER DISTRIBUTION IN BARLEY ANALYSED THROUGH RFLP LINKAGE DATA. *Theoretical & Applied Genetics*. 89(2-3):211-216. English. [LUND UNIV DEPT GENET SOLVEGATAN 29 S-22362 LUND SWEDEN].

The pattern of recombination in barley with regard to (1) the distribution of crossover points among whole gametes, (2) the distribution of crossover points among individual chromosomes and (3) the distribution of crossover points within chromosomes has been analysed using data sets underlying two recently published restriction fragment length polymorphism (RFLP) linkage maps representing male and female meiosis, respectively. The data indicated that the process of recombination had been random with no interference. The two data sets gave similar results, indicating that male and female meiosis in barley do not differ significantly. The possibility of using RFLP data in studies of crossover distribution is stressed. [References: 43].

290 Sasek, A.; Prugar, J. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyně (Czech Republic)); Cerny, J.; Weipert, D.; Bechyne, M. (1994) Electrophoretic composition of high-molecular weight subunits of gliadins in winter wheat varieties (*T. aestivum*). *Genetika a Slechteni - UZPI (Czech Republic)* v. 30(2) p. 99-121. 5 graph., 5 tables; 6 ref. English. (AGRIS 94-107083).

An electrophoretic analysis of gliadins and HMW subunits of glutenins was performed in 58 varieties of common wheat, tested in German state varietal trials. The genetic structure of analysed varieties was determined by means of protein genetic markers. The correlation dependences were determined between the score value of baking quality prediction for gliadin and glutenin allelic blocks and the class of baking quality. The

gliadin markers of higher frost resistance and of stem rust resistance were discussed.

291 Sergio, L. (Istituto del Germoplasma, Bari (Italy)); Spagnoletti Zeuli, P.L. (1992) Study of the genetic structure of wheat germplasm entries by means of storage protein electrophoresis. *Plant Genetic Resources Newsletter* (IBPGR/FAO); *Bulletin des Ressources Genetiques Vegetales* (CIRP/FAO); *Noticario de Recursos Geneticos Vegetales* (CIRF/FAO) (no.90) p. 1-5. English. (AGRI 94-106959).

292 Shen Qiuquan; Yu Shenping; Xu Yizhong (Zhejiang Provincial Academy of Agricultural Sciences, Hangzhou (China)) (1993) Recurrent selection breeding by using Ta1 sterile gene for resistance to scab in wheat. *Acta Agriculturae Zhejiangensis* (China) v. 5(3) p. 152-157. 1 ill., 6 tables, 13 ref. Chinese. (AGRI 94-117197).

293 Shoran, J. (Vivekananda Parvatiya Krishi Anusandhan Shala, Almore (India)) (1992) Genotypic divergence in winter and spring wheat varieties. *Crop Improvement* (India) v. 19(2) p. 116-118. 2 tables; 9 ref. English. (AGRI 94-117204).

294 Singh, H. (Punjab Agricultural Univ. (India)); Dhaliwal, H.S.; Kaur, J.; Gill, K.S. (1993) Rust resistance and chromosome pairing in *Triticum x Aegilops* crosses. *Wheat Information Service* (Japan) (no.76) p. 23-26. 2 tables; 1 fig.; 8 ref. English. (AGRI 94-117016).

295 Singh, K.N.; Chattrath, R. (Central Soil Salinity Research Institute, Karnal, (India). Division of Crop Improvement) (1992) Genotype x salt stress interactions in tissue culture derivative lines of bread wheat. *Crop Improvement* (India) v. 19(2) p. 83-87. 3 tables; 7 ref. English. (AGRI 94-117203).

296 Song, J.S.; Hedgcock, C. (1994) A CHIMERIC GENE (ORF256) IS EXPRESSED AS PROTEIN ONLY IN CYTOPLASMIC MALE-STERILE LINES OF WHEAT. *Plant Molecular Biology*. 26(1):535-539. English. [KANSAS STATE UNIV AGR & APPL SCI DEPT BIOCHEM WILLARD HALL MANHATTAN, KS 66506 USA].

Mitochondria derived from *Triticum timopheevi* have a chimeric gene, orf256, immediately upstream from *coxI*. Antibodies to a peptide corresponding to a part of the encoded amino acid sequence of orf256 detect a 7 kDa protein on western blots of mitochondrial proteins from cytoplasmic male-sterile (ems) wheat (*T. aestivum* nucleus, *T. timopheevi* mitochondria) but not in mitochondrial proteins from *T. aestivum*, *T. timopheevi*, or ems plants restored to fertility by introduction of nuclear genes for fertility restoration. The 7 kDa protein appears to serve as a marker for ems wheat. Its occurrence as an integral protein of the inner membrane may indicate a ems effect through an influence on mitochondrial membrane function. [References: 30].

297 Stoinova, J. (1994) CYTOGENETIC STUDY OF F1 HYBRIDS OBTAINED BY CROSSING TRITICALE (2N=42) X TRITORDEUM (2N=42). *Cereal Research Communications*. 22(3):173-178. English. [ACAD D KOSTOV INST GENET BU-1113 SOFIA BULGARIA].

Trigeneric hybrids with genomes of *Triticum*, *Secale* and *Hordeum* were produced by hybridization of hexaploid *Triticale* and hexaploid forms of *Tritordeum*. The meiosis in PMC's revealed disorders typical for distant hybrids - univalents in metaphase I, underdeveloped chromosomes in anaphase I and micronuclei in telophase II. The hybrids of F1 have a long ear with a great number of small spikelets and florets and 56 to 69 seeds per main ear.

298 Straub, P.F.; Shen, Q.X.; Ho, T.H.D. (1994) STRUCTURE AND PROMOTER ANALYSIS OF AN ABA- AND STRESS-REGULATED BARLEY GENE, HVA1. *Plant Molecular Biology*. 26(2):617-630. English. [WASHINGTON UNIV DEPT BIOL DEPT BIOL & BIOMED SCI PLANT BIOL PROGRAM CAMPUS BOX 1137 ST LOUIS, MO 63130 USA].

A single-copy barley gene, HVA1, encoding a class 3 late embryogenesis-abundant protein, can be induced by either treatment with abscisic acid (ABA) or by stress conditions such as drought, cold, heat and salinity. We have isolated an HVA1 genomic clone containing about 400 bp of 5'-upstream sequence, a single 109 bp intron, and the full coding sequence. Lunker scan mutagenesis and transient expression studies were used to test the function of four HVA1 promoter elements conserved in

ABA-responsive genes. Mutations in two of these elements, the C box and the putative ABRE 1 (ABA-responsive element) containing an ACGT core, resulted in no significant change in transcription level or ABA induction. In contrast, mutations of the other two elements, putative ABRE 2 and 3 cause the level of transcription to drop to 10-20 % of that obtained with the wild-type promoter indicating that the high level of expression of HVA1 is dependent on both pABRE 2 and 3. Interestingly, despite their low level of expression, the mutated promoters still gave more than 20-fold induction in response to ABA treatment. We suggest that the ABA induction of barley HVA1 gene is governed by a complex consisting of pABRE 2 and 3 working together to regulate the absolute level of expression, and either of these elements or a possible third element may regulate ABA inducibility. Phylogenetic analysis by parsimony indicates that the barley HVA1 and wheat pMA2005 sequences share a recent common ancestor. These two genes are closely related to the carrot Dc3 and cotton D-7 genes with which they share a similar structural gene organization. [References: 48].

299 Svensson, G. (Weibullsholms Væxtfoerædlingsinst., Landskrona (Sweden)) (1992) Improved gluten quality through new breeding technique. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden. Johansson, H. (ed.)* p. 173-179. Svalöf AB. English. (AGRI 94-107091).

300 Takase, H.; Iwabuchi, M. (1993) TRANSCRIPTIONAL AND POST-TRANSCRIPTIONAL REGULATION OF THE EXPRESSION OF WHEAT HISTONE GENES - CIS-ACTING ELEMENTS AND TRANS-ACTING FACTORS. *Journal of Plant Research*. (Special Issue 3):37-50. English. [KYOTO UNIV FAC SCI DEPT BOT SAKYO KU KYOTO 60601 JAPAN].

301 Tang Borang (Beijing Agricultural Univ. (China). Dept. of Agronomy) (1993) Screening for sources of resistance to powdery mildew in wheat and the resistance of their F1 hybrids. *Acta Agriculturae Universitatis Pekinensis* (China) v. 19(4) p. 1-4. 3 tables, 6 ref. Chinese. (AGRI 94-117202).

302 Thoern, E. (Svalöf Weibull AB, Svalöv (Sweden). Traedgaardsdivisionen); Oehlund, R. (1993) [From microspore to plant - a haploid method in barley]. *Fraan mikroskop till planta - en haploidmetod i kom. Sveriges Utsaendesfoerædlings Tidsskrift* (Sweden) v. 103(4) p. 198-207. 25 ref. Swedish. (AGRI 94-106978).

303 Timpe, U.; Kuhne, T. (1994) THE COMPLETE NUCLEOTIDE SEQUENCE OF RNA2 OF BARLEY MILD MOSAIC VIRUS (BAMMV). *European Journal of Plant Pathology*. 100(3-4):233-241. English. [FED CTR BREEDING RES CULTIVATED PLANTS INST RESISTANCE RES THEODOR ROEMER WEG 4 D-06449 ASCHERSLEBEN GERMANY].

Barley mild mosaic virus is a member of the Bymoviruses, a genus of the family Potyviridae. The virus consists of two types of flexuous rod-shaped particles. Each of them contains one single-stranded polyadenylated RNA in plus orientation of approximately 7.6 kb (RNA1) and 3.6 kb (RNA2). Complementary DNAs of both RNAs have been synthesised and cloned. The nucleotide sequence of RNA2 has been determined. It is 3524 nucleotides in length, excluding the 3' poly(A) tail, and contains one large open reading frame (2679 nts), coding for a polyprotein of approximately 98 kDa. There are indications that a putative proteolytic activity in the N-terminal part can cleave the polyprotein autocatalytically into a 25 kDa protein (putative proteinase) and a 73 kDa polypeptide of unknown function. [References: 22].

304 Uhlen, A.K.; Ringlund, K.; Skinnes, H. (Norges Landbrukshegskole, Aas (Norway). Inst. for Plantekultur) (1992) [Kalle - a new early winter wheat variety]. *Kalle - en ny tidlig hoesthvetsort. Norsk Landbruksforskning* (Norway); *Norwegian Agricultural Research* v. 6(3) p. 275-283. 6 tables, 1 figure; 14 ref. Norwegian. (AGRI 94-116997).

305 Valenchi, D.; Saurer, W.; Weilenmann, F.; Winzeler, H.; Winzeler, M. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Reckenhol (Switzerland)) (1994) [Swiss official list for 1994 of soft wheat varieties and varieties of feeds (except maize)]. *Schweizerische Liste der Brot- und Futtergetreidesorten, 1994 (ohne Mais). Agrar Forschung*

(Switzerland) v. 1(8) p. 1-XVI. numerous tables. German. (AGRS 94-107079).

306 Varughese, George (CIMMYT); Martinez Santana, Jose de Jesus (INIFAP. CIR Noroeste, Ap. Postal 515, 85000 Cd. Obregon, Sonora (Mexico)) (1992) [Triticale breeding in Mexico]. [Mejoramiento del triticale en Mexico]. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 289-294*. Centro de Investigacion Regional del Noroeste. 1 tabla; 5 ref. 2o. tomo. English. (AGRS 94-116907).

307 Villaroya, M.; Escorial, C.; Garcia Baudin, J.M.; Chueca, M.C.; Silvela, L. (Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria, Madrid (Espana). Dept. de Proteccion Vegetal) (1993) [Inheritance of tolerance to metribuzin in hard wheat: first results]. Herencia de la tolerancia a metribuzina en trigo duro: primeros resultados. Congreso 1993 de la Sociedad Espanola de Malherbologia; Lugo (Espana); 1-3 Dic 1993. [Proceedings of 1993 Meeting of the Spanish Society for Weed Control, Lugo, 1-3 Dec 1993]. *Actas del Congreso 1993 de la Sociedad Espanola de Malherbologia, Lugo, 1-3 Dic 1993. Sociedad Espanola de Malherbologia, Madrid (Espana) P. 226-229*. SEM. 25 ref. Spanish. (AGRS 94-117156).

308 Villasenor Mir, Hector Eduardo (INIFAP. C.E. Valle de Mexico. Ap. Postal 10, Chapingo, Mex. 56230 (Mexico)) (1992) [Genetic improvement in wheat and the breeding of varieties for use under rainfed conditions in the high valleys of Mexico]. Mejoramiento genetico de trigo para la obtencion de variedades temporales para los valles altos de Mexico. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 183-195*. Centro de Investigacion Regional del Noroeste. 2 tablas; 10 ref. Spanish. (AGRS 94-116904).

309 Waghmare, V.N. (Indian Agricultural Research Inst., New Delhi (India)); Mathur, H.C. (1993) Genes for susceptibility of *Ustilago nuda tritici* in bread wheat [*Triticum aestivum*]. *Wheat Information Service (Japan) (no.76) p. 16-19*. 2 tables. English. (AGRS 94-117208).

310 Waha, DP.; Dawa, T.; Plaha, P. (1994) GENETICS OF YIELD COMPONENTS IN SPRING WHEAT. *Cereal Research Communications*. 22(3):185-186. English. [HIMACHAL PRADESH AGR UNIV DEPT PLANT BREEDING & GENET PALAMPUR 176062 HIMACHAL PRADESH INDIA].

Genetics of yield components of a spring wheat cross (CPAN1796 x HD2323) was studied by raising its 16 generations, viz., P1, P2, F1, F2, B1, B2, F3, F2, b1p, B11, B12, B22, B21, B1F1, B2F1, B1s and B2s, during winter 1991-92. The estimates of genetic effects revealed the presence of additive, dominance and epistatic components in the inheritance of 100-grain weight. Additive x additive epistatic component was important for grains/spike, whereas both additive and dominance components were important in the genetic control of spike length. However, none of the genetic components was significant for spikes/plant. The 6-parameter model failed to account variation for all the traits studied.

311 Wang Yaping; Liu Yiqiang; Shi Lei (Beijing Univ. (China). National Lab. of Protein Engineering and Plant Genetic Engineering) (1993) SOD activity of wheat varieties with different resistance to scab. *Acta Phytophysiological Sinica (China) v. 19(4) p. 353-358*. 3 ill., 2 tables, 11 ref. Chinese. (AGRS 94-117199).

The changes in SOD activity and isozyme patterns of calli and blooming spikes of rume wheat varieties, infected and uninfected by deoxynivalenol and spore suspension of *Gibberella zeae*, were inspected. It was found that the SOD activity in uninfected calli and blooming spikes of resistant varieties was significantly higher than in those of susceptible ones. The increase of SOD activity in infected calli and spikes of resistant varieties was greater than in those of susceptible ones. There are significantly

positive correlations between SOD activity in infected and uninfected calli and blooming spikes and resistance to scab in wheat varieties. The resistant variety Wangshuibai had two more bands in SOD isozyme pattern than the susceptible one Alondra "S". New bands appeared in isozyme patterns of the two varieties 24 hs after being inoculated. SOD may play an important role in resistance to scab in wheat. It was suggested that SOD activity as an index of resistance to scab might be useful in screening wheat varieties for their resistance to scab.

312 Warren E, Kronstad; Scott, Nan H. (Oregon State University, Oregon, USA) (1992) [Utilization of winter x spring gene pools in wheat breeding and its implication in widening genetic variability]. [Uso de genes de trigo de invierno x primavera en mejoramiento y su implicacion en ampliar la variabilidad genetica]. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 105-113*. Centro de Investigacion Regional del Noroeste. English. (AGRS 94-116900).

313 Weber, WE.; Westermann, T. (1994) PREDICTION OF YIELD FOR SPECIFIC LOCATIONS IN GERMAN WINTER-WHEAT TRIALS. *Plant Breeding-Zeitschrift fur Pflanzenzuchtung*. 113(2):99-105. English. [UNIV HALLE WITTENBERG INST PFLANZENZUCHTUNG & SAATGUTWIRTSCHAFT BERLINER STR 2 D-06188 HOHENTHURM GERMANY].

The interaction between varieties and environment can make the prediction of crop performance difficult. The farmer is obviously interested in achieving optimum product ion within the particular growing environment of his farm, thus, this paper investigates if crop performance predictions can be improved by taking information from other locations into account. The investigation is based on yield data from winter wheat resulting from official German variety-performance tests. The predictors are based on the single location (control), unweighted means, principal components, and weighted means, produced using regression coefficients as weights. These predictors were tested on an independent data set from another year. For the given yield data in winter wheat, the overall mean proved to be the best, which suggests that prediction for all locations should be the same, and predictors for specific locations cannot, therefore, be recommended. The main reason for this is the relatively small interaction between genotype and location, in comparison to the second-order interaction between genotypes, locations and years. [References: 30].

314 Weeks, JT. (1994) HOT PAPERS - PLANT BIOLOGY - RAPID PRODUCTION OF MULTIPLE INDEPENDENT LINES OF FERTILE TRANSGENIC WHEAT (TRITICUM-AESTIVUM) - WEEKS, J.T., ANDERSON, O.D., BLECHL, A.E. *Scientist*. 8(22):15. English. [USDA ARS WESTERN RES CTR ALBANY, CA USA].

Biologist J. Troy Weeks reports on a protocol for producing transgenic wheat lines. [References: 5].

315 Weining, S.; Ko, L.; Henry, RJ. (1994) POLYMORPHISMS IN THE ALPHA-AMY1 GENE OF WILD AND CULTIVATED BARLEY REVEALED BY THE POLYMERASE CHAIN REACTION. *Theoretical & Applied Genetics*. 89(4):509-515. English. [UNIV QUEENSLAND QUEENSLAND AGR BIOTECHNOL CTR GEHRMANN LABS ST LUCIA QLD 4072 AUSTRALIA].

alpha-Amylases are the key enzymes involved in the hydrolysis of starch in plants. The polymerase chain reaction (PCR) was used to detect polymorphisms in the length of amplified sequences between the annealing sites of two primers derived from published alpha-amyl gene sequences in barley. These two primers (Bsw1 and Bsw7), flanking the promoter region and the first exon, amplified two PCR fragments in barley. One of the amplified products, with the expected length of 820 bp, appeared together with another shorter PCR band of around 750 bp. This 750-bp fragment seems to be derived from an alpha-amylase gene not reported previously. Both of the PCR products could be amplified from the two-rowed barley varieties tested, including cv Himalaya from which the sequence information was obtained. Five of the six-rowed barley varieties also have the two PCR fragments whereas another two have only the long

fragment. These two fragments seem to be unique to barley, neither of them could be amplified from other cereals; for example, wheat, rye or sorghum. These two alpha-amylase fragments were mapped to the long arm of 6H, the location of the alpha-amyl genes, using wheat-barley addition lines. Amplification of genomic DNA from wild barley accessions with primers Bsw1 and Bsw7 indicated that both of the fragments could be present, or the long and short fragments could be present alone. The results also demonstrated that the genes specifying these two fragments could be independent from each other in barley. The conserved banding pattern of these two fragments in the two-rowed barley varieties implies that artificial selection from these genes may have played an important role in the evolution of cultivated barley from wild barley. [References: 25].

316 Yamamori, M. (1994) AN N-BAND MARKER FOR GENE LR18 FOR RESISTANCE TO LEAF RUST IN WHEAT. *Theoretical & Applied Genetics*. 89(5):643-646. English. [JAPAN INT RES CTR AGR SCI OKINAWA SUBTROP STN ISHIGAKI OKINAWA 907 JAPAN].

The leaf rust resistance gene, Lr18, of common wheat cultivars has been derived from *Triticum timopheevi* and is located on chromosome arm 5BL. Chromosome banding (N-banding) analyses revealed that in the wheat cultivars carrying Lr18 that were examined, which had been bred in 6 different countries, chromosome arm 5BL possessed a specific terminal band not carried by their susceptible parental cultivars. It was suggested that this terminal N-band was introduced from *T. timopheevi* together with Lr18. N-banding analysis of a *T. timopheevi* strain showed that one of two *timopheevi* chromosomes had provided Japanese wheat lines containing Lr18 with the terminal band. [References: 13].

317 Yamamori, M.; Nakamura, T.; Endo, TR.; Nagamine, T. (1994) WAXY PROTEIN DEFICIENCY AND CHROMOSOMAL LOCATION OF CODING GENES IN COMMON WHEAT. *Theoretical & Applied Genetics*. 89(2-3):179-184. English. [JAPAN INT RES CTR AGR SCI OKINAWA SUBTROP STN OKINAWA 907 JAPAN].

Deficiency of the wheat waxy (Wx) proteins (Wx-A1, Wx-B1 and Wx-D1) was studied in 1,960 cultivars derived from several countries. Gel electrophoretic analyses revealed that the null allele for the Wx-A1 protein occurred frequently in Korean, Japanese and Turkish wheats but was relatively rare in cultivars from other countries and regions. About 48% of the wheats deficient for the Wx-B1 protein were from Australia and India. One Chinese cultivar lacked the Wx-D1 protein. While 9 Japanese cultivars were deficient in both the Wx-A1 and Wx-B1 proteins, no cultivars lacked both the Wx-A1 and Wx-D1 proteins, both the Wx-B1 and Wx-D1 proteins or all three Wx proteins. Two-dimensional gel electrophoresis revealed polymorphisms of the three Wx proteins that varied according to isoelectric points or molecular weight. The Wx-A1 gene coding the Wx-A1 protein and the Wx-B1 gene coding the Wx-B1 protein were localized in the distal regions of chromosome arms 7AS and 4AL, respectively, by deletion mapping using the deletion lines developed in the common wheat cultivar 'Chinese Spring'. [References: 21].

318 Yue Ping; Zhang Aimin (Beijing Agricultural Univ. (China)); Song Xiyun (1993) Analysis of nonparametric stability of yield and its components in hybrid wheat. *Journal of Laiyang Agricultural College (China)* v. 10(2) p. 92-95. 2 tables, 4 ref. Chinese. (AGRI 94-117196).

319 Zapryanov, S.; Stefanov, T.; Burgazova, J. (Institut po Echemika, Karnobat (Bulgaria)); Tsankova, D. (1993) [Zenit and Izgrev - new forage winter barley varieties [Bulgaria]]. Zenit i Izgrev - novi sortove zimen furazhen echemik [Bulgaria]. Selskостопанска Академия, Sofia (Bulgaria). *Rasteniev' dni Nauki (Bulgaria); Plant Science v. 30(5-6) p. 73-76. 2 ill., 3 tables; 6 ref. Bulgarian. (AGRI 94-106979).*

320 Zhong, GY.; McGuire, PE.; Qualset, CO.; Dvorak, J. (1994) CYTOLOGICAL AND MOLECULAR CHARACTERIZATION OF A TRITICUM AESTIVUM X LOPHOPYRUM PONTICUM BACKCROSS DERIVATIVE RESISTANT TO BARLEY YELLOW DWARF. *Genome*. 37(5):876-881. English. [UNIV CALIF DAVIS DEPT AGRON & RANGE SCI DAVIS, CA 95616 USA].

Barley yellow dwarf is the most damaging virus-caused disease in bread wheat (*Triticum aestivum* L.). A resistant line, SW(3)35.1.2-13-11-1-5 (2n = 47), derived from a cross of *T. aestivum* X *Lophopyrum ponticum* was characterized by meiotic chromosome pairing, by in situ DNA

hybridization and by expression of molecular markers to determine its chromosome constitution. All progeny of this line had three pairs of *L. ponticum* chromosomes from homoeologous chromosome groups 3, 5, and 6 and the 2n = 47 progeny had an additional *L. ponticum* monosome. The pairs from groups 3 and 6 were in the added state, while the group 5 pair was substituted for wheat chromosome 5D. Several wheat-wheat translocations with respect to the parental wheat genotype occurred in this line, presumably owing to the promotion of homoeologous chromosome pairing by *L. ponticum* chromosomes. It was hypothesized that homoeologous recombination results in homoeologous duplication-deletions in wheat chromosomes. An aberrant 3:1 disjunction creates the potential at each meiosis for replacement of these wheat chromosomes by homoeologous *L. ponticum* chromosomes. Wheat chromosomes 3A and 6A appeared to be in intermediate stages of this substitution process. [References: 27].

321 Zhou Wenchun; Zhao Yinhuai; Zou Minglie (Jiangsu Provincial Academy of Agricultural Sciences, Nanjing (China). Inst. of Food Crops); Gu Minghong (1993) Studies on the genetic effects of Rht3 gene in wheat. *Jiangsu Journal of Agricultural Sciences (China)* v. 9(4) p. 1-6. 5 ill., 1 table, 16 ref. Chinese. (AGRI 94-117198).

440 PLANT ECOLOGY

322 Aggarwal, PK.; Kalra, N. (1994) ANALYZING THE LIMITATIONS SET BY CLIMATIC FACTORS, GENOTYPE, AND WATER AND NITROGEN AVAILABILITY ON PRODUCTIVITY OF WHEAT 2. CLIMATICALLY POTENTIAL YIELDS AND MANAGEMENT STRATEGIES. *Field Crops Research*. 38(2):93-103. English. [INDIAN AGR RES INST DIV ENVIRONM SCI NEW DELHI 110012 INDIA].

The objectives of this paper are to establish the climatically determined potential grain yields of wheat for different locations of India, to quantify the gap between actual and potential yields and to determine the optimal levels of irrigation and N required for given productivity levels. The analysis is based on simulations made with the crop growth model WTGROWS. Simulated potential grain yields, determined by solar radiation and temperature, varied between 2.56 and 8.25 t ha⁻¹ for 138 locations spread throughout India. In general, yields increased with latitude and inland locations had greater yields than the coastal locations at the same latitude. These trends were related to mean temperature differences over latitude/location. The results indicate a strong linear decline in grain yield as mean temperature increased. Late sowings had smaller yields as well as increased variability. The decrease for each day's delay in sowing was more when potential yield was high. The yield gap was at least 2 t ha⁻¹ irrespective of location and a significant portion of this was due to delayed sowing. Crop simulation with different amounts of nitrogen and irrigation inputs showed significant interaction between water and N availability as well, as inter-seasonal climatic variability, particularly with low input of water. The optimal N application depended on the amount of water availability. Yield variance of stressed wheat crops is moderated greatly by irrigation but reduced N fertilizer application may modify the response. [References: 16].

323 Aggarwal, PK.; Kalra, N.; Singh, AK.; Sinha, SK. (1994) ANALYZING THE LIMITATIONS SET BY CLIMATIC FACTORS, GENOTYPE, WATER AND NITROGEN AVAILABILITY ON PRODUCTIVITY OF WHEAT 1. THE MODEL DESCRIPTION, PARAMETRIZATION AND VALIDATION. *Field Crops Research*. 38(2):73-91. English. [INDIAN AGR RES INST CTR WATER TECHNOL NEW DELHI 110012 INDIA].

A mechanistic crop growth simulation model, WTGROWS, is developed for use in analyzing effects of climatic variables and crop management on productivity of wheat in tropical and sub-tropical wheat regions of India. The model, written in CSMP and FSE, simulates daily dry matter production as a function of radiation and temperature, and water and nitrogen availability. Crop aspects of the model are arranged in submodels covering development, photosynthesis, respiration, carbohydrate partitioning, dry matter production, leaf area, grain growth and transpiration. A soil water balance model is attached to simulate water uptake and to determine water stress. Another submodel determines nitrogen uptake, distribution and N stress. Water and nitrogen stresses, depending upon their severity, affect various physiological processes. The model requires inputs relating to site, daily weather, soil

physical characteristics and crop management. Switches allow water and/or nitrogen stresses to be terminated to establish climatically determined potential grain yield. Various aspects of the model were validated using a large number of independent experiments. Comparison of simulated and measured quantities indicated satisfactory performance of the model in reference to water and nitrogen uptake, dry matter growth and grain yield in potential as well as Water- and N-limited environments. The model appears useful as a tool for optimizing use of water and nitrogen. [References: 67].

324 Moreby, S.J.; Aebischer, N.J.; Southway, S.E.; Sotherton, N.W. (1994) A COMPARISON OF THE FLORA AND ARTHROPOD FAUNA OF ORGANICALLY AND CONVENTIONALLY GROWN WINTER WHEAT IN SOUTHERN ENGLAND. *Annals of Applied Biology*. 125(1):13-27. English. [GAME CONSERVANCY TRUST FORDINGBRIDGE SP6 1EF HANTS ENGLAND].

Fields of winter wheat on organic and conventional farms were sampled for weeds and invertebrates in June/July in 1990 and 1991. Organic fields were paired with adjoining conventional ones and their invertebrate fauna compared with a D-vac vacuum suction sampler. Weed counts showed greater percentage cover of broad-leaved weeds in organic fields than in conventional ones, with three times as many species present where herbicides were not used. Significantly higher densities of nematoceran and acalypteran Diptera, Hemiptera (especially aphids), aphid-specific predators, parasitic Hymenoptera and cryptophagid and cantharid Coleoptera were found in conventionally grown fields. Significantly higher densities of weevils, spiders, springtails, plant hoppers and sawfly larvae were found in organic fields. Reasons for these differences or the lack of them are discussed. [References: 33].

325 Singh, K.N. (Central Soil Salinity Research Inst. (India)); Chattrath, R. (1993) Genetic divergence in bread wheat (*Triticum aestivum* L. em thell) under sodic soil conditions. *Wheat Information Service (Japan)* (no.76) p. 35-38. 4 tables. English. (AGRI 94-117693).

F50 PLANT STRUCTURE

326 Heneen, W.K.; Brismar, K.; Karlsson, G. (1992) Structural aspects related to grain quality in wheat. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden*. Johansson, H. (ed.) p. 149-162. Svalof AB. 44 ref. English. (AGRI 94-107579).

327 Qin Yueqiu; Yang Dekui (Shandong Normal Univ., Jinan (China). Dept. of Biology); Wang Fahong (1993) Effects of paclobutrazol on the growth and anatomical structure of leaf and stem tissue in wheat. *Journal of Laiyang Agricultural College (China)* v. 10(3) p. 166-171. 8 ill., 5 tables, 12 ref. Chinese. (AGRI 94-117778).

F60 PLANT PHYSIOLOGY AND BIOCHEMISTRY

328 Ahman, I.; Johansson, M. (1994) EFFECT OF LIGHT ON DIMBOA-GLUCOSIDE CONCENTRATION IN WHEAT (*TRITICUM AESTIVUM* L.). *Annals of Applied Biology*. 124(3):569-574. English. [SVALOF WEIBULL AB S-26881 SVALOV SWEDEN].

DIMBOA (2, 4-dihydroxy-7-methoxy-1, 4-benzoxazin-3-one) glucoside in wheat has been suggested to play a role in plant resistance to cereal aphids. Thus there is considerable interest in trying to breed modern wheat varieties with increased concentrations of this compound. To further such work we assessed the effects of light intensity on DIMBOA glucoside production in wheat seedlings under both indoor and outdoor conditions. Light had a marked effect on DIMBOA-glucoside concentrations, with levels in plants being negatively related to light intensity. Our findings suggest that breeding aimed at increasing levels of DIMBOA-glucoside would be most effective if test plants for selection were to be grown under weak light conditions. [References: 8].

329 Arz, M.C.; Grambow, H.J. (1994) POLYPHOSPHOINOSITIDE PHOSPHOLIPASE C AND EVIDENCE FOR INOSITOL-PHOSPHATE-HYDROLYSING ACTIVITIES IN THE PLASMA-MEMBRANE FRACTION FROM LIGHT-GROWN WHEAT (*TRITICUM AESTIVUM* L.) LEAVES. *Planta* 195(1):57-62. English. [RHEIN WESTFAL TH

AACHEN KLINIKUM INST BIOL 3 WORRINGERWEG 1 D-52074 AACHEN GERMANY].

The phospholipase C (PLC; EC 3.1.4.3) activity in isolated plasma membranes of light-grown wheat (*Triticum aestivum* L. cv. Prelude) leaves was investigated. The activity against the polyphosphoinositides was strongly dependent on Ca^{2+} and was affected by the anionic detergent deoxycholate (DOC). In the presence of 20 μ M Ca^{2+} the PLC activity preferred phosphatidylinositol 4, 5-bisphosphate (PIP2) over phosphatidylinositol 4-monophosphate (PIP) as a substrate. Instead, with 1 mM Ca^{2+} the enzyme clearly favoured PIP. In addition, the PIP2-PLC activity was increased by Mg^{2+} and in the presence of GTP, guanosine 5'-(gamma-thio)-triphosphate as well as ATP, CTP, guanosine 5'-diphosphate and guanosine 5'-(beta-thio)-diphosphate. Further analysis showed that a molybdate-sensitive phosphatase activity catalysing the dephosphorylation of inositol 1, 4, 5-trisphosphate (Ins(1, 4, 5)P3) is also associated with the plasma-membrane vesicles. Dephosphorylation of Ins(1, 4, 5)P3 was reduced in the presence of GTP or by inclusion of the unspecific phosphatase inhibitor molybdate. The results indicate the presence of a PIP2-PLC activity and the presence of a molybdate-sensitive phosphatase activity in wheat plasma-membrane vesicles. [References: 38].

330 Blum, A.; Sinmena, B. (1994) WHEAT SEED ENDOSPERM UTILIZATION UNDER HEAT STRESS AND ITS RELATION TO THERMOTOLERANCE IN THE AUTOTROPHIC PLANT. *Field Crops Research*. 37(3):185-191. English. [ARO VOLCANI CTR INST FIELD & GARDEN CROPS POB 6 BET DAGAN ISRAEL].

Tolerance of wheat (*Triticum aestivum*) to chronic heat stress and the subsequent effect on growth and yield are largely mediated by the plant carbon balance at high temperature. Seed endosperm utilization for seedling growth in the dark can be a simple model for studying tolerance to chronic heat stress in terms of the carbon balance. Seed endosperm utilization efficiency (EUE) was defined as the ratio of gain in seedling (shoot and radicle) dry mass to loss in seed dry mass during germination. This study was designed to evaluate heat tolerance in terms of EUE and its relations to heat tolerance in the autotrophic plant. Endosperm utilization efficiency was measured by periodic sampling of germinating seed in the dark under normal (25 degrees C) and high (35 degrees C) temperatures in 18 wheat cultivars. Heat tolerance of the autotrophic juvenile plant was measured in the same cultivars in terms of plant growth rate (GR) between 17 to 24 days after emergence under normal (15 degrees/25 degrees C) and high (25 degrees/ 35 degrees C) (night/day) temperatures. Mean final seedling dry mass in the dark was greater at low than at high temperature. Total dry matter loss from the seed did not differ much between temperatures, indicating that the lower seedling dry mass under high temperature was probably due to a relatively greater loss of carbon to respiration. Averaged over 18 cultivars, EUE was reduced by chronic heat stress from 0.64 gg(-1) at 25 degrees C to 0.53 gg(-1) at 35 degrees C. There were significant differences among cultivars in EUE at both low and high temperatures and there was a very significant (P less than or equal to 0.01) temperature by cultivar interaction for EUE. Endosperm utilization efficiency at high temperature ranged from 0.30 gg(-1) to 0.85 gg(-1) among cultivars and was independent of cultivar seed mass. Percent GR reduction from 15 degrees/25 degrees C to 25 degrees/35 degrees C ranged from null to 53% in the different cultivars. A significant negative correlation ($r = -0.81$; P less than or equal to 0.05; $df=16$) was found between EUE at 35 degrees C and the rate of GR reduction from low to high temperature, indicating an association across cultivars between heat tolerance in carbon utilization during seed germination and heat tolerance in growth of the autotrophic plant. The common mechanism underlying the variation among cultivars in heat tolerance at both stages could be in catabolic processes affecting carbon use efficiency. [References: 13].

331 Boldt, R.; Pelzerreith, B.; Borner, T.; Schnarrenberger, C. (1994) ALDOLASES IN BARLEY (*HORDEUM VULGARE* L.) - PROPERTIES AND REPRESSION OF THE PLASTID ENZYME IN THE PLASTOME MUTANT ALBOSTRIANS. *Journal of Plant Physiology*. 144(3):282-286. English. [N CAROLINA STATE UNIV DEPT GENET BOX 7614 RALEIGH, NC 27695 USA].

The plastidic and cytosolic aldolases were purified from green leaves of barley (*Hordeum vulgare* L. cv. Salome) to almost homogeneity on DEAE- Fractogel, P-Cellulose and Fractogel AX 300 (HPCL). The two homotetrameric aldolases have molecular masses of the subunits of 36 and 38 kDa, respectively, and K_m (FBP) values of 10 μ M and 2 μ M.

respectively. Both enzymes were extremely unstable. Loss of activity could partly be prevented by the addition of the protease inhibitors leupeptin or PMSF. In white leaf tissue of the plastome mutant <<albostrians>> of barley the activity of the plastidic isoenzyme is strongly reduced while the activity of the cytosolic isoenzyme was little affected. Western and Northern blot analyses indicated a strong reduction in protein content and in mRNA level of the plastidic but not of the cytosolic aldolase. The protein content and mRNA level of the cytosolic aldolase were similar in white and green leaf tissue. The results support the hypothesis that a plastidic signal causes the repression of the nuclear-encoded plastidic aldolase on a transcriptional level but does not affect the expression of the cytosolic aldolase. [References: 30].

332 Bruix, M.; Jimenez, M.A.; Santoro, J.; Gonzalez, C.; Colilla, F.J.; Mendez, E.; Rico, M. (1993) Solution structure of gamma 1-H and gamma 1-P thionins from barley and wheat endosperm determined by 1H-NMR: a structural motif common to toxic arthropod proteins. *Biochemistry (USA)* v. 32(2) p. 715-724. references. English. (AGRI 94-118067).

The complete assignment of the proton NMR spectra of the homologous gamma 1-hordothionin and gamma 1-purothionin (47 amino acids, 4 disulfide bridges) from barley and wheat, respectively, has been performed by two-dimensional sequence-specific methods. A total of 299 proton-proton distance constraints for gamma 1-H and 285 for gamma 1-P derived from NOESY spectra have been used to calculate the three-dimensional solution structures. Initial structures have been generated by distance geometry methods and further refined by dynamical simulated annealing calculations. Both proteins show identical secondary and tertiary structure with a well-defined triple-stranded antiparallel beta-sheet (residues 1-6, 31-34, and 39-47), an alpha-helix (residues 16-28), and the corresponding connecting loops. Three disulfide bridges are located in the hydrophobic core holding together the alpha-helix and the beta-sheet and forming a cysteine-stabilized alpha-helical (CSH) motif. Moreover, a clustering of positive charges is observed on the face of the beta-sheet opposite to the helix. The three-dimensional structures of the gamma-thionins differ remarkably from plant alpha- and beta-thionins and crambin. However, they show a higher structural analogy with scorpion toxins and insect defensins which also present the CSH motif.

333 Casano, LM.; Martin, M.; Sabater, B. (1994) SENSITIVITY OF SUPEROXIDE DISMUTASE TRANSCRIPT LEVELS AND ACTIVITIES TO OXIDATIVE STRESS IS LOWER IN MATURE-SENESCENT THAN IN YOUNG BARLEY LEAVES. *Plant Physiology*. 106(3):1033-1039. English. [UNIV ALCALA DE HENARES DEPT BIOL VEGETAL E-28871 ALCALA DE HENARES SPAIN].

Antioxidant enzyme activities are inducible by oxidative stress and decrease during senescence. To determine if the age-dependent decrease of superoxide dismutase (SOD) activities is due to decreased sensitivity to oxidative stress, we have investigated the changes in steady-state levels of transcripts and activities of mitochondrial Mn-SOD (SOD1), chloroplastic Fe-SOD (SOD2), and cytoplasmic Cu-Zn-SOD (SOD3) in young and mature-senescent detached barley (*Hordeum vulgare* L.) leaves in response to incubation in darkness, growth light (20 W m⁻²), and photooxidative stress conditions (100 W m⁻²) with 21 or 100% O₂. For a comparison, changes in the mRNA for ribulose biphosphate carboxylase were also measured. After leaf detachment, the abundance of all three SOD mRNAs increased, then decreased and eventually stabilized after 6 h of incubation. After 20 h of incubation under darkness SOD transcripts decreased in both young and mature-senescent leaves. While under strong photooxidative stress the levels of the three SOD transcripts significantly increased in young leaves; in mature-senescent leaves SOD2 and, to lesser extent, SOD1 and SOD3 transcripts decreased. Generally, SOD activity changes were similar to those of mRNAs. It is proposed that oxidative damage during senescence could be favored by the inability of senescing leaves to modulate the steady-state level of SOD mRNA, and probably those of other antioxidant enzymes, concomitant with the rate of oxyradical formation. [References: 33].

334 Chen Zhende (Qingdao Municipal Inst. of Agricultural Sciences, Shandong (China)); Zou Qi; Cheng Bingsong (1993) Effects of N on the distribution of P and K in plants for wheat varieties with various nutrient tolerances. *Soils and Fertilizers (China)* (no. 4) p. 24-27. 5 tables. Chinese. (AGRI 94-118055).

335 Cheng, WX.; Coleman, DC.; Carroll, CR.; Hoffman, CA. (1994) INVESTIGATING SHORT-TERM CARBON FLOWS IN THE RHIZOSPHERES OF DIFFERENT PLANT SPECIES, USING ISOTOPIC TRAPPING. *Agronomy Journal*. 86(5):782-788. English. [UNIV GEORGIA INST ECOL ATHENS, GA 30602 USA].

Many difficulties exist in studying rhizosphere carbon flows in situ because of limited methodologies. Current photosynthate allocation to root respiration, rhizosphere microbial respiration and soluble root exudates in the rhizospheres of winter wheat (*Triticum aestivum* L.), tall fescue (*Festuca arundinacea* Schreb.) and buffalo gourd (*Cucurbita foetidissima* HBK) were investigated using an isotopic trapping procedure. Plants were grown in containers with 165 g of sandy clay loam soil for 3 wk before the time of C-14 pulse labeling. Most root exudates were utilized by the microbes in the immediate rhizosphere and released as (CO₂)-C-14. Only a small amount of exudates was found in the bulk soil (2.7, 2.5, and 3.7% in the control treatments of wheat, tall fescue, and buffalo gourd respectively). The isotopic trapping mechanism was valid for all three species even though the patterns of total rhizosphere respiration (measured as total (CO₂)-C-14 rates during the initial 8 h of tracing for the three plant species were different in peak time and peak height. The isotopic trapping procedure can be used in rhizosphere studies for various plant species in principle. Some modifications to the procedure may be needed for different plant-soil systems. [References: 25].

336 Chirido, FG.; Fossati, CA.; Anon, MC. (1994) FRACTIONATION OF WHEAT, BARLEY, AND RYE PROLAMINS BY CATION EXCHANGE FPLC. *Journal of Agricultural & Food Chemistry*. 42(11):2460-2465. English. [NATL UNIV LA PLATA FAC CIENCIAS EXACTAS CTR INVEST & DESARROLLO CRIOTECNOL ALIMENTOS 47 & 116 RA-1900 LA PLATA ARGENTINA].

Wheat, rye, and barley prolamins were separated using optimized elution conditions by cation exchange FPLC on an analytical Mono-S column. Wheat gliadins were resolved into a larger number of peaks than has been obtained hitherto. Most fractions contained a mixture of components as determined by SDS-PAGE and A-PAGE. At least one fraction was obtained for each group of gliadins that contains only one major component with minimal contamination by other components. Only omega-gliadins occurred in five of the fractions. A preparative S-Sepharose Fast Flow column, run under similar chromatographic conditions, was used to isolate omega-gliadins. This procedure could be used as the first step for the purification of individual gliadin components. Chromatography on the Mono-S column was highly reproducible and showed promise as a means of differentiating wheat cultivars. Furthermore, FPLC was applied to fractionate prolamins from barley and rye. [References: 19].

337 Dent, RM.; Cowan, AK. (1994) ABSCISIC ACID-INDUCED SENESCENCE IN LIGHT-INCUBATED AND DARK-INCUBATED DETACHED LEAVES OF BARLEY. *South African Journal of Botany-Suid-Afrikaanse Tydskrif vir Plantkunde*. 60(6):340-344. English. [RHODES UNIV SCHONLAND BOT LABS DEPT BOT GRAHAMSTOWN 6140 SOUTH AFRICA].

Abscissic acid (ABA)-induced foliar senescence was examined using detached leaf segments of light-grown *Hordeum vulgare* L. cv. Dyan seedlings, incubated with or without exogenous ABA in either total darkness or under continuous illumination. In darkness, the chlorophyll (Chl) content declined rapidly, ABA levels increased sharply whereas carotenoid levels were sustained, and declined gradually during the course of senescence. By comparison, untreated leaf segments exposed to continuous illumination displayed enhanced loss of Chl and carotenoids and slower rates of ABA accumulation. In response to exogenous ABA, Chl and carotenoid content of light-incubated leaf segments declined markedly and the rate of decline increased with an increase in exogenous ABA concentration. In dark-incubated leaf segments, exogenous ABA, in the range 0.1-100 µM, had little or no significant effect on the rate of Chl loss, and calculation of the Chl: carotenoid ratio revealed that dark-incubated leaf segments were insensitive to exogenous ABA. At 1 mM ABA, Chl loss was delayed. It is proposed that the inability of exogenous ABA to accelerate Chl breakdown in dark-incubated leaves was caused by a transient accumulation of carotenoids, and in particular xanthophylls, possibly related to the rapid elevation in endogenous ABA levels. Furthermore, it is suggested that retardation of carotenoid breakdown is a

contributing factor accounting for differences in ABA-induced Chl loss between light- and dark-incubated senescing leaves.

335 Dreyfuss, BW.; Thornber, JP. (1994) ASSEMBLY OF THE LIGHT-HARVESTING COMPLEXES (LHCS) OF PHOTOSYSTEM II - MONOMERIC LHC IIB COMPLEXES ARE INTERMEDIATES IN THE FORMATION OF OLIGOMERIC LHC IIB COMPLEXES. *Plant Physiology*. 106(3):829-839. English. [UNIV CALIF LOS ANGELES DEPT CHEM & BIOCHEM 405 HILGARD AVE LOS ANGELES, CA 90024 USA].

The light-induced assembly of light-harvesting complex (LHC) II has been followed during the biogenesis of the plastid. Seedlings grown in intermittent light (IML) accumulate only small amounts of chlorophyll b. The minor LHC II apoproteins are present; however, the apoprotein levels of the major LHC II complex, LHC IIb, are severely depressed after exposure to IML. The levels of all LHC II apoproteins increase rapidly upon exposure to continuous illumination. The 25-kD, type 3 LHC IIb subunit appears to be more abundant during the early hours of greening in relation to its level in mature thylakoids. The LHC IIb apoproteins are initially associated with pigments to form monomeric pigment-protein complexes. The abundance of monomeric LHC IIb complexes gradually decreases during exposure to continuous light and a concomitant increase occurs in the amount of the trimeric and higher-order oligomeric forms. Pulse-chase experiments verify that labeled LHC IIb monomeric complexes are intermediates in the formation of trimeric and higher-order oligomeric LHC IIb-pigmented complexes. Therefore, the assembly of LHC II occurs via the initial pigmentation of the apoproteins to form monomeric complexes and proceeds in a sequential manner. [References: 67].

339 Dreyfuss, BW.; Thornber, JP. (1994) ORGANIZATION OF THE LIGHT-HARVESTING COMPLEX OF PHOTOSYSTEM I AND ITS ASSEMBLY DURING PLASTID DEVELOPMENT. *Plant Physiology*. 106(3):841-848. English. [UNIV CALIF LOS ANGELES DEPT CHEM & BIOCHEM 405 HILGARD AVE LOS ANGELES, CA 90024 USA].

Photosystem I (PSI) holocomplexes were fractionated to study the organization of the light-harvesting complex I (LHC I) pigment-proteins in barley (*Hordeum vulgare*) plastids. LHC Ia and LHC Ib can be isolated as oligomeric, presumably trimeric, pigment-protein complexes. The LHC Ia oligomeric complex contains both the 24- and the 21.5-kD apoproteins encoded by the *Lhca3* and *Lhca2* genes and is slightly larger than the oligomeric LHC Ib complex containing the *Lhca1* and *Lhca4* gene products of 21 and 20 kD. The synthesis and assembly of LHC I during light-driven development of intermittent light-grown plants occurs rapidly upon exposure to continuous illumination. Complete PSI complexes are detected by nondenaturing Deriphat (disodium N-dodecyl-beta-iminodipropionate-160)-PAGE after 2 h of illumination, and their appearance correlates with that of the 730- to 740-nm emission characteristic of assembled LHC I. However, the majority of the newly synthesized LHC I apoproteins are present as monomeric complexes in the thylakoids during the early hours of greening. We propose that during development of the protochloroplast the LHC I apoproteins are first assembled into monomeric pigmented complexes that then aggregate into trimers before becoming attached to the pre-existing core complex to form a complete PSI holocomplex. [References: 42].

340 Ejiri, S. (1994) SIMPLE METHOD FOR ANALYZING PHOSPHOAMINO ACIDS BY THIN-LAYER CHROMATOGRAPHY - APPLICATION TO ELONGATION FACTOR 1 FROM WHEAT EMBRYO. *Bioscience Biotechnology & Biochemistry*. 58(11):2066-2067. English. [IWATE UNIV FAC AGR INST CELL BIOL & GENET MORIOKA IWATE 020 JAPAN].

A simple and rapid method was developed separating phosphoserine, phosphothreonine, phosphotyrosine, phosphoric acid, and ATP by one-dimensional cellulose thin-layer chromatography, using a freshly prepared solvent system of 1-butanol-formic acid-water (5:2:1). This system was applied to determine phosphoamino acid (phosphoserine) of wheat elongation factor 1 beta phosphorylated by casein kinase II from the wheat embryo. [References: 9].

341 El Faham, S.Y.; Saleh, A.I.; Abd El Haleem, A.K. (National Research Centre, Cairo (Egypt). Food Technology Dept.) (1994) The chemical composition of wheat grains as affected by nitrogen and potassium

fertilizers and water regime. *Monoufeya Journal of Agriculture Research (Egypt)* v. 19(1) p. 17-34. 2 ill. 5 tables; 27 ref. English. (AGRIS 94-107758).

342 Florack, DEA.; Stiekema, WJ. (1994) THIONINS - PROPERTIES, POSSIBLE BIOLOGICAL ROLES AND MECHANISMS OF ACTION (Review). *Plant Molecular Biology*. 26(1):25-37. English. [DLO CTR PLANT BREEDING & REPROD RES DEPT MOLEC BIOL POB 16 6700 AA WAGENINGEN NETHERLANDS].

Thionins are low-molecular-weight proteins (M(r) ca. 5000) occurring in seeds, stems, roots and leaves of a number of plant species. The different members of this family of plant proteins show both sequence and structural homology, and are toxic to bacteria, fungi, yeasts and various naked cells in vitro. Toxicity requires an electrostatic interaction of the positively charged thionin with the negatively charged phospholipids making up the membrane, followed by either pore formation or a specific interaction with a certain lipid domain. This domain might be composed of phosphoinositides, which mediate transduction of environmental signals in eukaryotes. Their in vitro toxicity to plant pathogenic bacteria and fungi could reflect a direct role in plant defence, although, in view of the many divergent activities displayed by thionins both in vitro and in vivo, a biological role other than inhibition of microbial growth is equally plausible. [References: 104].

343 Hause, B.; Zurnieden, U.; Lehmann, J.; Wasternack, C.; Parthier, B. (1994) INTRACELLULAR LOCALIZATION OF JASMONATE-INDUCED PROTEINS IN BARLEY LEAVES. *Botanica Acta*. 107(5):333-341. English. [INST BIOCHEM PFLANZEN POSTFACH 250 D-06018 HALLE GERMANY].

The plant growth substance jasmonic acid and its methyl ester (JA-Me) induce a set of proteins (jasmonate-induced proteins, JIPs) when applied to leaf segments of barley (*Hordeum vulgare* L. cv. Salome). Most of these JIPs could be localized within different cell compartments by using a combination of biochemical and histochemical methods. Isolation and purification of various cell organelles of barley mesophyll cells, the separation of their proteins by one-dimensional polyacrylamide gel electrophoresis and the identification of the major abundant JIPs by Western blot analysis, as well as the immune-gold labelling of JIPs in ultrathin sections were performed to localize JIPs intracellularly. JIP-23 was found to be in vacuoles, peroxisomes, and in the granular parts of the nucleus as well as within the cytoplasm; JIP-37 was detected in vacuoles and in the nucleoplasm; JIP-66 is a cytosolic protein. Some less abundant JIPs were also localized within different cell compartments: JIP-100 was found within the stromal fraction of chloroplasts; JIP-70 is present in the peroxisome and the nucleus; JIP-50 and JIP-6 accumulate in vacuoles. The location of JIP-66 and JIP-6 confirms their possible physiological role deduced from molecular analysis of their cDNA. [References: 57].

344 Horak, O. (Oesterreichisches Forschungszentrum Seibersdorf GmbH (Austria)); Herger, P.; Benetka, E. (1993) [Studies about transfer of some trace elements in winter wheat]. *Untersuchungen zum Transfer einiger Spurenelemente in Winterweizen*. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). *VDLUFA-Schriftenreihe (Germany)*; no. 37 p. 721-724. VDLUFA. 2 ill., 2 tables; 5 ref. German. (AGRIS 94-107846).

345 Horton, P.; Ruban, AV.; Walters, RG. (1994) REGULATION OF LIGHT HARVESTING IN GREEN PLANTS - INDICATION BY NONPHOTOCHEMICAL QUENCHING OF CHLOROPHYLL FLUORESCENCE. *Plant Physiology*. 106(2):415-420. English. [UNIV SHEFFIELD ROBERT HILL INST DEPT MOLEC BIOL & BIOTECHNOL POB 594 WESTERN BANK SHEFFIELD S10 2UH S YORKSHIRE ENGLAND].

346 Jackson, GD.; Berg, RK.; Kushnak, GD.; Blake, TK.; Yarrow, GI. (1994) NITROGEN EFFECTS ON YIELD, BETA-GLUCAN CONTENT, AND OTHER QUALITY FACTORS OF OAT AND WAXY HULLESS BARLEY. *Communications in Soil Science & Plant Analysis* 25(17-18):3047-3055. English. [WESTERN TRIANGLE AGR RES CTR POB 1474 CONRAD, MT 59425 USA].

Oat (*Avena sativa* L.) and waxy hulless barley (*Hordeum vulgare* L.) are important sources of water soluble plant fiber (beta-glucan) needed in human diets to lower serum cholesterol. Recent studies have shown grain

beta-glucan content is influenced by soil type and environment, however, nitrogen (N) response data for oat and waxy hulless barley are lacking. In this study, we evaluated N effects on grain beta-glucan content and yield; grain yield, protein content, and test weight; and total dry matter production and N utilization of oat and waxy hulless barley. Rates of applied N were 0, 34, 67, and 101 kg N/ha at three field environments in central Montana during 1989 and 1990. Nitrogen increased all variables except test weight and beta-glucan content. Waxy hulless barley grain yields fluctuated from 0.82 to 4.11 Mg/ha, beta-glucan content from 62 to 76 g/kg, and beta-glucan yields from 51 to 354 kg/ha. Oat yields ranged from 0.85 to 3.83 Mg/ha, beta-glucan content from 37 to 51 g/kg, and beta-glucan yields from 35 to 178 kg/ha. Oat beta-glucan content was positively related to grain protein content, and waxy hulless barley beta-glucan content was positively related to test weight. beta-glucan content appeared more related to environmental factors other than N. [References: 19].

347 Jiang Hongming (Yantai Municipal Inst of Agricultural Sciences, Shandong (China)); Liu Shouzheng; Yu Jingchuan (1993) Studies on matter transference and milking characters after flowering in different maturing phases of wheat. *Journal of Laiyang Agricultural College (China)* v. 10(3) p. 177-182. 2 ill., 5 tables, 8 ref. Chinese. (AGRIS 94-118115).

348 Lam, TBT.; Iiyama, K.; Stone, BA. (1994) AN APPROACH TO THE ESTIMATION OF FERULIC ACID BRIDGES IN UNFRACTIONATED CELL WALLS OF WHEAT INTERNODES. *Phytochemistry*. 37(2):327-333. English. [LA TROBE UNIV DEPT BIOCHEM BUNDOORA VIC 3083 AUSTRALIA].

A modification of a published procedure has been developed to allow the estimation of ester-ether bridges involving hydroxycinnamic acids in unfractionated walls of grasses. The modified procedure involves the use of a soluble catalyst, chlorotris-(triphenylphosphine) rhodium, for the conversion of the propenoic to propanoic sidechains, and lithium triethylborohydride for reduction of ester-linked propanoic acids. The reaction conditions for hydrogenation are severe and tests with a synthetic feruloyl-arabinoxylan showed that significant cleavage of ester-linked hydroxycinnamic acid results. Nevertheless, it was shown that 40% of ether-linked ferulic acid in whole internode walls is involved in ester-ether bridges. If these values are corrected, based on the loss of feruloyl ester-linkages during the hydrogenation reaction, the proportion of ester-ether-linked ferulic acid in the walls approaches 100%. On the other hand, the occurrence of ester-ether bridges through p-coumaric acid appears to be low. [References: 29].

349 Lim, U.K.; Lee, K.H. (Seoul National University, Suwon (Korea Republic). College of Agriculture and Life Sciences); Pek, U.H. (Doosan Technical Center, Yongin (Korea Republic)) (1993) Comparison of eleven cultivars of barley (*Hordeum vulgare* L.) for SOD activity of seeds and seedlings. *Journal of Agricultural Sciences-Seoul University (Korea Republic)* v. 18(2) p. 119-126. 2 illus.; 3 tables; 53 ref. English. (AGRIS 94-107772).

350 Loreto, F.; Dimarco, G.; Tricoli, D.; Sharkey, TD. (1994) MEASUREMENTS OF MESOPHYLL CONDUCTANCE, PHOTOSYNTHETIC ELECTRON TRANSPORT AND ALTERNATIVE ELECTRON SINKS OF FIELD GROWN WHEAT LEAVES. *Photosynthesis Research*. 41(3):397-403. English. [CNR IST BIOCHIM & ECOFISIOLOGIA VEGETALI I-00116 ROME ITALY].

Photosynthetic electron transport drives the carbon reduction cycle, the carbon oxidation cycle, and any alternative electron sinks such as nitrogen reduction. A chlorophyll fluorescence-based method allows estimation of the total electron transport rate while a gas-exchange-based method can provide estimates of the electron transport needed for the carbon reduction cycle and, if the CO₂ partial pressure inside the chloroplast is accurately known, for the carbon oxidation cycle. The gas-exchange method cannot provide estimates of alternative electron sinks. Photosynthetic electron transport in flag leaves of wheat was estimated by the fluorescence method and gas-exchange method to determine the possible magnitude of alternative electron sinks. Under non-photorespiratory conditions the two measures of electron transport were the same, ruling out substantial alternative electron sinks. Under photorespiratory conditions the fluorescence-based electron transport rate could be accounted for by the carbon reduction and carbon oxidation cycle only if we assumed the CO₂ partial pressure inside the chloroplasts to be

lower than that in the intercellular spaces of the leaves. To further test for the presence of alternative electron sinks, carbon metabolism was inhibited by feeding glyceraldehyde. As carbon metabolism was inhibited, the electron transport was inhibited to the same degree. A small residual rate of electron transport was measured when carbon metabolism was completely inhibited which we take to be the maximum capacity of alternative electron sinks. Since the alternative sinks were small enough to ignore, the comparison of fluorescence and gas-exchange based methods for measuring the rate of electron transport could be used to estimate the mesophyll conductance to CO₂ diffusion. The mesophyll conductance estimated this way fell as wheat flag leaves senesced. The age-related decline in photosynthesis may be attributed in part to the reduction of mesophyll conductance to CO₂ diffusion and in part to the estimated decline of ribulose 1, 5-bisphosphate carboxylase amount. [References: 18].

351 Ma, BL.; Dwyer, LM.; Smith, DL. (1994) EVALUATION OF PEDUNCLE PERFUSION FOR IN VIVO STUDIES OF CARBON AND NITROGEN DISTRIBUTION IN CEREAL CROPS. *Crop Science*. 34(6):1584-1588. English. [AGR CANADA RES BRANCH CLBRN CENT EXPTL FARM OTTAWA K1A 0C6 ON CANADA].

Peduncle perfusion, a recently developed technique for delivery of N solution into hollow-stemmed crops, may be useful for various studies of nutrient allocation within the plant. The objectives of this study were to assess whether peduncle perfusion was suitable for in vivo studies of N and/or C distribution in cereal crops and to determine how N, growth regulator, or sucrose solutions altered C and N accumulation and partitioning in barley (*Hordeum vulgare* L.) and wheat (*Triticum aestivum* L. emend. Thell.). Ten treatments [25 and 50 mM N, 30 μ M chlormequat (2-chloroethyl-N, N, N-trimethyl ammonium chloride), 15 μ M ethephon [(2-chloroethyl)phosphonic acid], N + chlormequat or ethephon, detillering + N, 250 mM sucrose, distilled water and non-perfusion] were evaluated in four greenhouse experiments (two for barley, two for wheat). Treatments containing N were enriched with a 5% atom N-15. Perfusion lasted 30 d beginning 5 to 8 d after spike emergence. The total volume of solution taken up ranged from 10 to 178 mL for barley, and 8 to 129 mL for wheat. The N-15 tracer showed that peduncle-perfused N was transported and incorporated into all plant tissues. Applying N increased grain N concentration an average of 9.5 g kg⁻¹ for barley and 18.1 g kg⁻¹ for wheat with levels as high as 36 and 55 g kg⁻¹, respectively. Nitrogen levels in flag leaves and non-grain tissues of the spike were two- to eight-fold higher in N perfused plants. Perfusion with sucrose or growth regulators did not affect C or N content in grain or non-grain tissues. The data indicate that peduncle perfusion delivers substances in solution into both barley and wheat plants. Nitrogen supplied after spike emergence can substantially increase grain N accumulation without restricting C deposition. [References: 20].

352 Mack, G.; Tischner, R. (1994) CONSTITUTIVE AND INDUCIBLE NET NH₄⁺ UPTAKE OF BARLEY (*HORDEUM VULGARE* L.) SEEDLINGS. *Journal of Plant Physiology*. 144(3):351-357. English. [UNIV GOTTINGEN INST PFLANZENPHYSIOL UNTERE KARSPULE 2 D-37073 GOTTINGEN GERMANY].

High initial NH₄⁺ depletion rates were measured immediately after exposure of N-free grown and NH₄⁺-induced barley to NH₄⁺. We provide evidence that this rapid initial NH₄⁺ depletion was due primarily to the filling of the Apparent Free Space of the root cell wall. The high initial depletion rates depended on the NH₄⁺ concentration of the uptake solution and on the degree of prior NH₄⁺ saturation of the Apparent Free Space. N-free grown barley seedlings were able to take up NH₄⁺ constitutively with a V-max of 3.7 μ mol.(g root FW)⁻¹ h⁻¹ and a K-s of 153 μ M. However, an induction of NH₄⁺ uptake by the NH₄⁺ reserves of the grain (105 nmole per dry grain; 74% of which was stored in the dormant seed) during early germination cannot be excluded. Exposure of N-free grown seedlings to external NH₄⁺ (< 1 mM) resulted in an induction of NH₄⁺ uptake after a 80 min lag; the rates were higher (V-max = 6-8.3 μ mol.(g root FW)⁻¹ h⁻¹) than the constitutive rates, but K. remained unchanged (154 to 166 μ M after induction and 153 μ M prior to induction). This indicates that the same NH₄⁺ uptake system (low-capacity uptake system) was operating in N-free and NH₄⁺-induced barley and that during induction the amount of transport proteins was increased. A linear uptake component (high-capacity system) was measured at high external (> 1 mM) NH₄⁺ concentrations with NH₄⁺-induced and N-free grown plants. The steady-state rates were about 10-

fold higher than that of the low-capacity system although no additional protein synthesis was required. [References: 23].

353 Nielsen, TH. (1994) **PYROPHOSPHATE-FRUCTOSE-6-PHOSPHATE 1-PHOSPHOTRANSFERASE FROM BARLEY SEEDLINGS - ISOLATION, SUBUNIT COMPOSITION AND KINETIC CHARACTERIZATION.** *Physiologia Plantarum*. 92(2):311-321. English. [ROYAL VET & AGR UNIV DEPT PLANT BIOL PLANT BIOCHEM LAB THORVALDSENVEJ 40 DK-1871 FREDERIKSBURG DENMARK].

Pyrophosphate:fructose-6-phosphate 1-phosphotransferase (PFP; EC 2.7.1.90) was purified 260-fold from leaves of etiolated barley seedlings. The purified enzyme consisted of two subunits, with apparent molecular masses of 65 (alpha) and 60 (beta) kDa. Polyclonal antibodies were raised against the denatured PFP protein eluted from an SDS-polyacrylamide gel. The antibodies recognized both denatured and native PFP. Western blots of crude extracts showed that the activity of PFP in barley leaves is correlated to the amount of PFP protein, and that both the alpha- and the beta-subunits are present in near stoichiometric amounts in all investigated tissues. The apparent molecular mass of the holoenzyme, as determined by gel filtration chromatography, was dependent on the presence of pyrophosphate. In absence of pyrophosphate, barley PFP elutes as a heterotetramer whereas it elutes as a heterooctamer in the presence of 20 mM pyrophosphate. Pure PFP obtained by gel filtration chromatography in the presence of 20 mM pyrophosphate reached a specific activity of 28 U mg⁻¹. Barley PFP was characterized with respect to kinetic properties in the forward direction (use of P_i) and in the reverse direction (formation of P_i). The affinity for the activator Fru-2, 6-P-2 was very high, with an estimated K_a of 2.8 nM when PFP activity was assayed in the forward direction. [References: 36].

354 Penny, M.; Willis, CL.; Gaskin, P.; Lenton, JR. (1994) **PREPARATION OF GIBBERELLINS A(91) AND A(92) AND THEIR OCCURRENCE IN DEVELOPING WHEAT GRAIN.** *Phytochemistry*. 37(4):1063-1067. English. [UNIV BRISTOL SCH CHEM CANTOCKS CLOSE BRISTOL BS8 1TS AVON ENGLAND].

Extracts of endosperm of developing grains of *Triticum aestivum* (cv Maris Huntsman) were analysed by GC-MS and found to contain a previously known synthetic compound, 1 beta-hydroxyGA(5), now named GA(92). The structure of a new GA metabolite, 2 beta-hydroxyGA(60), was confirmed by comparison with a synthetic sample prepared in nine steps from GA(3) methyl ester and assigned the trivial name GA(91). [References: 14].

355 Popovic, M.; Gasic, O.; Hong, Z. (Prirodno matematički fakultet, Novi Sad (Yugoslavia). Institut za hemiju) (1992) [Investigation into the influence of nitric salts on the activity of glutamine synthetase at wheat]. Proučavanje uticaja azotnih soli na aktivnost glutamin sintetaze kod pšenice. 34. savetovanje Srpskog hemijskog društva; Beograd (Yugoslavia); 16-18 Jan 1992. [34 th Conference of Serbian Chemical Society, Beograd (Yugoslavia), January 16-18, 1992. Summaries of papers]. Popovic, I.; Blagojevic, N. (eds.) p. 96. Srpsko hemijsko društvo. Serbian. (AGRI 94-107760).

356 Qu, QS.; Liang, HG.; Zheng, HJ.; Chen, P. (1994) **CA²⁺-CALMODULIN-STIMULATED SUPEROXIDE GENERATION BY PURIFIED PLASMA MEMBRANE FROM WHEAT ROOTS.** *Plant Science* 101(2):99-104. English. [LANZHOU UNIV DEPT BIOL LANZHOU 730000 PEOPLES REPUBLIC OF CHINA].

Highly purified plasma membranes were isolated by aqueous two-phase partitioning from wheat roots. The superoxide generation was studied by EPR technique with Tiron as the spin trap. Ca²⁺-calmodulin could stimulate the TH signal, while SOD and several calmodulin antagonists, La³⁺, EGTA and CPZ could inhibit the TH signal. Stimulation of TH signal by Ca²⁺-calmodulin was dependent on NADH and calmodulin. The above results provided direct evidence for the connection of calmodulin to the redox system of plasma membranes. Similarly, catalase and KCN could also inhibit TH signal. No stimulation of superoxide production was observed when Ca²⁺ and calmodulin were added separately. NADPH could not elicit TH signal in the study of the stimulation of superoxide by Ca²⁺-calmodulin. Triton X-100 (0.05%) could not cause a significant increase in TH signal. [References: 22].

357 Sontag Strohm, T. (Helsingfors Univ. (Finland). Inst. of Biotechnology) (1992) **Gluten proteins and baking quality.** 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 225-229. Svalöf AB. 3 ref. English. (AGRI 94-107848).

358 Tetlow, IJ.; Blissett, KJ.; Emes, MJ. (1994) **STARCH SYNTHESIS AND CARBOHYDRATE OXIDATION IN AMYLOPLASTS FROM DEVELOPING WHEAT ENDOSPERM.** *Planta*. 194(4):454-460. English. [UNIV MANCHESTER SCH BIOL SCI 3614 STOPFORD BLDG MANCHESTER M13 9PT LANCS ENGLAND].

The rates of incorporation of various metabolites into starch by isolated amyloplasts from developing endosperm of spring wheat (*Triticum aestivum* L. cv. Axona) were examined. Of the metabolites tested that were likely to be present in the cytosol at concentrations sufficient to sustain starch synthesis, only glucose 1-phosphate (Glc1P) supported physiologically relevant rates of starch synthesis. Incorporation of Glc1P into starch was both dependent on the presence of ATP and intact organelles. The rate of incorporation of hexose into starch became saturated at a Glc1P concentration of less than 1 mol m⁻³ in the presence of 1 mol m⁻³ ATP. Starch synthesis from 5 mol m⁻³ ADP-glucose supplied to the organelles occurred at rates 15-fold higher than from similar concentrations of Glc1P, but it is argued that this is probably of little physiological relevance. The net incorporation of hexose units into starch from Glc1P was inhibited 50% by 100 mmol.m⁻³ carboxyatractylolide. Carbohydrate oxidation in the amyloplast was stimulated by the addition of 2-oxoglutarate and glutamine, and in such circumstances incorporation of C-14-labelled metabolites into starch was reduced. Glucose 6-phosphate proved to be a better substrate for oxidative pathways than Glc1P. Our results suggest that Glc1P is the primary substrate for starch synthesis in developing wheat endosperm, and that ATP required for starch synthesis is imported via an adenylate translocator. [References: 23].

359 Tormakangas, K.; Kervinen, J.; Ostman, A.; Teeri, T. (1994) **TISSUE-SPECIFIC LOCALIZATION OF ASPARTIC PROTEINASE IN DEVELOPING AND GERMINATING BARLEY GRAINS.** *Planta*. 195(1):116-125. English. [UNIV HELSINKI INST BIOTECHNOL POB 45 KARVAAMOKUJA 3 SF-00014 HELSINKI FINLAND].

Resting seeds of several plant species, including barley grains, have been reported to contain aspartic proteinase (EC 3.4.23) activity. Here, the expression of the *Hordeum vulgare* L. aspartic proteinase (HvAP) was studied in developing and germinating grains by activity measurements as well as by immunocytochemical and in-situ hybridization techniques. Southern blotting suggests the presence of one to two HvAP-encoding genes in the barley genome, while Northern analysis reveals a single 2.1-kb mRNA in grains and vegetative tissues. Western blotting with antibodies to HvAP shows the same subunit structure in different grain parts. In developing grains, HvAP is produced in the embryo, aleurone layer, testa and pericarp, but in the starchy endosperm HvAP is present only in the crushed and depleted area adjacent to the scutellum. During seed maturation, HvAP-encoding mRNA remains in the aleurone layer and in the embryo, but the enzyme disappears from the aleurone cells. The enzyme, however, remains in the degenerating tissues of the testa and pericarp as well as in resting embryo and scutellum. During the first three days of germination, the enzyme reappears in the aleurone layer cells but is not secreted into the starchy endosperm. The HvAP is also expressed in the flowers, stem, leaves, and roots of barley. The wide localization of HvAP in diverse tissues suggests that it may have several functions appropriate to the needs of different tissues. [References: 55].

360 Uhlen, A.K. (Norges Landbrukshegskole, Aas (Norway). Inst foer Plantekultur); Mosleth, E. (1992) **The effect of gliadins and high molecular weight (HMW) glutenin subunits on gluten quality of wheat.** 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 163-172. Svalöf AB. 26 ref. English. (AGRI 94-107847).

361 Vanbeckum, JMM.; Wang, M. (1994) **EFFECT OF SHORT CHAIN FATTY ACIDS ON PHYSIOLOGY OF BARLEY GRAINS CV TRIUMPH WITH A DIFFERENT LEVEL OF DORMANCY.** *Plant Science*

We studied the role of fatty acids in dormancy of barley cv. Triumph using isogenic grains grown in phytotrons with either a relatively high or a relatively low degree of dormancy and non-dormant grains grown in the field; The level of endogenous short chain saturated fatty acids (SCSFAs) and unsaturated fatty acids (USFAs) were analysed in these grains. We did not detect SCSFAs and could not find a significant difference in the levels of USFAs between the different types of grain. Exogenous SCSFAs had inhibitory effects on both grain germination and germination of isolated embryos and GA(3)-induced alpha-amylase secretion of isolated aleurone layers. In the concentration range between 6.7 mM and 10 mM the germination of non-dormant grains grown in the field was sharply inhibited by heptanoic acid (C7), octanoic acid (C8) and nonanoic acid (C9). A 10-mM concentration of decanoic acid (C10) did not affect the grain germination significantly; however, C10 reduced the germination of isolated embryos and the GA(3)-induced alpha-amylase secretion of isolated aleurone layers. Embryos from dormant grains were more sensitive to C9 and C10 than embryos from non-dormant grains, whereas aleurone layers from both types of grain did not show a clear difference in responses towards these fatty acids. C9, however, had a stronger inhibitory effect on isolated embryos and on isolated aleurone layers from both types of grain than C10 had. As compared with grains, a 20-fold and a 40-fold lower concentration SCSFAs were effective on isolated embryos and aleurone layers, respectively. The findings as presented underline the obviously different role of the aleurone and embryo in grain dormancy. [References: 30].

362 Wang, HL.; Offler, CE.; Patrick, JW. (1994) NUCLEAR PROJECTION TRANSFER CELLS IN THE DEVELOPING WHEAT GRAIN. *Protoplasma*. 182(1-2):39-52. English. [UNIV NEWCASTLE DEPT BIOL SCI NEWCASTLE NSW 2308 AUSTRALIA].

Transfer cells in the nucellar projection of wheat grains at 25 +/- 3 days after anthesis have been examined using light and electron microscopy. Within the nucellar tissue, a sequential increase in non-polarized wall ingrowth differentiation and cytoplasmic density was evident. Cells located near the pigment strand were the least differentiated. The degree of differentiation increased progressively in cells further removed from the pigment strand and the cells bordering the endosperm cavity had degenerated. Four stages of transfer cell development were identified at the light microscope level. Wall ingrowth differentiation followed a sequence from a papillate form through increased branching (antler-shaped ingrowths) which ultimately anastomosed to form a complex labyrinth. The final stage of wall ingrowth differentiation was compression which resulted in massive ingrowths. In parallel with wall ingrowth deposition cytoplasmic density increased. During wall deposition, paramural and multivesicular bodies were prominent and were in close association with the wall ingrowths. The degeneration phase involved infilling of cytoplasmic islets within the wall ingrowths. This was accompanied by complete loss of the protoplast. The significance of this transfer cell development for sucrose efflux to the endosperm cavity was assessed by computing potential sucrose fluxes across the plasma membrane surface areas of the nucellar projection cells. Transfer cell development amplified the total plasma membrane surface area by 22 fold. The potential sucrose flux, when compared with maximal rates of facilitated membrane transport of sugars, indicated spare capacity for sucrose efflux to the endosperm cavity. Indeed, when the total flux was partitioned between the nucellar projection cells at the three stages of transfer cell development, the fully differentiated stage III cells located proximally to the endosperm cavity alone exhibited spare transport capacity. Stage II cells could accommodate the total rate of sucrose transfer, but stage I cells could not. It is concluded that the nucellar projection tissue of wheat provides a unique opportunity to study transfer cell development and the functional role of these cells in supporting sucrose transport. [References: 35].

363 Williams, M.; Shewry, PR.; Harwood, JL. (1994) THE INFLUENCE OF THE GREENHOUSE EFFECT ON WHEAT (TRITICUM AESTIVUM L) GRAIN LIPIDS. *Journal of Experimental Botany*. 45(279):1379-1385. English. [UNIV WALES COLL CARDIFF DEPT BIOCHEM POB 903 CARDIFF CF1 1ST S GLAM WALES].

There have been few studies conducted with the objective of investigating comprehensively the 'greenhouse effect' on wheat growth using field-grown crops and even less on the effects on the lipid composition of harvested grains. Therefore, the aim of this study was to define any changes in wheat grain acyl lipids which could result from alterations in environmental growth conditions predicted to mimic the 'greenhouse effect'. Quantitative changes were recorded for both the non-starch and starch lipids. When supplied with low concentrations of nitrogen fertilizer, plants showed increased amounts of total grain lipids when grown under an elevated (700 $\mu\text{mol l}^{-1}$) carbon dioxide atmosphere. Increasing the ambient temperature by 4 degrees C, however, reduced the total lipid content of grains. Wheat plants treated with high concentrations of nitrogen fertilizer accumulated less lipid compared to low nitrogen controls. Qualitative changes were also observed in the proportions of non-starch and starch lipid classes. However, changes in total acyl composition were limited to starch grain acyl lipids, as a result of changes in atmospheric carbon dioxide, growth temperature and nitrogen fertilizer application. The alterations in wheat lipids observed are likely to affect the properties of the flour produced from the grains. [References: 32].

364 Zhang Hui; Feng Xianzhong; Guo Aiguang (Northwest Agricultural Univ., Yangling, Shaanxi (China). Lab. of Plant Biochemistry) (1993) A labelling method for protein and nucleic acid in wheat leaves. *Plant Physiology Communications (China)* v. 29(4) p. 287-289. 1 table, 6 ref. Chinese. (AGRIS 94-118116).

365 Zoric, D. (Faculty of Agriculture, Belgrade (Yugoslavia)) (1993) [Structure and relationships between protein fractions in the grain of Yugoslav high-yielding wheat cultivars]. *Review of research work at the Faculty of Agriculture (Yugoslavia)* v. 38(1) p. 61-66. 5 tables; 13 ref. English. (AGRIS 94-107759).

The paper presents the investigation result of total wheat proteins, amounts of certain protein fractions and their relative relationships in the content of major protein groups (albumins, globulins, gliadins, glutelins) in the grain of high-yielding wheat cultivars sown at various locations. It also presents the effects of agroecological conditions on the relationships between protein fractions in dependence on the cultivars grown under uniform and controlled environment. The following cultivars were studied: Partizanka, Novosadska Rana-2, Kragujevacka-56, Kragujevacka-58, Krajinka, Zlatna Dolina, Balkan, Orasanka, Posavka-2, Bezostaja.

F61 PLANT PHYSIOLOGY-NUTRITION

366 Beissner, L. (Goettingen Univ. (Germany). Inst. fuer Agrikulturchemie); Roemer, W. (1993) [Activity of acid phosphatase as measure for P-nutrition state of wheat and rape]. *Die Aktivitaet saurer Phosphatasen als Mass fuer den P-Ernaehrungszustand von Weizen und Raps*. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 559-562. VDLUFA. 2 ill., 3 tables; 1 ref. German. (AGRIS 94-108491).

367 Billore, SD.; Singh, K.; Bargale, M. (1994) EVALUATION OF PRODUCTION AND ENERGY BALANCE IN WHEAT (TRITICUM AESTIVUM) UNDER RESOURCE-CONSTRAINT CONDITIONS. *Indian Journal of Agronomy*. 39(2):299-301. English. [JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA RAK COLL AGR SEHORE 466001 MADHYA PRADESH INDIA].

368 Helal, H.M. (Bundesforschungsanstalt fuer Landwirtschaft, Braunschweig (Germany). Inst. fuer Pflanzenernaehrung und Bodenkunde); Abdelmonem, M.A. (1993) [N-balance of spring barley under salt stress]. *N-Haushalt von Sommergerste unter Salzstress*. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 571-574. VDLUFA. 3 tables; 4 ref. German. (AGRIS 94-108475).

369 Kelly, JT.; Bacon, RK.; Wells, BR. (1994) RELATION OF NITROGEN UTILIZATION TO YIELD COMPONENTS IN SOFT RED WINTER WHEAT. *Journal of Plant Nutrition*. 17(12):2105-2118. English. [UNIV ARKANSAS DEPT AGRON FAYETTEVILLE, AR 72701 USA].

This study was conducted to characterize soft red winter wheat (*Triticum aestivum* L.) cultivars for nitrogen (N) utilization efficiency and to determine which traits were most affected and the predictive value of these traits. Grain yield, number of spikes per m², kernels/m², kernels/spike and 1,000 kernel weight (TKW) were measured at maturity. Data were collected for three growing seasons from field plots grown on a silt loam and one growing season on a sandy loam. Results indicated that N utilization efficiency was not associated with grain yield. Kernels/m² had the highest correlation with grain yield ($r = 0.50$) of the yield components. Kernels per spike had a correlation of 0.43 with grain yield. However, TKW was not correlated with grain yield. There was variation among cultivars as to how the yield components produced final grain yields. Path coefficients indicated a strong positive direct effect for kernels/spike on grain yield and N utilization efficiency. Kernels/spike was found to be the most effective trait to be used as a predictive value for grain yield and N utilization efficiency. [References: 20].

370 Kim, S.D. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station.); Kwon, Y.W.; Soh, C.H. (Seoul National University, Suwon (Korea Republic). College of Agriculture and Life Sciences) (1993) N uptake and assimilation of barley seedlings as affected by N availability, temperature and water potential. *Korean Journal of Crop Science (Korea Republic)* v. 38(5) p. 458-465. 5 illus.; 3 tables; 28 ref. Korean. (AGRI 94-108476).

371 Loch, J. (Agrarwissenschaftliche Univ., Debrecen (Hungary)) (1993) [Effect of varying fertilization on sulphur uptake of winter wheat]. Die Wirkung einer variierten Düngung auf die Schwefelaufnahme von Winterweizen. 105. VDLUFA-Kongress; Hamburg (Germany); 20-25 Sep 1993. (Quality and hygiene of foods in production and processing). VDLUFA, Darmstadt (Germany). VDLUFA-Schriftenreihe (Germany); no. 37 p. 87-90. VDLUFA. 3 ill., 1 table; 9 ref. German. (AGRI 94-108472).

372 Mandal, AB. (1994) EFFECT OF BORON ON WHEAT (TRITICUM-AESTIVUM) VARIETIES AND ON BORON AND NITROGEN CONCENTRATION OF PLANT TISSUES. *Indian Journal of Agricultural Sciences*. 64(11):783-784. English. [BIDHAN CHANDRA KRISHI VISWAVIDYALAYA DEPT GENET & PLANT BREEDING MOHANPUR 741252 INDIA].

373 Merbach, W. (Zentrum fuer Agrarlandschafts und Landnutzungsforschung Muencheberg, (Germany). Inst. fuer Oekophysiologie der Primaerproduktion) (1993) [Apparent CO₂ assimilation, incorporation of (14)CO₂ and (14)C dislocation in spring barley in dependence on sink manipulations]. Apparente CO₂-Assimilation, (14)CO₂-Einbau und (14)C-Verlagerung bei Sommergerste in Abhaengigkeit von sink-Manipulationen. (Vegetable ecophysiology and substance cycle in agricultural ecosystems). Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany). Inst. fuer Oekophysiologie der Primaerproduktion. ZALF-Berichte (Germany); no. 3 p. 11-20. Selbstverlag. 4 tables; 16 ref. German. (AGRI 94-108474).

374 Rerkasem, B.; Loneragan, JF. (1994) BORON DEFICIENCY IN 2 WHEAT GENOTYPES IN A WARM, SUBTROPICAL REGION. *Agronomy Journal*. 86(5):887-890. English. [CHIANG MAI UNIV FAC AGR CHIANG MAI 50200 THAILAND].

Yield losses due to boron deficiency are becoming common in the warmer subtropical regions into which wheat has been expanding. This study evaluated the B response of two wheat (*Triticum aestivum* L.) genotypes (SW41 and Sonora 64) in Chiang Mai, Thailand. A sand culture experiment imposed six B levels in nutrient solution (0, 0.1, 0.2, 0.5, 1, and 10 µM B). A series of field experiments in a sandy loam (Typic Tropoqualf) under rainfed conditions imposed four levels of borax application (0, 0.5, 1, and 2 kg B ha⁻¹) over three successive years. In sand culture, B deficiency depressed the number of grains per spikelet in both genotypes (more strongly in SW41 than in Sonora 64). At 0 µM B, SW41 had no grain in any spikelet. In the field, B deficiency depressed grain number and grain yield of SW41 but not Sonora 64. Flag leaf B at boot stage of both genotypes grown in sand culture was closely related to the number of grains per spikelet at maturity; the critical level was determined to be 3 mg B kg⁻¹. For field-grown plants, the data suggest that, at the boot stage, flag leaf B concentrations of <5 mg kg⁻¹ are deficient, and >7 are

sufficient. Boron deficiency can depress wheat yield through grain set failure, but susceptibility to B deficiency varies with genotype. Sensitivity to B deficiency should be included as a criterion for breeding programs for low-B soils. [References: 24].

375 Sun Leixin; Zhang Li (Beijing Agricultural Univ. (China). Coll. of Agricultural Resources and Environmental Sciences) (1993) The influence of environmental factors on the leaf photosynthesis characteristics of winter wheat. *Acta Agriculturae Universitatis Pekinensis (China)* v. 19(4) p. 15-20. 4 ill., 3 tables, 6 ref. Chinese. (AGRI 94-118408).

376 Wilkinson, RE. (1994) WHEAT ROOT RESPONSE TO HYDROGEN IONS AND INDOLEACETIC ACID (IAA). *Journal of Plant Nutrition*. 17(12):2185-2188. English. [UNIV GEORGIA AGR EXPT STN DEPT CROP & SOIL SCI GEORGIA STN GRIFFIN, GA 30223 USA].

Wheat (*Triticum aestivum* L. cv (9733) seedling (10 day) root length was decreased 60% when plants were watered with 0.01M sodium acetate (NaAc) pH 4.5 in comparison to plants exposed to the same NaAc concentration at pH 6.0. 3-indoleacetic acid (IAA) (10⁻¹⁰) and 10⁻⁹(M) (incorporated into the sand potting medium) reversed the excess hydrogen ions (H⁺) influence. [References: 5].

377 Zou Chunqin; Yang Zhifu (Beijing Agricultural Univ. (China)) (1993) Effects of different forms of nitrogen in limy soil on the uptake of nitrogen and phosphorus by spring wheat. *Chinese Journal of Soil Science (China)* v. 24(4) p. 169-171. 1 ill., 6 tables, 13 ref. Chinese. (AGRI 94-118407).

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378 Casale V, Rafael H.; Reta Sanchez, David Guadalupe (INIFAP. C.E. Laguna. Ap. Postal 247, Torreón, Coah. 27440 (Mexico)) (1992) [Accumulated heat-units as an indicator of wheat growth]. *Acumulación de unidades calor como índice de desarrollo del trigo*. Primera conferencia nacional sobre la producción de trigo en México. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en México. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicación Especial. Centro de Investigación Regional del Noroeste (Mexico)*; no. 4 p. 441-452. Centro de Investigación Regional del Noroeste. 4 tablas; 10 ref. 2o. tomo. Spanish. (AGRI 94-118513).

379 Davis, MH.; Simmons, SR. (1994) TILLERING RESPONSE OF BARLEY TO SHIFTS IN LIGHT QUALITY CAUSED BY NEIGHBORING PLANTS. *Crop Science*. 34(6):1604-1610. English. [UNIV MINNESOTA DEPT AGRON & PLANT GENET 1991 UPPER BUFORD CIRCLE ST PAUL, MN 55108 USA].

Tillering is important in establishing the yield potential of spring barley (*Hordeum vulgare* L.). Two field experiments were conducted for 3 yr to test if early season shifts in the red/far-red ratio (R/FR) modulate barley tillering patterns. Experiments were designed to determine (i) the extent to which shifts in light quality associated with the presence of neighboring plants modulate barley tillering patterns in the absence of shading and competition for soil resources, (ii) barley responses to sudden changes in light quality during the tillering phase, (iii) the influence of plant spacing on response to shifts in light quality, and (iv) the impact of the response to shifts in light quality on productivity. Plants within treatment rows were grown 18 cm from densely sown border rows of barley. Barriers set into the soil assured negligible competition between border and treatment rows for soil resources during the early growing season. The borders functioned to reflect light, especially far-red (FR), which reduced R/FR within the treatment rows without shading them. Tiller production was reduced in bordered plants relative to unbordered controls. The removal of borders at 20 d after emergence (DAE) caused an increase in treatment row tiller production, whereas the imposition of borders at 20 DAE halted tillering. Shoot survival was increased by the presence of borders. Border effects on final spike number, biomass production, and grain yield per plant were inconsistent during the experiments. We conclude that early season shifts in light quality associated with FR reflection from

neighboring plants contribute to modulating barley tillering under field conditions. [References: 26].

380 DeJager, JM. (1994) ACCURACY OF VEGETATION EVAPORATION RATIO FORMULAE FOR ESTIMATING FINAL WHEAT YIELD. *Water SA*. 20(4):307-314. English. [UNIV ORANGE FREE STATE DEPT AGROMETEOROL POB 339 BLOEMFONTEIN 9300 SOUTH AFRICA].

Vegetation evaporation ratio was here defined as the ratio of actual vegetation evaporation rate to potential vegetation evaporation rate. The accuracies of 5 different yield formulae based upon 5 different ways of combining vegetation evaporation ratio simulated for the different growth stages of wheat were compared. Additive, multiplicative and exponential combination methods were tested on wheat grown under 29 different water stress treatments. The multiplicative model proved most accurate, closely followed by the additive and exponential models and a model utilising a single vegetation evaporation ratio for the entire season, in that order. Mean absolute errors ranged from 9 to 12% of the mean of the measured values. This accuracy is acceptable for decision support purposes. [References: 26].

381 Delgado, E.; Mitchell, RAC.; Parry, MA.; Driscoll, SP.; Mitchell, VJ.; Lawlor, DW. (1994) INTERACTING EFFECTS OF CO₂ CONCENTRATION, TEMPERATURE AND NITROGEN SUPPLY ON THE PHOTOSYNTHESIS AND COMPOSITION OF WINTER WHEAT LEAVES. *Plant Cell & Environment*. 17(11):1205-1213. English. [AFRC INST ARABLE CROPS RES DEPT BIOCHEM & PHYSIOL ROTHAMSTED EXPTL STN HARPENDEN AL5 2JQ HERTS ENGLAND].

Winter wheat (*Triticum aestivum* L., cv. Mercia) was grown at two different atmospheric CO₂ concentrations (350 and 700 $\mu\text{mol mol}^{-1}$) two temperatures (ambient temperature (i.e. tracking the open air) and ambient +4 degrees C) and two rates of nitrogen supply (equivalent to 489 kg ha⁻¹ and 87 kg ha⁻¹). Leaves grown at 700 $\mu\text{mol mol}^{-1}$ CO₂ had slightly greater photosynthetic capacity (10% mean increase over the experiment) than those grown at ambient CO₂ concentration, but there were no differences in carboxylation efficiency or apparent quantum yield. The amounts of chlorophyll, soluble protein and ribulose-1, 5-bisphosphate carboxylase/oxygenase (Rubisco) per unit leaf area did not change with long-term exposure to elevated CO₂ concentration. Thus winter wheat, grown under simulated field conditions, for which total biomass was large compared to normal field production, did not experience loss of components of the photosynthetic system or loss of photosynthetic competence with elevated CO₂ concentration. However, nitrogen supply and temperature had large effects on photosynthetic characteristics but did not interact with elevated CO₂ concentration. Nitrogen deficiency resulted in decreases in the contents of protein, including Rubisco, and chlorophyll, and decreased photosynthetic capacity and carboxylation efficiency. An increase in temperature also reduced these components and shortened the effective life of the leaves, reducing the duration of high photosynthetic capacity. [References: 35].

382 Duguid, SD.; Brulebabe, AL. (1994) RATE AND DURATION OF GRAIN FILLING IN FIVE SPRING WHEAT (*TRITICUM AESTIVUM* L.) GENOTYPES. *Canadian Journal of Plant Science*. 74(4):681-686. English. [UNIV MANITOBA DEPT PLANT SCI WINNIPEG R3T 2N2 MB CANADA].

Final grain dry weight, a component of yield in spring wheat, is determined by the rate and duration of grain filling. The objective of this study was to compare grain dry weight and rate and duration of grain filling amongst five spring wheat genotypes (*Triticum aestivum* L.) that differed in time to maturity. Glenlea, Katepwa, PT516, Roblin, and Wildcat were sown in replicated trials on four seeding dates in 1988 and 1989 at Winnipeg, Manitoba. Mean grain dry weight was measured at various intervals from anthesis to maturity. A logistic equation was used to characterize grain filling and estimate final grain dry weight, and the duration and maximum rate of grain filling. Stepwise multivariate analysis indicated that final grain dry weight was the most important variable characterizing the grain filling curves, followed by duration and then maximum rate of grain filling. The highest grain dry weights were produced by Glenlea (40.4 mg) and Wildcat (36.9 mg). Roblin (34.9 mg) was intermediate in grain dry weight while Katepwa (32.4 mg) and PT516 (30.3 mg) produced the smallest grains. Genotypes with the highest grain

dry weights had shorter durations and higher maximum rates of grain filling. [References: 27].

383 Grieve, CM.; Francois, LE.; Maas, EV. (1994) SALINITY AFFECTS THE TIMING OF PHASE DEVELOPMENT IN SPRING WHEAT. *Crop Science*. 34(6):1544-1549. English. [USDA ARS US SALIN LAB 4500 GLENWOOD DR RIVERSIDE, CA 92501 USA].

Understanding effects of environmental factors on crop phenological development is useful for predicting crop growth stages and scheduling management practices. We evaluated the effect of salinity on the rate of leaf appearance and the duration of critical stages of growth in wheat (*Triticum aestivum* L.) in terms of both thermal unit (TU/degrees C day) and phyllochron intervals. Two hard red spring wheat cultivars, Yecora Rojo and Anza, were grown two cropping years in greenhouse sand cultures and outdoor field lysimeters. In each case, two saline treatments were compared with a nonsaline control. The sand cultures were irrigated with complete nutrient solutions to which NaCl and CaCl₂ were added. The electrical conductivities, $\kappa(\text{iw})$, were 2.0, 14.3, and 18.1 dS m⁻¹ in 1989 and 1.7, 12.2, and 15.1 dS m⁻¹ in 1990. The $\kappa(\text{iw})$ for the held lysimeters were 0.9, 10.7, and 17.2 dS m⁻¹ in 1989 and 0.8, 11.4, and 17.1 dS m⁻¹ in 1990. Leaf appearance rate was determined by regressing the number of mainstem leaves against cumulative TU. In all treatments, the cultivars differed in both rate and duration of leaf appearance. The phyllochron increased with salinity. Leaves emerged more slowly in the greenhouse than in the field. Durations of the vegetative stages (degrees C day) from sowing to the initiation of the flag leaf and its subsequent appearance were relatively insensitive to salinity inasmuch as increases in leaf plastochron (TU between the initiation of successive leaves on a culm) and leaf phyllochron were balanced by decreases in leaf number. However, for both cultivars, salinity significantly reduced the thermal time between sowing and the reproductive phenological stages. [References: 29].

384 Huang, BR.; Johnson, JW.; Nesmith, DS.; Bridges, DC. (1994) ROOT AND SHOOT GROWTH OF WHEAT GENOTYPES IN RESPONSE TO HYPOXIA AND SUBSEQUENT RESUMPTION OF AERATION. *Crop Science*. 34(6):1538-1544. English. [UNIV GEORGIA DEPT CROP & SOIL SCI GEORGIA STN GRIFFIN, GA 30223 USA].

Understanding plant responses to hypoxia and subsequent resumption of aeration is important for breeding tolerant genotypes. The growth response of six wheat genotypes (*Triticum aestivum* L.) to hypoxia and subsequent recovery was evaluated. Plants were grown for 14 and 21 d in nutrient solutions flushed with air (aerated control) or with a mixture of O₂ and N₂ (hypoxia) or hypoxia for 14 d followed by aeration for 7 d (recovery). Shoot and root growth was inhibited by hypoxia, with roots being more sensitive. Stomatal conductance (and) was reduced beginning 5 to 7 d after hypoxia. The adverse effect of hypoxia was most severe for Bayles and FL302, intermediate for BR34 and Coker-9766, and least for Gore and Savannah. Hypoxia enhanced formation of aerenchyma in roots, to a greater extent for Gore and Savannah. Aerenchyma became more conspicuous with duration of hypoxia. Seven days after resumption of aeration, shoot growth recovered completely for Gore and Savannah but only partially for Bayles, FL302, BR34, and Coker-9766. The number and length of crown roots increased to the value of the controls for all genotypes, whereas seminal root length was restored only in Bayles, Gore, and Savannah. Stomatal conductance recovered within 5 d for Savannah and 10 d for Gore but never recovered for Bayles, FL302, BR34, and Coker-9766. Breeding for hypoxia tolerance could be facilitated by selecting genotypes that develop more crown roots and more aerenchyma in those roots, maintain stomatal opening under hypoxic conditions, and resume seminal root growth and opening of stomata after termination of hypoxia. [References: 33].

385 Ingvarsdson, C.; Veierskov, B. (1994) RESPONSE OF YOUNG BARLEY PLANTS TO CO₂ ENRICHMENT. *Journal of Experimental Botany*. 45(279):1373-1378. English. [ROYAL VET & AGR UNIV DEPT PLANT BIOL COPENHAGEN DENMARK].

Barley (*Hordeum vulgare* L. cv. Digger) was grown for 22 d in enclosed chambers with a CO₂ enrichment of 35, 155, 400 or 675 $\mu\text{mol CO}_2 \text{ mol}^{-1}$. CO₂ enrichment increased photosynthetic capacity in the plants grown at either of the two highest levels of pCO₂. A CO₂ enrichment of 675 $\mu\text{mol CO}_2$ caused a significant increment of shoot dry weight, whereas no changes were observed in fresh weight, chlorophyll or protein levels. At a

light intensity of 860 $\mu\text{mol m}^{-2} \text{s}^{-1}$ CO_2 enrichment caused photosynthetic capacity to increase by 250%, whereas no effect was observed at 80 $\mu\text{mol m}^{-2} \text{s}^{-1}$. Over time, photosynthesis decreased by 70% independent of CO_2 . A time-dependent increase in the level of extractable fructose was observed whereas total extractable carbohydrate only changed slightly. [References: 20].

386 Jiang Lin; Shen Zhenyou; Zhang Zhiliang (East China Normal Univ., Shanghai (China). Dept. of Biology) (1993) The effect of polyamines on metabolism of active oxygen in detached leaves of *Hordeum vulgare* var. nudum Hook. f. *Acta Phytophysiological Sinica (China)* v. 19(4) p. 367-371. 4 ill., 18 ref. Chinese. (AGRIS 94-118544).

387 Jin Mingdian; Li Qiren (Yunnan Univ., Kunming (China). Dept. of Biology) (1994) Delaying action of kinetin on the decrease of protein content in detached wheat leaves. *Plant Physiology Communications (China)* v. 30(1) p. 11-14. 4 ill., 20 ref. Chinese. (AGRIS 94-118574).

388 Khannachopra, R.; Rao, PSS.; Maheswari, M.; Xiaobing, L.; Shivshankar, KS. (1994) EFFECT OF WATER DEFICIT ON ACCUMULATION OF DRY MATTER, CARBON AND NITROGEN IN THE KERNEL OF WHEAT GENOTYPES DIFFERING IN YIELD STABILITY. *Annals of Botany*. 74(5):503-511. English. [INDIAN AGR RES INST CTR WATER TECHNOL NEW DELHI 110012 INDIA].

Water stress effects on accumulation of dry matter, carbon and nitrogen in grains were analysed in varieties and species of wheat differing in yield stability. Variable water environments were generated using a line source sprinkler system. Although large fluctuations occurred in the water potentials of the flag leaf and ear, grain growth remained relatively buffered under moisture stress. Developing grains were at a lower moisture level throughout grain growth in plants subjected to moisture stress relative to the unstressed plants. Carbon content decreased more than the nitrogen content in the stressed grains of the species and varieties. Reduction in the duration of grain growth and the rate of dry weight accumulation induced by water stress was more prominent in *T. aestivum* var. C306 and *T. sphaerococcum*. Grain yield was reduced significantly under water stress, the maximum being in the high yielding cultivar HD2329. Both grain number and grain weight were reduced in response to stress, the extent of reduction being different in different genotypes. [References: 26].

389 Kim, C.S.; Cho, J.W. (Chungnam National University, Taejeon (Korea Republic). College of Agriculture); Cho, J.W.; Lee, S.Y. (Rural Development Administration, Suwon (Korea Republic). Agricultural Biotechnology Institute) (1993) Mechanisms of salt tolerance in crop plants-(1)-Physiological responses of barley, rye and Italian ryegrass seed germination to NaCl concentrations. *Korean Journal of Crop Science (Korea Republic)* v. 38(4) p. 371-376. 5 tables; 13 ref. Korean. (AGRIS 94-108548).

390 Kim, C.S.; Cho, J.W. (Chungnam National University, Taejeon (Korea Republic). College of Agriculture); Lee, S.Y. (Rural Development Administration, Suwon (Korea Republic). Agricultural Biotechnology Institute) (1993) Mechanisms of salt tolerance in crop plants-(2)-Physiological responses of barley, rye, and Italian ryegrass seedling to NaCl concentration. *Korean Journal of Crop Science (Korea Republic)* v. 38(5) p. 391-397. 2 illus.; 6 tables; 16 ref. Korean. (AGRIS 94-108549).

391 Kumar, A.; Sharma, DK.; Sharma, HC. (1994) GROWTH, YIELD AND WATER-USE EFFICIENCY OF WHEAT (*TRITICUM AESTIVUM*) AS INFLUENCED BY IRRIGATION AND NITROGEN IN SODIC SOILS. *Indian Journal of Agronomy*. 39(2):220-224. English. [INDIAN AGR RES INST DIV AGRON NEW DELHI 110012 INDIA].

A field experiment was conducted during the winter seasons (December to April) of 1990-91 and 1991-92 on reclaimed sodic soils to study the effect of irrigation and nitrogen on growth, yield and water-use efficiency of wheat (*Triticum aestivum* L. emend. Fiori and Paol.). The irrigated treatments were superior to the unirrigated one in respect of growth (crop-growth rate and leaf-area duration), yield attributes, yield, harvest index and water-use efficiency. Frequent irrigations at 1.2 IW : CPE ratio (4) gave significantly higher spike length, 1,000-grain weight and grain yield. However, the water-use efficiency was maximum at 0.6 IW : CPE ratio. N 180 kg N/ha resulted in higher growth (crop-growth rate and leaf-area duration), yield attributes and grain yield. The optimum

economic dose of N was 156 kg/ha with an expected grain yield of 2,933 kg/ha. Increasing N levels positively influenced the water-use efficiency, maximum being 9.21 kg/ha/mm at 180 kg N/ha.

392 Li, XM.; Feng, YS.; Boersma, L. (1994) PARTITION OF PHOTOSYNTHATES BETWEEN SHOOT AND ROOT IN SPRING WHEAT (*TRITICUM AESTIVUM* L.) AS A FUNCTION OF SOIL WATER POTENTIAL AND ROOT TEMPERATURE. *Plant & Soil*. 164(1):43-50. English. [UNIV ALBERTA DEPT SOIL SCI EDMONTON T6G 2E3 AB CANADA].

Low soil water potential and low or high root temperatures are important stresses affecting carbon allocation in plants. This study examines the effects of these stresses on carbon allocation from the perspective of whole plant mass balance. Sixteen-day old spring wheat seedlings were placed in a growth room under precisely controlled root temperatures and soil water potentials. Five soil water potential treatments, from -0.03 MPa to -0.25 MPa, and six root temperature treatments, from 12 to 32 degrees C were used. A mathematical model based on mass balance considerations was used, in combination with experimental measurements of rate of net photosynthesis, leaf area, and shoot/root dry masses to determine photosynthate allocation between shoot and root. Partitioning of photosynthates to roots was the lowest at 22-27 degrees C root temperature regardless soil water potential, and increased at both lower and higher root temperatures. Partitioning of photosynthates to the roots increased with decreasing soil water potential. Under the most favourable conditions, i.e. at -0.03 MPa soil water potential and 27 degrees C root temperature, the largest fraction, 57%, of photosynthates was allocated to the shoots. Under the most stressed conditions, i.e. at -0.25 MPa soil water potential and 32 degrees C root temperature, the largest fraction, more than 80%, of photosynthates was allocated to roots. [References: 34].

393 Maas, EV.; Lesch, SM.; Francois, LE.; Grieve, CM. (1994) TILLER DEVELOPMENT IN SALT-STRESSED WHEAT. *Crop Science*. 34(6):1594-1603. English. [USDA ARS US SALIN LAB 4500 GLENWOOD DR RIVERSIDE, CA 92501 USA].

Wheat (*Triticum aestivum* L. emend. Thell.) grain yields are highly dependent upon the number of spike-bearing tillers produced per plant. Salinity, drought, and other environmental stresses can greatly affect the development and viability of tillers. We determined the effects of soil salinity on the occurrence and rate of tiller development and the incidence of tiller abortion in spring wheat cultivars, Anza and Yecora Rojo. Plants were grown in Pachappa fine sandy loam soil (mixed, thermic, Mollic Haploxeralf) in outdoor lysimeters. Three salinity treatments were imposed by irrigating with waters containing equal weights of NaCl and CaCl₂ (electrical conductivities of similar or equal to 1, 12, or 18 dS m⁻¹). Salinity significantly decreased the number of primary and secondary tillers in both cultivars. Soil water salinities greater than or equal to 7.5 dS m⁻¹ (mean electrical conductivity of the soil water in the rootzone during tiller development, kappa(SW)) eliminated most of the secondary tillers and greatly reduced the number of T0, T3, and T4 tillers. However, the percentage of tillers producing spikes actually increased at kappa(SW) up to 8 dS m⁻¹. Higher salinities reduced the percentage of tillers with spikes, but not as much as the reduction in tillers. Tiller and spike production per plant decreased about 0.13 to 0.15 organs for each unit increase in kappa(SW). Of all the potential tillers these cultivars can produce, the primary tillers on Leaves 1 and 2 (i.e., T1 and T2) were the least susceptible to salt stress, partly because they emerged before salinity builds up during the irrigation season. Adjusting planting densities to increase the number of anticipated spike-bearing culms per unit area could help to maintain yields on salt-affected soils. [References: 24].

394 Mirschel, W. (Zentrum fuer Agrarlandschafts- und Landnutzungsforschung, Muencheberg (Germany)); Schultz, A.; Wenkel, K. O. (1993) [Comparison of the simulation models AGROSIM-Wheat and CERES-Wheat both for winter time]. Vergleich der Winterweizenmodelle AGROSIM-Wheat und CERES-Wheat. 14. Jahrestagung der Gesellschaft fuer Informatik in der Land-, Forst- und Ernahrungswirtschaft (GIL); Leipzig (Germany); 4-6 Oct 1993. (Lectures delivered at the 14th Annual Meeting of the GIL, Leipzig (Germany) 1993). Schulze, E. (Leipzig Univ. (Germany). Wissenschaftsbereich Agrarökonomie); Petersen, B.; Geidel, H. (eds.). Gesellschaft fuer Informatik in der Land-, Forst- und Ernahrungswirtschaft, Stuttgart

(Germany). *Berichte der Gesellschaft fuer Informatik in der Land-, Forst- und Ernaehrungswirtschaft (Germany)*; v. 5 p. 29-34. GIL. 2 tables; 8 ref. German. (AGRI 94-108546).

The main focus of the paper is the comparison of the complex crop growth models AGROSIM-Wheat and CERES-Wheat both for winter wheat with regard to the model structure, the growth and development processes involved and the model accuracy. Data sets (1986/87.. 1991/1992, irrigated and non-irrigated) of the two locations Muencheberg and Hohenfinow (Federal State Brandenburg) are the base of the performance test. The results of the comparison are presented and discussed.

395 Ortiz Trejo, Ceferino; Velazquez Garcia, Jaime de Jesus (INIFAP. C.E. Valle de Mexico. Ap. Postal 10, Chapingo, Mex. 56230 (Mexico)); Arteaga Ramirez, Ramon (Universidad Autonoma Chapingo, Depto. de Irrigacion) (1992) [Estimation of baseline temperature and accumulated heat-units in the cultivation of wheat (*Triticum aestivum* L.)]. Estimacion de la temperatura base y acumulacion de unidades calor en el cultivo del trigo (*Triticum aestivum* L.). Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 453-470. Centro de Investigacion Regional del Noroeste. 7 tablas; 10 ref. 2o. tomo. Spanish. (AGRI 94-118573).

396 Reynolds, MP.; Acevedo, E.; Sayre, KD.; Fischer, RA. (1994) YIELD POTENTIAL IN MODERN WHEAT VARIETIES - ITS ASSOCIATION WITH A LESS COMPETITIVE IDEOTYPE. *Field Crops Research*. 37(3):149-160. English. [CIMMYT LISBOA 27 COL JUAREZ APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Field experiments were conducted with modern semidwarf spring wheat cultivars representing a range of yield potential in order to compare their adaptation to levels of interplant competition for resources. Levels of competition were altered, in both leaf canopy and underground, by manipulating rows of plants in eight-row yield plots. Competition for light was decreased by bending adjacent rows away from the central two rows thus permitting greater penetration of light to lower leaves of the central rows (light treatment). Reduced competition underground was realized, simultaneously with reduced competition for light, by uprooting the plants adjacent to the central two rows (root/light treatment). These treatments were implemented at the developmental stage of flag-leaf ligule emergence (FLE), when interplant competition was assumed to become maximal. While the average yield responses were 25%, and 40% to the light and root/light treatments respectively, there was a significant interaction with genetic material. Low-yield-potential (LYP) lines responded more to reduced competition than high-yield-potential (HYP) lines suggesting that the greater efficiency of the HYP lines, reflected in their higher yield, is related to their better adaptation to interplant competition. Physiological bases for improved performance are examined and discussed in relation to ideas about crop ideotypes and possible implications to breeding. These data appear to support the idea that genes conferring yield potential through improved adaptation to the crop environment are associated with a less competitive phenotype. [References: 33].

397 Savin, R.; Hall, A.; Satorre, EH. (1994) TESTING THE ROOT GROWTH SUBROUTINE OF THE CERES-WHEAT MODEL FOR 2 CULTIVARS OF DIFFERENT CYCLE LENGTH. *Field Crops Research*. 38(3):125-133. English. [UNIV MELBOURNE DEPT GENET MOLEC CTR CROP IMPROVEMENT PARKVILLE VIC 3052 AUSTRALIA].

The objective of this study was to test the root growth subroutine from the CERES-Wheat model during a growing season. The study involved observation and analysis of root growth and distribution throughout the growing season, and their simulation, using two wheat cultivars of different cycle length and two water regimes. The model accurately predicted crop development and yield, but overpredicted root depth by 90 cm at terminal spikelet and by 50 cm at booting, anthesis and mid grain-filling period. In addition, the model underpredicted root mass, presumably because of the way it handles root-shoot partitioning. There was good agreement between observed and simulated values of root-length density and soil water content ($R^2 = 0.66$ and 0.86 , respectively).

The value of the specific root-length parameter in CERES-Wheat lies closer to data reported from a winter wheat crop experiment than to data from spring wheat reported in this and other studies. The model's ability to predict these attributes is discussed. [References: 32].

398 Serrano Covarrubias, Luis Manuel; Rodriguez O, J.L.; Benitez, R. (Colegio de Postgraduados, Montecillo, Mex. (Mexico) Centro de Genetica) (1992) [The physiological changes in wheat plants that result from selections under moisture-limited conditions]. Cambios fisiologicos como respuesta a la seleccion de plantas de trigo en condiciones limitantes de humedad. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 141-150. Centro de Investigacion Regional del Noroeste. 2 tablas; 14 ref. Spanish. (AGRI 94-118512).

399 Slafer, GA.; Connor, D.J.; Halloran, GM. (1994) RATE OF LEAF APPEARANCE AND FINAL NUMBER OF LEAVES IN WHEAT - EFFECTS OF DURATION AND RATE OF CHANGE OF PHOTOPERIOD. *Annals of Botany*. 74(5):427-436. English. [UNIV MELBOURNE CTR CROP IMPROVEMENT DEPT AGR PARKVILLE VIC 3052 AUSTRALIA].

This study was conducted to test the hypothesis that photoperiod or its rate of change significantly affects the rate of leaf appearance (RLA) and final number of leaves (FNL) in wheat, as suggested from several time-of-sowing experiments. Two wheat cultivars (Condor and Thatcher) were sown in the field on 2 Sep. 1992 at Melbourne (38 degrees S). Photoperiod was extended artificially to give five treatments up to terminal spikelet initiation (TS) viz.: natural photoperiod (rate of change of photoperiod = 2 min d⁻¹), two faster rates of change (8.5 and 13.3 min d⁻¹) and two constant photoperiods of 14.0 and 15.5 h. After TS, the two constant photoperiods were extended to 15.0 and 16.5 h, respectively, and treatments were re-randomised, i.e. some plots received different photoperiod regimes before and after TS. The rate of leaf appearance maintained strong linear relationships with thermal time. It was greater for Condor [0.012-0.013 (degrees C d⁻¹)] than for Thatcher [0.011-0.012 (degrees C d⁻¹)] and did not alter during plant development or in response to the change in photoperiod at TS. Rate of leaf appearance on the main culm was not influenced by the rate of change of photoperiod nor by the average photoperiod. Cultivar and photoperiod significantly affected FNL on the main culm. Condor produced more leaves than Thatcher under long but not under short photoperiods. The rate of change of photoperiod did not affect FNL independently of the effect of average photoperiod. Most of the variation in FNL due to photoperiod resulted from differences in duration of leaf initiation. The lack of effects of the photoperiod treatments on RLA contrast with previous reports of its effects on the rate of phasic development from seedling emergence to double ridge. Therefore, the number of visible leaves on the main culm (NL) at double ridge and at TS were not constant. However, NL on the main culm at double ridge was closely correlated with FNL. [References: 64].

400 Slafer, GA.; Savin, R. (1994) POSTANTHESIS GREEN AREA DURATION IN A SEMIDWARF AND A STANDARD-HEIGHT WHEAT CULTIVAR AS AFFECTED BY SINK STRENGTH. *Australian Journal of Agricultural Research*. 45(7):1337-1346. English. [UNIV MELBOURNE DEPT AGR CTR CROP IMPROVEMENT PARKVILLE VIC 3052 AUSTRALIA].

Postanthesis green area duration (GAD) has been associated frequently with yield. The senescence pattern of green organs is a major component of GAD. It has been proposed that delayed or accelerated senescence is strongly controlled by environmental conditions and the level of source or sink limitation on grain growth. In particular, it has been generally reported that the removal of reproductive structures delays the senescence process. However, results reporting this effect in wheat are not conclusive. A field experiment was conducted at the experimental station of The University of Melbourne comprising a factorial combination of a semidwarf and a standard-height wheat, and two levels of sink strength. At anthesis, 20 main shoots were tagged and detilled. Ten days after anthesis all the spikelets from one side of 10 tagged ears were removed by hand. The experiment was performed under natural, and 3 h-extended

photoperiods from seedling emergence to heading. The photoperiod treatments induced differing grain filling environments and differing plant characteristics at onset of grain filling. Green area senescence was similar for both sink size treatments at any combination of cultivar and grain filling condition, indicating that the dynamics of plant senescence was insensitive to a severe reduction in number of grains per spike. Therefore, GAD was not significantly affected by the reduction in sink strength. The number of grains per spike were reduced to ca. 50% due to trimming. Therefore, source-sink ratio was doubled, but no significant changes in individual grain weight were found. There was no relationship between GAD and individual grain weight, confirming that grain growth in field-grown wheat is not limited by the strength of the source. Alternatively, our results confirmed that field-grown wheat is sink limited during grain filling and that the likely accumulation of soluble carbohydrates in leaves does not affect the onset or rate of senescence. [References: 31].

401 Valadez Gutierrez, Juan; Serrano Covarrubias, Luis Manuel; Mendoza Onofre, Leopoldo Ernesto (Universidad Autonoma Chapingo, Chapingo, Mex. (Mexico); Colegio de Postgraduados, Montecillo, Mex. (Mexico)) (1992) [Morphological criteria of physiological maturity in wheat]. *Criterios morfológicos de la madurez fisiológica en trigo. Revista Fitotecnica Mexicana (Mexico)* v. 15(2) p. 114-124. 1 illus; 5 tablas; 11 ref. Tambien como tesis Ing. Agr. Universidad Autonoma Chapingo (Mexico). Spanish. (AGRI 94-118572).

402 Veneklaas, E.; Vandenboogaard, R. (1994) LEAF AGE-STRUCTURE EFFECTS ON PLANT WATER USE AND PHOTOSYNTHESIS OF TWO WHEAT CULTIVARS. *New Phytologist*. 128(2):331-337. English. [UNIV UTRECHT DEPT PLANT ECOL & EVOLUT BIOL POB 80084 3508 TB UTRECHT NETHERLANDS].

The wheat cultivars 'Katya A1' and 'Mexipak 65', grown in pots under field conditions in a Mediterranean climate, differed only slightly in growth and water use on a whole-plant basis, although Mexipak had a smaller leaf area. When expressed on a leaf area basis, plant biomass increase and transpiration were significantly greater in Mexipak. However, previous gas exchange measurements on the youngest fully expanded leaf showed only minor differences between the two cultivars. The hypothesis that different patterns of leaf ageing contributed to the differences in plant growth and water use was tested by combining leaf demography and gas exchange measurements. Plants were subjected to two moisture treatments: 'well-watered' (frequent watering to initial soil water content) and 'intermittent drought' (five drying-rewatering cycles). Mexipak had, on average, older leaves than Katya in both treatments because of fast early growth, which in turn was due to a larger area of individual leaves rather than a faster leaf appearance rate. Stomatal conductance and net photosynthetic rate were nearly the same for the two cultivars, but were considerably reduced by drought and did not fully recover after rewatering. Stomatal conductance and photosynthesis tended to decrease with age, but effects of age or treatment or their interactions were not significant and could not explain the discrepancy between whole plant and leaf observations. One possible explanation is that age effects do exist in leaves older than those investigated. Another explanation may be that changes in microclimatic conditions caused photosynthesis and transpiration to differ from rates measured under standard conditions. [References: 13].

403 Yu Jingchuan; Liu Zhaohua; Jiang Hongming (Yantai Municipal Inst. of Agricultural Sciences, Shandong (China)) (1993) Studies on the relationship of grain filling components and thousand grain weight of winter wheat. *Journal of Liaoyang Agricultural College (China)* v. 10(2) p. 83-87. 3 tables, 4 ref. Chinese. (AGRI 94-118538).

F63 PLANT PHYSIOLOGY-REPRODUCTION

404 Engell, K. (1994) EMBRYOLOGY OF BARLEY 4. ULTRASTRUCTURE OF THE ANTIPODAL CELLS OF HORDEUM VULGARE L CV BOMI BEFORE AND AFTER FERTILIZATION OF THE EGG CELL. *Sexual Plant Reproduction*. 7(6):333-346. English. [UNIV COPENHAGEN INST BOT BOT LAB DK-1123 COPENHAGEN K DENMARK].

The antipodal cells have been the stepchildren in most investigations of the female gametophyte. In *Hordeum vulgare* cv. Bomi, three antipodal

cells are originally developed chalazally but because of differential growth of the embryo sac they soon become laterally situated and their number increases to 35-50 cells and the shape, size and structure of the cells change in the time before as well as after fertilization. The cells persist until about 60-70 h after pollination. At that time, the embryo consists of about 12-15 cells and a cellularization of the nuclear endosperm has started peripherally. The size of nuclei, and especially nucleoli, in the antipodal cells increases tremendously in the investigated period and the amounts of organelles also change. The walls of antipodals are diversified depending on which cells they are separating, and wall invaginations are developed especially between antipodal cells and surrounding nucellar cells in the placental region. The mitochondria appear in various shapes in section view, very often as cups or dumbbells with a rim in the ends containing cristae and a thin cristae-free base. These bases are sometimes stretched out as thin parts and at last a simple parting occurs. Binary fissions of the plastids happen especially in the hours before and just after egg fertilization. ER is extraordinarily well developed in the whole period of investigation and many ribosomes are attached to the membranes. Dictyosomes form numerous vesicles, especially in the antipodals near the nucellar cells in the placental region. These ultrastructural details support the opinion that antipodal cells may play an important role in the embryo sac and are able to be responsible for the supply of nutrition for the whole gametophyte and take part in the supply of nutrition during embryo formation. [References: 34].

H01 PROTECTION OF PLANTS-GENERAL ASPECTS

405 Suess, A. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Kleinmachnow (Germany). Inst. fuer Oekotoxikologie im Pflanzenschutz); Jahn, M.; Klementz, D. (1994) [Model investigations on the influence of rain on the efficiency and on the residue levels of some selected insecticides and fungicides]. *Modelluntersuchungen zum Einfluss von Regen auf die Wirksamkeit und das Rueckstandsverhalten ausgewaehlter Insektizide und Fungizide. Nachrichtenblatt des deutschen Pflanzenschutzdienstes (Germany)* v. 46(5) p. 97-104. 15 ill., 1 table; 28 ref. German. (AGRI 94-118884).

In model trials the influence of simulated rainfall on the efficiency of six insecticides against *Adoxophyes reticulana* Hbn. and *Aphis pomi* de Geer on apple leaves and five fungicides against *Erysiphe graminis* DC. on wheat and barley was investigated. For two insecticides and fungicides respectively, residues were analysed. The rain quantity and the time between application and rainfall were chosen as important factors. With simulated rainfall within 24 hours after application in the registered concentration, there was observed no decrease of efficiency of Decis fluessig, a little decrease of Ultracid 40 Ciba-Geigy, Pirimor 50 DP and Bi 58 EC and a greater decrease of efficiency of Filitox and Wofatox-Konzentrat 50 against apple pests. The efficiency of Bayleton fluessig, Tilt 250 EC, Corbel and Sportak 45 EC against mildew on wheat and barley was not influenced by simulated rain one hour after application. In contrary to these observations, Netzschwefel fluessig was significantly influenced by rain. Investigations with reduced concentrations showed the importance of the dose-effect-relation with regard to the rainfastness of pesticides.

H10 PESTS OF PLANTS

406 Al Hussein, I.A. (Halle Wittenberg Univ., Halle (Germany). Inst. fuer Zoologie) (1993) [Abundance dynamics of cereal aphids (Hom., Aphididae) and their natural antagonists on different wheat sorts in Deir Ezzor (Syrian Arab Rep.)]. *Abundanzdynamik von Getreideblattlaeusen (Hom., Aphididae) und ihrer natuerlichen Antagonisten an verschiedenen Weizensorten in Deir Ezzor (Syrische Arab. Rep.)*. *Archives of phytopathology and plant protection (Germany)* v. 28(5) p. 439-445. 3 ill.; 9 ref. German. (AGRI 94-119156).

407 Andersen, A. (Statens Plantevern, Aas (Norway). Avd. Skadedyr) (1993) [Effects of spraying different insecticides [LAMBDA CYHALOTRIN, ETHIOFENCARB, FENITROTIN] against *Chromatomyia fuscata* (Zett.) (Dipt., Agromyzidae) in spring barley fields]. *Effekt av tidlig og sein sproeing med et fosformiddel, et pyretroid og et karbamat mot havrebladmuenerflue i bygg. Norsk*

408 Balde, M. (Institut Senegalais de la Recherche Agricola (ISRA), Bambey (Senegal)); Richter, S. (1993) [Influence of the photoperiod on broad bean and barley as well as development and reproduction of *Acyrtosiphon pisum* Harris and *Rhopalosiphum padi* L.]. Einfluss der Photoperiode auf Ackerbohne und Gerste sowie Entwicklung und Vermehrung von *Acyrtosiphon pisum* Harris und *Rhopalosiphum padi* L. *Archives of phytopathology and plant protection* (Germany) v. 28(5) p. 463-469. 3 tables; 11 ref. German. (AGRI 94-119106).

409 Balde, M. (Institut Senegalais de la Recherche Agricola (ISRA), Bambey (Senegal)); Richter, S. (1993) [Influence of water supply of the soil on broad bean and barley as well as development and reproduction of *Acyrtosiphon pisum* Harris and *Rhopalosiphum padi* L.]. Einfluss der Wasserversorgung des Bodens auf Ackerbohne und Gerste sowie Entwicklung und Vermehrung von *Acyrtosiphon pisum* Harris und *Rhopalosiphum padi* L. *Archives of phytopathology and plant protection* (Germany) v. 28(5) p. 471-480. 3 ill., 2 tables; 16 ref. German. (AGRI 94-119107).

410 Bernal, J.; Gonzalez, D.; Natwick, E.T.; Loya, J.G.; Leon Lopez, R.; Bendixen, W.E. (1993) Natural enemies of Russian wheat aphid identified in California. *California agriculture* (USA) v. 47(6) p. 24-28. references. English. (AGRI 94-108905).

411 Buntin, G.D. (1994) SIMULATED INSECT DEFOLIATION OF SEEDLINGS AND PRODUCTIVITY OF WINTER SMALL-GRAIN CROPS. *Journal of Entomological Science*. 29(4):534-542. English. [UNIV GEORGIA COLL AGR & ENVIRON SCI DEPT ENTOMOL EXPTL STN GEORGIA STN GRIFFIN, GA 30223 USA].

Insects, such as grasshoppers, Spodoptera spp. armyworms and flea beetles, occasionally defoliate seedlings of autumn-planted small grain crops. Seedlings of wheat, *Triticum aestivum* L., barley, *Hordeum vulgare* L., oats, *Avena sativa* L., rye, *Secale cereale* L., and triticale, *X Triticosecale* Wittmack, were mechanically clipped at the soil surface to simulate insect leaf injury for various periods after planting up to the 1-, 2-, and 4-leaf stages. Defoliation up to the Q-leaf stage (i.e., greater than or equal to 30 days after planting) delayed spike emergence of all crops by several days. Seedling defoliation generally had little adverse effect on grain yield and test weight of rye in any year and reduced yield of triticale in one of three years. Furthermore, plants of both species defoliated in the 2- and 4-leaf stages were less severely damaged by cold temperatures and yielded as much or more than nondefoliated plants when late freezes occurred. Seedling defoliation up to the 4-leaf stage also had little negative effect on grain yield and test weight of wheat. Grain yield of barley and oats declined with increasing length of defoliation period in two of three seasons with most of the reduction occurring when defoliation exceeded 20 days. Results imply that seedling defoliation up to the 4-leaf stage has little effect on grain yield and test weight of winter wheat, rye, and triticale. Defoliation only adversely affected yield of barley and oats when it occurred beyond the 2-leaf stage. As long as plant stand is not reduced, economic thresholds for seedling pests of winter small-grain crops that do not allow for the loss of most leaf tissue for several weeks after planting probably are too conservative. [References: 14].

412 Diaz Castro, Gabriel (INIFAP. C.E. Celaya, Ap. Postal 112, Celaya, Gto. 38000 (Mexico)) (1992) [Studies of aphid resistance and the selection of parental lines of wheat]. Estudios de resistencia para la seleccion de progenitores de trigo a pulgones. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 351-360. Centro de Investigacion Regional del Noroeste. 5 tablas; 9 ref. 2o. tomo. Spanish. (AGRI 94-118945).

413 Girma, M.; Wilde, G.E.; Reese, J.C.; Backus, E.A. (1994) COMMITTED PHLOEM INGESTION OF APHIDS (HOMOPTERA, APHIDIDAE) - DIFFICULTIES IN ITS APPLICATION TO HOST-PLANT RESISTANCE STUDIES. *Environmental Entomology*. 23(5):1061-1065.

English. [KANSAS STATE UNIV AGR & APPL SCI DEPT ENTOMOL MANHATTAN, KS 66506 USA].

The application of the concept of committed phloem ingestion (CPI) of aphids was studied for different aphid species feeding on resistant and susceptible plants. Greenbugs, *Schizaphis graminum* (Rondani) (biotype E), were monitored electronically on wheat, *Triticum aestivum* L., and *Sorghum bicolor* (L.) Moench, cultivars, and Russian wheat aphids, *Diuraphis noxia* Mordvilko, were monitored on wheat cultivars. The duration of phloem ingestion (PI) events of these aphids was not randomly distributed and almost-equal-to 53% of them were <60 min in duration. The minimum PI duration to be considered as committed feeding (threshold of CPI) was determined for each aphid-host combination. Thresholds varied depending on the aphid species and host plants, indicating the difficulty of assigning a single threshold value that could be useful as a measure of host acceptability. Also, if a given threshold duration is chosen as a criterion for having achieved CPI (e.g., 15 min), the proportion of PI events that continues for a long time period varies from host to host. Therefore, we recommend that use of this parameter be discontinued, and that measurements of the time from the beginning of the experiment to PI and the time from the initiation of a probe to PI be substituted for time to first CPI. [References: 15].

414 Mason, JR.; Clark, L. (1994) EVALUATION OF PASTIC AND MYLAR FLAGGING AS REPELLANTS FOR SNOW GEESE (CHEN-CAERULESCENS). *Crop Protection*. 13(7):531-534. English. [MONELL CHEM SENSES CTR USDA ANIM & PLANT HLTH INSPECT SERV DENVER WILDLIFE RES CTR PHILADELPHIA, PA 19104 USA].

The effectiveness of white flags, black flags and Mylar streamers as visual repellents to snow geese (*Chen caerulescens*) was evaluated. Five farms in Cumberland and Salem counties, New Jersey served as test sites. At each farm, four 10.12 ha fields were selected randomly, and then assigned to four treatment conditions: (a) white plastic flags (one flag per 0.4 ha); (b) black plastic flags (one flag per 0.4 ha), (c) Mylar streamers (one streamer per 0.4 ha); and (d) stakes only (one stake per 0.4 ha). From 2 December 1992 to 24 March 1993, vegetation samples and goose droppings were collected in all fields. Dropping weights were significantly less in black- or white-flagged fields than they were in fields with Mylar streamers or bare stakes. Although vegetation weights tended to increase in white- or black-flagged fields (and to decrease in fields with Mylar streamers or bare stakes), there were no significant differences. The results show that white or black flags can economically and effectively deter snow geese from agricultural fields, at least when alternative grazing sites are available. [References: 22].

415 Miller, J.C.; Gerth, W.J. (1994) TEMPERATURE-DEPENDENT DEVELOPMENT OF APHIDIUS-MATRICARIAE (HYMENOPTERA, APHIDIIDAE), AS A PARASITOID OF THE RUSSIAN WHEAT APHID. *Environmental Entomology*. 23(5):1304-1307. English. [OREGON STATE UNIV DEPT ENTOMOL CORVALLIS, OR 97331 USA].

Temperature-dependent development of a Czechoslovakian population of the parasitoid *Aphidius matricariae* Haliday was measured at eight constant temperatures between 11 and 31-degrees-C using the Russian wheat aphid, *Diuraphis noxia* (Mordvilko), as a host. Development rate from oviposition to emergence of adult wasps increased linearly with increasing temperature between 11 and 26-degrees-C. No adult wasps emerged from parasitized aphids at 31-degrees-C. Requirements for development from oviposition to adult eclosion were 273.1 +/- 5.9 degree-days above a threshold of 4.5 +/- 0.4-degrees-C. These results are compared with previously reported data on temperature-dependent development of other populations of *A. matricariae* and the host, *D. noxia*. [References: 12].

416 Morgham, A.T.; Richardson, P.E.; Campbell, R.K.; Burd, J.D.; Eikenbary, R.D.; Sumner, L.C. (1994) ULTRASTRUCTURAL RESPONSES OF RESISTANT AND SUSCEPTIBLE WHEAT TO INFESTATION BY GREENBUG BIOTYPE-E (HOMOPTERA, APHIDIDAE). *Annals of the Entomological Society of America*. 87(6):908-917. English. [USDA ARS PLANT SCI & WATER CONSERVAT LAB 1301 N WESTERN ST STILLWATER, OK 74075 USA].

Biotype E greenbugs, *Schizaphis graminum* (Rondani), were allowed to feed for at least 1 h on leaves of resistant and susceptible wheat, *Triticum aestivum* L. Cellular responses were studied using transmission electron microscopy. Greenbugs caused severe degenerative changes in vascular

cells of susceptible plants as early as 1 h after aphid removal. In mesophyll tissue, cells adjacent to the stylet path were most affected, and amount of cellular damage decreased as distance from the stylet path increased. Ultrastructural damage included disruption of chloroplast and cellular membranes and enlargement of the plastoglobuli within chloroplasts. Cell wall appositions occurred in susceptible tissue 1 d after infestation, and they became more pronounced by 4 d. By 7 d, cellular organelles had degenerated, and it was impossible to distinguish their primary structural features. In contrast, few mesophyll cells of resistant plants were damaged; however, cellular debris was found in intercellular spaces. Bacterial cells were observed among cellular debris at the feeding sites in some resistant plants. Moreover, aphid salivary sheaths, which were prominent in susceptible plants, did not persist in resistant plants beyond 4 d after infestation. Resistance in wheat to biotype E greenbug appears to depend on ability of the host plant to resist cellular alterations induced during the feeding process rather than on differences in feeding site location or mechanical damage. [References: 33].

417 Nakhla, J.M.; Abd El Hafez, A.A. (Ministry of Agriculture, Cairo (Egypt). Plant Protection Research Inst.) (1992) Ability of *Acomys cahirinus* to feed on wheat and maize grains infested with different insect species with note on the influence of adding sugar and salt to the grains. *Assiut Journal of Agricultural Sciences (Egypt)* v. 23(4) p. 227-234. 2 tables; 12 ref. English. (AGRIS 94-108935).

418 Petrovic, O. (Poljoprivredni fakultet, Beograd (Yugoslavia)) (1992) [Initial recordings of *Diuraphis noxia*, Mordvilko (Homoptera: Aphididae) presence in Serbia (Yugoslavia)]. *Prva zapazanja prisustva Diuraphis noxia, Mordvilko (Homoptera: Aphididae) u Srbiji [Jugoslaviji]*. *Zastita bilja (Yugoslavia)* v. 43(200) p. 145-147. 8 ref. Serbian. (AGRIS 94-109060).

The objective of this study was to determine the occurrence of *Diuraphis noxia* in the areas producing cereals in Serbia, Yugoslavia, to estimate its number and its parasitoids. Investigations were carried out on a number of localities in the period 1989-1991. Small grain plots were examined and aphids were collected from the plant parts above the ground. In south Serbia, Yugoslavia, *Diuraphis noxia* has been detected on wheat and barley plots. In both cases the number of aphids was low. The primary parasitoid *Diaeretiella rapae* and the hyperparasitoid *Syrphophagus aphidivorus* were obtained from the aphid.

419 Raatikainen, M.; Raatikainen, T.; Vasarainen, A. (1994) EFFECT OF FEEDING BY METADELPHAX-PROPINQUA (FIEBER) (HOMOPTERA, DELPHACIDAE) ON BARLEY. *Agricultural Science in Finland*. 3(5):513-517. English. [UNIV JYVASKYLA DEPT BIOL & ENVIRON MSCI POB 35 SF-40351 JYVASKYLA FINLAND].

The effect of feeding by the Turkish *Metadelphax propinqua* on barley was investigated in Finland. The number of *M. propinqua* nymphs and the length of their feeding period on barley did not have any major effects on the barley plants. *M. propinqua* males had a greater effect on the properties of barley than did the nymphs. The effect of *M. propinqua* females on the barley was much greater than that of either the nymphs or males. Their number and the length of feeding time lowered the length and weight of plants, the number of grains, the grain yield and the 1000-grain weight.

420 Simova Tomic, D.; Spasic, R.; Milojevic, D.; Bozinovic, I. (Faculty of Agriculture, Belgrade (Yugoslavia)) (1992) Influence of mineral fertilizers on wheat entomofauna. *Zastita bilja (Yugoslavia)* v. 43(199) p. 73-80. 4 tables; 8 ref. English. (AGRIS 94-109042).

The application of different combinations of mineral fertilizers had no significant influence on wheat entomofauna. The insect species in the trial plot detected were uniformly represented except for grain aphids whose number varied significantly. Numerous colonies of *Sitobion avenae* and *Metopolophium dirhodum* were estimated following the spring treatment employing highest nitrogen application amount (285 kg/h KAN). Greatest leaf damage caused by cereal leaf beetle (*Lema melanogaster* L.) larvae amounted to 21.7 and has been recorded following the use of an optimal NPK application rate, whereby the nitrogen-containing fertilizer had been employed in spring treatment.

421 Stamenkovic, S. (Poljoprivredni fakultet, Novi Sad (Yugoslavia). Institut za ratarstvo i povrtarstvo) (1993) [Study of winter wheat

resistance to the cereal bug (*Eurygaster austriaca* Schrk., Pentatomidae, Heteroptera)]. *Proučavanje otpornosti ozime pšenice prema zimoj stenici (Eurygaster austriaca Schrk., Pentatomidae, Heteroptera)*. *Zastita bilja (Yugoslavia)* v. 44(203) p. 31-37. 2 ill.; 2 tables; 20 ref. Serbian. (AGRIS 94-109043).

The resistance of winter wheat to the cereal bug *Eurygaster austriaca* Schrk. was investigated in production conditions and a nursery in the 1979-1988 period. Several hundreds of Yugoslav and foreign cultivars and lines (from 144 to 203) were tested annually. In production conditions the grain damage was from 1.3 to 5.1, and in controlled conditions in the nursery it was from 1.1 to 12.0. The cultivars Balkan, Macvanka 1, Sremica and lines PI 285960, PI 321931 and PI 266157 had the lowest percentage of damages.

422 Tonet, G.L.; Dasilva, R.F. (1994) ANTIBIOSIS OF WHEAT GENOTYPES TO C-BIOTYPES OF SCHIZAPHIS-GRAMINUM (RONDANI, 1852) (HOMOPTERA, APHIDIDAE). *Pesquisa Agropecuaria Brasileira*. 29(8):1181-1186. Portuguese. [EMBRAPA CTR NACL PESQUISA TRIGO CAIXA POSTAL 569 BR-99001970 PASSO FUNDO RS BRAZIL].

The objective of this work was to quantify the antibiosis mechanism of different wheat genotypes to C biotype of the greenbug, *Schizaphis graminum* (Rondani, 1852) (Homoptera: Aphididae). This test was developed at EMBRAPA/CNPq, Passo Fundo, RS, Brazil, and 14 wheat lines and 4 cultivars were maintained in a growth chamber having one bug per plant and ten replications. Parameters assessed were: duration of nymph stages, prereproduction period, reproduction period, longevity of adults, total cycle, number of nymphs/female, and average weight of adult bugs. The results obtained indicate that all lines and Trigo BR 36 cultivar were unfavorable to the development and reproduction of greenbugs.

423 Volkmar, C. (Halle Wittenberg Univ., Halle (Germany). Inst. fuer Phytopathologie und Pflanzenschutz); Wetzel, T. (1994) [Pests of spikes of winter barley control "by the way"?]. *Aehrenschaedlinge an Wintergerste 'nebenbei' bekämpfen? Pflanzenschutz-Praxis (Germany)* (no.2) p. 45-47. 7 ill.; 1 table. German. (AGRIS 94-119108).

424 Weibull, J. (1994) RESISTANCE TO RHOPALOSIPHUM PADI (HOMOPTERA, APHIDIDAE) IN HORDEUM VULGARE SUBSP SPONTANEUM AND IN HYBRIDS WITH H-VULGARE SUBSP VULGARE. *Euphytica*. 78(1-2):97-101. English. [HASSELSTIGEN 16 S-26030 VALLAKRA SWEDEN].

Accessions of *Hordeum vulgare* subsp. *spontaneum*, the progenitor of cultivated barley, were screened in field and glasshouse trials for resistance to the aphid *Rhopalosiphum padi*. A few selected lines were furthermore hybridized with a modern barley variety and the resulting populations evaluated. High levels of resistance were found among some of the 'spontaneum' accessions resulting in lower aphid growth rates (maximum reduction 57%). Segregation patterns among siblings in F2 populations were continuous, indicating the presence of several genes with possibly additive effects. The usefulness of *H. vulgare* subsp. *spontaneum* for breeding aphid resistant barley is discussed. [References: 18].

425 Zabel, A.; Kostic, M.; Manojlovic, B. (Institut za zastitu bilja i zivotnu sredinu, Beograd (Yugoslavia)) (1992) [Efficiency of some insecticides for corn leech control, *Lema melanopus* L. (Coleoptera: Chrysomelidae)]. *Efikasnost nekih insekticida za suzbijanje zitne pijavice Lema melanopus L. (Coleoptera: Chrysomelidae)*. *Pesticidi (Yugoslavia)* v. 7(4) p. 173-179. 12 tables; 16 ref. Serbian. (AGRIS 94-109059).

The investigations have been done under the field conditions as well as the spring barley or wheat located on the regions near Belgrade (Yugoslavia). According to the four-year investigations, the mixture of active substances and its acting is very good as well as the effectiveness of pyrethroids themselves. Chemical Bancol 5WP is very effective in *Lema melanopus* L. control, and is based on chemicals. Chemicals which consist of the mixture of two active substances (pyrethroids and organic-phosphor compounds) are very effective and have the great advantage in comparison with the others. It is established that the *Lema melanopus* L. is very sensitive to all tested insecticides.

426 Adams, M.J. (1994) PARTIAL RESISTANCE TO BARLEY MILD MOSAIC VIRUS IN BARLEY CV SPRITE. *Annals of Applied Biology*. 124(Suppl 5):78-79. English. [AFRC ROTHAMSTED EXPT STN INST ARABLE CROPS RES DEPT PLANT PATHOL HARPENDEN AL5 2JQ HERTS ENGLAND].

427 Adams, M.J.; Jacquier, C. (1994) INFECTION OF CEREALS AND GRASSES BY ISOLATES OF POLYMYXA GRAMINIS (PLASMODIOPHORALES). *Annals of Applied Biology*. 125(1):53-60. English. [AFRC INST ARABLE CROPS RES ROTHAMSTED EXPTL STN HARPENDEN AL5 2JQ HERTS ENGLAND].

The host range of isolates of *Polymyxa* was tested in mono-fungal sand cultures. Fourteen isolates of *P. graminis*, obtained from barley, wheat, oats or *Poa annua* and from several different countries, all infected barley and all but one infected wheat. Rye was also a good host, whereas oats (nine cultivars), *Lolium multiflorum* and *Poa pratensis* became only slightly infected. Wheat cultivars differed in susceptibility, with Galahad much more resistant than Avalon. Several common weed and pasture grasses were not infected by the two isolates tested. A range of wild *Hordeum* spp. were mostly susceptible to *P. graminis* and/or barley mild mosaic virus, which it transmits. An isolate of *P. betae*, used for comparison, caused slight infection on oats but not on other cereals. The variation within and between species of *Polymyxa* needs more detailed investigation. [References: 19].

428 Andrade, O.A.; Mathre, D.E.; Sands, D.C. (1994) NATURAL SUPPRESSION OF TAKE-ALL DISEASE OF WHEAT IN MONTANA SOILS. *Plant & Soil*. 164(1):9-18. English. [MONTANA STATE UNIV DEPT PLANT PATHOL BOZEMAN, MT 59717 USA].

This research was initiated to determine whether soils suppressive to take-all of wheat caused by *Gaeumannomyces graminis* var. *tritici* (Ggt) occur in Montana, and to identify the organisms most likely involved in this suppression. From an initial screening of eight soils collected from different wheat growing areas of Montana, two were highly suppressive to take-all. Microbial characterization of these soils indicated that different mechanisms were involved in the suppression. In Larshan soil, mycoparasitism appeared to be the main mechanism. Two different fungi with exceptional ability to reduce the severity of take-all were isolated from this soil. One of these fungi could parasitize the hyphae of Ggt. Field tests with these fungi in Ggt infested soil showed increases of over 100% in both harvestable tillers and grain yield as compared to treatments without these two fungi. In tests with 48 different bacteria and 10 actinomycetes from Larshan soil, none were able to consistently reduce severity of take-all alone, or in mixtures. In Toston soil, antibiosis by actinomycetes and perhaps the involvement of *Pseudomonas* spp. in production of antibiotics and/or siderophores appeared to be the most likely mechanisms involved in take-all suppression. Increases in shoot dry weight over that in the Ggt infested control using mixtures of pseudomonads and actinomycetes ranged from 25% to 87%. Actinomycetes added individually or in mixtures to soil infested with Ggt consistently reduced the severity of the disease to a greater extent than did mixtures of *Pseudomonas* spp. [References: 36].

429 Ash, G.J.; Rees, R.G. (1994) EFFECT OF POST-INOCULATION TEMPERATURE AND LIGHT INTENSITY ON EXPRESSION OF RESISTANCE TO STRIPE RUST IN SOME AUSTRALIAN WHEAT CULTIVARS. *Australian Journal of Agricultural Research*. 45(7):1379-1386. English. [CHARLES STURT UNIV RIVERINA SCH AGR POB 588 WAGGA WAGGA NSW 2650 AUSTRALIA].

Temperature sensitive resistance to stripe rust in selected Australian wheat cultivars was found to be most strongly expressed at a constant post-inoculation temperature of 19 degrees C and at high light intensities. At 25 degrees C the infection type on the susceptible host was reduced, indicating incompatibility, while at the lower temperature of 13 degrees C all cultivars were susceptible to the rust. At low light intensities there was a movement towards low infection types in cultivars possessing this resistance even at low temperatures. This made it essential to use high light intensities to differentiate this resistance to stripe rust. The host-pathogen interaction leading to the low infection types became irreversible after 6 to 7 days' exposure to the higher temperatures. As well as affecting disease progress towards the end of the growing season in the warmer

areas of the wheat belt, this resistance could have a marked effect on the ability of *Puccinia striiformis* f.sp. *tritici* to overwinter in the Australian wheat growing areas. [References: 22].

430 Balaz, F. (Faculty of Agriculture, Novi Sad (Yugoslavia)); Tosic, M. (Faculty of Agriculture, Belgrade (Yugoslavia)) (1992) Occurrence of Barley Yellow Dwarf Virus on maize grown in the Vojvodina Province (Yugoslavia) in 1990. 6th Conference on virus diseases on Gramineae in Europe; Torino (Italy); 18-21 Jun 1991. *Zastita bilja (Yugoslavia)* v. 43(200) p. 129-133. 2 tables; 45 ref. English. (AGRIC 94-109464).

In 1989 and 1990, in addition to the symptoms of maize dwarf mosaic, maize plants in many localities of Vojvodina, Yugoslavia, showed the reddening of lower leaves, severe dwarfing, sterility, as well as undersized and non-functional roots. Leaf tissues necrosis was a frequent accompanying symptom, too. The serological analysis performed by ELISA test showed that the maize plants with such symptoms were infected with Barley Yellow Dwarf Virus. Maize infection by Barley Yellow Dwarf Virus was also proved by aphid transmission of the virus. The epidemics of Barley Yellow Dwarf Virus on maize was in correlation with the epidemics of the same virus on small grain crops in the same years.

431 Barreras Soto, Manuel Abundio (INIFAP. C.E. Valle del Fuerte. Ap. Postal 342, Los Mochis, Sin. 81200 (Mexico)) (1992) [Survey for karnal bunt (*Neovossia indica*) in wheat-growing areas of the Valle del Fuerte, Sinaloa 1986-87]. *Muestreo para carbon parcial del trigo (Neovossia indica) (Mitra-Mundkur) en areas trigueras del Valle del Fuerte, Sinaloa 1986-87*. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 369-378. Centro de Investigacion Regional del Noroeste. 4 tablas; 2 ref. 2o. tomo. Spanish. (AGRIC 94-119415).

432 Bartos, P.; Stuchlikova, E.; Hanusova, R. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyně (Czech Republic)) (1994) [Genetics of stem and leaf rust resistance of winter wheat cultivars Ilona, Livia, Blava and Torsya]. *Genetika rezistence odrud psenice ozime Ilona, Livia, Blava a Torsya ke rzi travni a rzi psenice. Genetika a Slechteni - UZPI (Czech Republic)* v. 30(2) p. 123-132. 3 tables; 9 ref. Czech. (AGRIC 94-109478).

Genes for stem rust resistance were studied in winter wheat cultivars Ilona, Livia, Blava, Torsya, and genes for leaf rust resistance in the cultivars Livia, Blava and Torsya. The reactions of the cultivars were compared with similar reactions of cultivars or lines possessing known resistance genes. Five stem rust races and one leaf rust race were used to study the segregation of rust reaction in the F2 generations in the crosses with cultivars Ilona, Livia and Torsya, and in the F3 generation of crosses with the cultivar Ilona. Cultivar Ilona was shown to possess stem rust resistance gene Sr11. It was susceptible to leaf rust. Cultivar Livia displayed 'rye resistance' (1BL/1RS translocation, resistance genes Sr31, Lr26, Yr9, Pm8) and also gene Sr11. From the parental cultivars and the reactions to six leaf rust races it appears that cultivar Blava has gene Lr3 and other resistance gene(s) to leaf rust. The reactions of seedlings of the cultivar Blava to most of the stem rust races was not uniform which does not allow a conclusion on stem rust resistance genes in this cultivar. Leaf rust resistance of the cultivar Torsya seems to be derived from the parental cultivar Maris Marksman, stem rust resistance from the second parent, the cultivar Vala (Sr29). Cultivar Torsya displayed heterogeneity in reactions to several races of both rusts, like cultivar Blava.

433 Beck, R.J.; Smith, O.P.; Tooley, P.W.; Peterson, G.L.; Bonde, M.R. (1994) CHARACTERIZATION OF DOUBLE-STRANDED RNA FROM TILLETIA-INDICA. *Mycologia*. 86(5):656-659. English. [USDA ARS FOREIGN DIS WEED SCI RES UNIT FT DETRICK BLDG 1301 FREDERICK, MD 21702 USA].

Double-stranded RNA was identified in six isolates of *Tilletia indica*, the causal agent of Karnal bunt disease of wheat. Double-stranded RNAs ranged from 2.8 to 12.3 kbp in size, similar to sizes reported for double-stranded RNAs from other plant pathogenic fungi. The six isolates revealed diverse double-stranded RNA banding patterns; however, identical patterns were found for two isolates (one from India, one from

Mexico). A random-primed cDNA probe generated from the high molecular weight double-stranded RNA segment of isolate PV-18 hybridized only to double-stranded RNA of isolate PV-18 and not to double-stranded RNA of the other five isolates, indicating a high degree of sequence specificity within the double-stranded RNA from at least one of the isolates tested. This is the first report of double-stranded RNA occurring in any species of *Tilletia*. [References: 27].

434 Boskovic, M.; Boskovic, J. (Faculty of Agriculture, Novi Sad (Yugoslavia)) (1992) Approaches and procedures for European-Mediterranean analysis of populations of *Puccinia recondita tritici*. 9th Yugoslav symposium for plant protection; Vrnjaka Banja (Yugoslavia); 1-5 Dec 1992. *Zastita bilja* (Yugoslavia) v. 43(200) p. 85-97. 2 tables; 37 ref. English. (AGRIS 94-109441).

The first results presented are related to numerous wheat materials tested in the field and in the seedling stage with selected international cultures of *Puccinia recondita tritici*. For genetic differentiation of numerous resistant wheat material, Boolean modelling with series of mathematical functions was applied. Based on this investigations, twenty genetically different winter wheat sources of resistance and sixteen spring wheat sources were selected for the first European Leaf Rust Nursery (ELRWN).

435 Brodny, U.; Wahl, I. (1994) EFFECTS OF SUBLETHAL CONCENTRATIONS OF TRIADIMEFON ON RUST DEVELOPMENT ON FAST AND SLOW RUSTING BARLEY LINES. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection*. 101(5):467-474. English. [TEL AVIV UNIV FAC LIFE SCI INST CEREAL CROPS IMPROVEMENT IL-69978 TEL AVIV ISRAEL].

Pretreatment of barley plants with sublethal concentrations of Bayleton WP50 (triadimefon) before inoculation at the seedling or adult stage with *Puccinia bordei* Oth resulted in diminished infection severity. The data obtained indicate enhanced efficacy of the fungicide in slow rusting. Fast rusting lines responded to low fungicide dosage by developing symptoms similar to those in untreated slow rusting lines. [References: 21].

436 Burdon, J.; Abbott, DC.; Brown, AHD.; Brown, JS. (1994) GENETIC STRUCTURE OF THE SCALD PATHOGEN (*RHYNCHOSPORIUM SECALIS*) IN SOUTH EAST AUSTRALIA - IMPLICATIONS FOR CONTROL STRATEGIES. *Australian Journal of Agricultural Research*. 45(7):1445-1454. English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

A survey of electrophoretic variation in 89 isolates of *Rhynchosporium secalis* collected from cultivated and wild barley grass in Victoria, New South Wales and Tasmania detected an average of 2.5 alleles at each of 11 loci in 5 enzyme systems. At five loci, two alleles each occurred at frequencies exceeding 0.2. Comparison of the frequency of alleles at these loci showed little association with host or geographic origin, pathogenicity of the isolates or with the allelic state at other loci. Given that this pathogen reproduces asexually only, this lack of association confirms previous suggestions that some means of asexual recombination is important in this pathogen. Furthermore, the results suggest that the most effective means whereby long-term control over *R. secalis* will be achieved is through the use of both pathotype-specific and field resistance complemented by other strategies like the use of fungicides and possibly varietal mixtures. [References: 37].

437 Carmi, R.; Carmeli, S.; Levy, E.; Gough, FJ. (1994) (+)-(S)-DIHYDROAERUGINOIC ACID, AN INHIBITOR OF SEPTORIA TRITICI AND OTHER PHYTOPATHOGENIC FUNGI AND BACTERIA, PRODUCED BY PSEUDOMONAS FLUORESCENS. *Journal of Natural Products*. 57(9):1200-1205. English. [TEL AVIV UNIV RAYMOND & BEVERLY SACKLER FAC EXACT SCI SCH CHEM IL-69978 TEL AVIV ISRAEL].

Three antibiotics were isolated from a CH₂Cl₂ extract of the liquid culture of *Pseudomonas fluorescens* strain PFM2. Two of the antibiotics were identified as 2, 4-diacetylphloroglucinol and pyoluteirin. The structure elucidation, absolute stereochemistry, synthesis, and biological activities of the new antibiotic (+)-(S)-dihydroaeruginic acid IU are reported. [References: 19].

438 Christen, O. (Kiel Univ. (Germany). Inst. fuer Pflanzenbau und Pflanzenzüchtung. Lehrstuhl fuer Allgemeinen Pflanzenbau); Sieling, K.

(1994) [Wheat after wheat: The importance of variety]. *Weizen nach Weizen: Die Rolle der Sorte. DLG-Mitteilungen (Germany)* v. 109(2) p. 29-31. 2 ill., 2 tables. German. (AGRIS 94-109439).

439 Dileone, JA.; Mundt, CC. (1994) EFFECT OF WHEAT CULTIVAR MIXTURES ON POPULATIONS OF PUCCINIA STRIIFORMIS RACES. *Plant Pathology*. 43(5):917-930. English. [OREGON STATE UNIV DEPT BOT & PLANT PATHOL CORDLEY HALL 2082 CORVALLIS, OR 97331 USA].

This study quantifies the frequency of simple and complex races (races that can infect two or more components) of *Puccinia striiformis* in mixtures of wheat cultivars possessing different race-specific resistance genes. Treatments were designed so that the complex race changed depending on the host mixture, thus enabling us to observe the influence of pathogen complexity in different genetic backgrounds. Six cultivar mixtures and one pure stand of winter wheat were inoculated with three races of *P. striiformis* at two locations for two seasons. Potted plants of three winter wheat cultivars, each susceptible to one of the three races of the pathogen, were used to sample the pathogen during the field epidemics. Disease incidence on the differential cultivars was used to calculate the proportion of the three races in each treatment. The specific cultivars included in the mixtures influenced the frequencies of the three races. Increasing the number of virulent races in a mixture reduced the frequency of the complex race relative to the other two races. The results suggest that genetic background of the pathogen race, host composition, and interaction among pathogen races may be as important as cost of virulence in determining race frequencies in mixtures. [References: 23].

440 Donald, R.G.K.; Zhou, H.; Jackson, A.O. (1993) Serological analysis of barley stripe mosaic virus-encoded proteins in infected barley. *Virology (USA)* v. 195(2) p. 659-668. references. English. (AGRIS 94-119487).

Polyclonal antisera raised against proteins or peptides corresponding to barley stripe mosaic virus (BSMV) open reading frames were used in immunoblot experiments to investigate the in vivo expression of BSMV-encoded proteins during infection of barley. Six of the seven putative gene products, whose functional roles have been defined in previous genetic studies, were detected at one or more stages of infection in barley tissue sampled at 4, 7, 10, and 14 days postinoculation (DPI). The alpha a, beta a, beta b, gamma a and gamma b gene products were observed during the course of infection, but a protein corresponding to the beta c gene could not be identified. The 130-kDa alpha a and the 74-kDa gamma a proteins, which comprise the essential BSMV-encoded replicase components, differed in the time course of their expression and in their subcellular distribution. The highest concentration of the alpha a protein coincided with the appearance of leaf symptoms at 4 DPI and declined gradually as infection progressed. The alpha a protein was found primarily in the soluble protein fraction but some of the protein was also found in the membrane and cell wall fractions. In contrast, the gamma a protein peaked in concentration later at 7 to 10 DPI and was more abundant in membranous fractions. The cysteine-rich 17-kDa gamma b protein was located predominantly in the soluble fraction and its concentration remained relatively constant during the course of infection. The 25-kDa capsid protein (beta a) was present in the highest amounts in the soluble fraction at 4 DPI and it continued to increase in abundance throughout the sampling period. The transiently expressed 58-kDa beta b protein, which like beta c and beta d is required for systemic infection, was most abundant at the onset of symptoms, but declined precipitously in concentration as the infection progressed. Although larger amounts of beta b were present in the soluble fraction, the cell wall fraction contained a substantial.

441 Ducek, L. (1994) RELATIONSHIP BETWEEN A GREENHOUSE AND FIELD ASSAY FOR BIOLOGICAL CONTROL OF COMMON ROOT ROT OF SPRING WHEAT AND BARLEY. *Canadian Plant Disease Survey*. 74(2):135-140. English. [AGR & AGRI FOOD CANADA SASKATOON RES CTR 107 SCI PL SASKATOON S7N 0X2 SK CANADA].

Bacteria and fungi, isolated from coleoptiles of seedlings of spring wheat and barley collected from commercial fields in Saskatchewan, were evaluated as seed treatments to reduce common root rot. There was no relationship between greenhouse and field trials in effectiveness of isolates in controlling common root rot. Some isolates reduced symptoms in the field, with the best showing a 61% decrease in disease compared to the control. Some isolates also reduced symptoms in the greenhouse assay. As

currently described, the greenhouse assay is unsuitable as a screening technique to evaluate potential efficacy in the field.

442 Ebrahimnesbat, F.; Rohringer, R.; Heitefuss, R. (1994) EFFECT OF RUST INFECTION ON CELL WALLS OF BARLEY AND WHEAT - IMMUNOCYTOCHEMISTRY USING ANTI-BARLEY THIONIN AS A PROBE. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 141(1):38-44. English. [GEORG AUGUST UNIV INST PFLANZENPATHOL & PFLANZENSCHUTZ GRIEBACHSTR 6 D-37077 GOTTINGEN GERMANY].

Polyclonal antiserum prepared against barley cell wall thionin was used to localize and quantitate immunoreactive material on the cellular level in healthy and rust-infected leaves of barley and wheat. Three types of sites were used for the immunocytochemical analysis: as control sites, mesophyll cell walls were selected in uninoculated leaves, and in leaves that were inoculated with rust but where the sites were not in contact with the pathogen; these were compared with mesophyll cell walls that were in contact with intercellular rust hyphae in inoculated leaves. Similar amounts of cell wall thionin were detected in all 3 barley cultivars before inoculation. At sites where intercellular hyphae of *Puccinia hordei* had made contact with mesophyll cell walls, less thionin was found in the compatible host cv. Larker, but in incompatible hosts (cvs. Gold and Bolivia) the thionin concentration did not differ from that of the controls. Two cultivars of wheat were studied with respect to immunoreactive material in their mesophyll cell walls, the universal rust susceptible cv. Little Club and the highly rust-resistant cv. Khapli. Before inoculation, leaves of cv. Khapli contained about twice the amount of immunoreactive material in mesophyll cell walls than those of cv. Little Club. This relation was unchanged in walls that had made contact with *P. graminis tritici*, but in non-contacted walls of infected cv. Little Club leaves, the concentration of this material had risen to levels typical for those of cv. Khapli. Tests for immunoreactive material with pre-embedding cytochemistry yielded negative results, indicating that it is not exposed on the surface of mesophyll walls in barley and wheat. [References: 15].

443 Ellis, SA.; Gooding, MJ.; Davies, WP.; Fenwick, R. (1994) BLACKPOINT INFECTION OF SPRING WHEAT CULTIVARS. *Annals of Applied Biology*. 124(Suppl 5):130-131. English. [ROYAL AGR COLL CIRENCESTER GL7 6JS GLOS ENGLAND].

444 Fric, F. (1993) LIPOXYGENASE AND SUPEROXIDE DISMUTASE ACTIVITIES IN POWDERY MILDEWED BARLEY LEAVES. *Acta Phytopathologica et Entomologica Hungarica*. 28(2-4):173-183. English. [INST BOT DUBRAVSKA 14 CS-84223 BRATISLAVA SLOVAKIA].

Alterations of host cell permeability in infected tissues seems to be important in pathogenesis of powdery mildew disease. As a consequence, a significant increase of oxidative enzyme activities occurs. There is a correlation between the increased lipoxygenase activity and the increased protein exocytosis. A good correlation was also found between the protein exocytosis, the increased free calcium ion level and the activity of lipoxygenase. Superoxide dismutase (SOD) activity increased in the preparasitic phase but in the parasitic phase only the resistant genotypes of barley exhibited higher SOD activity.

445 Fric, F.; Tamas, L. (1993) BARLEY RESPONSES TO ERYSIPIHE-GRAMINIS F SP HORDEI (MARCHAL) ATTACK IN THE PREPARASITIC STAGE OF THEIR INTERACTION. *Acta Phytopathologica et Entomologica Hungarica*. 28(2-4):161-172. English. [SLOVAK ACAD SCI INST BOT DUBRAVSKA 14 CS-84223 BRATISLAVA SLOVAKIA].

This review presents the main biochemical and physiological symptoms of barley cells in the presence of *Erysiphe graminis*, *hordei* infection structures. Several mechanisms may operate within barley cells affecting growth and spread of the fungus. There is a marked need to focus attention on the prepenetration and preparasitic phase of their interaction to get insights into induced metabolic and physiological processes in the host plant. It is likely that some biochemical reactions or physiological processes in the preparasitic phase of barley - *E. graminis* f. sp. *hordei* interaction may induce resistance mechanisms, which are still poorly understood. Papers accumulated in the last decade show that there is a new search for "early" metabolic and physiological events to characterize biochemical and physiological processes determining or controlling the degree of host-parasite compatibility or incompatibility.

446 Froment, MA.; Cooper, ND. (1994) EVALUATION OF FENOXAPROP-ETHYL ALONE AND IN MIXTURES AGAINST BLACKGRASS ALOPECURUS-MYOSUROIDES IN WINTER WHEAT. *Annals of Applied Biology*. 124(Suppl 5):60-61. English. [AGR DEV & ADVISORY SERV BRIDGETS RES CTR WINCHESTER SO21 1AP HANTS ENGLAND].

447 Fu Qinfang (Hebei Academy of Agricultural Sciences, Baoding (China). Inst. of Plant Protection) (1993) A brief report on the resistance identification of 24 wheat varieties to powdery mildew and their yield losses. *Plant Protection (China)* v. 19(6) p. 18. 1 table. Chinese. (AGRI 94-119541).

448 Garbe, V. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Braunschweig (Germany). Inst. fuer Pflanzenschutz in Ackerbau und Gruenland) (1994) (Reduced tillage - Decreasing plant protection problems). Reduzierte Bodenbearbeitung: Wenig Pflanzenschutzprobleme. *Pflanzenschutz-Praxis (Germany)* (no.2) p. 25-28. 3 ill., 1 table. German. (AGRI 94-119478).

449 Gladders, P.; Hims, MJ. (1994) IMPROVING SPRING AND SUMMER FUNGICIDE TREATMENTS FOR WINTER BARLEY. *Crop Protection*. 13(8):597-606. English. [AGR DEV & ADVISORY SERV BOXWORTH RES CTR CAMBRIDGE CB3 8NN ENGLAND].

The response of winter barley to broad-spectrum fungicides applied at first node stage [growth stage (GS) 31] or as two-spray programmes [first node stage and flag leaf to ear emergence (GS 39-59)] was examined at 22 sites over five years during 1986-1990. Single sprays were also applied at an intermediate timing [third node to flag leaf emerging (GS 33-37)] at all sites in 1989 and 1990. The mean response to the single spray at GS 30-31 was 0.86 t ha⁻¹ but ranged from 0.25 to 3.03 t ha⁻¹ (4-80%). With the addition of a late spray (GS 39-59) of propiconazole plus tridemorph to the spring treatment, mean response was 2.25 t ha⁻¹ [range 0.35-3.32 t ha⁻¹ (5-87%)]. There were some differences between fungicides and fungicide mixtures applied at GS 31 and a prochloraz component was needed for effective control of eyespot. Seasonal differences in the mean response to the GS 39-59 treatment reflected differences in disease pressure after GS 59. The GS 30-31 treatment failed to maintain disease control up to the milky ripe stage (GS 75) in years when disease pressure was high. Yield responses were correlated with disease severity on leaf 2 at the time of the spring (GS 31) application and with the degree of control of eyespot on the stem base and of foliar diseases on the flag leaf at GS 75. A single spray applied at GS 33-37 gave comparable yields to the two-spray programmes and has potential to improve profitability where disease levels are low at the first node stage. [References: 19].

450 Goodwin, SB.; Webster, RK.; Allard, RW. (1994) EVIDENCE FOR MUTATION AND MIGRATION AS SOURCES OF GENETIC VARIATION IN POPULATIONS OF RHYNCHOSPORIUM SECALIS. *Phytopathology*. 84(10):1047-1053. English. [CORNELL UNIV DEPT PLANT PATHOL 334 PLANT SCI ITHACA, NY 14853 USA].

Four isolates of the barley scald disease pathogen, *Rhynchosporium secalis*, that differed both for pathogenicity to 14 barley differential cultivars and for isozyme genotype were coinoculated onto barley plants in the field and the greenhouse to test for mutation, migration, and parasexual recombination. Ten isozyme genotypes and 37 pathotypes were identified among 96 isolates recovered from 10 field plots. Most (62%) of the isolates recovered in the field experiment had an isozyme genotype like that of one of the four inoculated isolates. Among the remaining isolates were six different isozyme genotypes, two of which were probably introduced by migration; the other four fifteen single-spore derivatives of the original isolates had changes for pathogenicity, which were almost certainly the result of mutation, to one or more of the differential cultivars, but there were no changes in isozyme genotype among single-spore derivatives. The four original isolates were also inoculated pairwise onto a susceptible barley cultivar in the greenhouse. No isozyme recombinants were found among 240 isolates recovered after two asexual generations; three greenhouse isolates were definitely migrants; one was a mixed culture of parental isozyme genotypes; and the remaining 236 were parental types. Among more than 1,000 isolates analyzed in this and two other studies, no three-banded (heterodimeric) isozyme phenotypes (indicating heterozygotes at intermediate stages in

the parasexual cycle) were found. Taken together, these results indicate that parasexual recombination, if it occurs at all, probably plays at most a small role in generating genetic variability in *R. secalis* populations in nature. However, there is clear evidence that mutation and migration are very important, and the mutation rate for pathogenicity appears to be very much higher than that for isozymes. [References: 24].

451 Gourmet, C.; Hewings, AD.; Kolb, FL.; Smyth, CA. (1994) EFFECT OF IMIDACLOPRID ON NONFLIGHT MOVEMENT OF RHOPALOSIPHUM-PADI AND THE SUBSEQUENT SPREAD OF BARLEY YELLOW DWARF VIRUS. *Plant Disease*. 78(11):1098-1101. English. [UNIV ILLINOIS DEPT AGRON URBANA, IL 61801 USA].

The bird cherry-oat aphid (*Rhopalosiphum padi*) is an important vector of the barley yellow dwarf luteovirus, BYDV-PAV-IL. Insecticides used to reduce the abundance of the vector on small grains can result in an increase in aphid activity and a subsequent increase in disease incidence. The transmission characteristics of viruliferous wingless (nymphs and apterous adults) *R. padi* after access to oats treated with different rates of imidacloprid, a seed-treatment insecticide, were compared. After access to treated plants, aphid fecundity was reduced and aphids walked and fed atypically and often abandoned the host plant. The spread of BYDV from a focus of infestation to individual imidacloprid-treated oats planted in a grid was followed by observation of symptoms and by enzyme-linked immunosorbent assay. Aphids transmitted the virus to both treated and untreated plants, but the percentage of infected insecticide-treated seedlings was one-half that of untreated seedlings. [References: 36].

452 Havis, ND.; Walters, DR.; Martin, WP.; Cook, FM.; Robins, DJ. (1994) EVALUATION OF THE PUTRESCINE ANALOGUE (E)-1, 4-DIAMINO-2-BUTENE AGAINST POWDERY MILDEW ON SPRING BARLEY. *Annals of Applied Biology*. 124(Suppl S):14-15. English. [SCOTTISH AGR COLL DEPT PLANT SCI AUCHINCRAIG KA6 5HW SCOTLAND].

453 Heye, UJ.; Speich, J.; Siegle, H.; Steinemann, A.; Forster, B.; Knaufbeiter, G.; Herzog, J.; Hubele, A. (1994) CGA-219417 - A NOVEL BROAD-SPECTRUM FUNGICIDE. *Crop Protection*. 13(7):541-549. English. [CIBA GEIGY AG RES & DEV CROP PROTECT CH-4002 BASEL SWITZERLAND].

CGA 219417 (proposed common name: cyprodinil) is a pyrimidinamine currently being developed as a foliar fungicide for cereals, grapes, vegetable crops and deciduous fruit. It has a new mode of action and shows no cross-resistance to any current market product. On cereals, CGA 219417 exhibits a broad fungicidal spectrum with good activity against *Pseudocercospora herpotrichoides*, *Erysiphe graminis*, *Pyrenophora teres*, *Rhynchosporium secalis* and *Septoria nodorum* on ears. The strength of CGA 219417 on grapes, vegetable crops and strawberries is its excellent activity against *Botrytis* spp. On deciduous fruit the key target pathogen genera are *Venturia*, *Alternaria* and *Monilinia* spp. The fungicide has excellent safety for users, consumers and environment. In addition, its other characteristics, such as not being harmful to beneficial organisms, make it a promising product for flexible integrated disease-control practices. [References: 23].

454 Huth, W. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Braunschweig (Germany). Inst. fuer Biochemie und Pflanzenvirologie); Lesemann, D. E. (1994) [Evidence of wheat virus in Germany]. *Nachweis des wheat dwarf virus in Deutschland. Nachrichtenblatt des deutschen Pflanzenschutzdienstes (Germany)* v. 46(5) p. 105-106. 3 ill.; 12 ref. German. (AGRIS 94-119547).

In wheat and barley plants with conspicuous dwarfing and leaf yellowing, found in several locations in central Germany, geminivirus particles were detected using a Swedish antiserum to wheat dwarf virus (WDV) for immunoelectron microscopical trapping. Thus, the occurrence of wheat and barley strains of WDV in Germany is proven.

455 Ireta Moreno, Javier (INIFAP. C.E. Jalisco, Ap. Postal 56, 47600 Tepic, Jal. (Mexico)) (1992) [Histopathology of *Fusarium graminearum* Schw. penetration in wheat]. *Histopatología de la penetración de Fusarium graminearum* Schw. en trigo. Primera conferencia nacional sobre la producción de trigo en México. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)].

Conferencia nacional sobre la producción de trigo en México. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicación Especial. Centro de Investigación Regional del Noroeste (Mexico)*; no. 4 p. 345-349. Centro de Investigación Regional del Noroeste. 5 ref. 2o. tomo. Spanish. (AGRIS 94-119413).

456 Jasníc, S.; Stakić, D.; Falak, I. (Poljoprivredni fakultet, Novi Sad (Yugoslavia)) (1993) [Effect of barley yellow dwarf luteovirus on growth and yield of wheat and barley]. *Uticaj zute patuljivosti jecma na porast i prinose pšenice i jecma. Zastita bilja (Yugoslavia)* v. 44(203) p. 39-45. 3 tables; 17 ref. Serbian. (AGRIS 94-109458).

According to the results of the investigations it can be concluded that there is a harmful effect of barley yellow dwarf luteovirus on growth and yield of winter and spring wheat and barley in artificial infections under field conditions. Harmful effect of the virus was more severe in fall infection than in spring infection of winter crops. There are very significant statistical differences in reducing the growth parameters of plants and yield per plant. The harmful effect of virus was especially high on yield per plant.

457 Jerković, Z.; Jević, R.; Momčilović, V. (Poljoprivredni fakultet, Novi Sad (Yugoslavia)) (1992) [Incomplete resistance to *Puccinia recondita* tritici in some wheat varieties]. *Nekompletna otpornost prema Puccinia recondita tritici nekih sorti pšenice. Zbornik Matice srpske za prirodne nauke (Yugoslavia)* (no. 83) p. 91-96. 2 tables; 11 ref. Text in Cyrillic. Serbian. (AGRIS 94-109444).

A group of very different wheat genotypes, twelve from nine countries from all over the world and seven from Yugoslavia was tested. The infection intensity of *Puccinia recondita* tritici was estimated on the basis of areas under disease progress curve (AUDPC). A high degree of partial resistance (a type of incomplete resistance) was expressed by the varieties Centurk, Grana, Aura and Ibarka. Since the varieties Jugoslavija and Zvezda exhibited the intermediate reaction at the seedling stage, their resistance is not partial. It is obvious that incomplete resistance is an active resistance, resulting from the interaction of host and parasite genes in the actual environmental conditions.

458 Jimenez Diaz, Florencio; Salazar Gomez, Mario; Moreno Martinez, Ernesto (INIFAP. C.E. Laguna. Ap. Postal 247, Torreon, Coah. 27440 (Mexico)) (1992) [Pathology problems: their implications for Mexico's wheat production]. *Problemas patológicos: Sus implicaciones en la producción de trigo en México. Primera conferencia nacional sobre la producción de trigo en México. (Memoria)*; Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. *Conferencia nacional sobre la producción de trigo en México. (1, 1988, Cd. Obregon, Son.) (Memoria). Publicación Especial. Centro de Investigación Regional del Noroeste (Mexico)*; no. 4 p. 333-344. Centro de Investigación Regional del Noroeste. 19 ref. 2o. tomo. Spanish. (AGRIS 94-119412).

459 Jones, DR. (1994) EVALUATION OF FUNGICIDES FOR CONTROL OF EYESPOT DISEASE AND YIELD LOSS IN WINTER WHEAT. *Plant Pathology*. 43(5):831-846. English. [ADAS BRIDGETS WINCHESTER SO21 1AP HANTS ENGLAND].

Following the discovery of resistance to benzimidazole fungicides in the cereal eyespot pathogen *Pseudocercospora herpotrichoides* in the UK in 1981, and an initial in vitro screen to select the fungicides with greatest activity against the pathogen, 40 held experiments were carried out between 1983 and 1986 to evaluate alternative fungicides for control of eyespot. At the majority of experimental sites, benomyl-resistant strains of the pathogen were present, and carbendazim did not control eyespot. Prochloraz was the most effective fungicide, reducing the eyespot index by 30-60%. There was no extra benefit from adding carbendazim to prochloraz. Flusilazole was almost as effective as prochloraz, but other fungicides had little or no effect. At sites with a high incidence of eyespot, prochloraz, with or without the addition of carbendazim, generally gave the largest yield increase. The mean yield increases each year were in the range 0.36-0.85 t/ha, and the greatest yield increase at any site was 2.27 t/ha. Most other fungicides increased yield, but carbendazim did not from 1984 to 1986. There were also yield increases at many sites with a low incidence of eyespot. Yield increases were associated with increases in thousand-grain weight at the majority of sites, but in only a few instances were there associated increases in specific weight. Prochloraz application at GS30-31 was cost effective at 71% of sites. At most sites, in regression of

yield on eyespot, eyespot accounted for less than 25% of the variance in yield. The mean relationship between severe eyespot lesions and yield loss was such that each 1% increase in the percentage of tillers affected by severe eyespot was associated with a yield loss of 0.21%. There was a significant positive correlation between eyespot at GS75 and GS30-31, and between yield increase from prochloraz treatment (at GS30-31) and eyespot at GS75, but not between yield increase and eyespot at GS30-31. The ADAS threshold for fungicide application of 20% tillers affected at GS30-31 was a reliable indicator of the cost-effectiveness of treatment at 60% of sites. [References: 29].

460 Kaysoe, E.; Munk, L. (The Royal Veterinary and Agricultural Univ., Taastrup (Denmark). Dept. of Plant Biology) (1992) Side-effects of the herbicide isoproturon on the severity of powdery mildew in spring barley and winter wheat. 188. NJF Seminar; Aas (Norway); 11-14 Feb 1991. Disease resistance in agricultural crops. NJF-Seminar no. 188. Elen, O.; Tronstmo, A.M. (eds.). Scandinavian Association of Agricultural Scientists (NJF). *Norwegian Journal of Agricultural Sciences (Norway)*; no. 7(suppl.) p. 89-94. Statens Fagteneste for Landbruget. 3 tables, 1 figure; 7 ref. English. (AGRIS 94-119482).

461 Keller, B.; Winzeler, H.; Winzeler, M.; Fried, PM. (1994) DIFFERENTIAL SENSITIVITY OF WHEAT EMBRYOS AGAINST EXTRACTS CONTAINING TOXINS OF SEPTORIA NODORUM - FIRST STEPS TOWARDS IN VITRO SELECTION. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 141(3):233-240. English. [SWISS FED RES STN AGRON DEPT PLANT BREEDING RECKENHOLZSTR 191 CH-8046 ZURICH SWITZERLAND].

As a first step towards the development of an in vitro-selection system for septoria nodorum blotch resistance, wheat embryo culture on media containing extracts from Septoria nodorum was established. Extracts prepared from inoculated wheat grains had a toxic activity. Control extracts from uninoculated grains showed at least a 10-fold lower toxic activity. Two wheat breeding lines susceptible to Septoria nodorum showed reduced growth in the presence of the fungal extract when compared to a breeding line known to have good resistance in the field. A test with seven additional wheat lines showed a good agreement between field resistance of the ear and embryo resistance. Mellein is one of the toxins produced by Septoria nodorum and was used in pure form for in vitro-selection. It showed toxic effects at 50 µg/ml, a concentration which is about 200-fold higher than the mellein concentration in the diluted extract with embryotoxic activity. This indicates the importance of additional toxic compounds in the crude extract. Mellein acted non-selectively on embryos of the different cultivars. [References: 20].

462 Khan, M.I.; Saxena, SK.; Khare, MN. (1994) SCREENING OF WHEAT CULTIVARS AND ACCESSIONS AGAINST LEAF BLIGHT CAUSED BY ALTERNARIA-TRITICINA. *Annals of Applied Biology*. 124(Suppl 5):128-129. English. [ALIGARH MUSLIM UNIV DEPT BOT ALIGARH 202002 INDIA].

463 Konc, B. (Institute for Plant Protection (Croatia)) (1993) Effect of Septoria nodorum blotch on yield and size of processed wheat seed. *Wheat Information Service (Japan) (no.76)* p. 32-34. 2 tables; 7 ref. English. (AGRIS 94-119476).

464 Kremb, S. (Technische Univ. Muenchen, Freising (Germany). Lehrstuhl fuer Phytopathologie); Appel, J. (1993) [Profitability of winter barley can be improved]. *Rentabilitaet der Wintergerste laesst sich deutlich verbessern. Bayerisches Landwirtschaftliches Wochenblatt (Germany)* v. 183(36) p. 50-51. 2 ill., 1 table. German. (AGRIS 94-119483).

465 Lascans, D.; Deacon, JW. (1994) INVITRO GROWTH AND MICROCYCLE CONIDIATION OF IDRIELLA-BOLLEYI, A BIOCONTROL AGENT OF CEREAL PATHOGENS. *Mycological Research*. 98(Part 10):1200-1206. English. [UNIV EDINBURGH INST CELL & MOLEC BIOL RUTHERFORD BLDG EDINBURGH EH9 3JH MIDLOTHIAN SCOTLAND].

The minimum nutrient requirements for growth of Idriella (= Microdochium bolleyi) in shaken liquid culture were mineral salts, nitrate nitrogen, glucose and thiamine. Typical batch culture kinetics were displayed in this medium and were assessed by culture turbidity when sodium alginate was used to induce growth by dispersed mycelia. Conidia

were produced during exponential growth and reached maximum numbers (ca 6 x 10(7) ml-1) by the deceleration or early stationary phase. Applying the Monod equation to culture parameters at different glucose concentrations, the minimum doubling time in glucose-nitrate-thiamine medium at 25-degrees-C was calculated as between 5.25 and 6.1 h, and K(s) (limiting substrate concentration at half maximum specific growth rate) was between 0.049 and 0.077% glucose. Conidial germination was oxygen-dependent but did not require nutrients. On water agar or 0.1% glucose agar most spores germinated by germ-tubes, but up to 15% of spores swelled and produced further conidia (2-5) from one or both poles of the parent spore. This microcycle conidiation was suppressed at higher glucose levels. The findings are discussed in relation to production of biocontrol inocula and efficiency of I. bolleyi in biocontrol on roots. [References: 44].

466 Laverick, RM. (1994) EFFECTS OF A VEGETABLE OIL CARRIER (CODACIDE) APPLIED WITH FLUTRIAFOL TO WINTER WHEAT ON SEPTORIA-TRITICI. *Annals of Applied Biology*. 124(Suppl 5):42-43. English. [ADAS ROSEMAUND PRESTON HR1 3PG HEREFORD ENGLAND].

467 Leyva Mir, Gerardo (Universidad Autonoma Chapingo. Departamento de Pasitologia Agricola, Chapingo, Mex. 56230); Villasenor Mir, Eduardo (Instituto Nacional de Investigaciones Forestales y Agropecuarias, Mexico D.F. (Mexico), Campo Experimental Valle de Mexico, Apdo. Postal 10, Chapingo, Mex. 56230) (1992) [Fungicide evaluation for the control of wheat foliar diseases in Juchitepec, Mexico]. Evaluacion de fungicidas para el control de enfermedades foliares en trigo en Juchitepec, Mexico. *Revista Mexicana de Fitopatologia (Mexico)* v. 10(1) p. 72-74. 4 cuadros; 7 ref. Spanish. (AGRIS 94-119532).

Prochloraz and Propiconazole increased in 2.1 and 0.7 ton/ha. respectively, the yield of wheat var. Verano S91 (susceptible to foliar and head diseases caused by Fusarium nivale, F. graminearum, Septoria tritici y Helminthosporium tritici-repentis) in Juchitepec, Mexico. The five fungicides tested did not result in any difference on the var. Temporalera (tolerant to a complex of leaf diseases).

468 Leyva Mir, Gerardo; Villasenor Mir, Eduardo (Instituto Nacional de Investigaciones Forestales y Agropecuarias, Mexico D.F. (Mexico), Campo Experimental Valle de Mexico, Apdo. Postal 10, Chapingo, Mex. 56230); Rodriguez C, Elsa (Universidad Autonoma Chapingo, Chapingo, Mex. (Mexico), Departamento de Parasitologia, Chapingo, Mex. 56230) (1992) [Incidence and control of wheat (Triticum aestivum L.) head blight (Fusarium graminearum Schw.) in Juchitepec, Mexico]. Incidencia de la rona de la espiga (Fusarium graminearum Schw.) en trigo (Triticum aestivum L.) y su combate quimico en Juchitepec, Mexico. *Revista Mexicana de Fitopatologia (Mexico)* v. 10(1) p. 75-77. 1 cuadro; 7 ref. Spanish. (AGRIS 94-119533).

Fusarium graminearum Schw. was isolated from seed of scabby wheat heads collected in Juchitepec, Mexico. Disease incidence from 54 to 70 occurred on heads of the variety Salamanca. Propiconazole, carbendazim and prochloraz in seed treatments, decreased the disease incidence in 100 percent in the Salamanca S-75 and Temporalera M87.

469 Macek, J.; Lesnik, M. (1994) THE INFLUENCE OF PRIMISULFURON AND TRIASULFURON HERBICIDES ON MYCELIAL GROWTH AND SPORULATION OF SOME PARASITIC SOIL FUNGI. *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection*. 101(5):492-497. German. [UNIV LJUBLJANA FAK BIOTECH LJUBLJANA 61001 SLOVENIA].

The effect of three herbicides on the growth of four and the sporulation of two soil parasitic fungi were studied on potato-dextrose agar. Triasulfuron (Logran), triasulfuron + fluoroglycofen (Satis) inhibited in all concentrations the spore formation of Fusarium moniliforme (Fm), primisulfuron (Tell) stimulated it in the highest concentration. On Trichoderma longibrachiatum (Tl), herbicides exerted different influences. All herbicides inhibited in field concentrations the mycelial growth of Tl. Tell and Satis stimulated it with the middle and the lowest concentration. Logran and Satis inhibited in field concentrations the mycelial growth of Rhizoctonia solani (Rs), in some concentrations stimulation esp. with Tell was ascertained. Field concentrations of all herbicides inhibited the mycelial growth of Fm and Sclerotinia sclerotiorum (Sc), particularly also

with the lower concentrations. Fm and Ss are apparently very sensitive. [References: 14].

470 Makkouk, KM.; Comeau, A.; Stpierre, CA. (1994) SCREENING FOR BARLEY YELLOW DWARF LUTEOVIRUS RESISTANCE IN BARLEY ON THE BASIS OF VIRUS MOVEMENT. *Journal of Phytopathology-Phytopathologische Zeitschrift*. 141(2):165-172. English. [INT CTR AGR RES DRY AREAS VIROL LAB GENET RESOURCES UNIT POB 5466 ALEPPO SYRIA].

The movement of barley yellow dwarf luteovirus (BYDV) was evaluated in susceptible and resistant barley and bread wheat genotypes. After leaf inoculation, the virus infected the root system and the growing point of susceptible earlier than resistant barley genotypes. No difference in virus movement occurred in resistant and susceptible wheat genotypes. It was possible to reliably differentiate susceptible from resistant genotypes when root extracts of 41 barley genotypes were tested by DAS-ELISA 3 or 4 days after inoculation at the oneleaf stage. When barley plants inoculated at the two- or three-leaf stage were assayed by tissue-blot ELISA on nitrocellulose membrane, virus was detected in the phloem vessels of the growing points of the susceptible, but not of the resistant genotype, 4-6 days after inoculation. Our results thus suggest that screening for BYDV resistance in barley could be done quickly and cheaply especially when assays are made by the tissue-blot test. [References: 14].

471 Manninger, K. (1994) DIVERSITY AND VIRULENCE OF PUCCINIA-RECONDITA IN HUNGARY DURING 1990-1992. *Cereal Research Communications*. 22(3):219-226. English. [HUNGARIAN ACAD SCI INST PLANT PROTECT H-1361 BUDAPEST 5 HUNGARY].

Wheat leaf rust disease, caused by *Puccinia recondita* f. sp. *tritici* was found every year at the wheat country areas in Hungary during 1990-1992, and became the most important wheat disease. The main races in the population were the races 77 and 61. The proportion of the sporadic races in the population increased from 2.6% to 8.6% in the last three years. From Hungarian leaf rust populations 50 virulence forms (pathotypes) of wheat leaf rust have been isolated, among them 20 pathotypes belong to race 77. More than 70 % of the cultures were virulent on lines with genes Lr1, Lr2a, Lr2b, Lr2c, Lr3, Lr3ka, Lr13, Lr14a, Lr14b, Lr16, Lr17, Lr18, Lr20, Lr22, LrB and LrCIFF. Genes for resistance Lr15, Lr23, Lr24 were effective to all survey cultures tested. Resistance genes Lr9, Lr10, Lr12 were effective to 65-75% of isolates in the seedling plants. New pathotypes have been found virulent on the near isogenic backcross lines with genes Lr10, Lr19 and Lr25. The increasing number of sporadic races and the new virulence genes in the population confirmed the increase of virulence of wheat leaf rust pathogen.

472 Manninger, K. (1994) SURVEY OF VIRULENCE GENES IN WHEAT STEM RUST IN HUNGARY DURING 1989-1991. *Cereal Research Communications*. 22(3):227-234. English. [HUNGARIAN ACAD SCI INST PLANT PROTECT H-1361 BUDAPEST 5 HUNGARY].

Stem rust disease, caused by *Puccinia graminis* f. sp. *tritici* occurred sporadically every year in Hungary during 1989-1991. The main races, identified by Stakman method, in the population were the races 1, 11, 34, and 218. Races 17, 21 and 126 were in the population in traces. The stem rust population was stable during this period, new race was not found. From the above races 24 pathotypes have been identified by 23 single gene lines at this time. The all cultures were virulent on lines with gene Sr7b. Single genes for resistance Sr22, Sr24, Sr31, Sr32, Sr33 and Sr36 were effective to all survey cultures tested. Among these resistance genes are Sr31 and Sr36 the most important resistance genes for Hungarian wheat varieties.

473 Matijevic, D. (Institut za zastitu bilja i zivotnu sredinu, Beograd (Yugoslavia)) (1993) [Effect of the different dosages of fungicides on barley seed germination and germination energy]. *Uticaj razlicitih doza fungicida na klijavost i energiju klijanja semena jecma. Pesticidi (Yugoslavia)* v. 8(3) p. 103-112. 9 tables; 10 ref. Serbian. (AGRI 94-109457).

In this paper the effect of different fungicides on barley seed germination and germination energy was tested. The obtained results demonstrate that at the most of investigated barley strains, treated by these fungicides, there is no negative effect on seed germination. The increased dosages of some investigated preparations cause the decrease or increase of the germination. The preparations which showed the negative

influence on the germination energy of barley seed have in their formulation the active ingredients from the groups of triazol and imidazol.

474 Matijevic, D.; Gavran, M. (Institut za zastitu bilja i zivotnu sredinu, Beograd (Yugoslavia)) (1993) [Testing fungicides toxicity on germination of the *Cochliobolus sativus* fungi conidia]. *Ispitivanje toksicnosti fungicida na klijavost konidija gljiva Cochliobolus sativus. Zastita bilja (Yugoslavia)* v. 44(203) p. 21-30. 5 graphs; 3 tables; 37 ref. Serbian. (AGRI 94-109661).

Cochliobolus sativus is particularly significant since it is attacking most of the plants from the family of grasses and especially wheat and barley. This work dealt with the toxicity of 28 fungicides and their effects on germination of the *Cochliobolus sativus* fungi conidia. According to the results expressed in LD50 values, the toxicity of fungicides is wide in range from 0.44 mg/L to 10.000 mg/L. As far as toxicity effects on germination of *Cochliobolus sativus* fungi conidia is concerned, the most prominent are the fungicides with contact properties. The systemic fungicides from the trial group, have demonstrated lower toxicity on the conidia of this fungi, with LD95 values unequalling the applied quantities.

475 Mendoza Zamora, Cecilio; Ponce Gonzalez, Francisco; Carrillo, Armando (Universidad Autonoma Chapingo, Chapingo, Mex., (Mexico). Departamento de Parasitologia Agricola, Chapingo, Mex., 56230) (1992) [Chemical control of barley stripe rust (*Puccinia striiformis* West.) in Hidalgo, Mexico and Tlaxcala States]. *Control quimico de la roya linea amarilla (Puccinia striiformis West.) de la cebada en los estados de Hidalgo, Mexico y Tlaxcala. Revista Mexicana de Fitopatologia (Mexico)* v. 10(1) p. 69-71. 2 cuadros; 5 ref. Spanish. (AGRI 94-119480).

Tebuconazol, Propiconazol and Tetraconazol behaved statistically similar in the control of barley stripe rust in Chapingo, Mex. Tebuconazol and Tetraconazol (125 ml. i.a./ha) were the best treatments in Apan, Hidalgo. Only Tebuconazol (125 ml i.a./ha) was effective in La Union, Tlaxcala.

476 Milovanovic, M.; Stojanovic, S. (Institut za istrazivanja u poljoprivredi "Srbija", Kragujevac (Yugoslavia). Centar za strna zita) (1992) [Triticale reaction to some prominent parasites (*Erysiphe graminis tritici*, *Puccinia recondita tritici*, *Puccinia graminis tritici*, *Septoria* spp. and *Fusarium* spp.)]. *Reakcija Triticale prema vaznijim parazitima (Erysiphe graminis tritici, Puccinia recondita tritici, Puccinia graminis tritici, Septoria spp. i Fusarium spp.)*. *Zastita bilja (Yugoslavia)* v. 43(202) p. 249-255. 1 table; 33 ref. Serbian. (AGRI 94-109438).

The resistance of the mature plants of 18 Triticale genotypes to pathogens was tested. The obtained results showed that Triticale was more resistant to more diseases than wheat. There were genotypes resistant and the genotypes sensitive to *Puccinia recondita tritici* and *Puccinia graminis tritici*. Triticale was less resistant to the causers of leaf rust and leaf spot than to the powdery mildew. A complex resistance to the powdery mildew, leaf and stalk rust was found. As far as the leaf spot is concerned, both the resistant and sensitive genotypes were noticed. There were no genotypes immune to *Fusarium* spp.

477 Mojasevic, M.; Kovacevic, D.; Vuksa, P.; Miletic, N. (Poljoprivrednu fakultet, Beograd (Yugoslavia). Institut za zastitu bilja i prehrambenih proizvoda) (1993) [Dissipation rate of fungicide triadimefon in wheat]. *Brzina iscezavanja fungicida triadimefona u pšenici. Pesticidi (Yugoslavia)* v. 8(2) p. 77-80. 3 graphs; 14 ref. Serbian. (AGRI 94-109443).

Dynamics of the system of triadimefon fungicide vanishing from a cob and grain wheat has been tested. An average deposit of triadimefon on/in a wheat cob was relatively equal in two years of their investigation and observations: 1.03 - 1.33 mg/kg in micro experiments, i.e. 0.99 - 1.54 mg/kg in macro experiments. In all treated samples, the seventh day after their application the quantity of triadimefon was reduced to 40 in comparison to deposit. The content of this fungicide in samples was below maximally permitted quantity (0.3 mg/kg) fourteen days later. The rests of triadimefon can be seen in wheat during the harvest and are on the level of the discovered quantity in controlled samples.

478 Nair, MG.; Chandra, A.; Thorogood, DL.; Ammermann, E.; Walker, N.; Kiehs, K. (1994) GOPALAMICIN, AN ANTIFUNGAL MACRODIOLIDE PRODUCED BY SOIL ACTINOMYCETES. *Journal of Agricultural & Food Chemistry*. 42(10):2308-2310. English. [MICHIGAN STATE UNIV DEPT HORT BIOACT NAT PROD LAB E LANSING, MI 48824 USA].

Gopalamycin, an antifungal antibiotic, was isolated from the cells of two actinomycetes, MSU-625 and MSU-616. Gopalamycin is structurally similar to salbomycin and elaiophycin. Gopalamycin completely inhibited the growth of all pathogenic fungi tested in vitro at 12-16 ppm. Similarly, it was somewhat effective in controlling wheat powdery mildew, grape downy mildew, and rice blast pathogens in greenhouse experiments. Gopalamycin was ineffective against all Gram-positive and -negative bacteria tested. [References: 9].

479 Nakajima, T.; Abe, J. (1994) DEVELOPMENT OF RESISTANCE TO MICRODOCHIUM NIVALE IN WINTER WHEAT DURING AUTUMN AND DECLINE OF THE RESISTANCE UNDER SNOW. *Canadian Journal of Botany-Revue Canadienne de Botanique*. 72(8):1211-1215. English. [TOHOKU NATL AGR EXPTL STN MORIOKA IWATE 02001 JAPAN].

The effect of autumn climate on the development of resistance to pink snow mold (*Microdochium nivale*) in winter wheat was estimated in mid-December. Changes in resistance over time under snow cover were also determined. Resistance in December was closely correlated with the accumulated degree-days above 0 degrees C from sowing. The number of days of incubation at which 50% of the plants are killed (LI(50)) was lowest in the cool autumn in 1988 and highest in the warm autumn in 1989. Temperatures below 5 degrees C were also required for expression of resistance. Differences in LI(50) between resistant and susceptible cultivars were most apparent in late autumn. Continuous snow cover was found to reduce resistance to pink snow mold. The rate of decline of the resistance in cv. Nanbukomugi during the winters under snow was lower than in cv. PI 173438 and cv. Kitakomugi. The resistance to pink snow mold was correlated with the amount of etiolated growth at 25 degrees C. This indicates that exhaustion of food reserves during prolonged snow cover predisposed wheat plants to snow mold diseases. [References: 20].

480 Nirenberg, H.I.; Schmitzsherie, H.; Kling, C.I. (1994) OCCURRENCE OF FUSARIA AND SOME BLACKENING MOULDS ON DURUM WHEAT IN GERMANY .1. INCIDENCE OF FUSARIUM SPECIES. *Zeitschrift für Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection*. 101(5):449-459. German. [BIOL BUNDESANSTALT LAND & FORSTWIRTSCHAFT INST MIKROBIOL KONIGIN LUISE STR 19 D-14195 BERLIN GERMANY].

In 1985-1987, at growth stage 87 (hard dough) and 92 (caryopsis hard) Fusarium-infected grains of two cultivars of durum wheat ('Grandur', 'Mondur') from control plots without fungicide treatment of field trials at four locations: Köln-Wahn (North Rhine-Westphalia), Herxheim (Rhineland-Palatinate), Ludwigsburg (Baden-Württemberg), and Hannover (Lower Saxony), were counted; in 1987, the halm bases at stages 87 were also examined. The following Fusarium species were identified. They are listed in order of decreasing frequency: Fusarium avenaceum, F. graminearum, F. nivale (= *Microdochium nivale*) and F. culmorum, but only rarely F. poae, F. tricinctum, F. cerealis, F. sporotrichoides, F. equiseti and F. lateritium. In 1985 F. nivale, in 1986 F. graminearum, and in 1987 F. avenaceum were the dominating species. Distinct differences in the occurrence of the fungi at the different locations due to temperature, rainfall and previous crop could be recognized. On the halm bases, F. equiseti, F. avenaceum, F. culmorum, F. flocciferum, F. nivale, F. graminearum and F. tricinctum occurred most often; F. merismoides, F. oxysporum, F. venenatum, and F. solani were recorded in low numbers. No correlation between counts of Fusarium species on infected halm bases and on infected grains could be found. [References: 14].

481 Obst, A. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau, Muenchen (Germany). Abt. Pflanzenschutz) (1994) [Septoria on wheat leaves - identification of symptoms - new methods]. *Septoria - Befallsermittlung auf neuen Wegen. Pflanzenschutz-Praxis (Germany)* (no. 2). p. 39-41. 6 ill., 1 table. German. (AGRI 94-119545).

482 Oku, T. (Tokyo Univ. (Japan). Faculty of Agriculture); Tsuchizaki, T. (1992) Virulence analysis of wheat (*Triticum aestivum*) powdery mildew fungus population by mobile nurseries. *Annals of the Phytopathological Society of Japan (Japan)* v. 58(5) p. 752-756. 3 tables; 17 ref. Japanese. (AGRI 94-119551).

483 Reglinski, T.; Lyon, G.D.; Newton, A.C. (1994) INDUCTION OF RESISTANCE MECHANISMS IN BARLEY BY YEAST-DERIVED

ELICITORS. *Annals of Applied Biology*. 124(3):509-517. English. [SCOTTISH CROP RES INST DUNDEE DD2 5DA SCOTLAND].

Yeast cell-wall extracts (YE) had high phytoalexin elicitor activity on soybeans and induced resistance against barley powdery mildew in the normally highly susceptible cv. Golden Promise. Following treatment with YE there was rapid stimulation of phenylalanine ammonia-lyase (PAL) activity and faster formation of papillae in response to attempted fungal penetration. The spray adjuvants Agral and LI-700 each had poor phytoalexin elicitor activity and caused a slight enhancement of papilla formation and a low level of mildew control. The addition of the adjuvant to YE did not affect phytoalexin elicitation on soybeans but significantly enhanced the speed and the extent of PAL activity, papilla formation and mildew control. It is proposed that this is due to greater coverage and improved persistence enabling increased uptake of YE into the barley leaves. [References: 35].

484 Rengel, Z.; Graham, R.D.; Pedler, J.F. (1994) TIME-COURSE OF BIOSYNTHESIS OF PHENOLICS AND LIGNIN IN ROOTS OF WHEAT GENOTYPES DIFFERING IN MANGANESE EFFICIENCY AND RESISTANCE TO TAKE-ALL FUNGUS. *Annals of Botany*. 74(5):471-477. English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

Inhibition of lignin biosynthesis in *Triticum aestivum* L. roots by Mn deficiency has been suggested as the mechanism of reduced resistance of Mn-deficient wheat roots to infection by the take-all fungus (*Gaeumannomyces graminis* var. *tritici*). This study evaluated phenolics and lignin accumulation in roots of wheat genotypes differing in Mn efficiency (measured as growth and yield in Mn-deficient soils) and take-all resistance. Seedlings of the Mn-inefficient, take-all sensitive genotype Bayonet and the Mn-efficient, more take-all resistant genotype C8MM were grown in nutrient solution without added Mn for 18 d and then transferred to a Mn-deficient sandy soil fertilized with Mn at 0 or 30 mg kg⁻¹. Both genotypes had Mn-deficient roots and shoots at the time of transfer to the soil. Roots of both genotypes were inoculated with the take-all fungus 0, 1, 3 and 7 d after transfer. Twenty-four hours after inoculation, take-all fungus penetrated the root stele of take-all sensitive Bayonet but not of more resistant C8MM wheat. Rates of phenolics and lignin accumulation in roots declined steadily during growth in soil for up to 8 d, were higher in mature, fully differentiated parts of the root system compared to distal, younger root tissue, and were higher in Bayonet than in C8MM. Manganese fertilization did not significantly influence rates of phenolics and lignin accumulation but reduced depth of radial penetration by hyphae in both genotypes. The rate of phenolics accumulation was positively ($r = 0.91$ to 0.96) correlated with the rate of lignin accumulation. Mn-efficient C8MM had a higher rate of lignin accumulation per unit of phenolics than Mn-inefficient Bayonet over a wide range of phenolics synthesis rates. From this we suggest that C8MM has a more efficient mechanism for conversion of phenolics to lignin, the trait which appears related to higher take-all resistance of this genotype. [References: 26].

485 Roelfs, A.P. (USDA ARS, Cereal Rust Laboratory, St. Paul, Minnesota, U.S.A.) (1992) [Advances and understanding of rust resistance]. [Avances y entendimiento de la resistencia a royas]. Primera conferencia nacional sobre la producción de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicación Especial. Centro de Investigación Regional del Noroeste (Mexico)*; no. 4 p. 313-332. Centro de Investigación Regional del Noroeste. 6 tablas; 34 ref. 2o. tomo. English. (AGRI 94-119411).

486 Roelfs, A.P.; Huertaespino, J. (1994) SEEDLING RESISTANCE IN HORDEUM TO BARLEY STRIPE RUST FROM TEXAS. *Plant Disease* 78(11):1046-1049. English. [UNIV MINNESOTA USDA ARS CEREAL RUST LAB ST PAUL, MN 55108 USA].

Stripe rust of barley was recently found in Texas, and the pathogen has been reported to be virulent to U.S. barley cultivars. The stripe rust isolate collected in Texas was used to evaluate the resistance of barley cultivars, germ plasm, and other *Hordeum* species. Limited sources of resistance were found; most were from two of the five primary barley-growing areas. The resistance traces to Czechoslovakia and Ethiopia land cultivars and to the cultivar Derr Winter of unknown origin. The U.S. cultivars with

seedling resistance were Barsoy, Betzes, Boxer, Clayton, Compana, Custer, Hazen, Hudson, Kamiak, Kenate, Keowee, Maury, Norbert, and Vanguard. These cultivars represent a range of types that could be a starting point in breeding for resistance. No resistance was found in the economically valuable six-row spring malting type of the north central states. The two most common wild barleys of the Great Plains, *H. jubatum* and *H. pusillum*, were both susceptible to the stripe rust culture used; neither is likely to be a host during the non-crop-growing season. [References: 7].

487 Royle, D.J. (1994) UNDERSTANDING AND PREDICTING EPIDEMICS - A COMMENTARY BASED ON SELECTED PATHOSYSTEMS. *Plant Pathology*, 43(5):777-789. English. [UNIV BRISTOL DEPT AGR SCI INST ARABLE CROPS RES LONG ASHTON RES STN BRISTOL BS18 9AF AVON ENGLAND].

488 Saini, R.S. (Haryana Agricultural Univ. (India)); Chawla, H.K.L.; Wagle, D.S. (1993) Studies on enzymatic activities and leakage of solutes from wheat (*Triticum aestivum*) leaf during an early course of differential brown rust pathogenesis. *Wheat Information Service (Japan)* (no.76) p. 27-31. 2 tables; 17 ref. English. (AGRI 94-119548).

489 Saini, R.S.; Chawla, H.K.L.; Wagle, D.S. (1994) FATTY ACIDS COMPOSITIONS OF POLAR AND NON-POLAR LIPID FRACTIONS OF WHEAT LEAVES INOCULATED WITH 3 BROWN RUST RACES DURING PROGRESSIVE PATHOGENESIS. *Biologia Plantarum*, 36(3):469-475. English.

The fatty acids composition of the polar and non-polar lipid fractions of wheat leaves was affected due to progressive brown rust infection during early stages of pathogenesis, i.e. 0, 12, 24, 36, 48 and 72 h after inoculation. The three races of *Puccinia recondita* differentially affected the composition of saturated and unsaturated fatty acids and their relative occurrence in wheat leaves. The infection of wheat by race 77 resulted in a relative decrease in fatty acid chain length as measured through C16:C18 fatty acid ratio. An increase in the relative degree of unsaturation (18:2/18:3 acids ratio) was recorded in both lipid fractions. Such changes may be taken as one of the earliest characteristics of disease development.

490 Schilder, A.M.C.; Bergstrom, G.C. (1994) PYRENOPHORA-TRITICI-REPENTIS AS A COMPONENT OF THE FUNGAL FLORA OF WINTER WHEAT SEED IN NEW-YORK. *Seed Science & Technology*, 22(2):285-297. English. [CORNELL UNIV DEPT PLANT PATHOL ITHACA, NY 14853 USA].

Pyrenophora tritici-repentis incites tan spot, a common foliar disease of soft white winter wheat in New York. Since seedborne inoculum is suspected of playing a role in the epidemiology of the disease, an assessment was made of the occurrence of *P. tritici-repentis* among the fungal flora of soft white winter wheat seed in New York in 1990 and 1991. The fungus was recovered from 54% of the seed lots in 1990 and from 36% of the seed lots in 1991, infecting an average of 2.1% and 0.6% of the seeds, respectively. Seed infection by fungal pathogens was generally low in 1991. *Alternaria* spp. were the fungi most commonly associated with soft white winter wheat seed in both years. *Stagonospora nodorum*, *Epicoccum nigrum*, and various *Fusarium* spp. were also prevalent, especially in 1990. Mycelium of *P. tritici-repentis* was detected by culturing and light microscopy in all layers of the pericarp of the wheat seed, but not in the seed coat or in the embryo. Surface infestation of the seed by conidia and conidiophores was minimal.

491 Schmidt, G.; Boyle, C.; Aust, H.J.; Wagner, K.G. (1994) ADENOSINE ADENINE-CONTAINING NUCLEOTIDES IN THE LEAVES AND ROOTS OF YOUNG BARLEY PLANTS AFTER INFECTION OF THE PRIMARY LEAF BY Erysiphe graminis. *Journal of Phytopathology. Phytopathologische Zeitschrift*, 141(4):402-414. English. [TECH UNIV CAROLO WILHELMINA BRAUNSCHWEIG BIOZENTRUM INST MIKROBIOL SPIELMANNSTR 7 D-38106 BRAUNSCHWEIG GERMANY].

The levels of adenosine, the adenine nucleotides AMP, ADP, ATP, as well as NAD, NADP, protein and chlorophyll were determined in young barley plants of which the primary leaves were infected by *Erysiphe graminis* DC. f. sp. *hordei* MARCHAL. The largest changes of these metabolite levels, compared to the non-infected control, occurred in the infected leaf and to a lesser degree also in the roots and in healthy younger leaves. The increase in the levels of most metabolites in the primary leaf revealed the sink property of this infected tissue and possible stress or

defence reactions of the host, whereas the reductions in the roots showed the impaired supply of this natural sink organ due to the infection. Changes in the healthy leaves were most pronounced in the tertiary leaf and may reflect metabolic stimulation in that healthy organ. The changes of the adenosine pool, a precursor of the adenine nucleotides, were discussed in terms of translocation and its possible role as a precursor for fungal purine nucleotide synthesis. [References: 41].

492 Shen Xiaorong (Jiangsu Provincial Academy of Agricultural Sciences, Nanjing (China). Inst. of Agrobiological Genetics and Physiology); Zhang Zhongting (1993) A preliminary report on random amplified polymorphic DNA (RAPD) analysis of wheat cultivars resistant and susceptible to scab. *Jiangsu Journal of Agricultural Sciences (China)* v. 9(4) p. 50-52. 2 ill., 5 ref. Chinese. (AGRI 94-119540).

493 Shirako, Y.; Wilson, T.M.A. (1993) Complete nucleotide sequence and organization of the bipartite RNA genome of soil-borne wheat mosaic virus. *Virology (USA)* v. 195(1) p. 16-32. references. English. (AGRI 94-109433).

The complete nucleotide sequences of RNAs 1 and 2 of soil-borne wheat mosaic virus (SBWMV), type member of the furovirus group, were determined. RNA 1 is 7099 nucleotides (nt) and encodes a 150-kDa protein from the 5' end region, the UGA termination codon of which can be partially read through to produce a 209-kDa protein, and a 37-kDa protein in the 3' end region. The C-terminal region of the 150-kDa protein contains an NTP-binding helicase motif and the readthrough region, an RNA polymerase motif, indicating that these two overlapping proteins may form an RNA replication complex similar to those of tobamovirus and tobamoviruses. The 37-kDa protein has sequence similarity with the cell-to-cell transport protein of dianthoviruses. RNA 2 is 3593 nt and, from the 5' end region, encodes the 19-kDa capsid protein, whose UGA termination codon can be partially suppressed to produce an 84-kDa readthrough protein and, at the 3' proximity, a 19-kDa protein which is rich in cysteine residues. The 28K (kilodaltons, as estimated by SDS-PAGE) protein, previously considered as another capsid read through product, is apparently initiated at an in-frame non-AUG codon upstream from the capsid protein gene. In both RNAs 1 and 2, the 5' terminus is capped, and the 3' untranslated region possibly forms internal consecutive pseudoknots as found in tobamovirus RNA as well as a terminal tRNA-like structure similar to tymovirus RNA. An amino acid sequence comparison of RNA replicase genes indicates that, phylogenetically, SBWMV belongs to a cluster formed by tobamovirus, tobamovirus, and hordeviruses. Differences in the 3' end structure and in the cell-to-cell movement protein, and the distant phylogeny of the RNA replicase genes of SBWMV and beet necrotic yellow vein virus, suggest that the furoviruses should be divided into at least two groups.

494 Stephens, P.M.; Davoren, C.W.; Ryder, M.H.; Doube, B.M.; Correll, R.L. (1994) FIELD EVIDENCE FOR REDUCED SEVERITY OF RHIZOCTONIA BARE-PATCH DISEASE OF WHEAT, DUE TO THE PRESENCE OF THE EARTHWORMS APORRECTODEA-ROSEA AND APORRECTODEA-TRAPEZOIDES. *Soil Biology & Biochemistry*, 26(11):1495-1500. English. [CSIRO COOPERAT RES CTR SOIL & LAND MANAGEMENT PRIVATE BAG 2 GLEN OSMOND SA 5064 AUSTRALIA].

A study demonstrated the ability of the earthworms *Aporrectodea rosea* and *Aporrectodea trapezoides* (added at an equivalent density of 100 or 300 m⁻²) to reduce the disease severity of *Rhizoctonia solani* Kuhn on wheat in the field. In a calcareous sandy loam artificially infested with *R. solani*, the addition of these earthworms caused a significant ($P = 0.02$) reduction of the *Rhizoctonia* root disease rating and had a significant ($P = 0.01$) positive effect on shoot weight. Neither earthworm number or earthworm species had a significant ($P < 0.05$) effect on root disease rating or shoot weight. In a red-brown earth soil artificially infested with *R. solani*, neither the presence of these earthworms, earthworm species nor earthworm number influenced root disease rating. However, under these conditions the addition of earthworms ($P = 0.01$) had a significant positive effect upon shoot weight. To our knowledge these results demonstrate for the first time, the potential of earthworms to contribute to the disease suppression of a cropping soil in a field situation. [References: 34].

495 Stojanovic, S. (Institut za istrazivanja u poljoprivredi "Srbija". Kragujevac (Yugoslavia). Centar za strna zita); Stojanovic, J.; Jevtic, R.

Jerkovic, Z. (1992) [The international program wheat varieties (IWWPMP) resistance to the powdery mildew causing agent - *Erysiphe graminis*]. Otpornost sorata pšenice iz Internacionalnog programa (IWWPMP) prema prouzrokovacu pepelnice - *Erysiphe graminis*. Zastita bilja (Yugoslavia) v. 43(202) p. 239-247. 4 tables; 11 ref. Serbian. (AGRI 94-109442).

Investigations have revealed that not all the varieties included in International Winter Wheat Powdery Mildew Program (IWWPMP) are resistant to powdery mildew. In the three years of investigations (1990-1992) at the two localities in Serbia (Yugoslavia), the number of resistant and susceptible varieties has been approximately the same. The different reactions of individual genotypes that varied from year to year and from one locality to another caused by specific ecological conditions and virulence of the parasite population have been established. Effectiveness of the individual Pm resistance genes was not satisfactory.

496 Tinline, RD. (1994) ETIOLOGY OF PREMATURE BLIGHT OF HARD RED SPRING WHEAT AND DURUM WHEAT IN SASKATCHEWAN. *Canadian Journal of Plant Pathology-Revue Canadienne de Phytopathologie*. 16(2):87-92. English. [AGR CANADA RES STN 107 SCI PL SASKATOON SK S7N 0X2 CANADA].

The dominant pathogens isolated from wheat plants exhibiting premature blight in commercial fields in Saskatchewan were *Cochliobolus sativus* and *Fusarium culmorum*. Only *F. culmorum* was obtained from blighted oat plants. In growth chamber tests, wheat plants inoculated at the tillering stage with isolates of each of the fungi developed common root rot. Prematurity blight developed in some of these plants, particularly when they were subjected to moisture stress for 6-12 days at the flag leaf or boot stage. Under comparable conditions, *F. culmorum* caused a higher incidence of premature blight than *C. sativus*. However, the latter is the prevalent cause of common root rot in the field and consequently both fungi are considered to be important agents of premature blight. Cultivars differed in reaction to premature blight initiated by *F. culmorum*. *Triticum durum* cvs. Coulter and Wakooma appeared to be more resistant than Hercules, Pelissier, and Wascana, and the *T. aestivum* cvs. Columbus, Neepawa, and Sinton were more resistant than Wascana durum wheat. It is concluded that premature blight in this region is a severe manifestation of common root rot and that this blight is akin to fusarium crown rot in other areas.

497 Torres T, Enrique (CIMMYT); Figueroa Lopez, Pedro (INIFAP. C.E. Valle del Yaqui, Ap. Postal 515, 85270 Cd. Obregon, Sonora (Mexico)) (1992) [Research on karnal bunt and its effects on wheat in Mexico]. La investigacion de carbon parcial de trigo en Mexico. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 361-368. Centro de Investigacion Regional del Noroeste. 4 tablas; 5 ref. 2o. tomo. Spanish. (AGRI 94-119414).

498 Tosa, Y. (1994) GENE-FOR-GENE INTERACTIONS BETWEEN THE RYE MILDEW FUNGUS AND WHEAT CULTIVARS. *Genome*. 37(5):758-762. English. [KOCHI UNIV FAC AGR NANKOKU KOCHI 783 JAPAN].

Genetic mechanisms of the incompatibility between *Erysiphe graminis* f.sp. *secalis* and wheat cultivars were analyzed using F-1 hybrids between *E. graminis* f.sp. *secalis*, Sk-1, and f.sp. *tritici*, Tk-1. The avirulence of Sk-1 on *Triticum aestivum* 'Norin 4', 'Chinese Spring', and 'Kokeshi-komugi' was controlled by a single gene. The resistance of the three cultivars to Sk-1 was also controlled by a single gene, Pm15, a gene for resistance to *E. graminis* f.sp. *agropyri*. Implications of these results were discussed in terms of host-parasite coevolution. [References: 12].

499 Wildermuth, GB.; Mcnamara, RB. (1994) TESTING WHEAT SEEDLINGS FOR RESISTANCE TO CROWN ROT CAUSED BY FUSARIUM-GRAMINEARUM GROUP-1. *Plant Disease*. 78(10):949-953. English. [QUEENSLAND WHEAT RES INST POB 2282 TOOWOOMBA 4350 AUSTRALIA].

Resistance to crown rot of wheat caused by *Fusarium graminearum* Group 1 is currently measured in mature plants that have been grown in inoculated soil in the field. This technique is laborious and time-

consuming, and a faster technique is desired. Seedlings of different cultivars of wheat were grown in steam-air treated soil inoculated with a band of wheat-barley grain colonized by *F. graminearum*. Plants were grown at 13, 19, and 25 C; and after 22 days the sheaths of leaves 1, 2, and 3 were rated for the extent of necrotic lesions. At each temperature, this rating was positively correlated with disease ratings of the same cultivars grown in the field. At 25 C, the correlation coefficient between seedling and mature plant ratings of 28 cultivars was 0.78 (P less-than-or-equal-to 0.01). This close relationship gives confidence that seedlings can be used to measure resistance to crown rot. Use of seedlings will speed the selection of resistant progeny in wheat breeding programs where resistance to crown rot is an objective. [References: 17].

500 Yang, HA.; Sivassithamparam, K.; Alemohammad, J.; Barton, JE.; Obrien, PA. (1994) ASSOCIATION OF RHIZOCTONIA STRAINS WITH BARE PATCH DISEASE OF WHEAT IN WESTERN AUSTRALIA. *Plant Pathology*. 43(5):878-884. English. [UNIV WESTERN AUSTRALIA SCH AGR NEDLANDS WA 6009 AUSTRALIA].

Rhizoctonia-like fungi were isolated from the roots of diseased wheat plants sampled from the centre and periphery of three bare patches, and from apparently healthy plants from outside the patches. Of the isolates recovered, 81% were multinucleate and belonged to *R. solani* anastomosis group 8, and pectic zymogram group 1-1; the remaining isolates were binucleate *Rhizoctonia* spp. The multinucleate isolates could be grouped into highly virulent, intermediately virulent, and weakly virulent types. The binucleate isolates were all non-pathogenic. The multinucleate isolates were obtained at a significantly higher frequency from plants within the patches compared with outside the patches, and with the exception of a single isolate, the highly virulent isolates were not found outside the patches. The weakly virulent isolates were present at much lower frequencies than the highly virulent and intermediately virulent forms within the patches. The frequency of occurrence of binucleate isolates did not vary significantly among the locations sampled. None of the multinucleate isolates contained plasmids. Some of the isolates contained a prominent single dsRNA species and one or more minor dsRNA species. The distribution of these dsRNAs was not correlated with pathogenicity. [References: 21].

501 Yarham, DJ.; Pye, D. (1994) COPPER BASED FUNGICIDES FOR THE CONTROL OF BUNT (TILLETIA-CARIES) IN WHEAT. *Annals of Applied Biology*. 124(Suppl 5):40-41. English. [AGR DEV & ADVISORY SERV PLANT DIAGNOST LAB CAMBRIDGE CB2 2PT ENGLAND].

502 Zhang, HS.; Delarosa, R.; Rubiales, D.; Lubbers, HH.; Molenveld, JW.; Niks, RE (1994) ROLE OF PARTIAL RESISTANCE TO PUCCINIA HORDEI IN BARLEY IN THE DEFENCE OF BARLEY TO INAPPROPRIATE RUST FUNGI. *Physiological & Molecular Plant Pathology*. 45(3):219-228. English. [AGR UNIV WAGENINGEN DEPT PLANT BREEDING 6700 AJ WAGENINGEN NETHERLANDS].

The partial resistance (PR) of barley to *Puccinia hordei* and the non-host reaction to inappropriate rust fungi are both based on a pre-haustorial barrier. It has been suggested that genes for PR in barley also confer resistance to inappropriate rust fungi. This hypothesis was tested by determining the correlation between the level of PR to *P. hordei* and the level of resistance to two inappropriate rust species in barley seedlings. The latent period of *P. hordei* and infectibility by *P. recondita* f.sp. *tritici* and by *P. hordei-murini* showed continuous segregation among the F-8 lines derived from two crosses between barley lines. The significant correlation between these parameters suggests that genes for partial resistance to *P. hordei* in barley play a role in the resistance to *P. recondita* f.sp. *tritici*. There is evidence, however, that a large part of the genetic variation between the lines for resistance to *P. recondita* f.sp. *tritici* and to *P. hordei-murini* is not associated with the determination of the latent period of *P. hordei*. Lines with relative susceptibility to *P. recondita* f.sp. *tritici* also tended to be relatively susceptible to *P. hordei-murini*. These results indicate that some of the genes for resistance segregating in the progenies studied in this work are effective against more than one rust fungal species. [References: 20].

503 Zwatz, B. (Bundesanstalt fuer Pflanzenschutz, Wien (Austria)) (1994) [Minimization of chemical protection by the use of resistant varieties]. Minimierung des chemischen Pflanzenschutzes durch Nutzung

resistenter Sorten. *Genetika a Slechteni - UZPI (Czech Republic) v. 30(2) p. 151-156. 3 graph., 2 tables. German. (AGRI 94-109453).*

There exist realistic possibilities of reducing fungicide application in cereals by using resistant varieties. It has been confirmed that these varieties can guarantee similarly high yields and quality as the susceptible ones, but without fungicide application. Resistant - low input - varieties form a basis of the integrated plant production and protection. The situation in plant protection in Austria requires further improvement with regard to its future membership in the European Union.

H50 MISCELLANEOUS PLANT DISORDERS

504 Ali, A.A. (Monoufeya Univ., Shebin El Kom (Egypt). Faculty of Agriculture) (1993) Effect of nitrogen nutrition and ethephon on lodging and yield of wheat (*Triticum aestivum* L.). *Menofiya Journal of Agricultural Research (Egypt) v. 18(4 part 1) p. 2225-2234. 2 tables; 11 ref. English. (AGRI 94-109813).*

505 Carr, S.J.; Ritchie, G.P. (1994) INTERACTING EFFECTS OF TOPSOIL WATER AND NITROGEN SUPPLY ON SUBSOIL ALUMINIUM TOXICITY. *Communications in Soil Science & Plant Analysis. 25(19-20):3335-3356. English. [DEPT AGR BARON HAY COURT S PERTH WA 6151 AUSTRALIA].*

The interacting effects between topsoil water supply, nitrogen (N) placement and subsoil aluminum (Al) toxicity on wheat growth were studied in two split-root pot experiments. The native nitrate-N ($\text{NO}_3\text{-N}$) in the topsoil used in each experiment differed and were designated as high (3706 μM) and low (687 μM) for experiments one and two, respectively. Wheat was grown in pots that enabled the root system to be split so that half of the roots were in topsoil and the other half were in subsoils containing varying concentrations of soluble Al. Treatments were imposed which varied the supply of water to the topsoil (either 'wet' or 'dry'). Placement of applied N in either the topsoil or subsoil had little effect on either shoot or root fresh weight, or on the length of roots produced in the subsoil section of the split pots. When water supply to the topsoil was decreased, both shoot and root growth of wheat declined and the yield decrease increased with subsoil Al. In the high-N experiment, wheat grown in the low Al subsoil with the high native soluble subsoil (NO_3 (3002 μM)) was able to exploit the N and subsoil water, hence both shoot and root growth increased considerably in comparison to shoot and root growth of wheat grown in soils containing higher concentrations of subsoil Al. When the native NO_3 was lower (i.e. the low-N experiment) inadequate root proliferation restricted the ability of plants to use subsoil N and water irrespective of subsoil Al. The results from this study suggest that wheat, grown on yellow earths with Al-toxic subsoils, will suffer yield reductions when the topsoil dries out (e.g. in the spring when winter rainfall ceases) because subsoil reserves of water and nitrogen are under utilised. [References: 27].

506 Crook, M.J.; Ernos, A.R. (1994) STEM AND ROOT CHARACTERISTICS ASSOCIATED WITH LODGING RESISTANCE IN 4 WINTER WHEAT CULTIVARS. *Journal of Agricultural Science. 123(Part 2):167-174. English. [UNIV MANCHESTER DEPT ENVIRONM BIOL WILLIAMSON BLDG OXFORD RD MANCHESTER M13 9PT LANCS ENGLAND].*

The effects of root and shoot characteristics on the lodging resistance of four cultivars of winter wheat were investigated by combining results from a field trial (set up at Manchester University's Experimental Grounds, Jodrell Bank, in mid-September 1991) with morphological and mechanical measurements on their stems and anchorage systems. Cultivars showed contrasting lodging resistance: Widgeon was most susceptible, followed by Galahad, Riband and Hereward which, alone, did not lodge. Lodging resistance was not related to the strength and stiffness of the stems, which were usually adequate to withstand the forces to which they were subjected. Most plants instead failed in their root system which rotated through the soil. Resistance was associated with short and light stems (and hence on the force applied to the plants by wind and gravity) and with high values of the anchorage strength of the root system (and hence on the force resisting lodging). Lodging occurred during grain filling when the ears were heaviest and when the soil was wet. The anchorage strength of a plant depended on two characteristics of the root system: the bending strength and the angle of spread of the basal coronal roots. Plants with

stronger, more widely spread coronal roots produced larger soil cones during anchorage failure and resisted larger forces. Future breeding for lodging resistance, therefore, should continue to select for plants with shorter stems and with stiffer, more widely spread, coronal roots. [References: 15].

507 Doty, J.A.; Kennedy, A.C.; Pan, W.L. (1994) RAPID BIOASSAY FOR INHIBITORY RHIZOBACTERIA USING DIGITAL IMAGE ANALYSIS. *Soil Science Society of America Journal. 58(6):1699-1701. English. [WASHINGTON STATE UNIV USDA ARS 215 JOHNSON HALL PULLMAN, WA 99164 USA].*

Current methods for assaying the potential effects of rhizobacteria on plant growth are tedious and time consuming. A rapid, automated bioassay has been developed using a flatbed scanner and digital image analysis. Comparisons were made between manual measurements of root length and computed values based on an edge discrimination image analysis procedure. The assay consisted of bacterial cultures or filtrates added to 18 ml of 0.9% agar in square petri plates. Seeds were planted along a marked axis and incubated for 4 d at 15 degrees C, and then the roots were measured. Total root length measurements for the two methods, manual and image analysis, were well correlated ($r(2) = 0.94$), and both were equally able to identify bacteria inhibitory to plant growth. Root measurements by the scan method were five times faster than the manual method. Each sample required 53 s to read with the scan method vs. 250 s with the manual method. The scan method provides a quick and accurate method for screening inhibitory activity of rhizobacteria based on seedling root length and has potential in the screening of toxic substances of other origin. [References: 19].

508 Gruters, U.; Fangmeier, A.; Jager, H.J. (1995) MODELLING STOMATAL RESPONSES OF SPRING WHEAT (*TRITICUM AESTIVUM* L. CV TURBO) TO OZONE AND DIFFERENT LEVELS OF WATER SUPPLY. *Environmental Pollution. 87(2):141-149. English. [INST PFLANZENOKOL HEINRICH BUFF RING 38 D-35392 GIESSEN GERMANY].*

Spring wheat (*Triticum aestivum* L. cv. Turbo) was exposed to different levels of ozone and water supply in open-top chambers in 1991. Air was charcoal filtered (CF), non-filtered (NF) and CF plus proportional addition of ambient or twice ambient ozone (CF1, CF2). Seasonal means of O₃, taken over 24 h, were 2.3, 20.6, 17.3, and 34.5 nl litre(-1) for CF, NF, CF1 and CF2 treatments, respectively. A split-plot design was used to obtain two levels of water supply. one-half of the pots was irrigated sufficiently not to show any symptoms of drought stress, the others were exposed to low water supply and received 50% of these amounts. Using a steady-state porometer approximately 800 measurements of stomatal conductance ($g(s)$) were made on flag leaves from 68 to 106 days after sowing. The measurements yielded only small differences of maximum conductance between the two levels of water supply. Therefore, low water supply did not protect wheat plants against ozone injury via reduced stomatal uptake in this experiment. To describe the effects of environmental variables on the stomatal behaviour, boundary-line analysis and non-linear regression analysis were used. Besides microclimatic parameters, the ozone dose of flag leaves was introduced as an independent variable affecting stomatal aperture. A well-defined boundary line for ozone dose was found, suggesting that increasing ozone dose caused stomatal closure in wheat flag leaves. But at high ozone doses, co-acting senescence seems also responsible for the decrease in stomatal conductance. A multiplicative boundary-line model was used to predict stomatal conductance from combinations of environmental variables. In the test carried out with the measurements of stomatal conductance, the model accounted only for 40% of the variation of $g(s)$. Generalized stomatal response patterns of the herbaceous growth form, the dependence of the variables' age and ozone dose and the lack of an important factor influencing stomatal response (water status of the plant) in the model, are suggested as explanations of the poor results of the test. [References: 28].

509 Habekuss, A. (Bundesanstalt fuer Zuechtungsforschung und Kulturpflanzen, Aschersleben (Germany)); Obst, A. (1994) [News to ml-onet blotch on barley]. *Neues zu ml-o-Blattflecken bei Sommergerste. Pflanzenschutz-Praxis (Germany) (no.2) p. 42-44. 7 ill. German. (AGRI 94-119857).*

510 Hao Luning; Yu Shuwen (Academia Sinica, Shanghai (China). Shanghai Inst. of Plant Physiology) (1993) The response of Ca^{2+} transport system of barley root plasma membrane to salinity stress. *Acta Phytophysiological Sinica (China)* v. 19(3) p. 275-284. 5 ill., 5 tables, 10 ref. Chinese. (AGRS 94-119856).

511 Issa, AA.; Abdalla, MH.; Mahmoud, ALE. (1994) EFFECT OF BIOLOGICAL TREATMENTS ON GROWTH AND SOME METABOLIC ACTIVITIES OF BARLEY PLANTS GROWN IN SALINE SOIL. *Microbiological Research*. 149(3):317-320. English. [UNIV ASSIUT FAC SCI DEPT BOT ASSIUT EGYPT].

The ability of different microorganisms to alleviate the noxious effect of salinity was tested. Barley grains were planted under salt stress and were inoculated with cyanobacteria, *Pseudomonas fluorescens* and *Dunaliella tertiolecta*. All tested microorganisms improved growth of barley plants as indicated by dry weight, photosynthetic pigments and vitality of the plants. Cyanobacterial inoculant was the most effective and significantly diminished the adverse effect of salinity. Results of the present study hold promise for use of such microorganisms to cultivate plants in saline soils.

512 Kock, M.; Stajner, D.; Gasic, O.; Schlee, D. (1994) ALACHLOR-INDUCED CHANGES OF SUPEROXIDE DISMUTASE ACTIVITY IN SEEDS AND YOUNG PLANTS OF WHEAT (*TRITICUM AESTIVUM*). *Biologia*. 49(3):365-370. English. [MARTIN LUTHER UNIV HALLE WITTENBERG INST BIOCHEM DEPT GEN & PLANT BIOCHEM WEINBERGWEG 16A D-06099 HALLE GERMANY].

Relative activities of superoxide dismutase (SOD) and pigment contents have been determined in crude extracts of wheat seeds and leaves treated with the herbicide alachlor (0.05 to 50 ppm). The contents of all pigments in leaves of 21-day-old plants were lowered by the action of alachlor and in dependence on its concentration. As compared to the controls, the contents of chlorophyll a, chlorophyll b and carotenoids decreased to 63.5%, 69% and 95%, respectively. While SOD activity decreased to the half in swollen seeds at the highest alachlor concentration, in leaves of 21-day-old plants the activity reached the fivefold value at an intermediate concentration (5 ppm) and dropped to the control level at the highest concentration (50 ppm). Using native polyacrylamide electrophoresis, SOD isoforms were separated and determined in different tissues. Inhibition studies revealed the existence of two Cu/Zn enzymes and one Mn containing enzyme. Incubation of germinating seeds with alachlor as well as a 21-day treatment of young plants did not alter the isoenzyme pattern of SOD in seeds and green leaves.

513 Liu Wan; Liu Youliang (Nanjing Agricultural Univ., Jiangsu (China). Dept. of Agronomy) (1993) Stress of Na^+ , Cl^- and tolerable leaf Cl^- content in barley seedlings. *Journal of Nanjing Agricultural University (China)* v. 16(3) p. 15-19. 3 ill., 3 tables, 8 ref. Chinese. (AGRS 94-119855).

The ratio of Na^+/Cl^- in roots was higher than that in leaves of two barley varieties with different salt tolerance under NaCl , Na^+ and Cl^- stresses of the same osmotic potential. Na^+ content in leaves was lower and Cl^- content in leaves was higher than that in roots. Ionic damage to plant cells under Na^+ stress was greater than that under Cl^- stress. The lethal Cl^- content of leaf cells was 4.2-4.8 mmol/g DW. Under NaCl stress, Cl^- content in roots of the two varieties was about 20% of that in whole plant. Cl^- content in roots and shoots of Tanyin No.2 was lower than that of Keping No.7 due to less Cl^- uptake in Tanyin No.2.

514 Lu Zhuxiang; Wang Zhenggang (Nanjing Univ. (China). Dept. of Biology) (1993) The influence of calcium on distribution of inorganic ions and membrane fatty acids in roots of *Triticum aestivum* seedlings under salt stress. *Acta Phytophysiological Sinica (China)* v. 19(4) p. 325-332. 5 ill., 2 tables, 18 ref. Chinese. (AGRS 94-119880).

515 Mansour, MMF. (1994) CHANGES IN GROWTH, OSMOTIC POTENTIAL AND CELL PERMEABILITY OF WHEAT CULTIVARS UNDER SALT STRESS. *Biologia Plantarum*. 36(3):429-434. English. [AIN SHAMS UNIV FAC SCI DEPT BOT CAIRO 11566 EGYPT].

10-d-old wheat seedlings were grown hydroponically in presence and absence of 100 mM NaCl for 7 d. Salt stress decreased growth of shoots and roots of both cultivars; fresh mass of sensitive cultivar being more affected. NaCl increased membrane permeability to urea, methylurea and ethylurea and decreased membrane partiality in root cortex cells of sensitive cultivar. Neither parameter changed by NaCl in resistant

cultivar. NaCl treatment decreased water permeability and osmotic potential in both cultivars; sensitive cultivar was more affected. The results extend our previous data that cell membrane properties are different in salt sensitive and resistant genotypes and so cell permeability could be a potential trait indicating salt tolerance.

516 Mansour, MMF.; Vanhasselt, PR.; Kuiper, PJC. (1994) PLASMA MEMBRANE LIPID ALTERATIONS INDUCED BY NaCl IN WINTER WHEAT ROOTS. *Physiologia Plantarum*. 92(3):473-478. English. [UNIV GRONINGEN DEPT PLANT BIOL POB 14 9750 AA HAREN NETHERLANDS].

A highly enriched plasma membrane fraction was isolated by two phase partitioning from wheat roots (*Triticum aestivum* L. cv. Vivant) grown with and without 100 mM NaCl . The lipids of the plasma membrane fraction were extracted and characterized. Phosphatidylcholine and phosphatidylethanolamine were the major phospholipids with lesser amounts of phosphatidylinositol, phosphatidylglycerol, diphosphatidylglycerol, phosphatidic acid and phosphatidylserine. NaCl decreased the total phospholipids and the phosphatidylcholine portion of the plasma membranes. Salt treatment had no effect on total sterols and glycolipids, but the relative abundance of the free sterols was altered: cholesterol, stigmasterol and brassicasterol were significantly increased. Salt treatment resulted in an increase of the more planar/less planar ratio of the free sterols and in introduction of a double bond in the C-22 position in the side chain of stigmasterol and brassicasterol. The degree of fatty acid saturation of total phospholipids, phosphatidylcholine and phosphatidylethanolamine was increased after salt treatment. These lipid changes are discussed in relation to the salt tolerance mechanism. [References: 36].

517 Mortensen, L.; Engvild, KC. (1995) EFFECTS OF OZONE ON C-14 TRANSLOCATION VELOCITY AND GROWTH OF SPRING WHEAT (*TRITICUM AESTIVUM* L.) EXPOSED IN OPEN-TOP CHAMBERS. *Environmental Pollution*. 87(2):135-140. English. [NATL ENVIRONM RES INST DEPT EMISS & AIR POLLUT FREDERIKSBORGVGE] 399 DK-4000 ROSKILDE DENMARK].

Growth and yield were reduced but C-14 translocation velocity was not affected by increasing levels of ozone in spring wheat exposed in open top chambers to the following treatments: charcoal filtered air (CF), non-filtered ambient air (NF), or NF with addition of 30 $\mu\text{mol litre}^{-1}$ ozone, 8 h daily (NFO). Destructive harvests were performed at anthesis and at maturity. Parts of the flag leaf or the second leaf were exposed to $(\text{CO}_2)\text{-C-14}$ in small cuvettes for 5 min before, during and after anthesis. The translocation velocity was followed by autoradiography and scintillation counting of the plants frozen and lyophilized at different times after labelling. The label was transported at the same velocity in all the treatments. Ozone induced changes in carbon allocation or partitioning should probably be explained as amounts of carbon transported (mg s^{-1}), rather than as transportation velocity (mm s^{-1}). The amount translocated may be governed by source conditions under O-3 stress: reduced healthy green biomass and photosynthesis, but perhaps also by impairment of phloem loading because of membrane damage. [References: 30].

518 Orr, J.P.; Canevari, M.; Jackson, L. (1993) Influence of postemergence herbicides on three wheat varieties by stage of growth. *Proceedings (USA)* (no. 45th) p. 14-17. Paper presented at the Conference on "Weeds and People, Putting Weed Management in Perspective," January 18-20, 1993, Costa Mesa, California. English. (AGRS 94-109799).

519 Porter, DR.; Nguyen, HT.; Burke, JJ. (1994) QUANTIFYING ACQUIRED THERMAL TOLERANCE IN WINTER WHEAT. *Crop Science*. 34(6):1686-1689. English. [USDA ARS PLANT SCI & WATER CONSERVAT LAB 1301 N WESTERN ST STILLWATER, OK 74075 USA].

High temperature stress limits productivity of winter wheat (*Triticum aestivum* L.) in many environments. Identification of thermal tolerant germplasm is needed to improve plant productivity under heat stress. In this study we used 2, 3, 5-triphenyltetrazolium chloride (TTC) reduction, an indicator of mitochondrial activity, to characterize cultivar differences for acquired thermal tolerance in winter wheat. Seven-day-old seedlings of six hard red winter wheat cultivars grown at 25 degrees C were acclimated at 37 degrees C for 24 h followed by a 50 degrees C incubation for 2 h. Leaf sections sampled after each temperature treatment were infiltrated with TTC and the resultant formazan was ethanol-extracted for optical density

measurement at 530 nm. Under these test conditions, the TTC assay detected differential tolerance (expressed as percent cell viability of the 50 degrees C treated tissue compared to the 37 degrees C treated tissue) which ranged from a low of 6% for 'Siouxland', to a high of 72% for 'TAM 108'. The results of this study show that TTC reduction can be used to measure differences in acquired thermal tolerance in winter wheat. [References: 13].

520 Reggiani, R.; Bozo, S.; Bertani, A. (1994) CHANGES IN POLYAMINE METABOLISM IN SEEDLINGS OF THREE WHEAT (TRITICUM AESTIVUM L.) CULTIVARS DIFFERING IN SALT SENSITIVITY. *Plant Science*. 102(2):121-126. English. [CNR IST BIOSINTESI VEGETALI VIA BASSINI 15 I-20133 MILAN ITALY].

Germination is a developmental stage extremely sensitive to salinity. We studied the effects of three regimes of salinity (50, 100 and 150 mM NaCl) on polyamine (PA) metabolism during the germination of seeds of three wheat (*Triticum aestivum* L.) cultivars. These three genotypes exhibited inhibition of germination by salt, in the following order: Ardenica > Agimi > Dajti. The presence of salt decreased the putrescine (Put) level, especially in roots. On the contrary, the levels of spermidine (Spd) and spermine (Spm) were increased by salt with a greater effect in shoot. A positive correlation with the growth inhibition of the three cultivars was observed for the level of Spd and Spm and, even better, for the PA/diamine ratio. Feeding experiments with [C-14]Put showed that, in the presence of 150 mM NaCl, Ardenica tissues synthesize more PAs than Dajti tissues. The effect of salinity on PA metabolism and the use of PAs as markers of salt sensitivity in wheat seedlings are discussed. [References: 23].

521 Roldan, H. (SELGEN, Stupice (Czech Republic). Slechtitelska Stanice); Blaha, L. (1994) [Tolerance of wheat varieties to low pH and to aluminium ions]. Hodnoceni tolerance pšenice k nizke hodnote pH a k toxicite hlinitých iontu. *Genetika a Slechteni - UZPI (Czech Republic)* v. 30(2) p. 89-97. 4 ill., 4 tables; 10 ref. Czech. (AGRIS 94-109812).

Six varieties of spring and winter wheats of Czech and Slovak origin (Regina, Sparta, Sida, Maja, Ilona, Linda) were tested at a high level of soluble aluminium (40 ppm) at low pH (4.5) by the method of hematoxylin staining of roots. The aim was to compare the results obtained at two experimental sites in two different environments (growth chamber and room growth conditions). A high tolerance was confirmed in the check variety Atlas 66 and, on the other hand, a high degree of susceptibility was found in Maja. The intermediate degrees of tolerance achieved by Regina, Ilona, Sparta and Sida varied to some extent. Hydroponic cultivation in small plastic containers filled with fine-grained quartz sand, with a stressed and a non-stressed variant, and hydroponic cultivation in glass cylinders (also filled with fine grained sand) were carried out. These two complementary tests were performed to find out potential differences in the reaction of genotypes to the mentioned stress factors at different growth stages. In both of them, the highest tolerance degree was shown by Atlas 66; the most sensitive variety in the plastic containers test was Linda, and in the test with glass cylinders Maja, but the difference between them was not significant. The intermediate levels of tolerance showed certain variability.

522 Singh, S.; Malik, RK. (1994) EVALUATION OF MON-13200 AGAINST WEEDS IN COTTON AND ASSESSMENT OF RESIDUAL EFFECTS ON WHEAT AND FODDER OATS. *Annals of Applied Biology*. 124(Suppl 5):46-47. English. [HARYANA AGR UNIV DEPT AGRON HISAR 125004 HARYANA INDIA].

523 Singh, S.; Malik, RK.; Balyan, RS. (1994) EFFECTS OF METHOD OF INCORPORATION OF MON-13200 AND TRIFLURALIN ON WEEDS IN COTTON AND RESIDUAL EFFECTS OF THE HERBICIDE TREATMENTS ON WHEAT AND SUNFLOWER. *Annals of Applied Biology* 124(Suppl 5):48-49. English. [HARYANA AGR UNIV DEPT AGRON HISAR 125004 HARYANA INDIA].

524 Sutka, J. (1994) GENETIC CONTROL OF FROST TOLERANCE IN WHEAT (TRITICUM AESTIVUM L.). *Euphytica*. 77(3):277-282. English. [HUNGARIAN ACAD SCI AGR RES INST H-2462 MARTONVASAR HUNGARY].

The frost tolerance of winter wheat is one component of winter hardiness. If seedlings are frost resistant, it means that they can survive the

frost effect without any considerable damage. To study the genetic control of frost tolerance, an artificial freezing test was used. Frost tolerance is controlled by an additive-dominance system. The results of diallel analyses indicate the importance of both additive and non-additive gene action in the inheritance of this character. The dominant genes act in the direction of lower frost tolerance and the recessive genes in the direction of a higher level of frost tolerance. The results of monosomic and substitution analyses show that at least 10 of the 21 pairs of chromosomes are involved in the control of frost tolerance and winter hardiness. Chromosomes 5A and 5D have been implicated most frequently. The gene Fr1 (Frost 1) was located on the long arm of chromosome 5A. Crosses between cultivars, chromosome manipulation and the induction of somaclonal variation may be suitable methods for broadening the gene pool for frost tolerance. [References: 19].

525 Taylor, GJ.; Macfie, SM. (1994) MODELING THE POTENTIAL FOR BORON AMELIORATION OF ALUMINUM TOXICITY USING THE WEIBULL FUNCTION. *Canadian Journal of Botany-Revue Canadienne de Botanique*. 72(8):1187-1196. English. [UNIV ALBERTA DEPT BOT EDMONTON T6G 2E9 AB CANADA].

Several recent reports have suggested that boron (B) may alleviate the toxic effects of aluminum (Al) on plant growth, providing improved plant performance on acid soils. To test this hypothesis, an Al-sensitive cultivar of *Triticum aestivum* L. (cv. Neepawa) was grown in solution culture with 10 concentrations of Al (0-300 μ M), in the presence of deficient (0 μ M), sufficient (6 μ M), luxury (75 μ M), or toxic (750 μ M) concentrations of B. The effects of both Al and B on the response of roots and leaves to Al was accurately modeled ($R^2 < 0.99$) using a modified Weibull function. Comparison of best fit function parameters for the response to Al under varying conditions of B supply failed to reveal any evidence of B amelioration of Al toxicity. The combined effects of Al and B were adequately explained by a multiplicative model. Although formation of stable Al-berate complexes could occur in growth solutions under our experimental conditions, varying the supply of B had little effect on accumulation of Al in roots and leaves. In contrast, increasing Al concentrations in solution resulted in increased immobilization of B in roots and decreased accumulation of B in leaves. Growth of plants with elevated B supply resulted in higher concentrations of B in roots and leaves without improving growth. We suggest that previous reports of B amelioration of Al toxicity must reflect the unique characteristics of soil-based media, and (or) differences among species in internal requirements for B and the effects of Al on B nutrition. [References: 15].

526 Tsvetkov, KS. (1994) TOLERANCE OF TRITICALE CV VIHREN (2N=6X=42) TO THE TOXICITY OF ALUMINUM. *Cereal Research Communications*. 22(3):257-263. English. [WHEAT & SUNFLOWER INST GEN TOSHEVO BULGARIA].

About 450, 000 hectares arable land in the foothill and mountain region, and some flat and hilly location of North and South Bulgaria are characterized by acid soil and low yields have been obtained by wheat, barley, maize, sunflower. It has been established that the cultivar of triticale "Vihren" shows a marked tolerance to the soil acidity. According to the data of State Varietal Testing on the average for three years (1984-1986) cv. "Vihren" yielded 13, 3% more than cv. "Sadovo 1", winter common wheat, in Vrabevo and Lesnovo regions with acid soils (pH=4.0-4.5). In laboratory conditions, the first depression in the root development was found at considerably higher concentration of Al^{3+} (30 ppm) in nutrient solution, where as in cv. "Sadovo 1" it was between 10-15 ppm. Our data indicated that the tolerance of cv. "Vihren" to the soil acidity was expressed in a weak depressive effect of aluminum-fulvate compounds on the uptake of P-32. It may grow in the regions mentioned above and could significantly increase grain yields.

527 Waern, P. (Statens Jordbruksverk, Uppsala (Sweden). Vaextskyddsentralen) (1994) [Physiological leaf spots of winter wheat]. Fysiologiska bladfläckar i höstvetete? *Vaextskyddsnotiser (Sweden)* v. 58(1) p. 10-14. 7 ref. Swedish. (AGRIS 94-109815).

528 Warden, MR.; Kettlewell, PS. (1994) EVALUATION OF GLYCEROL AS AN ADDITIVE FOR REDUCING LEAF SCORCH FROM FOLIAR APPLIED UREA IN WINTER WHEAT. *Annals of Applied Biology* 124(Suppl 5):76-77. English. [HARPER ADAMS AGR COLL CROP & ENVIRONM RES CTR NEWPORT TF10 8NB SHROPS ENGLAND].

529 Yao Dongrui; Zheng Xiaoming (Jiangsu Provincial Academy of Agricultural Sciences, Nanjing (China). Inst. of Plant Protection); Xue Yuegui (1993) A comparative study on the tolerance to diclofop-methyl between darnel (*Lolium temulentum* L.) and wheat (*Triticum aestivum*). *Jiangsu Journal of Agricultural Sciences (China)* v. 9(4) p. 22-25. 4 ill., 8 ref. Chinese. (AGRS 94-119879).

H60 WEEDS

530 Balyan, RS.; Singh, S.; Malik, RK. (1994) EVALUATION OF MON-13200 AND CHLORIMURON IN SOYBEAN AND OF RESIDUAL EFFECTS OF THE HERBICIDES ON WHEAT. *Annals of Applied Biology*. 124(Suppl 5):50-51. English. [HARYANA AGR UNIV DEPT AGRON HISAR 125004 HARYANA INDIA].

531 Beres, I.; Sardi, K. (1994) GERMINATION OF WINTER WHEAT AND 2 CEREAL WEEDS AS EFFECTED BY FERTILIZERS. *Novenytermeles*. 43(3):211-220. Hungarian. [PANNON UNIV AGR SCI KESZTHELY HUNGARY].

The effect of the aqueous solutions of ammonium nitrate (20, 4% N), ammonium sulphate, carbamide, ammonium nitrate (34% N), potassium sulphate, potassium chloride, triple phosphate and superphosphate fertilizers (calculated to active agents of N, P₂O₅ and K₂O) in concentrations of 10, 100 and 1000 ppm was studied on the germination of winter wheat (*Triticum aestivum* L.), variety Mv 15, and two cereal weeds, *Galium aparine* L. and *Matricaria inodora* L. The treatments were applied in 5 replications, at 22-degrees-C, for 21 days. Of the fertilizers tested only the carbamide in concentration of 1000 ppm inhibited significantly the germination of wheat, when a decline of 20% was observed. Each fertilizer had a decreasing effect on the germination of *Galium aparine*. The greatest inhibiting effect was observed in 1000 ppm concentration of carbamide, which caused an inhibition of 100% in germination. The germination of seeds of *Matricaria inodora* increased by 30-34% on the effect of fertilizers with nitrate contents, while it declined by 12-14% with phosphate fertilizers. Based on the results of the experiments it was stated that the fertilizers tested influenced the germination of wheat seeds only to a small extent. The germination of the two weed seeds were, however, essentially influenced by the fertilizers, a fact providing a potential tool in the integrated weed control.

532 Berti, A.; Zanin, G. (1994) DENSITY EQUIVALENT - A METHOD FOR FORECASTING YIELD LOSS CAUSED BY MIXED WEED POPULATIONS. *Weed Research*. 34(5):327-332. English. [UNIV PADUA CNR CTR STUDIO DISERBANTI VIA GRADENIGO 6 I-35131 PADUA ITALY].

A method to evaluate potential crop damage from multi-species weed infestations is presented. The method is based on the hyperbolic relationships between density of a single weed species and crop yield loss. When considering a mixed weed population, the density of each species is transformed into a Density Equivalent, defined as the density that is equal to the density of a reference species giving the same yield loss. A hypothetical species with i and a parameters both equal to 100 was adopted to describe the relationship between yield and reference density. The method has been evaluated with data from a 2-year experiment on soybean (*Glycine mar* (L.) Merrill) grown in mixtures with *Xanthium strumarium* L. subsp. *italicum*, *Polygonum persicaria* L. and *Panicum miliaceum* L. The mixtures included seven weed densities with different proportions of the three weed species. The model described the data well, but it showed an average 7.5% overestimation of crop damage. The reasons for this overestimation and the utility of the model in weed management is discussed. [References: 18].

533 Carranza, P.; Garcia Torres, L. (Consejo Superior de Investigaciones Científicas, Madrid (España). Instituto de Agricultura Sostenible); Saavedra, M. (1993) [Estimation losses caused by *Ridolfia segetum* Moris competition in wheat crops using the potential biomass parameter]. Estimacion de las pérdidas ocasionadas por *Ridolfia segetum* Moris en trigo mediante el uso del parametro biomasa potencial. Congreso 1993 de la Sociedad Española de Malherbología; Lugo (España); 1-3 Dic 1993. [Proceedings of 1993 Meeting of the Spanish Society for Weed Control, Lugo, 1-3 Dec 1993]. *Actas del Congreso 1993 de la Sociedad Española de Malherbología*.

Lugo, 1-3 Dic 1993. Sociedad Española de Malherbología, Madrid (España) P. 279-284. SEM. 1 fig., 3 tab.; 7 ref. Spanish. (AGRS 94-119999).

534 Darwent, AL.; Townleysmith, L.; Lefkovitch, LP. (1994) COMPARISON OF TIME AND DEPTH OF LAST TILLAGE ON THE GROWTH OF CANADA THISTLE (*CIRSIIUM ARVENSE*) IN SUMMERFALLOW AND ITS RESPONSE TO GLYPHOSATE. *Canadian Journal of Plant Science*. 74(4):867-873. English. [AGR & AGRIPOOD CANADA RES STN POB 29 BEAVERTON TOH 0C0 AB CANADA].

Field studies were conducted in summerfallow in 1990 and 1991 at Bezanson, Alberta Oat. 55 degrees 14'N, long. 118 degrees 22'W, and Melfort, Saskatchewan Oat. 52 degrees 52'N, long. 104 degrees 36'W, to compare the development of Canada thistle [*Cirsium arvense* (L.) Scop.] shoots following the discontinuance of normal tillage at three times (19 July, 30-31 July and 9-12 Aug.), at three depths (0, 10 and 20 cm), and its response to glyphosate applied at 0.9 kg ha⁻¹ 40 d after the last tillage (DALT). The tillage treatments had no consistent effect on shoot density when measured at 40 DALT at either location. At Bezanson, small increases (<5%) in shoot density occurred between 20 and 40 DALT where tillage was conducted at the shallowest depth, but increases of approximately 20-90% occurred during the same period following tillage at the 10 or 20-cm depth. The proportion of emerged shoots remaining as rosettes at 40 DALT increased as the time of discontinuing tillage was delayed. At Bezanson, the proportion of emerged shoots remaining as rosettes at 40 DALT increased from 0.17 +/- 0.05 to 0.59 +/- 0.02 when the time of discontinuing tillage was delayed from mid-July to early August, while at Melfort an increase from 0.47 +/- 0.04 to 0.93 +/- 0.02 occurred for a similar delay in time of discontinuing tillage. Increasing the depth of last tillage increased the proportion of emerged shoots remaining as rosettes at 40 DALT at Bezanson, but at Melfort the depth of last tillage had no effect on this proportion. The proportion of shoots remaining as rosettes declined between 20 and 40 DALT when measured at Bezanson. Factors causing an increase in the proportion of shoots remaining as rosettes appeared to be associated with exposure of emerged shoots to reduced daylengths. At both Bezanson and Melfort, shoot density measured 1 yr after tillage-glyphosate treatments was similar in all plots. Thus, the proportion of shoots remaining as rosettes at the time of glyphosate application did not appear to influence the response of Canada thistle to the herbicide. [References: 19].

535 Grover, R.; Smith, AE.; Cessna, AJ. (1994) FATE OF BROMOXNYL N-BUTYRATE AND ISO-OCTANOATE APPLIED AS A MIXTURE TO A WHEAT FIELD. *Journal of Environmental Quality*. 23(6):1304-1311. English. [AGR CANADA RES STN ENVIRONM CHEM & APPLICAT HERBICIDES SECT REGINA S4P 3A2 SK CANADA].

Dissipation of bromoxynil (3, 5-dibromo-4-hydroxybenzonitrile), applied as a 1:1 mixture of the n-butyrate and iso-octanoate esters, in the air, crop, and soil components was measured in a spring wheat (*Triticum aestivum* L.) field, both during and following its application. Drift losses during spraying were < 1% of the amount applied, with no phenol derivative being detected in air samples collected during application. Following application, cumulative vapor loss for the n-butyrate and iso-octanoate esters (phenol equivalent, p.e.) over the 5-d postapplication period were estimated to be 16 and 7%, respectively. Little or no free phenol residues were detected in the air above the treated field. The crop canopy intercepted approximately 20% of the application. Ester deposits on plant surfaces were rapidly dissipated with > 75% of the total ester residues on the crop being lost or hydrolyzed 24 h after treatment. There were no detectable residues in the seed or straw at harvest. In the soil, the half-lives of n-butyrate and iso-octanoate were < 1 and similar to 4 d, respectively. Hydrolysis was, however, more rapid under moist soil conditions, with the n-butyrate being converted more rapidly to phenol than the iso-octanoate. Phenol breakdown was also moisture dependent but much slower, with > 95% dissipation occurring only after 8 wk. [References: 22].

536 Hurle, K.; Kemmer, A. (comp.) (1993) [Joint field trials on weed control in cereal crops and maize in Baden-Wuerttemberg in 1993]. Gemeinschaftsversuche Baden-Wuerttemberg 1993. *Berichte aus dem Fachgebiet Herbolgie der Universitaet Hohenheim (Germany)* no. 34: 78 p. ill., tables. German. (AGRS 94-120054).

537 Kreuz, E. (1993) [The late weed infestation in winter wheat stands in relation to intensification of the cultivation and with crop rotation]. Die Späetverunkrautung im Winterweizenbestand in Abhängigkeit von Anbauintensivierung und Fruchtfolge. *Archives of phytopathology and plant protection (Germany)* v. 28(5) p. 379-388. 2 ill., 4 tables; 11 ref. German. (AGRIS 94-120083).

538 Kuhlmann, J. (Landwirtschaftskammer Weser Ems, Oldenburg (Germany). Pflanzenschutzamt); Lueschen, G. (1993) [Weed control in winter cereals in autumn - best application time is after emergence of weed-seeds]. Wenn im Herbst, dann beim Auflaufen der Unkrauter. *Landwirtschaftsblatt Weser-Ems (Germany)* v. 140(37) p. 30-32. 4 ill., 1 table. German. (AGRIS 94-120020).

539 Liu, SH.; Hsiao, AI.; Quick, WA. (1994) INTERACTION BETWEEN IMAZAMETHABENZ AND FENOXAPROP IN WILD OAT CONTROL AND CROP TOLERANCE. *Crop Protection*. 13(7):525-530. English. [UNIV REGINA DEPT BIOL REGINA S4S 0A2 SASKATCHEWAN CANADA].

Greenhouse experiments investigated wild oat (*Avena fatua* L.) control, and crop tolerance of spring and winter wheat (*Triticum aestivum* L.), and durum wheat (*T. turgidum* L.) to applications of imazamethabenz and fenoxaprop. Both regression technique and Colby's analysis showed the interaction between imazamethabenz, either liquid concentrate (LC) or suspension concentrate (SC) formulation, and fenoxaprop to be antagonistic. The antagonism was stronger with imazamethabenz-LC than with imazamethabenz-SC. The effect was greater with higher rates of fenoxaprop or imazamethabenz-SC. A 2 h interval between imazamethabenz-LC application followed by fenoxaprop application overcame the antagonism. The sequence of the split application was important in determining the interaction of these two herbicides. Norstar winter wheat was tolerant to imazamethabenz alone at all rates up to 600 g ha⁻¹ active ingredient (a.i.) but a rate of 600 g ha⁻¹ reduced shoot dry weight of Kyle durum wheat and Katepwa spring wheat. All crop varieties tested were injured by fenoxaprop alone at 100 g a.i. ha⁻¹. Combinations of imazamethabenz and fenoxaprop reduced crop phytotoxicity compared with fenoxaprop alone. [References: 24].

540 Matienzo, M.T.; Sixto, H.; Tadeo, J.L.; Garcia Baudin, J.M. (Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria, Madrid (Espana). Dept. de Proteccion Vegetal) (1993) [Chlortoluron levels in Triticale cultivars "Tajuna" and "Badiel"]. Niveles de Clortoluron en los triticales "Tajuna" y "Badiel". Congreso 1993 de la Sociedad Espanola de Malherbologia; Lugo (Espana); 1-3 Dic 1993. [Proceedings of 1993 Meeting of the Spanish Society for Weed Control, Lugo, 1-3 Dec 1993]. *Actas del Congreso 1993 de la Sociedad Espanola de Malherbologia, Lugo, 1-3 Dic 1993. Sociedad Espanola de Malherbologia, Madrid (Espana)* P. 222-225. SEM. 1 tab.; 13 ref. Spanish. (AGRIS 94-119941).

541 Mazor, A. (1993) Selective weed killers in wheat. Yifat (Israel). *Hassadeh (Israel)* v. 74(2) p. 135-. Hebrew. (AGRIS 94-119973).

542 Ogrjanovic, R.; Stojanovic, S. (Institut za istrazivanja u poljoprivredi "Srbija", Kragujevac (Yugoslavia). Centar za strna zita) (1993) [Effect of herbicides on morphological characteristics and yield of some winter wheat cultivars]. Dejstvo herbicida na morfoloske osobine i prinos nekih sorata ozime pšenice. 9. jugoslovenski simpozijum o zastiti bilja; Vrnjacka Banja (Yugoslavia); 1-5 Dec 1992. *Pesticidi (Yugoslavia)* v. 8(3) p. 117-121. 5 tables; 27 ref. Serbian. (AGRIS 94-109900).

This paper deals with hormone herbicides and their influence on different sorts of winter wheat. It has been shown that all varieties are, mainly, tolerant on applied herbicides. The advantage in application should be given to herbicides with wide spectre of influence on weeds, such as are the following combinations: mekoprop + 2, 4-D, dihalprop + mekoprop + MCPA, and 2, 4-D + MCPA + mekoprop. Production of wheat with herbicide application is economically justified although the yield of the examined varieties on land treated by herbicides is considerably bigger in relation to the control. The yield is less on plots of land where the weeds have been removed in mechanic way (weeding control).

543 Rapparini, G. (Bologna Univ. (Italy). Centro di Fitofarmacia) (1994) [The post-emergency treatments of wheat and of minor cereals]. I trattamenti di post-emergenza del frumento e dei cereali minori.

Informatore Agrario (Italy) v. 50(4) p. 61-68. 1 table. Italian. (AGRIS 94-109949).

544 Rouchaud, J.; Gustin, F.; Callens, D.; Vanhimme, M.; Bulcke, R. (1994) FORMATION AND PERSISTENCE OF METABOLITES OF IMAZAMETHABENZ-METHYL IN A SANDY LOAM SOIL *Weed Research*. 34(5):309-317. English. [UNIV CATHOLIQUE LOUVAIN PHYTOPHARM LAB B-1348 LOUVAIN BELGIUM].

The fate of imazamethabenz-methyl was studied in a sandy loam soil after application in spring to winter wheat (*Triticum aestivum* L.). Imazamethabenz-methyl and its metabolite 2 (2-(4, 5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-H-1-imidazol-2-yl)-4-methylbenzoic acid, in mixture with the 5-methylbenzoic acid isomer) were further transformed into the metabolites 3 (2-(4, 5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-H-1-imidazol-2-yl)-1, 4-benzenedicarboxylic acid, in mixture with the 1, 5-benzenedicarboxylic acid isomer), and 4 (1, 2, 4-benzenetricarboxylic acid, in mixture with the 1, 2, 5-isomer). Metabolites 3 and 4 reached maximum concentration levels in the 0-13 cm layer corresponding to 14-17% and 9-14% of the imazamethabenz-methyl dose, respectively. These maxima were reached between 105 and 177 days after application. Imazamethabenz-methyl metabolism was slower in plots treated with organic fertilizers than in untreated plots. After 196 days the concentrations of all metabolites in the 0-13 cm layer had declined to, at most, 0.01 mg kg⁻¹. There was no carry-over of residues that could be phytotoxic to the next crop. [References: 8].

545 Tal, A. (1993) The effect of timing the control of graminaceous weeds on the yield of unirrigated wheat in the Negev. Hebrew Univ., Rehovot (Israel). Faculty of Agriculture, Dept. of Field Crops. *Hassadeh (Israel)* v. 74(3) p. 245-248. 5 tables, 1 diagram. Hebrew. (AGRIS 94-119974).

546 Walter, A.; Romheld, V.; Marschner, H.; Mori, S. (1994) IS THE RELEASE OF PHYTOSIDEROPHORES IN ZINC-DEFICIENT WHEAT PLANTS A RESPONSE TO IMPAIRED IRON UTILIZATION. *Physiologia Plantarum*. 92(3):493-500. English. [UNIV HOHENHEIM INST PFLANZENERNÄHRUNG 330 D-70593 STUTTGART GERMANY].

The effect of zinc nutritional status on the time course of phytosiderophore release, and uptake of iron and translocation of iron to the shoot, was studied in nutrient solution cultures for two cultivars of wheat (*Triticum aestivum*, cv. Aroona; *T. durum*, cv. Durati) differing in their susceptibility to zinc deficiency. In the zinc-efficient cultivar Aroona, under zinc deficiency translocation of iron from roots to shoot was significantly decreased in 13- and 15-day-old plants, whereas release of phytosiderophores was enhanced when the plants were 16 days old. As zinc deficiency became more severe in older plants, translocation of iron to the shoot was further decreased and release of phytosiderophores was further enhanced. Resupplying zinc in nutrient solution to zinc-deficient plants significantly increased the translocation of iron to the shoot after 48 and 72 h. Concomitantly, the release of phytosiderophores was repressed. The other cultivar Durati, classified as zinc-inefficient in field observations, differed from cv. Aroona, by showing a lower rate of phytosiderophore release under zinc deficiency, and a less impaired translocation of iron to the shoot. Foliar application of iron citrate to zinc-deficient Aroona plants repressed the release of phytosiderophores and increased iron concentrations in shoot and roots. Application of Fe-55 to the leaves demonstrated that retranslocation of iron from the shoot to the roots was not affected by the zinc nutritional status. It is concluded that enhanced release of phytosiderophores in zinc-deficient wheat plants was induced primarily by impaired translocation of iron to the shoot. [References: 30].

111 HANDLING, TRANSPORT, STORAGE AND PROTECTION OF PLANT PRODUCT

547 Armutage, DM.; Cogan, PM.; Wilkin, DR. (1994) INTEGRATED PEST MANAGEMENT IN STORED GRAIN - COMBINING SURFACE INSECTICIDE TREATMENTS WITH AERATION. *Journal of Stored Products Research*. 30(4):303-319. English. [MAFF CENT SCI LAB LONDON RD SLOUGH SL3 7HJ BERKS ENGLAND].

Three aerated, commercial stores of 5000-10, 000 t of wheat in England were discovered to have surface infestations of *Sitophilus granarius* in

mid-winter when the grain temperature was 4-9-degrees-C. The infestations were monitored using pitfall and probe traps and catches dropped to zero after the application of etrimfos or pirimiphos-methyl 2% dust into the top 0.3 m at 50g/m². The effects of surface treatments in cooled bins were also examined in a farm scale experiment. Six, 20 t bins of wheat, were each aerated at 10 m³/h/t with an 0.02 kW fan and infested with 1/kg each of *S. granarius* and *Oryzaephilus surinamensis* and 0.5/kg of *Cryptolestes ferrugineus* as well as the mites *Glycyphagus destructor* and *Acarus siro*. The surface of three bins were treated with 45 g/m² of 2% pirimiphos-methyl dust. Insect numbers, as determined by pitfall traps and probe traps at the surface, 1 and 2 m, fell in all bins during the winter as temperatures fell to 5-degrees-C. As the bins warmed up in the spring, numbers of *O. surinamensis* rose again in the untreated bins. In the second year, *S. granarius* reached peak numbers in the untreated bins in mid-winter. The much lower numbers of insects trapped in the treated bins were a result of the surface treatment and the few found may have been attributable to migration from the untreated bins. *A. siro* and *G. destructor*, together exceeded 1500/kg at the surface of untreated bins, but were less than 10/kg in treated bins. In the second year, few of either species were found and the predatory mite, *Cheyletus eruditus*, reached 200/kg in all bins, before declining. The experiment showed some of the shortcomings of an integrated pest management system for stored grain, based on cooling, storage at 15% m.c. and monitoring of pest numbers. These were surface populations of mites in the first winter, spring surface re-occurrence of *O. surinamensis* and surface populations of *S. granarius* in the second winter. These were overcome by adding surface admixture to the other elements of the IPM system. The IPM programme cost less than half of the cost of admixing the bulk with the cheapest insecticide and used 10% of the insecticide. [References: 36].

548 Hagstrum, DW.; Dowdy, AK.; Lippert, GE. (1994) EARLY DETECTION OF INSECTS IN STORED WHEAT USING STICKY TRAPS IN BIN HEADSPACE AND PREDICTION OF INFESTATION LEVEL. *Environmental Entomology*. 23(5):1241-1244. English. [USDA ARS GRAIN MKT RES LAB MANHATTAN, KS 66502 USA].

Insect populations in 14 bins of newly harvested wheat on eight farms in Kansas were monitored with sticky traps in the bin headspace and with grain samples. Sticky trap catches during the first 3 wk of storage were used to provide an estimate of the species and densities of insects that were present in the headspace. Grain samples were taken every 2 wk during the first 3 mo of storage to provide an estimate of population growth under the grain temperature and moisture conditions in the bins. The sticky traps correctly predicted whether lesser grain borer, *Rhyzopertha dominica* (F.), and rusty grain beetle, *Cryptolestes ferrugineus* (Stephens), would be found in the grain samples in 85.8 and 78.6% of the bins, respectively. Traps were less reliable for foreign grain beetle, *Ahasverus advena* (Waltl), and hairy fungus beetle, *Typhaea stercorea* (L.), with correct predictions in 57.1 and 42.9% of bins, respectively. Indianmeal moth, *Plodia interpunctella* (Hubner), was found in both traps and grain samples in only one bin and red flour beetle, *Tribolium castaneum* (Herbst), and sawtoothed grain beetle, *Oryzaephilus surinamensis* (L.), were not found in both traps and grain samples in any of the bins. The traps in the center of the bin caught 4.7-14.2 times more beetles than those on the bin walls, but only 1.3 times more *P. interpunctella* adults. The total numbers of *C. ferrugineus* adults in the grain samples could be predicted better from the product of mean grain temperature times maximum grain moisture than from sticky trap catch. [References: 12].

549 Regner, S.; Lindblom, H. (1992) Harvest moisture content, drying procedure and storage - influence on quality of wheat grain. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden. Johansson, H. (ed.)* p. 283. Svalof AB. English. (AGRI 94-110067).

L02 ANIMAL FEEDING

550 Apple, K.; Hutson, A.L.; Lusby, K.S. (1993) Managing the cow-calf herd on wheat pastures. *Circular (USA)*; no. E-916 13 p. English. (AGRI 94-110693).

551 Carrillo Mendez, Luis Enrique (INIFAP. C.E. Valle del Yaqui. Ap. Postal 515. Cd. Obregon, Son. 85270 (Mexico)) (1992) [Nutritional and toxicological evaluation of wheat grain infected by karnal bunt (*Neovossia indica*)]. *Evaluacion nutricional y toxicologica del grano de trigo afectado por carbon parcial (Neovossia indica)*. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. *Conferencia nacional sobre la produccion de trigo en Mexico*. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 379-392. Centro de Investigacion Regional del Noroeste. 5 tablas; 6 ref. 2o. tomo. Spanish. (AGRI 94-120736).

552 Damme, K. (Lehr und Versuchsanstalt fuer Kleintierzucht, Kitzingen (Germany)) (1994) [27th Bavarian Feed Value Performance Test for complete feed and supplementary concentrate for layers]. 27. Bayerische FWLP fuer Legehennen-Alleinfuttermittel und Ergaenger. *Deutsche Gefluogelwirtschaft und Schweineproduktion (Germany)* v. 46(12) p. 6-8. 3 tables. German. (AGRI 94-110781).

553 Emrich, W. (1994) [An alternative? Supplementary feed and cereals in turkey fattening]. *Eine Alternative? Ergaenzungsfutter und Getreide in der Putenmast. Deutsche Gefluogelwirtschaft und Schweineproduktion (Germany)* v. 46(14) p. 6-9. 1 ill., 5 tables. German. (AGRI 94-110785).

554 Haefner, J. (Technische Univ. Muenchen, Freising (Germany). Inst. fuer Ernahrungsphysiologie); Schwarz, F.J.; Kirchessner, M. (1993) [Effects of molassed sugar-beet pulp, corn or a mixture of oats, wheat and soybean meal as supplements to grass silage on the feed intake and milk yield of dairy cows]. *Einfluss von melassierten Trockenschnitzeln, Koernermais oder einem getreidereichem Milchleistungsfutter auf Futteraufnahme und Leistung von Milchkuhen bei Fuetterung von Grassilage. Wirtschaftseigene Futter (Germany)* v. 39(3) p. 201-214. 6 tables; 48 ref. German. (AGRI 94-110613).

555 Hashish, S.M.A. (National Research Centre, Cairo (Egypt). Animal and Poultry Production and Nutrition Dept.); Gropp, J.M. (1992) The effect of using different levels of barley and carbohydrate splitting enzymes on broiler performance and nutrients digestibility. *Journal of Agricultural Sciences, Mansoura Univ. (Egypt)* v. 17(6) p. 2036-2042. 3 tables; 23 ref. English. (AGRI 94-110761).

556 Kraetzl, W.D. (Freie Univ. Berlin (Germany). Fachbereich Veterinaermedizin. Inst. fuer Tierernaehrung); Denell, S.; Nayer, S.; Kamphues, J. (1993) [Effects of intensive cleaning of barley for producing mixed feeds for weaned piglets]. *Untersuchungen zu Effekten einer intensiven Getreidereinigung zur Produktion von Mischfutter fuer die Ferkelaufzucht. Wirtschaftseigene Futter (Germany)* v. 39(3) p. 236-252. 2 ill., 5 tables; 36 ref. German. (AGRI 94-110732).

557 Martinez Ch, Luis Hernan (1993) [Levels of maize replacement for nude oat for broiler raising and fattening]. *Niveles de reemplazo de maiz por cebada desnuda en cria y engorda de pollos de carne*. Concepcion Univ., Chillan (Chile). Fac. de Agronomia. 34 ref. 56 p. Spanish. (AGRI 94-110752).

The purpose of the trial was to evaluate the productive behavior of the broiler chickens in relation to body weight variations, food consumption and feed conversion, when hull-less barley, in different levels was included to replace corn in the ration. Four hundred Hubbard one day old chickens were used, distributed in five treatments in a completely randomized design. The concentrated mixtures were treatment I: 0%; treatment II: 25%; treatment III: 50%; treatment IV: 75% and treatment V: 100%, of hull-less barley substituting corn. Other ingredients in the diet were: soybean meal, wheat middling, fat animal, fish meal, oyster shell, salt, vitamins, minerals, methuonone and coccidiostat. Total average of food intake per chickens was: 4.228, 4.096, 4.009, 3.933 and 3.383 g in treatments I, II, III, IV and V, respectively. The average body weight gain for the chickens were: 1.747, 4; 1.628, 0; 1.572, 8; 1.454, 8 and 1.250, 8 g in treatments I, II, III, IV and V, respectively. Significant differences ($P \leq 0, 0$) were observed among all treatments. Food conversions were: 1. 42; 2. 51; 2. 54; 2. 7 and 2. 7 kg/kg for treatments I, II, III, IV and V, respectively. Significant differences ($P \leq 0, 05$) in treatment III, IV and V. Chickens skin

and tarsus pigmentation decreased when increasing amount of hull-less barley in the ration was included and only chickens with 0 and 25% of hull-less barley had a satisfactory pigmentation. The cost for the rations per kg body weight varied between \$ 172 and \$ 181, 2. The lowest value correspond to treatment without hull-less barley. It can be concluded that the inclusion of hull-less barley in the feed formulation for broilers promoted a decrease in the food consumption, in the body weight gain and the feed conversion.

558 Meng Qingxiang; Xiong Yiqiang (Beijing Agricultural Univ. (China). Dept. of Animal Sciences) (1993) Effects of wheat straw ammoniation and concentrate supplementation on lamb performance. *Acta Veterinaria et Zootechnica Sinica (China)* v. 24(1) p. 23-28. 2 ill., 3 tables, 8 ref. Chinese. (AGRIC 94-120739).

559 Tueller, R. (Versuchsanstalt fuer Gefluesselwirtschaft und Kleintierzucht der Landwirtschaftskammer Rheinland, Grosshuettenhof (Germany)) (1994) [Turkey fattening: Phase feeding "out", wheat feeding "in"?]. *Putenmast: Phasenfuetterung "out", Weizenfuetterung "in"?* *Deutsche Gefluesselwirtschaft und Schweineproduktion (Germany)* v. 46(14) p. 10-11. German. (AGRIC 94-110786).

L51 ANIMAL PHYSIOLOGY-NUTRITION

560 Alciček, A. (1994) [Comparative feeding trials about the influence of different catch crop plants as diet ingredients on nutritive-physiological parameters and fattening performance of lambs]. *Vergleichende Fuetterungsversuche ueber den Einfluss unterschiedlicher Zwischenfrucht-Futterpflanzen als Rationsbestandteil auf ernahrungsphysiologische Parameter und Mastleistung bei Laemmern*. Giessen Univ. (Germany). Fachbereich Agrarwissenschaften. Inst. fuer Tierernaehrung. 14 ill., 95 tables. Bibliography 291 ref. 180 p. German. (AGRIC 94-121396).

561 Rodehutschord, M. (Bonn Univ. (Germany). Inst. fuer Tierernaehrung); Duengelhoeft, M. (1994) [Use of phytase - [this subject to] assess single constituents]. *Phytaseeinsatz - Einzelkomponenten bewerten*. *Deutsche Gefluesselwirtschaft und Schweineproduktion (Germany)* v. 46(17) p. 25-27. 2 ill., 4 tables. German. (AGRIC 94-121422).

562 Schwarz, F.J. (Technische Univ. Muenchen, Freising (Germany). Inst. fuer Ernahrungsphysiologie) (1994) [Digestibility and energetic feed value of feedstuffs for carp]. *Verdaulichkeit und energetischer Futterwert von Karpfenfuettermitteln*. *Kraftfutter (Germany)* (no.4) p. 118-121, 134. 3 ill., 2 tables. German. (AGRIC 94-111257).

L74 MISCELLANEOUS ANIMAL DISORDERS

563 Luebke Al Hussein, M. (Halle Wittenberg Univ., Halle (Germany). Landwirtschaftliche Fakultät. Inst. fuer Phytopathologie und Pflanzenschutz); Wetzel, T. (1993) [Experiments on side effects of the fungicide furesan (flusilazol + pyrazophos) on predatory beetles (Carabidae: Staphylinidae) in winter barley]. *Untersuchungen zu Nebenwirkungen des Fungizids Furesan (Flusilazol + Pyrazophos) auf räuberische Käfer (Carabidae: Staphylinidae) in Wintergerste*. *Archives of phytopathology and plant protection (Germany)* v. 28(5) p. 447-452. 2 ill.; 7 ref. German. (AGRIC 94-122457).

N20 AGRICULTURAL MACHINERY AND EQUIPMENT

564 Sartori, L.; Sandri, R. (Padua Univ. (Italy). Dipartimento del Territorio e Sistemi Agroforestali) (1994) [The tillage and the seeding. Technical and management aspects of the machinery [for maize - soybeans and wheat]]. *Lavorazione del terreno e semina. Aspetti tecnici e gestionali delle macchine [per mais - soia e grano]*. *Informatore Agrario (Italy)* v. 50(17) p. 31-41. 1 table; 9 graphs. Italian. (AGRIC 94-112367).

P06 RENEWABLE ENERGY RESOURCES

565 Breloh, P. (Bundesministerium fuer Ernahrung, Landwirtschaft und Forsten, Bonn (Germany)) (1993) [The importance of renewable resources under aspects of the Federal Ministry of Food, Agriculture and Forestry (Germany)]. *Die Bedeutung nachwachsender Rohstoffe aus Sicht des BML*. 2. Symposium Nachwachsende Rohstoffe - Perspektiven fuer die Chemie; Frankfurt am Main (Germany); 5-6 May 1993. (Symposium on "Renewable Resources. Perspectives of Chemistry". Proceedings). Bundesministerium fuer Ernahrung, Landwirtschaft und Forsten, Bonn (Germany). *Schriftenreihe des Bundesministers fuer Ernahrung, Landwirtschaft und Forsten, Reihe A: Angewandte Wissenschaft (Germany); spec. no. p. 19-34*. Landwirtschaftsverlag. German. (AGRIC 94-112524).

566 Repka, J.; Danko, J. (Vysoka Skola Polnohospodarska, Nitra (Slovak Republic). Katedra Fyziologie Rastlin) (1993) [Rationalization of energy balance in plant production]. *Energetické aspekty racionalizácie rastlinnej výroby*. *Polnohospodárstvo Vychodoslovenskej Niziny v Regionálnych Súvislostiach*; Michalovce (Slovak Republic); 1-2 Dec 1992. [Regional aspects of the agriculture in the Vychodoslovenska Nizina Lowland, Slovakia. Proceedings of the international conference held in Michalovce, Slovakia, December 1-2, 1992]. *Oblasťný Vyskumny Ústav Agroekológie, Michalovce (Slovak Republic)* p. 123-126. *Oblasťný Vyskumny Ústav Agroekológie*. 2 tables; 9 ref. Slovak. (AGRIC 94-112522).

P30 SOIL SCIENCE AND MANAGEMENT

567 Ball, B.C.; Robertson, E.A.C. (1994) EFFECTS OF SOIL WATER HYSTERESIS AND THE DIRECTION OF SAMPLING ON AERATION AND PORE FUNCTION IN RELATION TO SOIL COMPACTION AND TILLAGE. *Soil & Tillage Research*. 32(1):51-60. English. [SAC DEPT SOIL SCI W MAINS RD EDINBURGH EH9 3JG SCOTLAND].

Cores of intact soil were taken in vertical and horizontal directions in two tillage experiments from horizons subjected to compaction. Cores from below the plough layer were equilibrated at a range of matric potentials by drainage. Cores from near the soil surface were subjected to hysteresis by drainage to -2 kPa from saturation, further drainage to -10 kPa and finally re-wetting to -2 kPa. Air-filled porosity, relative diffusivity, diffusion time delay and air permeability were measured at each potential, and pore continuity and pore organisation indices were calculated. Diffusion time delay is a measure of the time taken for gas to diffuse across a core at the beginning of a measurement of diffusion. Hysteresis influenced both air-filled porosity and the relationship between air-filled porosity and gas diffusivity and air permeability. Soil aeration was generally more favourable after wetting to -2 kPa from -10 kPa than after drainage to -2 kPa from saturation. Hysteresis effects were greater in ploughed than in direct drilled soils. Direction of sampling influenced diffusion and flow properties, mainly in compact direct drilled soil from near the surface. These effects were partly attributed to the sampling method but gave evidence of greater vertical than horizontal orientation of macropores in ploughed soil and greater horizontal than vertical orientation of macropores in direct drilled soil. [References: 20].

568 Carefoot, J.M.; Janzen, H.H.; Lindwall, C.W. (1994) CROP RESIDUE MANAGEMENT FOR IRRIGATED CEREALS ON THE SEMI-ARID CANADIAN PRAIRIES. *Soil & Tillage Research*. 32(1):1-20. English. [AGR CANADA RES STN POB 3000 LETHBRIDGE T1] 4B1 ALBERTA CANADA].

Cereals grown under irrigated conditions in the Canadian prairies produce large amounts of residues and proper management of these residues is required to produce good crop yields and maintain soil quality. Field studies from 1986 to 1990 assessed the effect of straw-tillage treatments on plant growth of irrigated cereals on a Dark Brown Chernozemic Lethbridge (Typic Boroll) loam in southern Alberta. The crop sequence was wheat (*Triticum aestivum* L.)-wheat-oats (*Avena sativa* L.) wheat. Straw was retained on the plots or removed by baling. Tillage treatments were autumn mouldboard ploughing, spring mouldboard ploughing or direct seeding. Grain yield was greater in the autumn plough compared with the spring plough treatments (4336 kg ha⁻¹ vs. 3763 kg ha⁻¹, respectively) in 1 year (1989) out of 4. Grain yield was greater in the no straw-spring plough than the straw-spring plough treatment (4242 kg ha⁻¹ vs. 3791 kg ha⁻¹, respectively) in 2 years out of 4. Spring plough treatments

had the advantage of ground cover over winter compared with autumn plough treatments. The problems associated with straw incorporation in the spring could be alleviated by removing the straw by baling but this practice removed 16.0 kg N ha⁻¹ year⁻¹ and 1600 kg C ha⁻¹ year⁻¹ from the soil system. Grain N concentration was decreased by 10% if straw was incorporated in the spring compared with autumn incorporation. Straw N concentration was decreased with spring ploughing compared with autumn ploughing when straw was incorporated and also when straw was removed by baling. Total plant N was decreased by spring ploughing compared with autumn ploughing if straw was incorporated. Incorporation of straw also decreased total plant N compared with removing the straw with spring but not with autumn ploughing. Under a no straw-direct seeding treatment, grain yield and plant N uptake were generally less than in the no straw-tillage systems. Straw-tillage treatment effects on grain yield and plant N uptake were attributed to differences in seedbed quality and mineral N levels. Lower spring and autumn soil NO₃-N levels in the straw-spring plough and direct seeding treatments throughout the 4 crop years were attributed to great N immobilisation compared with the autumn plough and no straw-spring plough treatments. This field study showed that although spring incorporation of straw and direct seeding treatments encountered seedbed problems and lower N availability, these treatments with added N could be as productive and be more sustainable systems than other treatments as they enjoy advantages in terms of better soil conservation and less harmful environmental impact. [References: 29].

569 Singh, B.; Chanasyk, D.S.; McGill, W.B.; Nyborg, M.P.K. (1994) RESIDUE AND TILLAGE MANAGEMENT EFFECTS ON SOIL PROPERTIES OF A TYPIC CRYOBOROLL UNDER CONTINUOUS BARLEY. *Soil & Tillage Research*. 32(2-3):117-133. English. [UNIV ALBERTA DEPT SOIL SCI EDMONTON T6G 2E3 AB CANADA].

Adoption of reduced or no-tillage practices on a large scale depends on the maintenance of a favorable soil environment for crop growth in addition to providing a sustained protection against soil erosion. We evaluated the changes in soil aggregation status (0-5 cm) and in other physical and chemical properties (0-15 cm) of a Malmo clay loam (Typic Cryoboroll, Black Chernozemic) subjected to three tillage and residue management systems after nine years in central Alberta with a subhumid temperate climate. The soil was cropped to spring barley (*Hordeum vulgare* L.) each year. The treatments included: no tillage, straw retained on the surface; tillage, straw incorporated into surface soil; and tillage, straw removed. Tillage consisted of two rotocultivations to a depth of 10 cm, one in late fall and another in spring before seeding. In the no till + straw treatment, the crop was directly seeded with a hoe drill. The no till + straw treatment provided 70 to 99% residue cover, followed by till + straw (41 to 85%) and till + no straw (6 to 14%). Tillage significantly increased the soil surface roughness, while seasonal rainfall greatly reduced it. Although the no till + straw treatment had a smaller surface roughness, it would provide more effective and sustained runoff and erosion control owing to its greater residue cover and a greater amount of larger water-stable aggregates. This treatment had significantly greater organic carbon content, lower pH, lower particle density and greater electrical conductivity in the 0-5 cm soil depth interval compared with the tilled treatments. The differences among treatments became less pronounced with depth. For the surface soil of the no till + straw treatment, the proportion of wind erodible (< 1 mm) and water-soluble micro-aggregates (< 0.25 mm) was also smaller, and mean weight diameter and geometric mean diameter greater compared to the tilled treatments. Soil structural stability increased due to straw addition and a better aggregate size distribution occurred due to a reduction in soil disturbance. [References: 34].

P33 SOIL CHEMISTRY AND PHYSICS

570 Yan Huijun; Wei Youqing; Zuo Yubao (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Soil and Fertilizers) (1993) A preliminary approach to investigation of wheat straw incorporated into the field with salt-affected soils. *Soils and Fertilizers (China)* (no. 5) p.15-17. 4 tables. Chinese. (AGRI 94-123580).

571 Zhang Yousheng; Nie Wei (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Soil and Fertilizers) (1993) The dynamic

analysis of soil moisture in the land under summer and autumn grain crops in Dingxi Regions, Gansu (China). *Soils and Fertilizers (China)* (no. 2) p. 35-37. 2 tables. Chinese. (AGRI 94-123650).

572 Zhao, F.; McGrath, S.P. (1994) EXTRACTABLE SULPHATE AND ORGANIC SULPHUR IN SOILS AND THEIR AVAILABILITY TO PLANTS. *Plant & Soil*. 164(2):243-250. English. [AFRC INST ARABLE CROPS RES DEPT SOIL SCI ROTHAMSTED EXPTL STN HARPENDEN AL5 2JQ HERTS ENGLAND].

Ten soils collected from the major arable areas in Britain were used to assess the availability of soil sulphur (S) to spring wheat in a pot experiment. Soils were extracted with various reagents and the extractable inorganic SO₄-S and total soluble S(SO₄-S plus a fraction of organic S) were determined using ion chromatography (IC) or inductively-coupled plasma atomic emission spectrometry (ICP-AES), respectively. Water, 0.016 M KH₂PO₄, 0.01 M CaCl₂ and 0.01 M Ca(H₂PO₄)₂ (2) extracted similar amounts of SO₄-S, as measured by IC, which were consistently smaller than the total extractable S as measured by ICP-AES. The amounts of organic S extracted varied widely between different extracts, with 0.5 M NaHCO₃ (pH 8.5) giving the largest amounts and 0.01 M CaCl₂ the least. Organic S accounted for approximately 30-60% of total S extracted with 0.016 M KH₂PO₄ and the organic C:S ratios in this extract varied typically between 50 and 70. The concentrations of this S fraction decreased in all soils without added S after two months growth of spring wheat, indicating a release of organic S through mineralisation. All methods tested except 0.5 M NaHCO₃ - ICP-AES produced satisfactory results in the regression with plant dry matter response and S uptake in the pot experiment. In general, 0.016 M KH₂PO₄ appeared to be the best extractant and this extraction followed by ICP-AES determination was considered to be a good method to standardise on. [References: 33].

573 Zhou Lingyun (Academia Sinica, Nanjing (China). Nanjing Inst. of Soil Science) (1993) Water supply and potential productivity in rainfed wheat field in Fengqiu Region, China. *Acta Pedologica Sinica (China)* 1: 30(3) p. 297-303. 3 ill., 3 tables, 7 ref. Chinese. (AGRI 94-123651).

P34 SOIL BIOLOGY

574 Bloem, J.; Lebbink, G.; Zwart, K.B.; Bouwman, L.A.; Burgers, S.L.G.; Devos, J.A.; Deruiter, P.C. (1994) DYNAMICS OF MICROORGANISMS, MICROBIVORES AND NITROGEN MINERALISATION IN WINTER WHEAT FIELDS UNDER CONVENTIONAL AND INTEGRATED MANAGEMENT. *Agriculture Ecosystems & Environment*. 51(1-2):129-143. English. [DLO AB AGROBIOL & SOIL FERTIL RES INST POB 129 9750 AC HAREN NETHERLANDS].

To reduce environmental problems, integrated farming has been proposed, which may involve a considerable reduction of fertiliser-N input. A reduced fertiliser-N input must be compensated for by a higher N mineralisation from organic matter. To reduce losses and to facilitate optimal use of the N mineralised for crop growth, knowledge of the effects of management on soil organisms and on their role in N cycling is needed. Therefore, biomass and activity of bacteria, biomasses of fungi, bacterivorous amoebae, flagellates and nematodes, and in situ N mineralisation were monitored during a full year in a winter wheat field under conventional management (CONV) and integrated management (INT). Fungal biomass was about 100-fold lower than bacterial biomass. The average bacterial biomass was not significantly higher in INT than in CONV, whereas amoebae and nematodes were 64% and 22% higher, respectively. Average N mineralisation was 30% higher in INT. The differences are attributed to the approximately 30% higher organic matter content of INT. Bacterial biomass and frequency of dividing-divided cells (FDDC) were relatively low in December and January, probably owing to temperatures just above 0 degrees C. At about 5 degrees C in February and March, relatively high FDDC values and a doubling of bacteria occurred. During summer, FDDC values were relatively low and bacterial numbers were stable, probably owing to nutrient limitation. After harvest and skim ploughing, rapid increases in FDDC and bacteria were found. In the non-fumigated INT field, protozoan peaks coincided with the bacterial peak, whereas in CONV bacterivorous fauna were drastically reduced by soil fumigation. Nevertheless, the bacterial peaks were similar in CONV and INT, indicating that bacteria were not controlled by bacterivores. Nitrogen mineralisation was relatively low in winter. The increased bacterial

growth in February and March, and in September appeared to enhance immobilisation rather than mineralisation of N. During the growing season from April to the end of August, bacterial growth was relatively low and N mineralisation was relatively high. This probably resulted from bacterivore feeding and from substrate- or nutrient-limited bacteria with a low growth efficiency. Considerable mineralisation rates after harvest confirmed the need for measures to stimulate immobilisation during periods without crop uptake. [References: 47].

575 Franzleubbers, A.J.; Hons, F.M.; Zuberer, D.A. (1994) SEASONAL CHANGES IN SOIL MICROBIAL BIOMASS AND MINERALIZABLE C AND N IN WHEAT MANAGEMENT SYSTEMS. *Soil Biology & Biochemistry*, 26(11):1469-1475. English. [TEXAS A&M UNIV TEXAS AGR EXPT STN DEPT SOIL & CROP SCI COLLEGE STN, TX 77843 USA].

Crop management strategies can affect the short-term dynamics of the active C and N pools of soil organic matter (SOM) by altering the timing, placement, quantity, and quality of crop root and residue input, as well as nutrient status and environmental conditions (i.e. soil temperature and water content). Our objectives were to quantify seasonal changes in soil microbial biomass (SMB) and mineralizable C and N in continuous wheat (*Triticum aestivum* L.), continuous wheat-soybean [*Glycine max* (L.) Merr.], and wheat-soybean-sorghum [*Sorghum bicolor* (L.) Moench.] sequences under conventional tillage (CT) and no tillage (NT) with or without N fertilization. Soil classified as a Weswood silty clay loam (fine, mixed, thermic Fluventic Ustochrept) located in southcentral Texas was sampled shortly after planting, during flowering, and following harvest of wheat. Soil microbial biomass C (SMBC) increased by 18% and mineralizable C increased by 37% from planting to flowering when averaged across crop sequence, tillage, and N fertilization regimes. At harvest, SMBC and mineralizable C had returned to the amount at planting in all crop sequences, except in continuous wheat, in which decomposition proceeded without C input during the long fallow. Mineralizable C was 64, 28, and 15% greater at flowering compared to planting under NT and 45, 38, and 29% greater under CT at depths of 0 to 50, 50 to 125, and 125 to 200 mm, respectively. The greater increase in mineralizable C near the surface may be related to the abundance of crop roots, rhizosphere products, and more optimal air-filled porosity. With N fertilization, mineralizable N followed the same seasonal pattern as SMBC and mineralizable C. Without N fertilization, mineralizable N did not change during the growing season, despite increased SMBC and mineralizable C at flowering, indicating greater immobilization of N at flowering. Seasonal inputs of crop roots, rhizosphere products, and crop residues significantly altered SMB and mineralizable C and N of this soil, illustrating the dependence of N dynamics on short-term C inputs. Seasonal changes in the active C and N pools of SOM depended upon (i) crop sequence for the quantity, quality, and frequency of C input, (ii) tillage for the depth distribution of added substrates, and (iii) N fertilization for the quantity and quality of substrates. These seasonal changes can alter N availability and conservation. [References: 27].

576 Franzleubbers, A.J.; Hons, F.M.; Zuberer, D.A. (1994) LONG-TERM CHANGES IN SOIL CARBON AND NITROGEN POOLS IN WHEAT MANAGEMENT SYSTEMS. *Soil Science Society of America Journal*, 58(6):1639-1645. English. [TEXAS A&M UNIV DEPT SOIL & CROP SCI TEXAS AGR EXPT STN COLLEGE STN, TX 77843 USA].

Crop management strategies that alter the timing, placement, quantity, and quality of crop residue input can affect the size, turnover, and vertical distribution of the active and passive pools of soil organic matter (SOM). Our objectives were to quantify long-term changes in soil organic, soil microbial biomass (SMB), and mineralizable C and N in continuous wheat (*Triticum aestivum* L.), continuous wheat/soybean [*Glycine max* (L.) Merr.], and wheat/soybean-sorghum [*Sorghum bicolor* (L.) Moench.] sequences under conventional tillage (CT) and no tillage (NT) with and without N fertilizer. A Weswood silty clay loam (fine, mixed, thermic Fluventic Ustochrept) in southcentral Texas was collected from a 9-yr field study. Soil microbial biomass C (SMBC) and N (SMBN) were determined with the chloroform fumigation-incubation method and mineralizable C and N were determined from 10-d aerobic incubations at 25 degrees C. More crop residue C input was retained as soil organic C (SOC), SMBC, and mineralizable C under NT than under CT. Soil organic C, SMBC, and mineralizable C at a depth of 0 to 50 mm were 33 to 125% greater under NT than under CT. Increasing cropping intensity increased SOC up to 22%, SMBC up to 31%, and mineralizable C up to 27% under NT. Differences in

crop management systems significantly altered SMB and the associated mineralizable N level, which supplies crops with mineral N. High clay content soils of central Texas can be effectively managed to increase the active and passive pools of SOM using minimal fallow with NT. [References: 35].

577 Govedarica, M.; Jarak, M.; Milosevic, N.; Vojvodic Vukovic, M.; Molnar, I.; Milosev, D. (Faculty of Agriculture, Novi Sad (Yugoslavia). Institute of Field and Vegetable Crops) (1993) Effect of saturation mud on the changes of microbiological properties of hydromorphic black soil. *Zemljiste i biljka (Yugoslavia)* v. 42(1) p. 87-91. 3 graphs; 13 ref. English. (AGRIS 94-112935).

The paper deals with the effect of different quantities of saturation mud and nitrogen on the frequency of individual groups of microorganisms in soil. The soil was used for growing wheat in a greenhouse. The frequency of microorganisms depended both on the quantity of saturation mud and doses of nitrogen. The application of saturation mud increased the frequency of microorganisms. The highest microorganism frequency was achieved with the highest quantity of saturation mud. The application of nitrogen decreased the frequency of microorganisms, while in combination with saturation mud it increased the frequency of microorganisms.

578 Hanel, L. (1994) STRUCTURE AND DYNAMICS OF SOIL NEMATODE COMMUNITY IN WHEAT AND POTATO FIELDS. *Biologia*, 49(2):153-159. English. [ACAD SCI CZECH REPUBL INST SOIL BIOL NA SADKACH 7 CS-37005 CESKE BUDEJOVICE CZECH REPUBLIC].

Soil nematode communities were studied in wheat and potato fields in South Bohemia during 1986-1987. A total of 71 species were found, 53 in the wheat and 65 in the potato fields with their mean abundance $0.58 \times 10(6)$ ind.m⁻² and $0.73 \times 10(6)$ ind.m⁻², respectively. Bacteriophages were the dominant group in the nematode communities. Mean biomass of nematodes was 0.22 g.m⁻² in the wheat field, and 0.46 g.m⁻² in the potato field, the highest biomass had omniphages. Two peaks were found in the seasonal changes of nematode abundance in both years.

579 Heimann Detlefsen, D. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Braunschweig (Germany). Inst. fuer Pflanzenschutz in Ackerbau und Gruenland); Theiss, S.; Heimbach, U. (1994) [Effects of different intensities of cultivation on the Collembola of agricultural soil]. Auswirkungen unterschiedlich intensiver Bewirtschaftungsintensitaeten auf die Collembolenfauna des Ackerbodens. Effects of a long-term application of plant protection products used in different intensities and development of assessment criterions. Bartels, G.; Kampmann, T. (comps.). *Mitteilungen aus der Biologischen Bundesanstalt fuer Land-und Forstwirtschaft Berlin-Dahlem (Germany)*; no. 295 p. 230-273. Blackwell. 14 ill., 4 tables. Bibliography 60 ref. German. (AGRIS 94-123782).

The effects of a graded intensity of agricultural cultivation on Collembola were recorded from 1987 to 1989 on the experimental fields 'Ahlum' of the Federal Biological Research Centre for Agriculture and Forestry. The crop rotation followed the order winter-wheat, winter-barley, sugar beets. The four intensities of cultivation differed mainly in the application of pesticides and N-fertilizer, and therefore also in the density of vegetation of cultured crops and accompanying weeds. Within the period of research, a total of 40 species of Collembola were recorded. *Isotoma notabilis*, *Isotomurus palustris* and *Folsomia fimetana* were almost always the dominant species. The mean density of individuals of the collembola was 230 ind. per 0.01 qm. The effects of the different intensities of cultivation showed up mainly in two opposed trends. The effects of the frequency of application of herbicides and the influence of the supply of nutrients. In the more extensive variant, with a large proportion of weeds and low density of cultivated crops, *Anurida pygmaea* and *Sphaeridia pumilis* had significantly higher densities of individuals in every investigation period than in the two variants with high intensities of cultivation. The function of these two species as bioindicators was discussed in this context. In addition, in the variants treated less intensively with pesticides, the proportion of the mainly phytophagous species of the total number of collembola was greater, as weeds were available as resource of food. The increased supply of nutrients in the middle variants led to a better coverage of plant of both cultivated crops and weeds, and thus, especially under moister conditions of weather, to an increase in the number of species of collembola.

580 Heulin, T.; Berge, O.; Mavingui, P.; Gouzou, L.; Hebban, K.P.; Balandreau, J. (1994) *BACILLUS-POLYMYXA AND RAHNELLA-AQUATILIS, THE DOMINANT N₂-FIXING BACTERIA ASSOCIATED WITH WHEAT RHIZOSPHERE IN FRENCH SOILS*. *European Journal of Soil Biology*. 30(1):35-42. English. [UNIV NANCY 1 CTR PEDOL BIOL CNRS EQUIPE ECOL MICROBIENNE RHIZOSPHERE UPR 6831 BP 5 F-54501 VANDOEUVRE LES NANCY FRANCE].

In a study of adaptive traits of rhizosphere inhabiting N₂-fixing bacteria, 56 strains representative for the diazotrophic population were isolated from the rhizosphere of three week old spring wheat plants (cv. Castan). For the isolation procedure, a medium was used which contained the exudates of sterile plantlets of wheat (the "spermosphere model"). N₂-fixing *Bacillus polymyxa* and *Bacillus circulans* were dominant in three out of four French soils studied. The dominant N₂-fixing microflora of the fourth soil was a population of *Rahnella aquatilis*, an enteric bacterium closely related to *Enterobacter agglomerans* and *Erwinia herbicola*. The sizes of these N₂-fixing populations were between 1 and 5 x 10⁵ cfu g⁻¹ dry weight of rhizosphere soil. These two rhizosphere populations differed markedly by two important characters: (1) when associated with plants under gnotobiotic conditions, the average acetylene reduction activity was much higher in *Bacillus* than in *R. aquatilis* strains; (2) in vitro, 90% of *Bacillus* isolates exhibited a clear antagonistic activity against *Gaeumannomyces graminis* var. *tritici* (Ggt), the causative agent of the take-all disease of wheat, whereas none of the 25 strains of *R. aquatilis* tested showed any antagonistic activity. [References: 49].

581 Juma, NG. (1994) *A CONCEPTUAL FRAMEWORK TO LINK CARBON AND NITROGEN CYCLING TO SOIL STRUCTURE FORMATION*. *Agriculture Ecosystems & Environment*. 51(1-2):257-267. English. [UNIV ALBERTA DEPT SOIL SCI 4-42 EARTH SCI BLDG EDMONTON T6G 2E3 AB CANADA].

A productive soil needs a favorable structure and an efficient nutrient cycling system. Management practices which simultaneously enhance these functions can lead to sustainable land use. The objective of this study was to develop concepts which can be used to link C and N cycling and soil structure formation by using the following model: (1) each organism produces cell structures which are resistant to decomposition. The amount of resistant material contributing to soil structure formation depends upon the size and turnover of the organism; (2) each organism contributes to mineralization of C and N as well as soil structure formation simultaneously, i.e. a portion of C and N during each trophic transfer is used for C and N cycling and a portion is used for soil structure formation. Using the data from the literature and our laboratory, I have: (1) described the structure of organisms; (2) linked the structure of organisms to C and N cycling through soil food webs and to the formation of stabilized soil organic matter; (3) described faunal effects on soil structure; (4) suggested ways to integrate C and N cycling and soil structure formation in current simulation models. The major limitation of current models describing soil organic matter dynamics is the lack of description of the formation of aggregates and alteration of porosity through plant root and faunal activity. The availability of fluorescence and micromorphological techniques for in situ visual inspection of soil microenvironments, and three dimensional imaging and modeling techniques, may provide essential data for a sound understanding of the soil matrix effects on microbial growth, microbial-faunal dynamics, fecal material deposition, and formation of macropores in soils and aid in integrating C and N cycling and soil structure formation. This knowledge can be used to develop management systems which enhance soil structure formation, increase the efficiency of C and N cycling, and lead to the development of sustainable land use practices. [References: 62].

582 Kampmann, T. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Braunschweig (Germany). Inst. fuer Pflanzenschutz im Gartenbau); Koellner, V. (1994) [Comparative investigations of soil-mite populations in agricultural soils with different intensities of cultivation]. *Vergleichende Untersuchungen von Milbenpopulationen in Ackerboeden bei unterschiedlicher Bewirtschaftungsintensitaet*. Effects of a long-term application of plant protection products used in different intensities and development of assessment criterions. Bartels, G.; Kampmann, T. (comps.). *Mitteilungen aus der Biologischen Bundesanstalt fuer Land-und Forstwirtschaft Berlin-Dahlem* (Germany); no. 295 p. 274-317. Blackwell. 15 ill., 2 tables; 45 ref. German. (AGRIS 94-123783).

The coenoses of mites in agricultural soils and their influence by different crops and intensities of cultivation were investigated. Soil samples were taken in 100 qm large areas in each of four intensities in all of the three crops (winter-wheat, winter-barley, sugar beet) in intervals of four weeks. In each of the intensities seven samples were taken two sample parts. Each sample was in a diameter of 5 cm. The samples were taken in the horizontal line separated into the parts 'in the seed-row' and 'between the seed-row'. And in the vertical line they were divided into two horizons of 0-5 and 5-10 cm. The 49 taxa (species to families) of 23 families found in the field the ones in the sugar beet were clearly less than in both of the cereals. Four taxa (*Alliphis siculus*, *Bakerdania blumentriti*, *Tectocephus velatus*, Tydeidae) were very dominant and also four taxa (*Arctoseius cetratus*, *Bakerdania sellnicki*, *Histiostoma strenzkei*, *Tarsonemus* sp.) were dominant. All the other 37 taxa were less than dominant. The distribution into the depth of the soil showed 75-85 % of all mites living in the upper soil layer. Divided into horizontal lines there were found twice the density of individuals in the seed-rows than between the seed-rows. The density of individuals/qm was 10000-20000 in average and changing the crops from winter-barley, to catch crop they increased to 100000 individuals/qm in average. The influence of cultivation was very different: - no effect was found on the number of taxa in the different intensities. - No or only little influence was found in most of the very dominant or dominant taxa. - To a few of the subdominant taxa a strong influence was observed: *Tyrophagus infestans*, *Tectocephus velatus*, *Siteroptes graminum* and *Dendroelaps foveolatus*.

583 Knuesting, E. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Braunschweig (Germany). Inst. fuer Pflanzenschutz in Ackerbau und Gruenland); Bartels, G. (1994) [Effects of different high intensities of plant production on population density of earthworms]. *Einfluss unterschiedlich hoher Intensitaeten acker- und pflanzenbaulicher Massnahmen auf die Populationsdichte der Regenwurmer*. Effects of a long-term application of plant protection products used in different intensities and development of assessment criterions. Bartels, G.; Kampmann, T. (comps.). *Mitteilungen aus der Biologischen Bundesanstalt fuer Land-und Forstwirtschaft Berlin-Dahlem* (Germany); no. 295 p. 192-229. Blackwell. 7 ill., 2 tables; 40 ref. German. (AGRIS 94-123768).

In the project of 'Ahlum' the population of earthworms were investigated in each of four intensities of crop rotation (winter-wheat, winter-barley, sugar beet) when cultivated in different intensive ways. Therefore the method of electric catching according to Thielemann (1986) was used. The efficiency of this method was tested in comparison with the method of formalin before. The results were similar, so that the method of electric catching could be considered as equivalent. On an area of 0.25 qm eight electrodes with a depth of catching of 50 cm were prosecuted for 30 minutes with a voltage of 60 V. This was done in intervals of four weeks during the vegetation period in eight repetitions of each date, culture and intensity. The repetitions of electric catching had a distance of 5 m in minimum. Altogether nine species of earthworms were caught. The genera of *Allolobophora*, *Lumbricus* and *Octolasion* were found. Except for the 'main species' *Allolobophora calliginosa*, *Allolobophora rosea*, *Allolobophora longa* and *Lumbricidae terrestris* five 'accompanying species' with less activity abundance were found. In comparison to other arable areas a relatively high number of species was caught. On one hand it corresponded with the high number of repetitions (higher probability, to find rare species) and on the other hand it was correlated with the particular conditions in the area which were similar to grassland before the investigation. The dries had a great influence and showed negative effects especially on the species of endogeic earthworms in 1986. The influence of the crop had no effect on the number of species, but there were significant differences in the activity abundance.

584 Leinhos, V. (Jena Univ. (Germany). Inst. fuer Umwelt und Ernaehrung); Vacek, O. (1994) Biosynthesis of auxins by phosphate-solubilizing rhizobacteria from wheat (*Triticum aestivum*) and rye (*Secale cereale*). Czechoslovak Academy of Sciences, Prague (Czech Republic). Inst. of Microbiology. *Microbiological Research* (Germany); v. 149(1) p. 31-35. 2 ill., 3 tables; 17 ref. English. (AGRIS 94-123785).

585 Leliveldt, B. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Muenster (Germany). Inst. fuer Nematologie und Wurbeltierkunde); Sturhan, D. (1994) [Studies on the impact of different

intensity of cultivation on the nematode community in field soil). Untersuchungen ueber Auswirkungen unterschiedlicher Bewirtschaftungsintensitaet auf die Nematodenzoenose eines Ackerbodens. Effects of a long-term application of plant protection products used in different intensities and development of assessment criterions. Bartels, G.; Kampmann, T. (comps.). *Mitteilungen aus der Biologischen Bundesanstalt fuer Land- und Forstwirtschaft Berlin-Dahlem (Germany)*; no. 295 p. 318-352. Blackwell. 9 ill., 8 tables; 9 ref. German. (AGRIS 94-123784).

In a multi-institute project to establish the long-term effect of different usage of pesticides and fertilizers on the ecosystem of agricultural fields, the experimental field at Ahlum, near Braunschweig, was used to study their influence on the soil nematode coenosis. Soil samples (250 g) were taken at depths of 0-15 cm and 15-30 cm from field plots with winter wheat, winter barley and sugar beet, each cultivated with four different intensities. The sampling took place, usually at a two months interval, from April 1987 to October 1989. From the 1248 collected samples the total number of nematodes was established quantitatively and qualitatively. A total of 83 species was found to be present representing 61 taxa. On the average, 35 taxa were present per sample of which 11.6 were classified as bacteriophages, 7.4 phytoparasites, 6.9 mycophages, 5.4 pantophages, 2.0 zooparasites, 1.1. zoophages and 0.6 phycophages. In general mycophages were the most abundant species followed by the bacteriophages and the phytoparasites, the remaining groups were detected usually only in small numbers. Total nematodes density and number of taxa found were similar for the two soil horizons studied; 83 % of all nematodes/qm lived in the 0-30 cm layer. The total nematode density varied considerably during the year depending on the crop cultivated. A correlation with increased intensity of cultivation and the occurrence of nematodes could be not established. For several trophic groups effects of the different agricultural practuces were observed: increased intensity of cultivation resulted in an increase of the phytoparasites density in winter barley and catch crop, but in a decrease when sugar beet was cultivated.

586 Li Zhenggao; Pan Yinghua (Academia Sinica, Nanjing (China). Nanjing Inst. of Soil Science) (1993) Dynamics of bacteria and their enzyme activity in rhizosphere of wheat of different genotypes. *Acta Pedologica Sinica (China)* v. 30(1) p. 1-8. 6 tables, 13 ref. Chinese. (AGRIS 94-123780).

587 Pant, HK.; Vaughan, D.; Edwards, AC. (1994) MOLECULAR SIZE DISTRIBUTION AND ENZYMATIC DEGRADATION OF ORGANIC PHOSPHORUS IN ROOT EXUDATES OF SPRING BARLEY. *Biology & Fertility of Soils*. 18(4):285-290. English. [MACAULAY LAND USE RES INST DIV PLANTS ABERDEEN AB9 2QJ SCOTLAND].

Seeds from two varieties of spring barley (Prisma and Camorgue) were grown axenically in water. After 14 days, the culture solutions contained organic P substances (about 4 mug P per plant) derived from root exudation, representing about 3% of the total P found in the seed. Gel filtration, separated the organic P into two well defined peaks, one with a high molecular weight (> 45 000 daltons) and the other with a low molecular weight (< 500 daltons). The bioavailability of the soluble organic P released was assessed enzymatically and chemically. At the optimum pH of 5.0, phytase and acid phosphatase hydrolysed about 80% and 65%, respectively of the organic P in the exudate after 24 h whereas at the optimum pH of 9.8, alkaline phosphatase hydrolysed up to 40% P after the same length of time. In a pH 5.0 buffer, up to 10% of the organic P was hydrolysed compared with up to 45% in a pH 9.8 buffer. The high molecular weight organic P fraction recovered from the G-75 Sephadex behaved similarly. [References: 32].

588 Pohl, K. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Braunschweig (Germany). Inst. fuer Unkrautforschung); Malkomes, H. P. (1994) [Influence of long-term application of different pesticide treatment systems on soil microbial activity]. Einfluss langjaehriger unterschiedlicher Pflanzenschutzintensitaeten im Ackerbau auf die Aktivitaet von Bodenmikroorganismen. Effects of a long-term application of plant protection products used in different intensities and development of assessment criterions. Bartels, G.; Kampmann, T. (comps.). *Mitteilungen aus der Biologischen Bundesanstalt fuer Land- und Forstwirtschaft Berlin-Dahlem (Germany)*; no. 295 p. 115-142. Blackwell. 5 ill., 2 tables; 21 ref. German. (AGRIS 94-123781).

The aim of the investigations was to analyse the negative effects of agricultural management of varying intensity on important microbial parameters in the soil and to find out how these effects can be evaluated and reduced. The effect of graded pesticide intensities (no pesticides on one hand, maximum pesticides applied on the otherhand) in a crop rotation of winter-wheat, winter-barley and sugar beet was studied in a field trial over three years. In addition, the effects of weediness were studied in 1989 within the untreated control plots in sugar beets. The microbial parameters studied were: dehydrogenase activity (TTC-reduction as an indicator of overall microbial activity), the biomass-related glucose-induced short-term respiration, some enzyme activities, which can be related to certain nutrient cycles (arylsulfatase and alkaline phosphatase), and the hydrolysis of fluorescein diacetate (indicator of general heterotrophic activity). Moreover the decomposition of straw (indicator of the decomposition of plant substances) was determined. In plots without pesticide applications (I0) the dehydrogenase activity was higher than in those with pesticide applications (I1-I3). In sugar beets no great differences occurred among the three systems of pesticide treatment. In winter cereals a gradation of dehydrogenase values with highest activity in I0 and lowest activity in I1-I3 was often found. The higher activities in I0, at least as far as sugar beets are concerned, were induced by a positive effect of weediness and by an inhibitory effect of the cropping systems in the higher intensities.

589 Sawicka, A.; Makarova, NM. (1994) NITROGEN FIXATION BY AZOSPIRILLUM WITH WHEAT AND MAIZE RADICLES AS A SOURCE OF CARBON AND ENERGY. *Acta Microbiologica Polonica*. 43(1):107-109. English. [ACAD AGR POZNAN DEPT AGR MICROBIOL WOLYNSKA 35 PL-60637 POZNAN POLAND].

An attempt was made to determine if wheat and maize radicles can be a carbon and energy source for Azospirillum dinitrogen fixing bacteria. The results show that the compounds from crushed wheat and maize radicles were not an optimal source of carbon and energy for Azospirillum. The most effective dinitrogen fixation by these bacteria was on control malate medium.

590 Umarov, MM.; Shabayev, VP.; Smolin, VY.; Mamedov, NM. (1994) RHIZOSPHERE NITROGENASE ACTIVITY AND TRITICALE YIELD IN MIXED CULTURES OF NITROGEN-FIXING MICROORGANISMS. *Eurasian Soil Science*. 26(4):64-72. English. [MOSCOW MV LOMONOSOV STATE UNIV FAC SOIL SCI MOSCOW 117234 RUSSIA].

Five different mixed nitrogen-fixing cultures were isolated, and their effect on nitrogenase activity in the triticale rhizosphere, grain yield, soil nitrogen content, and nitrogen removal from soil was studied in greenhouse experiments on Gray Forest Soil. Application of a mixture of bacilli and yeasts to the soil in the presence of potassium phosphate fertilizer resulted in higher yield and self-supporting nitrogen balance. Nitrogenous fertilizers significantly inhibited associative nitrogen fixation in the majority of the studied mixed cultures, the microorganisms themselves inducing nitrogen gas release from N-15-fertilizers. [References: 30].

591 Vonlutzow, M.; Ottow, JCG. (1994) EFFECT OF CONVENTIONAL AND BIOLOGICAL FARMING ON MICROBIAL BIOMASS AND ITS NITROGEN TURNOVER IN AGRICULTURALLY USED LUVISOLS OF THE FRIEDBERG PLAINS. *Zeitschrift fur Pflanzenernaehrung und Bodenkunde*. 157(5):359-367. German. [UNIV GIESSEN INST MIKROBIOL SENCKENBERGSTR 3 D-35390 GIESSEN GERMANY].

The influence of conventional and biological farming on microbial biomass-carbon (Bio-C) and nitrogen (Bio-N) of agriculturally used fields was compared. The fields were located on luvisols of the Friedberg plains and tilled according to each system for many years. Bio-C and Bio-N were measured using the chloroform-fumigation-extraction technique. During early spring and autumn (1990) Bio-C [% C(org)] and Bio-N [% N(t)] were slightly lower in sites of conventional farming than on fields tilled by biological farming. During the vegetation period Bio-C and Bio-N increased continuously in both systems. This increase, however was higher on conventional than on biological fields and may be ascribed to a higher C-input (rhizodeposition) and availability of mineral nutrients. In the soils of the biological farming system N-deficiency apparently decreased Bio-N (but not Bio-C) in spring time. Consequently the Bio-C/N-ratio increased. It seems as if plant growth affects the quality of microbes (Bio-C/N). The average turnover-time of Bio-N was about 1 year in all soils. However, the

average turnover-time of Bio-C was 1.6 years, being 2 times faster in the conventional than in the biological farming system. It seems as if long-term management practices may affect the amount of labile organic matter by changing the biomass pool and its turnover rate. [References: 27].

592 Xu Jing; Chen Wanhua; Chen Tingwei (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Soil and Fertilizers) (1994) Observation on para-nodules induced by 2, 4-D on foliage of wheat. *Soils and Fertilizers (China)* (no. 1) p. 45-46, 48. 1 tables, 4 ref. Chinese. (AGRIS 94-123779).

P35 SOIL FERTILITY

593 Han Langfeng (Beijing Agricultural Univ. (China)); Li Junliang; Liang Sue (1993) The study on form of phosphorus in calcareous soils. *Journal of Laiyang Agricultural College (China)* v. 10(2) p. 79-82. 4 tables, 4 ref. Chinese. (AGRIS 94-123842).

594 Li Junliang (Laiyang Agricultural Coll., Shandong (China). Dept. of Agronomy); Han Langfeng; Liang Sue (1993) The methods for determination of effective phosphorus in calcareous soils. *Journal of Laiyang Agricultural College (China)* v. 10(3) p. 161-165. 5 tables, 6 ref. Chinese. (AGRIS 94-123843).

595 Wu Ronggui; Lin Bao; Li Jiakang (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. of Soil and Fertilizers) (1994) Study on the effects of nitrophosphate fertilizer with different water-soluble phosphorus contents. *Soils and Fertilizers (China)* (no. 1) p. 22-26. 7 tables. Chinese. (AGRIS 94-123854).

P36 SOIL EROSION, CONSERVATION AND RECLAMATION

596 Lamey, F.J.; Lindwall, C.W.; Bullock, M.S. (1994) FALLOW MANAGEMENT AND OVERWINTER EFFECTS ON WIND ERODIBILITY IN SOUTHERN ALBERTA. *Soil Science Society of America Journal*. 58(6):1788-1794. English. [AGR & AGRI FOOD CANADA RES CTR LAND RESOURCE SCI SECT POB 3000 LETHBRIDGE T1J 4B1 AB CANADA].

Aggregate size distribution (ASD) is influenced by tillage and climate and greatly affects wind erodibility of soils. This study determined the effects of fallow management and winter effects on ASD in the chinook belt of Alberta. Geometric mean diameter (GMD), geometric standard deviation (GSD), and erodible fraction (EF) <0.84 mm were determined in fall and spring on five fallow systems on a Lethbridge clay loam soil (fine-loamy, mixed, Typic Haploboroll). The fallow systems were (i) tillage only, (ii) minimum tillage (herbicides and tillage), and (iii) zero tillage (herbicides only). In fall, one-way disk and heavy-duty cultivator fallow treatments had GMD values about 1 mm higher than blade cultivator or zero tillage treatments. The 1989-1990 winter with 90 cm of snowfall, 67 d of snow cover, and 101 d with a mean 2-cm soil temperature between +2 and -2 degrees C resulted in greater aggregate breakdown than the 1988-1989 winter, which had 129 cm of snowfall, 104 d of snow cover, and 68 d with 2-cm soil temperatures between +2 and -2 degrees C. Estimates of initiating wind velocities for erosion, based on residue cover and EF, were 13.3 m s⁻¹ for the tillage treatments, 13.7 m s⁻¹ for the minimum tillage treatment, and 15.4 m s⁻¹ for the zero tillage treatment. However, the minimum and zero tillage systems had EF values >60% at more sampling times than the tilled treatments, indicating that wind erosion problems may occur if the residue cover was jeopardized. [References: 42].

597 Tian Zhongxiao; Cao Jijiang (Guangxi Academy of Agricultural Sciences, Nanning (China). Inst. of Soil and Fertilizers) (1993) A study on improving alkali-saline soil with organic matter. *Soils and Fertilizers (China)* (no. 1) p. 16-19. 6 tables. Chinese. (AGRIS 94-123891).

P40 METEOROLOGY AND CLIMATOLOGY

598 Brunet, Y.; Ilier, B.; Mcaneney, J.; Lagouarde, J.P. (1994) DOWNWIND EVOLUTION OF SCALAR FLUXES AND SURFACE RESISTANCE UNDER CONDITIONS OF LOCAL ADVECTION 2. MEASUREMENTS

OVER BARLEY. *Agricultural & Forest Meteorology*. 71(3-4):227-245. English. [INRA BIOCLIMATOL STN BP 81 F-33883 VILLENAVE DORNON FRANCE].

It has been suggested in Part I of this paper that, after a dryland-to-irrigated transition, the surface sensible and latent heat fluxes may exhibit little change with downstream distance from the leading edge. It was argued that such step changes in surface fluxes could be caused by a feedback mechanism between surface resistance and changing saturation deficit. A simple model was derived for describing the streamwise change in surface resistance leading to such a step change in flux. The aim of the present paper is to test these assumptions against experimental data acquired specifically for this purpose. Measurements were performed over a transition between dryland and irrigated barley. Eddy covariance determinations of sensible heat flux at a height of 1 m showed little variation downwind of the transition and, once corrected from the footprint effect, exhibited patterns roughly compatible with a step change in surface flux. Transects of radiative temperature, and air temperature and humidity above the crop, also showed downwind changes in good agreement with the expected variation. The most convincing results were obtained from measurements of stomatal and canopy resistance, whose downwind variation was close to that required by a step change in evapotranspiration. [References: 21].

599 Kuchar, L. (1993) [Forecasting of total precipitation and mean air temperature for yield prediction of vegetable plants]. *Przewidywanie sum opadow i srednich temperatur powietrza w aspekcie prognozowania plonow roslin uprawnych*. Akademia Rolnicza, Wroclaw (Poland). Katedra Matematyki. *Zeszyty Naukowe Akademii Rolniczej we Wroclawiu. Rozprawa Habilitacyjna (Poland)*; no. 118 91 p. Wydawnictwo Akademii Rolniczej we Wroclawiu. 12 fig., 22 tables; 116 ref. Polish. (AGRIS 94-113140).

A method of forecasting rainfall and mean temperature is shown, which is based on plant phenology and probability distribution of both random variables. This method has been applied for yield forecasting of spring wheat using Exponential Polynomial Model (EPM) - modified version including weights of phenological periods. Presented method makes it possible to give forecast for each recorded phenological stage; the time horizon of the longest of them exceeds 100 to 110 days. Evaluation of method has been made by relative prediction error, mean and deviation for absolute error of prediction. A verification test based on data from different regions of Poland proved the method to be very efficient comparing to prediction using sample average.

600 Nejedlik, P.; Dunajsky, E.; Jenca, V. (Slovensky Hydrometeorologicky Ustav, Kosice (Slovak Republic). Pobočka) (1993) [Agroclimatic conditions of cereals grown in the Vychodoslovenska Nizina Lowland, Slovakia]. *Agroklimatecké zabezpečenie produkcie obilnin v oblasti VSN. Polnohospodárstvo Vychodoslovenskej niziny v regionalných súvislostiach*; Michalovce (Slovak Republic); 1-2 Dec 1992. [Regional aspects of the agriculture in the Vychodoslovenska Nizina Lowland, Slovakia. Proceedings of the international conference held in Michalovce, Slovakia, December 1-2, 1992]. *Oblasťný Vyskumný Ústav Agroekológie, Michalovce (Slovak Republic)* p. 137-145. *Oblasťný Vyskumný Ústav Agroekológie*. 3 tables; 3 ref. Slovak. (AGRIS 94-113096).

601 Stephens, D.J.; Walker, G.K.; Lyons, T.J. (1994) FORECASTING AUSTRALIAN WHEAT YIELDS WITH A WEIGHTED RAINFALL INDEX. *Agricultural & Forest Meteorology*. 71(3-4):247-263. English. [MURDOCH UNIV MURDOCH WA 6150 AUSTRALIA].

Monthly rainfall was correlated with shire wheat yields across the Australian wheat belt and an average correlation coefficient determined for each month. Based on this varying usefulness of rainfall throughout the year, a rainfall index that weights district rainfall over the wheat belt was found strongly to relate to state and national wheat yields. Accuracy of the model was improved by filtering out insignificant and excess rainfall according to the broad scale water holding capacities of regional soils. As one moves clockwise around Australia from the east the soil is less able to store water and truncated winter rainfall is a major problem on poorer soils. Assuming actual rainfall up to the forecast date and average rainfall beyond, hindcasted yields in 1988 and 1989 were within 10% of the final figure 3 months in advance of harvest. A marked trend to early sowing and higher yielding varieties, coupled with increased inputs caused the model to underestimate in 1990, 1991 and 1992. However, at the end of the

year model predictions equalled, or were more accurate than official predictions in 4 out of 5 years. Large-area Australian yields appear to be a function of both rainfall amount and distribution, as well as the time of sowing and extent of frost in critical periods. [References: 36].

Q01 FOOD SCIENCE AND TECHNOLOGY

602 Lim, J.K. (Kyushu Univ., Fukuoka (Japan). Faculty of Agriculture); Hayashi, N.; Matsuo, H.; Hayakawa, I.; Fujio, Y. (1993) Plasticization of wheat starch-gluten mixture under an elevated temperature. *Journal of the Faculty of Agriculture - Kyushu University (Japan)* v. 37(3-4) p. 307-313. 2 tables; 4 fig.; 11 ref. English. (AGRI 94-123979).

Wheat starch-gluten mixture was converted into a bioplastics like material (bioplastics) under processing at an elevated temperature. The density of the bioplastics was 1.24-1.26 g/cubic cm depending on the ratio of starch to gluten. The color difference of the bioplastics was altered with the starch-gluten ratio. Endothermic peak by differential scanning calorimetry was considerably decreased with the increase of the ratio of gluten to starch. It was revealed that the physical characteristics of the bioplastics were dependent on the starch-gluten ratio and that wheat starch and gluten interacts at their interface with the increase of the glass-transition temperature.

603 Popineau, Y. (1992) [Gluten : technological changes, new products, new outlets]. Le gluten : modifications technologiques, nouveaux produits, nouveaux débouchés. Institut National de la Recherche Agronomique, Ivry (France). ESR. UR Industries et Marchés Agroalimentaires. INRA. ref., tableaux. 65 p. French. (AGRI 94-113156).

604 Tanacs, L.; Petroczi, IM.; Matuz, J.; Huhn, E.; Gero, L. (1993) EFFECT OF HERBICIDES ON FLOUR QUALITY OF 2 WINTER WHEAT VARIETIES. *Acta Alimentaria*. 22(4):315-323. English. [UNIV HORT & FOOD IND FAC FOOD IND COLL MARS TER 7 H-6724 SZEGED HUNGARY].

Two winter wheat varieties were treated with 11 different herbicides (Belgran, Aniten D, Banvell M, Lorgan, Assert, Puma, Illoxan, IP-Flo, Starane, Dikamin D and Dikotex 40) in field trials. The baking properties of their grain yields (wet and dry gluten content, gluten spreading, valonographic value and water absorption, falling number (FN), SDS sedimentation volume) have been determined. Treatments with double doses of herbicides modified the dry gluten content, gluten spreading, water absorption, FN and the SDS sedimentation volume, respectively. Considering the properties except for dry gluten, the interaction between varieties and herbicides seemed to be reliable, namely the quality of varieties was changed by the herbicide treatment. This variety specific effect of herbicides was different for every quality parameter. Out of the 11 herbicides Logran and Assert were found to be the most favourable ones because the baking parameters have not been significantly damaged by them, moreover they were in some cases favourably influenced.

Q02 FOOD PROCESSING AND PRESERVATION

605 Abbott, M.S.; Pugh, T.A.; Pringle, A.T. (1993) Biotechnological advances in brewing. *ACS symposium series (USA)* (no. 536) p. 150-180. references. In the series analytic: Beer and wine production: analysis characterization, and technological advances / edited by B.H. Gump and D.J. Pruett. Meeting held April 5-10, 1992, San Francisco, California. English. (AGRI 94-124302).

A variety of biotechnological tools have been applied to improve the ingredients of the brewing process. Using these tools agricultural materials have been developed that are free of viruses, have improved agronomic yields, or are resistant to disease. Brewer's yeasts have been constructed with novel properties such as the ability to ferment normally unfermentable carbohydrates, chill-proof beer, or degrade beta-glucans. Yeasts have also been developed that produce less diacetyl, have altered flocculation properties, or are resistant to contamination. Although there are many advantages to biotechnologically improved agricultural materials and yeast, these advantages must be weighed against regulatory, legal and consumer concerns.

606 Asplund, I. (Staerkelsen AB, Kristianstad (Sweden)) (1992) Rheological methods for determination of gluten quality [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden. Johansson, H. (ed.)* p. 449. Svalof AB. English. (AGRI 94-113220).

607 Becker, H. G.; Lobitz, R. (ed.) (1994) [Buckwheat, spelt, barley, oats, millet, maize, rice, Muesli]. Buchweizen, Dinkel, Gerste, Hafer, Hirse, Mais, Reis, Muesli. Auswertungs- und Informationsdienst fuer Ernährung, Landwirtschaft und Forsten, Bonn (Germany). *AID Verbraucherdienst informiert (Germany)*; no. 1194 30 p. AID. 38 ill., 1 table; 7 ref. German. (AGRI 94-124077).

608 Calderon Dia, Jose H. (INIFAP. C.E. Valle de Mexico. Ap. Postal 10, Chapingo, Mex. 56230 (Mexico)) (1992) [Effects of four environments on the industrial quality of 20 varieties of wheat]. Ensayo de cuatro ambientes sobre la calidad industrial de 20 variedades de trigo. Primera conferencia nacional sobre la producción de trigo en Mexico. (Memoria): Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*; no. 4 p. 503-511. Centro de Investigacion Regional del Noroeste. 9 ref. 2o. tomo. Spanish. (AGRI 94-124175).

609 Galey, C.; Potus, J.; Drapron, R.; Poiffait, A.; Bar, C.; Fischer, J.; Giampaoli, P. (1994) CRUMB BREAD FLAVOUR - INFLUENCE OF WHEAT VARIETY AND BREADMAKING PROCESS. *Sciences des Aliments*. 14(5):643-653. French. [CONSERVATOIRE NATL ARTS & METIERS CHAIRE BIOCHIM IND & AGROALIMENTAIRE 292 RUE ST MARTIN F-75141 PARIS 03 FRANCE].

The influence of wheat varieties and fermentation conditions (i.e. durations of initial and final fermentation, storage of the dough at +1-degree-C for 18 h) on the volatile compounds content and on the odour of bread crumb were studied in an experiment involving breads made according to 3 reference methods with the flours from two varieties of wheat (Recital and Soissons). Volatile compounds were analysed by gas chromatography and the odour of bread crumbs was rated by 30 subjects. Correlations were found between the compounds and the results of the sensory evaluation. The content in volatile compounds of the bread crumb and the strength of the olfactory flavour called "spicy" were affected by the refrigeration of doughs under controlled growth. Bread crumb made from flour of Recital variety was richer in volatile compounds than those made with the flour from Soissons variety. Hypotheses are proposed which might explain these differences.

610 Hansen, B.; Hansen, Aa. (Kgl. Veterinaer og Landbohøjskole, Koebenhavn (Denmark). Mejeri og Levnedsmiddelinst.) (1992) The effect of sour dough fermentation on the gluten properties [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden. Johansson, H. (ed.)* p. 423-425. Svalof AB. English. (AGRI 94-113221).

611 Javanainen, P.; Linko, Y.Y. (Tekniska Högskolan, Esbo (Finland). Lab. foer Bioteknik och Livsmedelsteknik) (1992) Prolonged wheat bread shelf-life with mixed culture pre-ferments [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden. Johansson, H. (ed.)* p. 373. Svalof AB. English. (AGRI 94-113352).

612 Jimenez, A.; Calderon, G.; Vargas, D.; Valdes, S. (INIFAP. C.E. Valle de Mexico. Ap. Postal 10, Chapingo, Mex. 56230 (Mexico)) (1992) [Effects of different times of fermentation and of an emulsifier on the quality of bread made from wheat-triticale mixtures]. Efecto de diferentes tiempos de fermentación y un emulsificante sobre la calidad de pan elaborado con mezclas trigo-triticale. Primera conferencia nacional sobre la producción de trigo en Mexico. (Memoria): Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la producción de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico)*, no

4 p. 513-524. Centro de Investigacion Regional del Noroeste. 4 tablas; 11 ref. 2o. tomo. Spanish. (AGRI 94-124179).

613 Kobrehel, K. (Institut National de la Recherche Agronomique, Montpellier (France). Centre de Montpellier, Technologie des Cereales) (1993) [Germination and dough: a protein could make suitable for breadmaking other cereals than wheat (thioredoxin)]. Germination et pate a pain: une proteine pourrait rendre panifiable d'autres cereales que le ble (thioredoxine) cereale. *Pour la Science (France)* (no 189) p. 26. French. (AGRI 94-113163).

614 Lindahl, L. (Lund Univ. (Sweden). Kemiska Inst.) (1992) Some physical and chemical characteristics of durum and wheat flour doughs. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 321-329. Svalof AB. 11 ref. English. (AGRI 94-113339).

615 Loenner, C. (Lund Univ. (Sweden). Kemiska Inst.) (1992) Starter cultures for wheat sour doughs [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 375-384. Svalof AB. 7 ref. English. (AGRI 94-113340).

616 Mani, K. (Lund Univ. (Sweden). Kemiska Inst.) (1992) Rheological properties of wheat flour doughs produced by four mixing equipments (Farinograph, Mixograph, Krups and Hobart). 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 197-204. Svalof AB. 3 ref. English. (AGRI 94-113334).

617 Medina R, C.L.; Uvalle Bueno, Jaime Xavier (INIFAP. C.E. Valle del Yaqui, Ap. Postal 515, 85270 Cd. Obregon, Sonora (Mexico)) (1992) [Effect of different amounts of karnal-bunt infection on the quality of wheat and on the organoleptic properties of bread]. Efecto de diferentes niveles de infeccion de carbon parcial en la calidad de trigo y las caracteristicas organolepticas del pan. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 525-531.* Centro de Investigacion Regional del Noroeste. 8 tablas; 9 ref. 2o. tomo. Spanish. (AGRI 94-124180).

618 Narziss, L.; Miedaner, H.; Dietschmann, J. (1993) A micro-brewing process for differentiating brewing barley. Part 2: Brewing tests and data assessment. Methode de brassage en micro pour la differentiation des orges brassicoles. 2eme partie: essais de brassage et exploitation des donnees. Ein Mikrobrauverfahren zur Braugerstdifferenzierung. Teil 2: Brauersuche und Datenauswertung. *Monatsschrift fuer Brauwissenschaft (Germany)* v. 46(12) p. 451-460. 9 ill.; 2 ref. German. (AGRI 94-124278).

619 Pena, R.J.; Amaya, Arnoldo; Toro, E. del (CIMMYT) (1992) [Effects of storage and cleaning on the grain quality characteristics of wheat samples, cv. Seri 82, having different amounts of karnal-bunt disease (Neovossia indica)]. Efecto del almacenamiento y del lavado del grano en las caracteristicas de calidad de muestras de trigo var. Seri 82 con diferentes niveles de carbon parcial (Neovossia indica). Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 491-502.* Centro de Investigacion Regional del Noroeste. 2 tablas; 12 ref. 2o. tomo. Spanish. (AGRI 94-124074).

620 Ruiz Hernandez, A.; Cisneros Pestana, F.; Acosta Failde, M. (Instituto de Investigaciones para la Industria Alimentaria, La Habana (Cuba). Dept. de Biotecnologia) (1994) [Obtaining of a partially purified clotting

preparation]. Obtencion de un preparado coagulante parcialmente purificado. *Alimentaria (Espana)* (no. 254) p. 61-65. 8 tab., 2 fig.; 15 ref. Spanish. (AGRI 94-124173).

621 Shiiba, K. (Nisshin Flour Milling Co. Ltd., Ohi, Saitama (Japan)); Ijitsu, T.; Hara, H.; Okada, K. (1992) Preparation and characterization of water-soluble hemicellulose (arabinoxylan) from wheat bran. *Journal of the Japanese Society for Food Science and Technology (Japan)* v. 39(12) p. 1147-1155. 2 tables; 6 fig.; 29 ref. English. (AGRI 94-124176).

622 Sorvaniemi, J.; Kinnunen, A. (Statens Tekniska Forskningscentral, Esbo (Finland). Livsmedelslab.) (1992) Estimation of damaged starch in milled wheat by FT-NIR spectroscopy [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 447-448. Svalof AB. 1 ref. English. (AGRI 94-113348).

623 Sundby, J.E.; Danielsen, K. (Statens Kornforretning, Oslo (Norway)) (1992) Quality classifying of wheat. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 285-291. Svalof AB. English. (AGRI 94-113222).

624 Weyh, H.; Hagen, W. (1993) [Reproducibility and accuracy of determination of moisture content by drying chamber method]. Reproduzierbarkeit und Richtigkeit der Wassergehaltsbestimmung nach der Trockenschrankmethode. *Weihenstephaner (Germany)* v. 61(3) p. 186-191. 6 tables; 23 ref. German. (AGRI 94-124061).

625 Wicker F, R. (Universidad de Sonora, Hermosillo, Sonora. (Mexico)) (1992) [Post-harvest technologies for Mexican wheat, now and in the future]. La industrializacion actual y futura de trigo en Mexico. Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 481-490.* Centro de Investigacion Regional del Noroeste. 8 ref. 2o. tomo. Spanish. (AGRI 94-124174).

626 Zlateva, D.; Bratanova, P. (Vish Institut po Khranitelna i Vkusova Promishlenost, Plovdiv (Bulgaria)) (1994) [Freeze-dried yeasts from milk-acid Streptococci for the wheat bread production]. Prilozhenie na lifofilizirani zakvaski ot mlechnokiselni streptokoki pri proizvodstvoto na pshenichen khlyab. Firma "Nikolov-Internesh"n", Sofia (Bulgaria). Institut po Lifofilizatsiya i Kriobiologiya na Selskostopanska Akademuya. S'yuz po Khranitelno-vkusova Promishlenost. *Khranitelna Promishlenost (Bulgaria); Food Industry* v. 43(3) p. 25-27. 2 ill., 5 tables; 7 ref. Bulgarian. (AGRI 94-113350).

Q03 FOOD CONTAMINATION AND TOXICOLOGY

627 Glaze, L.E.; Bryce, J.R. (1994) EXTRACTION OF LIGHT FILTH FROM WHOLE WHEAT FLOUR, FLOTATION METHOD - COLLABORATIVE STUDY. *Journal of AOAC International*. 77(5):1150-1152. English. [US FDA DIV MICROBIOL WASHINGTON, DC 20204 USA].

An additional extraction/flotation method for the determination of light filth in whole wheat flour was validated through a collaborative study. A 50 g test portion is boiled in a 3% HCl solution. The mixture is washed with hot tap water on a No. 230 sieve. Then the residue is boiled in isopropanol, transferred to a No. 230 sieve, and washed again. The residue is transferred to a Wildman trap flask using 40% isopropanol. The filth is isolated by flotation in mineral oil and a mixture of Tween 80 and Na(4)EDTA in 40% isopropanol. Average recoveries by 8 collaborators were 88.8 and 91.7% for insect fragments and rat hairs, respectively. The extraction/flotation method for determination of light filth in whole wheat flour has been adopted first action by AOAC INTERNATIONAL as an additional procedure to the AOAC Official Method 941.16. Filth in Grain Products. [References: 1].

- 628 Jonsson, A. (Svenska Lantmannens Riksfoerbund, Stockholm (Sweden)) (1992) Heavy metals in Swedish winter wheat 1989 [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 365-368. Svalof AB. 7 ref. English. (AGRI 94-113609).
- 629 Schwarz, P.B.; Barr, J.M. (1993) Application of mineral oil to barley for dust control: analysis of malt, spent grains, and wort for residues. *Journal of the American Society of Brewing Chemists (USA)* v. 51(4) p. 152-155. references. English. (AGRI 94-113507).
- 630 Xu, Y.C.; Mirocha, C.J.; Xie, W. (1994) ANALYSIS BY LIQUID CHROMATOGRAPHY OF FUSAROCROMANONE (TDP-1) ADDED TO CORN AND WHEAT. *Journal of AOAC International*. 77(5):1179-1183. English. [UNIV MINNESOTA DEPT PLANT PATHOL ST PAUL, MN 55108 USA].
- An analytical method was developed for the detection of fusarochromanone (TDP-1) in corn and wheat by liquid chromatography. Extraction was done with methanol-water-ammonium hydroxide (90 + 10 + 2), and cleanup was by elution through a silica Sep-Pak cartridge. The limit of sensitivity of TDP-1, detected on the basis of its fluorescence properties, is 200 pg, whereas the detection limit of the method for corn and wheat is 5 ng/g. The average recoveries of TDP-1 added at 5, 25, 100, 500, and 1000 ppb were 86% for corn and 83% for wheat. Confirmation was done by thin-layer chromatography. [References: 8].
- Q04 FOOD COMPOSITION**
- 631 Aaman, P.; Westerlund, E.; Bengtsson, S. (1992) Structural studies on pentosans. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 247-254. Svalof AB. 5 ref. English. (AGRI 94-113859).
- 632 Andersson, B. (1992) Food quality as affected by batch of barley and processing technique [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 401-411. Svalof AB. 6 ref. English. (AGRI 94-113855).
- 633 Andersson, R.; Westerlund, E.; Aaman, P. (1992) Correlations between the chemical composition and baking properties of wheat flour [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 413-419. Svalof AB. 6 ref. English. (AGRI 94-113867).
- 634 Balcheva, L.; Marinov, V.; Stefanov, G. (Institut po Z'rneni Khrani i Furazhna Promishlenost, Kostinbrod (Bulgaria)) (1994) [Mill properties of wheat with different structural and mechanical endosperm characteristics]. Mlevni svojstva na pshenitsi s razlichni strukturo-mekhanichni kharakteristiki na endosperma. Firma "Nikolov-Internesh"n"l, Sofia (Bulgaria). Institut po Liofilizatsiya i Kriobiologiya na Selskostopanska Akademiya. S'yuz po Khranitelno-vkusova Promishlenost. Khranitelna Promishlenost (Bulgaria); *Food Industry* v. 43(2) p. 21-24. 2 ill., 4 tables; 8 ref. Bulgarian. (AGRI 94-113725).
- 635 Gebhardt, D.; Rasmusson, D.C.; Fulcher, R.G. (1993) Kernel morphology and malting quality variation in lateral and central kernels of six-row barley. *Journal of the American Society of Brewing Chemists (USA)* v. 51(4) p. 145-148. references. English. (AGRI 94-113716).
- 636 Hall, G. (AB Nord Mills, Malmoe (Sweden)) (1992) The quality of Swedish vital wheat gluten. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 231-237. Svalof AB. 4 ref. English. (AGRI 94-113726).
- 637 Karababa, E.; Schwarz, P.B.; Horsley, R.D. (1993) Effect of kiln schedule on micromalt quality parameters. *Journal of the American Society*

of *Brewing Chemists (USA)* v. 51(4) p. 163-167. references. English. (AGRI 94-113715).

- 638 Manev, M.; Kostkanova, E.; Stehno, Z. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyne (Czech Republic)) (1994) [Indicators of baking quality in some cultivars and advanced lines of spring wheat]. Ukazatele pekarske jakosti u vybranych odrud a novoslechteni pšenice jarni. *Genetika a Slechteni - UZPI (Czech Republic)* v. 30(2) p. 133-149. 10 tables; 11 ref. Czech. (AGRI 94-113724).

Two selected collections of spring wheat were investigated in order to determine the technological quality of grain, dry matter and crude protein yields per 1 ha, 1000-grain weight and plant height. Technological analyses involved crude protein content, microsedimentation value of groats, wet gluten content in flour, gluten swelling and extensibility. In the three-year trial, the crude protein content was highest in the Tr. durum cultivar Arcour from France (16.5 g per 100 g grain dry matter), followed by the Czechoslovak cultivar Maja (15.6 g) French cultivars Ventura (15.3 g) and Lobo (15.2 g). The Ventura cultivar had the highest microsedimentation value (8.1 ml). Grain and crude protein yields per 1 ha were highest in the Czechoslovak cultivars Maja (5.3 t and 837.7 kg), Saxana (5.3 t and 763.7 kg), Sandra (5.3 t and 760.9 kg), Jara (5.1 t and 759.3 kg) and in the Polish cultivar Eta (5.1 t and 746.3 kg). In the two-year trial, the American cultivar Treasure had the best quality, as well as good yields. In the three-year trial the 1000-grain weight was highest in the advanced line Pato (45.2 g) and in the Sigma cultivar from Poland (43.7 g). In the two-year trial, the highest 1000-grain weight was determined in the Messa pia cultivar of Tr. durum from Italy (46.0 g). In both trials, the values were influenced by individual years.

- 639 Perten, H. (Falling Number AB, Huddinge (Sweden)) (1992) The development and international growth of the falling number method. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 45-67. Svalof AB. 17 ref. English. (AGRI 94-113723).

- 640 Saarinen, S.; Kontturi, M.; Salo, Y. (1992) Grain protein solubility and breadmaking quality of spring wheat varieties grown in Finland [poster]. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 421. Svalof AB. English. (AGRI 94-113868).

- 641 Sasagawa, M. (Japan Tobacco Inc., Tokyo); Yasui, A. (1992) Dietary fiber and inorganic elements in wheat short. *Journal of the Japanese Society for Food Science and Technology (Japan)* v. 39(11) p. 984-993. 3 tables; 8 fig.; 9 ref. Japanese. (AGRI 94-124488).

- 642 Strass, F. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau, Freising Muenchen, Freising (Germany)); Zimmermann, G. (1993) [Corn composition and quality aspects of different wheat varieties]. Bei Weizen jede Chance nutzen - Im Augenblick sind Aufmischsorten sehr gefragt. *Bayerisches Landwirtschaftliches Wochenblatt (Germany)* v. 183(39) p. 34-35. 1 ill., 1 table. German. (AGRI 94-124492).

- 643 Watanabe, M.; Ikezawa, Z.; Arai, S. (1994) FABRICATION AND QUALITY EVALUATION OF HYPOALLERGENIC WHEAT PRODUCTS. *Bioscience Biotechnology & Biochemistry*. 58(11):2061-2065. English. [TOKYO GAKUJI UNIV FAC EDUC FOOD SCI LAB KOGANEI TOKYO 184 JAPAN].

Hypoallergenic wheat products in the form of pasta-like noodles and bread were fabricated. Wheat flour was added with a 0.6-fold weight of water dissolving collagenase to obtain hypoallergenic flour batter. Methods for producing hypoallergenic pasta-like noodles and bread from the batter were designed. In the noodle making, the batter was mixed with an oligosaccharide with a mild sweetness, a surfactant, and salt, and the mixture was extruded under heating. Both retorting and refrigerating processes were applied to the noodles. In the bread making a mixture of the batter, glucose, citric acid, sodium hydrogen carbonate and salt was baked at 180 degrees C. The addition of glucose contributed to generation of favorable flavor and color. [References: 7].

644 Chaudhry, AS.; Miller, EL. (1994) **IN VITRO DIGESTIBILITY OF BARLEY AND WHEAT STRAWS TREATED WITH HYDROGEN PEROXIDE, SODIUM HYDROXIDE AND SODIUM PEROXIDE UNDER VARIOUS CONDITIONS.** *Animal Feed Science & Technology*. 50(1-2):1-15. English. [UNIV BRISTOL DIV ANIM HLTH & HUSB BRISTOL BS18 7DU AVON ENGLAND].

Five factorial experiments were conducted to evaluate the use of different amounts (0-600 g kg⁻¹) of hydrogen peroxide (H₂O₂) in improving the in vitro digestibility of barley and wheat straws under different pH (5.6, 11.5), storage times (2, 7, 14, 21, 28 days) and straw/liquid ratios (8:1, 4:1, 2:1, 1:1, 1:6). The use of NaOH (50 g kg⁻¹) straw at 8:1, 4:1 and 1:1 ratios and Na₂O₂ (15 and 45 g kg⁻¹) straw at 1:1 ratio) was also tested. In vitro digestibility of untreated (UBS) and ammonia-treated barley straw increased linearly (Experiment 1) with increase in H₂O₂ at pH 11.5 (alkaline H₂O₂, AHP). In Experiment 2, however, the digestibility of UBS increased curvilinearly (P < 0.001) with increase in AHP. In contrast digestibility decreased curvilinearly (P < 0.001) when H₂O₂ was applied at pH 5.6 (Experiment 2). In vitro digestibility increased with AHP in a dose related manner at different storage times (Experiments 3 and 4). In vitro digestibility of wheat straw was also increased (P < 0.001) with AHP treatments. However, the effect was not as great as with Na₂O₂ (45 g kg⁻¹) or NaOH (50 g kg⁻¹) when compared at same ratios of 1:1 (Experiment 5), NaOH being the most effective (P < 0.001) in improving digestibility. The full potential of AHP was perhaps masked by inhibitory soluble products released from straws which may have hampered the in vitro microbial digestion. Further studies are suggested to exploit the full potential of AHP. [References: 24].

645 Fondevila, M.; Castrillo, C.; Guada, JA.; Balcels, J. (1994) **EFFECT OF AMMONIA TREATMENT AND CARBOHYDRATE SUPPLEMENTATION OF BARLEY STRAW ON RUMEN LIQUID CHARACTERISTICS AND SUBSTRATE DEGRADATION BY SHEEP.** *Animal Feed Science & Technology*. 50(1-2):137-155. English. [UNIV ZARAGOZA DEPT PROD ANIM & CIENCIA ALIMENTOS M SERVET 177 E-50013 ZARAGOZA SPAIN].

The effect of ammonia treatment and supplementation of barley straw with increasing levels (0, 200, 400 and 600 g day⁻¹) of meadow grass hay (H), rolled barley (B) or pelleted sugar-beet pulp (P) on ruminal characteristics and straw degradation was studied using eight adult ewes, divided in two groups, receiving either untreated (US) or ammonia treated (TS) straw, supplemented with H, B or P consecutively. Urea (30 g kg⁻¹) straw was added to US 24 h before feeding. Sheep fed US showed higher ammonia-N (NH₃-N) concentration than those fed TS, either as the only feed (17.5 and 12.3 mg per 100 ml) or supplemented (15.0 and 12.7 mg per 100 ml). There was no effect of ammoniation over rumen pH or total volatile fatty acid (VFA) concentration. Supplementation with B or P depressed pH and enhanced VFA concentration, whereas H did not have any great effect. Extent of straw rumen degradation was enhanced by ammoniation (maximum degradation of 593 and 741 g kg⁻¹) for US and TS), but rate of degradation and lag time remained unaffected. Both rate and extent of straw degradation were decreased to a similar extent when supplemented with B or P, while with H this effect was only noticeable when it was included in the diet at 600 g day⁻¹. [References: 42].

646 Haddad, SG.; Grant, RJ.; Klopstein, TJ (1994) **DIGESTIBILITY OF ALKALI-TREATED WHEAT STRAW MEASURED IN VITRO OR IN VIVO USING HOLSTEIN HEIFERS.** *Journal of Animal Science*. 72(12):3258-3265. English. [UNIV NEBRASKA DEPT ANIM SCI LINCOLN, NE 68583 USA].

Three experiments were conducted to determine the effect of different alkali solutions on in vitro degradation and in vivo digestibility of wheat straw. In Exp. 1, ground wheat straw was treated with 15 different alkali solutions grouped as NaOH, NH₄OH, urea, and Ca(OH)₂ (2). The greatest (P < .05) 48-h in vitro NDF degradability was obtained with 5% NaOH and the combination of 2.5% NaOH + 2.5% Ca(OH)₂ (2). In Exp. 2, chopped wheat straw was treated with one of the following: 1) untreated; 2) 2.5% NaOH; 3) 5% NaOH; 4) 2.5% Ca(OH)₂ (2) + 2.5% NaOH; or 5) 5% Ca(OH)₂ (2). Five Holstein heifers were fed diets that contained 60% straw, 20% alfalfa hay, and 20% concentrate mix (DM basis) fed as total mixed rations in a 5 x 5 Latin square design. The greatest in vivo NDF digestibility (P <

.05) was obtained with the NaOH and NaOH + Ca(OH)₂ (2) treatments. The 5% Ca(OH)₂ (2) treatment had higher fiber digestibility than the control and was equivalent to the 2.5% NaOH and 2.5% NaOH + Ca(OH)₂ (2) treatments. Rate of passage of straw was not affected by chemical treatment, whereas rate of passage of dietary alfalfa hay increased with NaOH. In Exp. 3, wheat straw ground through a 2-mm screen was treated with one of the following chemicals: 1) untreated (control); 2) 5% NaOH; 3) 5% NH₄OH; 4) urea supplying N equivalent to 5% NH₄OH; and 5) 5% Ca(OH)₂ (2) (all on DM basis). A significant interaction (P < .05) was observed between chemical and pH for lag, rate, and extent of NDF degradation in vitro, which reflected the varying magnitude by which straw treated with different alkali sources was affected at the more acidic pH. No mechanism was determined for the effect of Ca(OH)₂ (2), but it seems that Ca(OH)₂ (2) enhances fiber degradation at low pH in vitro. [References: 31].

647 Moss, AR.; Givens, DI.; Garnsworthy, PC. (1994) **THE EFFECT OF ALKALI TREATMENT OF CEREAL STRAWS ON DIGESTIBILITY AND METHANE PRODUCTION BY SHEEP.** *Animal Feed Science & Technology*. 49(3-4):245-259. English. [AGR DEV & ADVISORY SERV DRAUGHTON RES CTR FEED EVALUAT UNIT STRATFORD UPON AVON CV37 9RQ ENGLAND].

The effects of treating cereal straws with NaOH and ammonia on methane production by sheep are reported. One oat, two wheat and two barley straws were either untreated or treated with NaOH (45 kg t⁻¹ dry matter (DM)) and ammonia (35 kg t⁻¹ DM). The straws were supplemented with urea and sodium sulphate as appropriate to provide a dietary N/S ratio of 14.4:1 and given ad libitum to mature wether sheep. Methane production was measured in open circuit respiration chambers following a 20 day period on each diet. The digestibility of various feed fractions was measured both in vitro and in vivo. Methane production as a proportion of gross energy intake (range 0.047-0.067) was not significantly affected by treatment, although the volume of methane produced per animal was significantly (P < 0.001) increased (Control, 17.8; NH₃, 26.2; NaOH 30.11 per animal per day). However, when methane production was expressed relative to intake of digestible organic matter, treatment significantly (P < 0.001) reduced production (Control, 55.0; NH₃, 43.7; NaOH, 48.11 kg-1 organic matter apparently digested). The significance of these findings in relation to reducing methane emissions to the atmosphere is discussed. [References: 36].

648 Yadav, BS.; Virk, AS. (1994) **THE FIXATION OF NITROGEN USING ACID, GREEN FORAGE AND GERMINATED BARLEY DURING UREA TREATMENT OF STRAWS.** *Animal Feed Science & Technology*. 50(1-2):123-135. English. [HARYANA AGR UNIV CCS DEPT ANIM NUTR HISAR 125004 HARYANA INDIA].

In the treatment of gram straw hydrochloric acid had a more significant (P<0.01) effect than sulphuric acid in lowering the loss of ammonia nitrogen from 45.88% in control to 16.28% using 7.5% urea at a 40% (F-4) fixation level as compared with 30% (F-3), 20% (F-2) and 10% (F-1). Treatment of gram straw (*Cicer arietinum*) for 28 days with 7.5% urea having 44.88% moisture at F-4 could significantly (P<0.01) check the loss of ammonia and enhance the crude protein (CP) content to 19.37%. In Experiment 2, the loss of nitrogen was effectively reduced from 35% (T-0) to 22% (T-1) and 21% (T-2) by means of sulphuric acid (10.18 g kg⁻¹ dry matter (DM)) and green sorghum (*Sorghum vulgare*) mixed with wheat straw in the ratio of 1:2 at the time of storage. The relative retention of nitrogen (g day⁻¹) in male buffalo calves was significantly (P<0.05) superior in T-1 (53.31) and T-2 (45.58) than T-0 (35.42). The digestible CP (DCP) and total digestible nutrient (TDN) values of urea treated wheat straw were 7.10%, 8.33%, 6.49%, 57.90%, 55.64% and 62.58% in respective treatments. During Experiment 3, untreated wheat straw plus concentrate mixture, 20% CP (T-3), urea (7.5%) treated straw, US (T-4), urea treated straw plus acid (23 g kg⁻¹ DM) (T-5), and urea treated straw plus germinated barley 24% (T-6) were fed to buffalo calves in four groups. The daily body weight gain (g day⁻¹) was significantly (P<0.01) greater in T-6 (640.15) followed by T-5 (556.80), T-4 (499.99) and T-3 (458.32). Cost per kg gain in body weight (Rs.) was minimum in T-6 (12.47) followed by T-4 (14.15), T-5 (14.99) and T-3 (23.45). The loss of nitrogen was considerably lowered from 51.3% (T-4) to 19.07% (T-5) using sulphuric acid at farm scale. Urea treated straw with 24% germinated barley, containing 13.39% CP, 8.33% DCP and 58.54% TDN, may be an economical complete ration

for growing buffalo calves replacing native protein completely. [References: 35].

Q54 FEED COMPOSITION

649 Eng, K. (1992) Barley composition, starch utilization among conference topics. *Feedstuffs (USA)* v. 64(52) p. 10-11. references. English. (AGRIC 94-124816).

650 Hestangen, B. (Statens Kornforretning, Oslo (Norway)); Krogdahl, Aa. (1992) Extruded wheat in fish feed. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 205-213. Svalof AB. English. (AGRIC 94-114052).

651 Koci, S.; Kociova, Z. (1994) THE EFFECT OF ADMINISTRATION OF LOOSE FEEDING CONCENTRATES AND WHOLE WHEAT GRAIN ON EFFICIENCY OF LAYING HENS. *Zivocisna Vyroba*. 39(10):917-925. Czech. [VYSKUMNY USTAV ZIVOCISNE VYROBY STANICA CHOVU & SLACHTENIA HYDINY CS-90028 IVANKA PRI DUNAJI SLOVAKIA].

Two trials were conducted with laying hens heavier body type (Hisex Brown) and lighter body type (Shaver 579). Each of three groups comprised 90 laying hens and they were administered complete loose feed mixture intended for laying hens (169 g of protein, 11.3 MJ ME/kg) in control groups and experimental groups were fed with loose concentrate I (200 g of protein, 10.4 MJ ME/kg), or concentrate II (269 g of protein, 7.5 MJ ME/kg) in combination with whole wheat grain (60% of concentrate I + 40% of wheat), respectively, or 32% of concentrate II + 68% of wheat). Calculated content of nutrients in these combinations ranged from 165 to 170 g of protein and from 10.8 to 11.2 MJ ME/kg. In an independent group of one of trials the daily supplement of whole grain wheat to the complete feed mixture in ratio 900 g of mixture + 100 g of whole-grain wheat/kg. Experimental interventions had no effect on egg production of hens. The weight of eggs increased (trial I - statistically significantly, $P < 0.05$), feed consumption per day and egg (trial II - statistically significantly, $P < 0.05$) in reduction of efficiency of feed. The supplement of whole-grain wheat to the complete feed mixture had no statistically significant effect on assessed indicators. Experimental interventions had indifferent effect on egg quality (Haugh's units of egg white). Energy intake in experimental groups increased by 3 to 6 %, the weight of gizzard increased numerically. The costs of feeds in experimental groups decreased by 7.4 to 17.6%, that is due also to savings of 75% of electric energy for grinding of wheat. Combined administration of loose concentrates and whole-grain wheat may be considered as an alternative system of feeding of laying hens by which the breeder utilizes his own sources of cereals in production of heavier eggs particularly from genetically heavier body types of hens.

652 Nahashon, SN.; Nakau, HS.; Snyder, SP.; Mirosh, LW. (1994) PERFORMANCE OF SINGLE COMB WHITE LEGHORN LAYERS FED CORN-SOYBEAN MEAL AND BARLEY-CORN-SOYBEAN MEAL DIETS SUPPLEMENTED WITH A DIRECT-FED MICROBIAL. *Poultry Science*. 73(11):1712-1723. English. [OREGON STATE UNIV DEPT ANIM SCI CORVALLIS, OR 97331 USA].

An experiment was conducted with Single Comb White Leghorn (SCWL) layers to determine the effect of feeding either corn-soybean meal (C-S) or barley-corn soybean meal (B-C-S) diets with or without condensed cane molasses solubles (CCMS) or with or without CCMS-1, 100 mg Lactobacillus (Lacto)/kg (ppm) diet on performance, nutrient retentions, digesta passage rate, and histological changes of the gastrointestinal (GI) tracts. Six dietary treatments were fed for eight 28-d periods and consisted of C-S (control), C-S + CCMS, C-S + CCMS-1, 100 ppm Lacto (4.4 x 107 cfu/mg Lacto), B-C-S (control), B-C-S + CCMS, and B-C-S + CCMS-1, 100 ppm Lacto. The CCMS served as the carrier for the Lacto, and the CCMS-Lacto premix (55 g Lacto/kg) was incorporated at 2% of the diet. Lactobacillus supplementation in C-S diets improved ($P < 0.05$) egg weight, egg mass, egg size, and body weight gains, and in B-C-S diets improved body weight gains. There were no differences in feed consumption, feed conversion, internal egg quality, and egg specific gravity among the dietary treatments. Passage rates of digesta were increased ($P < 0.05$) when either C-S or B-C-S layer diets were supplemented with Lacto. Lactobacillus supplementations of the C-S and B-C-S diets increased ($P < 0.05$) fat and calcium, and fat, phosphorus, copper, and manganese

retentions, respectively. Increased cellularity of Peyer's patches in the ileum indicated a stimulation of the mucosal immune system that responds to antigenic stimuli by secreting immunoglobulin (IgA). [References: 44].

653 Smith, WA.; Duplessis, GS.; Griessel, A. (1994) REPLACING MAIZE GRAIN WITH TRITICALE GRAIN IN LACTATION DIETS FOR DAIRY CATTLE AND FATTENING DIETS FOR STEERS. *Animal Feed Science & Technology*. 49(3-4):287-295. English. [UNIV STELLENBOSCH DEPT ANIM SCI STELLENBOSCH SOUTH AFRICA].

USGEN 10 triticale was compared with maize as a feed grain in a digestibility trial, a milk production trial and a fattening trial. Apparent digestibilities were determined with eight Holstein steers, in two blocks of a balanced cross-over design. The grain component of the four diets contained triticale and maize in the ratios 100:0, 66:34, 34:66 and 0:100, respectively. Digestibility coefficients were unaffected by level of dietary triticale substitution for maize. For the milk production trial eight Holstein cows were also allocated to two blocks of four animals each and fed the four treatment diets in two consecutive periods. Cows received forage consisting of 20% lucerne hay, 15% wheat straw and 65% oat silage (dry matter basis) ad libitum and a concentrate at 0.5 kg kg⁻¹ milk produced. The grain component of the four concentrates was the same as in the digestibility trial. Milk fat percentage and 4% fat corrected milk production per kg concentrate consumed was lower ($P < 0.05$) on the dietary treatment containing only triticale grain compared to that on the treatments containing different levels of maize grain. For the fattening trial 30 steers were randomly allocated to the five dietary treatments by stratified sampling. The steers received complete diets for 100 days. The grain portion of the five fattening diets consisted of 100% maize, 75% maize:25% triticale, 50% maize:50% triticale, 25% maize:75% triticale and 100% triticale. Steers on the 50% maize:50% triticale diet tended to perform better than steers on diets containing only maize or triticale grain. Feed conversion ratio (carcass) was better ($P < 0.05$) for steers on the 50% maize:50% triticale diet than for steers on the 100% triticale diet. [References: 17].

654 Vesely, P. (1994) DIGESTIBILITY OF PREFORMED COMPLETE FEED MIXTURE WITH VARIOUS TREATED CEREAL. *Zivocisna Vyroba*. 39(10):895-902. Czech. [VYSOKA SKOLA ZEMEDELSKA ZEMEDELSKA 1 CS-61300 BRNO CZECH REPUBLIC].

An experiment with six rams of the Caucasian Merino breed was carried out to study the effect of introduction of various treated wheat grain into the complete feed mixture on their digestibility. The mixture contained 30% of wheat, 33% of lucerne flour, 32% of barley straw and 5% of molasses. In addition 26 g of urea was added per 1 kg of mixture and 15 g of NaCl in treatments without application of NaOH. Within balance nine-day periods the effect of four experimental interventions (I to IV) was compared; i.e. treatments with the whole untreated wheat grain (I), ground grain (II), whole grain treated with sodium hydroxide (III) and hydrothermally treated grain (IV). For treatment of wheat with NaOH (experimental intervention III) 4 kg of NaOH, dissolved in 7 l of water, was applied per 100 kg of wheat. After NaOH application urea was added to wheat, and wheat treated in this way was stored for three days in closed plastic bag before the proper stirring in the mixture. The whole wheat grain (experimental intervention I) was processed by the same technological procedure except for an application of 7 l of water without NaOH. Pressed steamed wheat (experimental intervention IV) was prepared in thermal flocculating device for cereals and legumes made by the firm BOCCHI. All treatments were shaped in the preforming press for preforms 64 cm in diameter. Dosing of dry matter of feed mixture was chosen on the nutrition level of 1.5. Intake of nutrients per 1 kg W0.75/day and average live weight are in Tab. II. The coefficients of balance digestibility and energy value of mixtures found are presented in Tab. III. Regarding the fact that identical technology of forming was used in all experimental interventions, it may be presupposed that the differences found in digestibility of organic nutrients were caused exclusively by corresponding treatment of wheat grain included in the experimental feed mixtures. Significantly highest digestibility of dry matter, crude protein, fat, nitrogen-free extract (BNLV) and organic matter was found in experimental treatment with grain treated with NaOH (III) and fibre in the experimental treatment with hydrothermally treated grain (IV). On the contrary, significantly lowest values of digestibility were found in experimental intervention with ground wheat. The significance of

differences in digestibility of organic nutrients is presented in Tab. IV. Within the context, the least effective was found to be the grain treatment with grinding. Hydrothermic treatment was also inefficient, in which, compared with the control (untreated grain), was found only significantly higher digestibility of fibre, but significantly lower digestibility of fat and N-free extract. Due to an increase in digestibility of crude protein, fat, N-free extract and organic matter, in feed mixture with wheat grain treated with NaOH a significant increase in indicators SH (starch value), ME, NEL and NEV occurred. It follows from the value found that the treatment of wheat grain with sodium hydroxide after its subsequent blending with the other constituents of the feed mixture and forming on the piston preforming press, an efficient seems to be the technology raising digestibility of feed mixture and its energy value.

Q55 FEED ADDITIVES

655 Flores, MP.; Castanon, JIR.; McNab, JM. (1994) EFFECT OF ENZYME SUPPLEMENTATION OF WHEAT AND TRITICALE BASED DIETS FOR BROILERS. *Animal Feed Science & Technology*. 49(3-4):237-243. English. [FAC VET LAS PALMAS DEPT PROD ANIM E-35016 LAS PALMAS SPAIN].

The effect of adding 1 g kg⁻¹ of a commercial enzyme preparation (containing beta-glucanase, hemicellulase, cellulase and pentosanase activities) to diets containing 300 and 600 g kg⁻¹ of wheat or each of three varieties of triticale (Lasko, Purdy and Proteus) was assessed in a feeding trial with male broiler chicks from 10 to 24 days of age. Also the TMEn value of diets was determined using adult cockerels. At inclusion rates of 300 or 600 g kg⁻¹ the TMEn (true metabolizable energy) values and the productive responses of chicks (feed intake, weight gain and feed efficiency) were similar for all four cereals, except that the weight gain for triticale Proteus at 300 g kg⁻¹ was lower ($P < 0.05$). Increasing the content of cereals from 300 to 600 g kg⁻¹ improved the TMEn of the diets ($P < 0.05$) and decreased the feed intake ($P < 0.05$), but did not affect the weight gain of birds, except the diet with triticale Proteus which decreased ($P < 0.05$). These results confirm that the nutritive value of some cultivars of triticale (i.e. Lasko and Purdy) for birds is similar to that of wheat, and that these varieties can be used at high inclusion rates in poultry diets. The enzyme supplementation of diets did not modify their TMEn value or feed intake of chicks, but the enzyme preparation improved ($P < 0.05$) feed efficiency of all diets and weight gain at the highest rate of inclusion of triticales. In this study, the best results with enzyme supplementation were obtained with the cereals with lowest nutritive value and when the inclusion rate of cereals was the highest. [References: 14].

656 Gomes, MJ.; Hovell, FDD.; Chen, XB.; Nengomasha, EM.; Fikremariam, D. (1994) THE EFFECT OF STARCH SUPPLEMENTATION OF STRAW ON MICROBIAL PROTEIN SUPPLY IN SHEEP. *Animal Feed Science & Technology*. 49(3-4):277-286. English. [ROWETT RES INST BUCKSBURN AB2 9SB ABERDEEN SCOTLAND].

The effect on microbial N (MN) supply of supplementation of straw with a mixture of maize starch and ground barley was examined. Urinary excretion of purine derivatives (PD) was used as an index of microbial protein supply. Six wether sheep of 42-48 kg with rumen cannulae were offered ad libitum either barley straw with 5% molasses, or barley straw with 15.5 or 31.0% of a mixture of maize starch and ground barley (1.2:1.0), and 9 and 13% molasses respectively. All sheep received all three diets for periods of 21 days, excreta being collected during the last 7 days. Digestible organic matter intake (DOMI) increased with starch inclusion as 435, 750 and 1043 (SED 47) g day⁻¹ for the three diets respectively. Total PD excretion was 7.0, 12.3 and 21.1 (SED 0.92) mmol day⁻¹, and the estimated MN supply was 5.7, 10.5 and 18.2 (SED 0.84) g day⁻¹. Expressed as per unit DOMI, MN supply was 12.8, 14.1 and 17.5 (SED 1.3) g N kg⁻¹ DOMI. Rumen liquid and solid outflow rates (fraction of rumen volume h⁻¹) were 0.047, 0.054 and 0.073 (SED 0.0074) and 0.078, 0.105 and 0.130 (SED 0.0083) respectively. MN supply per unit DOMI increased probably due to a greater rumen outflow rate. The practical implication is that with low quality straw, supplementation of starch concentrate up to 31% of the whole diet increased both voluntary food intake and the supply of microbial protein per unit of DOMI. [References: 23].

657 Guedes, CM.; Diasasilva, A. (1994) EFFECTS OF FISH-MEAL SUPPLEMENTATION ON THE DIGESTION AND RUMEN

DEGRADATION OF AMMONIATED WHEAT STRAW. *Annales de Zootechnie*. 43(4):333-340. English. [UNIV TRAS MONTES & ALTO DOURO DEPT ANIM PROD APARTADO 202 P-5001 VILA REAL PORTUGAL].

A digestibility experiment was designed to investigate the effect of fish-meal (FM) supplementation on digestion of urea-treated wheat straw. Ammoniated straw was offered alone in restricted amounts or with FM at the levels of 2.5, 5.0 and 10.0% of daily air-dried straw. Untreated straw supplemented with 10.0% FM was also offered. Straw was sprayed with a solution of urea to achieve similar levels of total nitrogen in all diets. Five mature rams fitted with rumen cannulae were used in a 5 x 5 latin square design. FM supplementation significantly increased organic matter (OM) and neutral detergent fibre (NDF) digestibility ($P < 0.05$) of urea-treated straw. There was no significant effect of FM level ($P > 0.05$). OM digestibility was enhanced 9 percentage units due to urea treatment (47.2 vs 56.3) when the straw was supplemented with 10% fish meal in the diet. The size of the potentially degradable fraction and the rate of degradation measured in situ by the nylon bag technique were consistently increased by FM supplementation. No effect on rate constant of dry matter and NDF degradation was observed due to urea treatment. The degradation lag time of NDF was reduced ($P < 0.05$) by FM supplementation. [References: 24].

Q60 PROCESSING OF NON-FOOD OR NON-FEED AGRICULTURAL PRODUCTS

658 Godon, B. (Institut National de la Recherche Agronomique, Nantes (France). Centre de Nantes, Biochimie et Technologie des Proteines) (1992) [Wheat cracking, a modern agribusiness]. *Le craquage du ble, une agro-industrie moderne. Pour la Science (France) (no 177) p. 62-69. French.* (AGRI 94-124909).

Q70 PROCESSING OF AGRICULTURAL WASTES

659 Blanco, MJ.; Almendros, G. (1994) MATURITY ASSESSMENT OF WHEAT STRAW COMPOSTS BY THERMOGRAVIMETRIC ANALYSIS. *Journal of Agricultural & Food Chemistry*. 42(11):2454-2459. English. [CIEMAT INST ENERGIAS RENOVABLES DIV BIOMASA AVE COMPLUTENSE 22 E-28040 MADRID SPAIN].

Thermogravimetric analysis in oxidizing atmosphere has been used to characterize composts prepared from wheat straw with different organic and mineral additives. After a wide range of classical parameters were determined for the chemical maturity of composts, plant yield improvement was studied in a greenhouse experiment. It was found that most chemical and agrobiological maturity indices paralleled peak area values in the differential thermogravimetric curves. In particular, the weight loss corresponding to compost material destroyed between 360 and 540 degrees C showed a very significant correlation with the germination index and the plant yield of the soils amended with compost. As expected, the extent of such thermal effects reflected also the H/C, O/C, and C/N ratios and the lignin content of the composts. Experiments during the methodological optimization of thermogravimetric analyses have shown the importance of removing the compost water-soluble fraction to prevent spurious results, probably due to the effect of salts on thermal decomposition in the lignocellulosic substrate. [References: 19].

660 Camarero, S.; Galletti, GC.; Martinez, AT. (1994) PREFERENTIAL DEGRADATION OF PHENOLIC LIGNIN UNITS BY TWO WHITE ROT FUNGI. *Applied & Environmental Microbiology*. 60(12):4509-4516. English. [CSIC CTR INVEST BIOL VELAZQUEZ 144 E-28006 MADRID SPAIN].

The differential biodegradation of phenolic and nonphenolic (C-4-etherified) lignin units in wheat straw treated with the white rot fungi *Pleurotus eryngii* and *Phanerochaete chrysosporium* was investigated under solid-state fermentation conditions. Two analytical techniques applied to permethylated straw were used for this purpose, i.e., alkaline CuO degradation and analytical pyrolysis (both followed by gas chromatography; mass spectrometry for product identification). Despite differences in the enzymatic machinery produced, both ligninolytic fungi caused a significant decrease in the relative amount of phenolic lignin units during the degradation process. Nevertheless, no differences in the biodegradation rates of phenolic and etherified cinnamic acids were observed. Changes in lignin composition and cinnamic acid content were

also analyzed in the phenolic and nonphenolic lignin moieties. The results obtained are discussed in the context of the enzymatic mechanisms of lignin biodegradation. [References: 29].

SO1 HUMAN NUTRITION-GENERAL ASPECTS

661 Tsuji, K. (National Inst. of Health and Nutrition, Tokyo (Japan)); Ichikawa, T.; Tanabe, N.; Abe, S.; Tarui, S.; Nakagawa, Y. (1992) Effects of beni-koji foods on blood pressure in spontaneously hypertensive rats. *Journal of the Japanese Society for Food Science and Technology (Japan)* v. 39(10) p. 919-924. 4 tables; 3 fig.; 11 ref. Japanese. (AGRI 94-125022).

662 Tsuji, K. (National Inst. of Health and Nutrition, Tokyo (Japan)); Ichikawa, T.; Tanabe, N.; Obata, H.; Abe, S.; Tarui, S.; Nakagawa, Y. (1992) Extraction of hypotensive substance from wheat beni-koji. *Journal of the Japanese Society for Food Science and Technology (Japan)* v. 39(10) p. 913-918. 3 tables; 2 fig.; 13 ref. Japanese. (AGRI 94-125034).

TO1 POLLUTION

663 Kula, C. (Biologische Bundesanstalt fuer Land und Forstwirtschaft, Braunschweig (Germany). Fachgruppe fuer Biologische Mittelpfuefung) (1994) [Effects of different intensity of plant production on carabid beetles (Coleoptera: Carabidae)]. Auswirkungen abgestufter Intensitaet der Pflanzenproduktion auf Laufkaefer (Coleoptera: Carabidae). Effects of a long-term application of plant protection products used in different intensities and development of assessment criterions. Bartels, G.; Kampmann, T. (comps.). *Mitteilungen aus der Biologischen Bundesanstalt fuer Land- und Forstwirtschaft Berlin-Dahlem (Germany)*; no. 295 p. 385-400. Blackwell. 4 ill., 3 tables; 11 ref. German. (AGRI 94-125414).

From 1984 to 1986 the effects of different intensities of plant production on carabid beetles were studied within an interdisciplinary program of the 'Deutsche Forschungsgemeinschaft'. The investigation took place in the research area 'Ahlum' several years before the 'BMFT project' started. Possible interactions between the degree of weed cover and the activity and density of carabid beetles were of special interest. The interactions between field margins and artificially sown strips with grass or *Phacelia tanacetifolia* were also studied. The research area was structured as in the BMFT project, but the 10-part was missing. The agricultural practice was comparable to the BMFT project taking into account the special situation of these years. To enable comparison and evaluation of the species combination in the different treatments a nearby situated bio-farm was also investigated. Different types of pitfall traps were used to investigate the activity abundance of the carabid beetles and their occurrence in the different treatments. From 1984 to 1986 in total 62 carabid species were found. Eleven of these species occurred every year and in every treatment. Some carabid species were more abundant in the lower intensity of plant production, especially the species of the genus *Amara*, which are known to be predominantly herbivorous. Activity density of these species was much greater in weedy plots with *Stellaria media* and *Poa annua* than in weedfree plots. In only a few cases relationships between application of pesticides and activity abundance of carabid beetles were evident. The application of the fungicide 'Afugan' reduced the number of beetles in the traps significantly.

664 Kunguru, K.; Tole, PM. (1994) CONTAMINATION OF SOILS, MAIZE, WHEAT AND MILK WITH LEAD FROM MOTOR VEHICLE EMISSIONS IN UASIN GISHU DISTRICT, KENYA. *Discovery & Innovation*. 6(3):261-264. English. [MOI UNIV SCH ENVIRONM STUDIES POB 3900 ELDOROT KENYA].

Levels of lead were determined for soil, maize, wheat and milk collected from sites close to heavily used roads, and compared to levels in control samples taken away from the roads. In soil samples, lead levels decrease exponentially from values of about 3 ppm at the edge of the road to values typically around 1 ppm, 80 metres away from the road. At the control site lead levels in soil have a value of 0.6 ppm. Maize cultivated close to the road had lead values of between 0.13 and 0.25 ppm, while maize grown at the control site had 0.06 ppm lead. Wheat cultivated close to the road had lead values ranging from 0.04 to 0.23 ppm, compared to a value of 0.05 ppm at the control site. Milk from cows that graze close to the roads had lead value ranging from 0.1 ppm to 0.5 ppm, as compared to a value of 0.1 ppm in milk from cows that graze away from the roads. All

the results indicate significant differences in lead content for samples from near the roads compared to samples in the control site at the 95% confidence level. By extrapolating the exponential decay curves obtained in this study, the minimum distance away from the road which farming activities can take place is deduced to be about 200 metres, in order for effects of vehicular emissions to be minimised.

665 Wadey, P.; Shaw, G.; Bell, JN.; Minaki, MJ. (1994) RADIONUCLIDE TRANSPORT ABOVE A NEAR-SURFACE WATER TABLE 2. VERTICAL DISTRIBUTION OF GAMMA ACTIVITIES WITHIN SOIL PROFILES IN RELATION TO WHEAT ROOTING DENSITY AND SOIL-TO-PLANT TRANSFERS. *Journal of Environmental Quality*. 23(6):1330-1337. English. [UNIV LONDON IMPERIAL COLL SCI & TECHNOL CTR ANALYT RES ENVIRONM SILWOOD PK ASCOT SL5 7TE BERKS ENGLAND].

Radiochemical results are described from a replicated field lysimeter experiment to investigate the upward migration of radionuclides in vegetated soils above near-surface contaminated groundwater. Water tables were maintained at depths of 35 cm (shallow) and 65 cm (deep), below which a cocktail of radionuclides including Cs-137, Cd-109, Co-60, and Na-22 was introduced. Results of the vertical migration and plant uptake are presented from the first 2 yr of an ongoing experiment with winter wheat (*Triticum aestivum* L.). As expected, Cs-137, (CO)-C-60, and Cd-109 proved to be highly sorbed to the soil solid phase in the regions of the water table and exhibited a lesser degree of up-profile transport than Na-22 in shallow lysimeters. However, in deep lysimeters, Cs-137 and Co-60 appeared to be preferentially accumulated at the soil surface; a biological translocation mechanism is postulated to account for this observation. It was clear from a statistical analysis of vertical radionuclide distributions that, in physicochemical terms, Na-22 was the most mobile of the radionuclides studied. The distribution of this radionuclide within the soil profiles showed a significant shift between the two growth seasons examined, whereas the distributions of the other radionuclides remained static between 1990 and 1991. Each radionuclide showed a distinct and consistent distribution pattern throughout the crop tissues, although the differences in tissue specific activities for individual radionuclides were found to be nonsignificant with the exception of Na-22. Soil-to-plant transfer factors (TFw) were calculated using mean soil specific activities weighted according to the fractional abundance of roots and measured soil specific activities in discrete soil layers. The TFw values were significantly lower in 1991 than in 1990 in both shallow and deep lysimeters; it is postulated that this was due to a much greater flux of water through the crop in 1990, which was characterized by high evapotranspiration rates and a substantial negative water budget. In both years, TFw values were, in general, significantly higher for deep lysimeters than for shallow lysimeters. This is thought to provide evidence of enhanced radionuclide absorption by the relatively small fraction of roots in the vicinity of the deeper water table. [References: 13].

666 Wetzel, A.; Alexander, T.; Brandt, S.; Haas, R.; Werner, D. (1994) REDUCTION BY FLUORANTHENE OF COPPER AND LEAD ACCUMULATION IN TRITICUM AESTIVUM L. *Bulletin of Environmental Contamination & Toxicology*. 53(6):856-862. English. [UNIV MARBURG DEPT BIOL KARL VON FRISCH STR D-35032 MARBURG GERMANY].

U10 MATHEMATICAL AND STATISTICAL METHODS

667 Bull, JK.; Cooper, M.; Basford, KE. (1994) A PROCEDURE FOR INVESTIGATING THE NUMBER OF GENOTYPES REQUIRED TO PROVIDE A STABLE CLASSIFICATION OF ENVIRONMENTS. *Field Crops Research*. 38(1):47-56. English. [BUR SUGAR EXPT STN POB 651 BUNDABERG QLD 4670 AUSTRALIA].

The technique of classification has been used to summarise relationships among test environments, based on the way they discriminate among genotypes, in multi-environment trials. However, once environments have been grouped, at a specified truncation level, there is generally no indication of the 'stability' and hence validity of the grouping. Further, there is currently no way to determine whether or not an adequate number of genotypes was used to give a robust assessment of the similarities among the environments. A procedure is presented which

allowed a determination of whether an adequate number of genotypes was used to assess similarities among the environments considered. The procedure also highlighted the effect of experimental error on environmental classifications. It was demonstrated using three genotype X environment data sets with pooled genetic correlations ranging from low to high. The process used for investigating the 'stability' of the classifications involved choosing increasing proportions of the total number of genotypes available in the data set, acid classifying the environments based on each of the resultant genotypic subsets. The grouping of environments was then investigated at a particular truncation level. The process was repeated 100 times for each sub-set size and the number of different partitions of the environments, and the frequency of each partition determined. These frequencies were compared with those that were obtained, using the same procedure, but applied to data sets (of equivalent dimensions) containing random numbers. Based on the differences between the experimental and random data an assessment of the number of genotypes necessary to provide a 'stable' classification was made. Results indicated that a 'stable' classification of environments could be reached for the two data sets with moderate and high pooled genetic correlations with relatively few genotypes. However, for the data set with a low pooled genetic correlation, a 'stable' classification was not reached even when almost all of the genotypes were included. Based on the results for these three data sets the working hypothesis that the 'stability' of an environmental classification is related to the strength of the pooled genetic correlation for the data set, is advanced. [References: 24].

668 Westerlund, E.; Andersson, R.; Aaman, P. (1992) Selection of representative grain samples with wide variation in properties using principal component analysis. 24. Nordic Cereal Congress; Stockholm (Sweden); 20-23 May 1990. *Cereals in the future diet. Proceedings from 24. Nordic Cereal Congress, May 20-23, 1990, Stockholm, Sweden.* Johansson, H. (ed.) p. 295-306. Svalof AB. 6 ref. English. (AGRI 94-114601).

U30 RESEARCH METHODS

669 Thomas, JB. (1994) RANKING WHEAT CULTIVARS FOR TEST WEIGHT BASED ON SMALL GRAIN SAMPLES. *Canadian Journal of Plant Science.* 74(4):675-679. English. [AGR & AGRI FOOD CANADA LETHBRIDGE RES CTR BOX 3000 MAIN LETHBRIDGE T1J 4B1 AB CANADA].

Although test weight is highly heritable in wheat (*Triticum aestivum* L. em. Thell.), selection for this important trait is limited in the early generations of a breeding program by the availability of seed. In winter wheat, the weight of seed discharged by the Balfour Seed Dispenser or BSD was highly correlated ($r = 0.97$ to 0.99) with test weight measured using the Dickey John Grain Analysis Computer. The BSD required less labour and less sample (25-80 g) than either the GAC II or Cox Funnel drop methods (300-1000 g) but was also less accurate. Nonetheless the lower confidence interval ($P < 0.025$) of a measurement on the BSD was only about -0.75% which is equivalent to a negative deviation of about 0.6 kg hL⁻¹. This degree of accuracy should identify most lines of wheat with low test weight in any breeding program. [References: 12].

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