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Literature Update on

Wheat, Barley, and Triticale

CIMMYT

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ICARDA

Distribution Restricted to Developing Countries Only.

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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 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].

(2 → Reynolds; 3 → 1994; 4 → INTERCROPPING; 6 → Science; 7 → English; 8 → CIMMYT)

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) 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.** *Agronomia Costarricense (Costa Rica) v. 16(2) p. 203-210.* 20 ref.; grafs. Spanish . (AGRIS 94-116456).

(2 → Alizaga; 3 → 1992; 5 → Evaluacion; 6 → Agronomia; 7 → Spanish; 8 → Rica; 9 → 94-116456)

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 research in relation to the production of wheat in Mexico]. Aspectos economicos de la investigacion agricola en el cultivo del trigo en Mexico.** 6 → Primera conferencia nacional sobre la produccion de trigo en Mexico. (Memoria); Cd. Obregon, Sonora (Mexico); 22-25 Mar 1988. [National conference on wheat production in Mexico. (1, 1988, Cd. Obregon, Son.) (Proceedings)]. Conferencia nacional sobre la produccion de trigo en Mexico. (1, 1988, Cd. Obregon, Son.) (Memoria). *Publicacion Especial. Centro de Investigacion Regional del Noroeste (Mexico); no. 4 p. 539-550.* Centro de Investigacion Regional del Noroeste. 21 ref. 2o. tomo. Spanish. (AGRIS 9 → 94-114649).

(2 → Gonzalez; 3 → 1992; 4 → Economic; 5 → Aspectos; 7 → Spanish; 8 → Valle)

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

Note to Readers

The source of each entry - whether *Current Contents* or AGRIS - can be readily inferred from its appearance: TITLES from *Current Contents* are wholly in uppercase, whereas those from AGRIS are in upper and lower. 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

1508 Asfaw Negassa; Hailu Beyene (Institute of Agricultural Research (IAR), Addis Ababa (Ethiopia)); Mwangi, W.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Economics Program) (1993) **Impacts on-farm research on farmers and their adoption of technologies around Bako, Ethiopia: Some selected cases.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 304-310.* CIMMYT. 4 tables; 14 ref. English. (AGRIS 95-020509).

1509 Collinson, M. (Consultative Group on International Agricultural Research (CGIAR), Washington, DC (US). TAC Secretariat. Science Advisor) (1993) **Reflections on the CIMMYT on-farm research program in Eastern and Southern Africa.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 1-11.* CIMMYT. English. (AGRIS 95-020513).

1510 Dickson Baguma, S. (Namulonge Research Station, Kampala (Uganda). Maize Program) (1993) **The impact of on-farm research on government, donors and other agencies in establishing agricultural development priorities: The Uganda experience.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 89-93.* CIMMYT. 7 ref. English. (AGRIS 95-020512).

1511 Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Mwangi, W.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Economics Program) (1993) **An overview of methods of research impact assessment.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 28-42.* CIMMYT. 1 graph., 81 ref. English. (AGRIS 95-020498).

1512 Hikwa, D.; Natarajan, M. (Agronomy Institute, Harare (Zimbabwe). Department of Research and Specialist Services) (1993) **On-farm research trials for technological generation: Evolution of the agronomy institute's program over the past decade and its impacts on the institute's research strategy.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 113-120.* CIMMYT. 1 table; 2 graphs., 5 ref. English. (AGRIS 95-020515).

1513 Johnson, P.H.S. (P. O. Box GD 113, Greendale, , Harare (Zimbabwe). Consultant) (1993) **The interface of agricultural hard and soft sciences and their relationship with the farmer: The need to look critically at methodology.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 75-81.* CIMMYT. 1 graph., 6 ref. English. (AGRIS 95-020499).

1514 Kassahun Seyoun; Hailu Beyene (Institute of Agricultural Research (IAR), Addis Ababa (Ethiopia)); Mwangi, W.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Economics Program) (1993) **The impact of on-farm research in the institute of agricultural research of Rwanda.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 108-112.* CIMMYT. 24 ref. English. (AGRIS 95-020508).

1515 Low, A. (University of Bradford, West Yorkshire (United Kingdom). Developing and Project Planning Centre) (1993) **The impact of sustainability concerns on the future of on-farm research in Eastern and Southern Africa.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 428-437.* CIMMYT. 1 table; 1 graph., 32 ref. English. (AGRIS 95-020507).

1516 Muwamba, J.M.; Sutherland, A.J. (Mount Makulu Research Station,Chilanga (Zambia)) (1993) **The impact of adaptive research on the Zambian national agricultural research system.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 67-74.* CIMMYT. 6 ref. English. (AGRIS 95-020517).

1517 Mwania, N.M. (Kenya Agricultural Research Institute, Kitale (Kenya). Senior Research Officer) (1993) **Creating an effective adaptive research program: Experience at Kitale, Kenya.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa: Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 94-100.* CIMMYT. English. (AGRIS 95-020510).

1518 Salasya, B. (Western Agricultural Research Centre, Kakamega (Kenya)) (1993) **Experiences of on-farm research: A case study from regional research centre, Kakamega, Kenya.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 121-133.* CIMMYT. 4 ref. English. (AGRIS 95-020511).

1519 Shumba, E.M. (Ministry of Lands, Agriculture and Water development, Harare (Zimbabwe). Department of Research and Specialist Services) (1993) **The future of on-farm research activities within national agricultural research systems.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 45-51.* CIMMYT. 3 tables; 14 ref. English. (AGRIS 95-020514).

This paper briefly reviews organizational structures adopted by some countries in southern Africa to accommodate OFR within NARS. This is followed by a discussion on how constraints of inadequate funding for OFR, lack of "on-the-shelf" technologies for adaptation in marginal rainfall environments and weak links with key actors could be handled to improve the effectiveness and sustainability of OFR efforts.

1520 Singogo, L.P. (Regional Program foe East and Southern Africa, Gaborone (Botswana). Farming System Programme) (1993) **The impact of networks on on-farm research in Eastern and Southern Africa.**

Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 209-214.* CIMMYT. 7 ref. English. (AGRIS 95-020506).

1521 Sutherland, A.J.; Muwamba, J.M. (Mount Makulu Research Station,Chulanga (Zambia)) (1993) **Experiences and methods in evaluating the performance and impact of on-farm research in Zambia.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 52-66.* CIMMYT. 4 tables; 21 ref. English. (AGRIS 95-020516).

1522 Tripp, R. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Economics Program) (1993) **Expectations and realities in on-farm research.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 12-27.* CIMMYT. 3 tables; 39 ref. English. (AGRIS 95-020502).

C10 EDUCATION

1523 Anandajayasekeram, P. (No. 8 Castlereagh Crescent, Canberra (Australia)) (1993) **On-farm research (OFR): Impacts on training in Southern and Eastern Africa.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 192-208.* CIMMYT. 4 tables; 19 ref. English. (AGRIS 95-020608).

1524 Arias, F.R. (Crop Management Research Training Project, Njoro (Kenya)) (1993) **Evaluating the impact of crop management research training programs: The CMRT case.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 221-229.* CIMMYT. 4 tables; 2 graphs. English. (AGRIS 95-020586).

1525 Gilchrist, L. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Wheat improvement research training course.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 48-49. CIMMYT. p. 48-49. English. (AGRIS 95-020620).

1526 Razzaque, M.A.; Samad, M.A.; Hossain, A.B.S.; Sufian, M.A.; Haque, M.; Saha, N.K.; Rahimullah; Rahman, A.B.M.; Hossain, A.; Zaman, M.S. (Bangladesh Agricultural Research Institute, Dinajpur (Bangladesh). Wheat Research Centre) (1994) **Technologies generated in wheat research and methods of their transfer in Bangladesh.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 317-322.* CIMMYT. 8 tables. English. (AGRIS 95-020629).

Technologies generated in wheat research have been transferred using different methods since 1973. Initially, the modern methods of transferring technologies were not adequately applied due to lack of proper facilities and manpower in Bangladesh. Since 1980, the methods that have been utilized are: demonstration, training, farmers' rallies, field days, workshops, seminars, travelling seminars, publications, mass-media publicity, diagnostic surveys, and monitoring at the farm level. Special emphasis has been given to demonstrations at the farm level, and training of farmers, agricultural extension personnel, and personnel engaged in related nongovernment organizations. As a result, 100 of the wheat area is now sown with high yielding varieties and 85 of seed wheat is preserved by the farmers themselves.

1527 Semgalawe, Z.M.; Meena, S.N. (Ministry of Agriculture, Livestock Development and Cooperatives (MALDC), Dar es Salaam (Tanzania).Research and Training Division) (1993) **The impact of FSR on training institutions: The case of Tanzania.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 230-234.* CIMMYT. 1 table; 3 ref. English. (AGRIS 95-020609).

C20 EXTENSION

1528 Norman, D.W. (Kansas State Univ., Kansas (US). Department of Agricultural Economics) (1993) **Impacts of on-farm research on extension and other promotional activities.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 134-147.* CIMMYT. 3 tables; 43 ref. English. (AGRIS 95-020639).

E10 AGRICULTURAL ECONOMICS AND POLICIES

1529 Adam, BD.; Kenkel, P.; Anderson, K. (1994) **THE ECONOMICS OF CLEANING WINTER WHEAT FOR EXPORT - AN EVALUATION OF PROPOSED FEDERAL CLEAN GRAIN STANDARDS.** *Journal of Agricultural & Resource Economics. 19(2):280-298.* English. [OKLAHOMA STATE UNIV DEPT AGR ECON STILLWATER, OK 74078 USA].

Buyer complaints about poor quality U.S. wheat have led to proposals to enforce minimum dockage standards for exports. An economic-engineering approach is used to evaluate costs and benefits of cleaning wheat in order to meet these standards for 13 possible cleaning configurations. These results are used in an optimization framework to estimate costs and benefits of cleaning all U.S. export wheat. The estimates indicate that cleaning U.S. export winter wheat to .35% dockage would cost an average of 1[/bu., requiring an initial capital investment of $28 million. Value of wheat lost in cleaning is a significant cost that previously has been overlooked. [References: 23].

1530 Ahmadiesfahani, FZ.; Stanmore, RG. (1994) **QUALITY PREMIUMS FOR AUSTRALIAN WHEAT IN THE GROWING ASIAN MARKETS.** *Australian Journal of Agricultural Economics. 38(3):237-250.* English. [UNIV SYDNEY DEPT AGR ECON SYDNEY NSW 2006 AUSTRALIA].

An hedonic price function is applied to Australia's wheat exports to the growing Asian markets. The values for the quality characteristics in the wheat markets of Indonesia, Malaysia, Singapore, South Korea, and Thailand are estimated. The data base for the study is from the Australian Wheat Board shipments over the period 1984 to 1991. The sample is divided into two separate time periods to test the consistency in demand for export wheat and to trace recent trends in quality premiums. The implications of the results for wheat marketing and trade are explored. [References: 15].

1531 Belaid, A. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Economics Program Consultant) (1994) **Nutritive and economic value of triticale as a feed grain for poultry.** *CIMMYT Economics Working Paper (CIMMYT); no. 94-01 42 p.* CIMMYT. 18 tables; 9 graphs., 64 ref. English. (AGRIS 95-020779).

This study reviews evidence of the nutritional value of triticale (X. Triticosecale Wittmack) for poultry feed. The economic value of triticale as a major ingredient in poultry diets, substituting for maize, barley, sorghum, wheat, and soybean meal, is analyzed using a linear programming model to formulate optimal minimum-cost feed rations, with and without triticale, for broiler and layer chickens at different growth stages. Triticale has the

potential to reduce the cost (at international feed ingredient prices) of poultry rations and substitutes completely for maize and partially for soybean meal when its price is less than or equal to that of maize. The same model is used to examine the potential use of triticale in Tunisia, where there is great potential for triticale production, the feed industry is dependent on imports, and triticale has a 20 per cent price discount over maize and barley. Two feed composition scenarios are considered: 1) maize, soybean meal, barley, triticale, wheat bran, and premixes (vitamins and minerals) are the only feed ingredients available, thus leading to the formulation of sub optimal rations; and 2) other energy-rich ingredients, e.g., maize gluten and soybean oil, become available, thus allowing the formulation of balanced poultry rations. Regardless of the scenario under consideration, the inclusion of triticale leads to cost savings resulting from the complete replacement of maize and from a considerable reduction of soybean meal in the rations. These results indicate that, in countries where the feed industry relies on maize and soybean meal imports, and where sufficient triticale can be produced, the inclusion of triticale in the diet has the potential to lower the cost of poultry rations and to act as a buffer when there are disruptions and/or shortages in the supply of imported feed ingredients.

1532 Borlaug, N.E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Consultant) (1994) **The political, socioeconomic, and institutional obstacles to empowering the farmer with improved production technology.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 3-7.* CIMMYT. English. (AGRIS 95-020760).

1533 Dutta, H.; Baroova, SR.; Rajkhowa, DJ. (1994) **FEASIBILITY AND ECONOMIC PROFITABILITY OF WHEAT (TRITICUM-AESTIVUM)-BASED INTERCROPPING SYSTEMS UNDER RAINFED CONDITIONS.** *Indian Journal of Agronomy. 39(3):448-450.* English. [ASSAM AGR UNIV DEPT AGRON JORHAT 785013 INDIA].

E14 DEVELOPMENT ECONOMICS AND POLICIES

1534 Byerlee, D. (International Maize and Wheat Improvement Centre (CIMMYT) (Mexico)) (1992) **Technical change, productivity, and sustainability in irrigated cropping systems of South Asia: emerging issues in the post-Green Revolution era.** *Journal of International Development (United Kingdom) v. 4(5) p. 477-496.* 32 ref., 6 fig., 4 tab. English. (AGRIS 95-031282).

1535 Byerlee, D.; Moya, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico)) (1993) **Impacts of international wheat breeding research in the developing world, 1966-90.** CIMMYT. 49 tables; 3 illus., 45 graphs., 102 ref. 87 p. English. (AGRIS 95-020926).

This study describes and analyzes the impacts of wheat breeding research in the developing world by national agricultural research systems (NARSs) and the International Maize and Wheat Improvement Center (CIMMYT), with particular attention to the "post-Green Revolution period" (1977-90). During this period, the adoption of modern wheat varieties has maintained its momentum, resulting in production increases and benefits that are as high as in the Green Revolution period. In 1969-70, semidwarf wheat occupied 12 million hectares in developing countries, or about 20 per cent of wheat area. In the 1980s an additional 16 million hectares (mostly in rainfed environments) were sown to modern wheat varieties (MVs), so that by 1990 MVs covered close to 50 million hectares, or 70 per cent of the wheat area in the developing world, excluding China. CIMMYT germplasm continues to be used extensively as source material for the varieties that have diffused since the mid-1970s. The proportion of spring bread wheat varieties originating directly from CIMMYT or having a CIMMYT parent had risen to 84 per cent by 1986-90. Overall, varieties originating directly from CIMMYT crosses or from NARS crosses using a CIMMYT parent occupy 40 million hectares of wheat in the developing world. It is estimated that adoption of MVs from 1977 to 1990 contributed an additional US$ 3,000 million to wheat producers and consumers in the developing world in 1990. Rough estimates of the rate of return to investment in wheat research in 1977-90 indicate that investment in international wheat research continues to provide very high returns of the order of 50-60 per cent.

1536 Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia); Matute, R. (Secretaria de Recursos Naturales de Honduras, Intubuca (Honduras). Departamento de Economia) (1993) **[Technological change and on-farm research in the Department of Atlantida, Honduras]. Cambio tecnologico e investigacion en fincas en el Departamento de Atlantida, Honduras.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 198-211.* Programa Regional de Maiz (PRM). 12 tables; 7 graphs., 10 ref. Spanish. (AGRIS 95-020958).

E16 PRODUCTION ECONOMICS

1537 Chaudhary, M.K. (Haryana Agricultural University, Haryana (India). Regional Research Station); Harrington, L.W. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Economics Program) (1993) **The rice wheat system in Haryana: Input-output trends and sources of future productivity growth.** CIMMYT. 52 p. English. (AGRIS 95-021035).

This study analyzes available secondary data for Haryana (Karnal Region), which encompasses the districts of Karnal, Kurukshetra, Panipat, and Kaithal) to examine hypotheses developed through a diagnostic survey of the rice-wheat cropping system in the region. Trends in production, area, and yields of rice, wheat, and other foodgrains are estimated, along with trends in input levels and input use efficiency for rice and wheat. The implications of these trends are discussed in light of the survey findings, especially with regard to future sources of productivity growth in foodgrain production in Haryana. The analysis reveals that for some time expanded foodgrain production has depended on increased rice and wheat production in Karnal. However, the expansion in rice and wheat area has halted, growth in rice productivity has slowed, and historical sources of productivity growth appear to have exhausted much of their potential. There is also reason to believe that sustained productivity of the rice-wheat system may be compromised by several factors, including groundwater depletion, a possible decline in soil fertility, and increasing populations of insects, diseases, and weeds. Furthermore, rice and wheat production are becoming less profitable over time. As a consequence, alternative crops (e.g., sugarcane) may increase in importance. An increased diversity in crops grown by farmers could help ameliorate some of the threat to natural resource quality and system productivity. However, the data presented in this report, combined with some of the findings of the diagnostic survey, indicate that continued rapid expansion of foodgrain production in Haryana is unlikely.

1538 Chiorri, M. (Perugia Univ. (Italy). Istituto di Economia e Politica Agraria) (1994) **[The cost of organic products [Umbria (Italy)]]. Il costo del "biologico" [Umbria, Italia].** *Terra e Vita (Italy) v. 35(13) p. 30-33.* 5 tables. Italian. (AGRIS 95-021058).

1539 Chiorri, M. (Perugia Univ. (Italy). Istituto di Economia e Politica Agraria) (1994) **[The production costs of organic cereal crops [Umbria (Italy)]]. Quanto costa coltivare i cereali biologici [Umbria].** *Terra e Vita (Italy) v. 35(43) p. 29-34.* 5 tables. Italian. (AGRIS 95-031462).

1540 Choto de Cerna, C. (Centro Nacional de Tecnologia Agropecuaria (CENTA), San Salvador (El Salvador). Unidad de Socio Economia); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia) (1993) **[Analysis of the residue market and its implications for the adoption of conservation tillage in El Salvador]. Analisis del mercado de rastrojo y sus implicaciones para la adopcion de la labranza de conservacion en El Salvador.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de*

Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 212-222. Programa Regional de Maiz (PRM). 11 tables; 2 graphs., 6 ref. Spanish. (AGRIS 95-021025).

1541 Choto de Cerna, C.; Montenegro, T. (Centro Nacional de Tecnologia Agropecuaria (CENTA), San Salvador (El Salvador). Unidad de Socio Economia); Sain, G.; Borbon, E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia) (1993) **[Economic feasibility of intercropping a legume in the maize-bean system prevalent in Opico-Quezaltepeque, El Salvador]. Factibilidad economica de intercalar una leguminosa en el sistema maiz-frijol predominante en Opico-Quezaltepeque, El Salvador.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 157-162.* Programa Regional de Maiz (PRM). 6 tables; 1 graph., 4 ref. Spanish. (AGRIS 95-021019).

1542 Escano, C.R. (Philippine Council for Agriculture Forestry and Natural Resources, Research and Development (PCARRD), Los Banos, Laguna (Philippines). Crops Research Division) (1994) **The wheat development action project: Philippine experiences.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 323-327.* CIMMYT. English. (AGRIS 95-021034).

Research on wheat began in the Philippines in the early 1960s, resulting in the release of three varieties to date. The possibility of wheat production was raised in the early 1980s and a Wheat Pilot Project was established to demonstrate its viability. Over a five-year period, it was shown that wheat production could be an economically viable option for farmers in northern Luzon in areas in which lack of irrigation precludes the growing of a second rice crop. More recently, wheat production projects have been implemented. The major technical problem encountered has been helminthosporium leaf blotch, which under certain circumstances, has resulted in near total crop failures.

1543 Faki, H.H.M. (Agricultural Research Corporation (ARC), Wad Medani (Sudan)); Ismail, M.A. (Sudan Gezira Board, Barakat (Sudan)) (1994) **Some indicators for wheat production prospects in Sudan.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 96-104.* CIMMYT. 5 tables; 4 graphs., 3 ref. English. (AGRIS 95-021010).

Sudan's strive towards wheat self-sufficiency has been accompanied by government support, control over wheat production and disposal, and high research input. Future prospects will be affected by farmers decisions under liberal production policy and subsidy removal. This paper addresses factors that may influence farmer decisions. Rising by five fold over the past three decades, high and increasing wheat demand has well been established, especially in urban areas. Despite the potential for high yields, wheat profitability and its contribution to farm income have been relatively low. While its yield variability, due to variation in winter temperatures, has been high, its yield trend has been significantly rising. Wheat represents a logical choice in most irrigation schemes due its utilization of land, water and capital at their slack periods and its limited use of labor when its requirements in other crops are high. Cotton is his main competitor in the use of winter water. Although wheat has lower gross margins per unit of land and irrigation water than cotton, those to labor and cash capital are higher. With improved technology, its returns to land and water are even comparable to those of cotton. Under a free crop choice, the wheat area would exceed half a million hectares at optimum crop organization in the irrigated sector. About one third of that area would be at a low technology level. Limited subsidy or increased input availability would lead to desired national production targets. The effect of wheat price on production is reflected by a relatively high supply elasticity. Its substitutability to sorghum is manifested by their high cross supply elasticities. With improved technology, wheat yields and farmers incomes will significantly improve. Current input/output price relationships would, however, induce lower input levels that would induce lower total wheat production.

1544 Francis, C.A. (University of Nebraska, Lincoln, Nebraska (US). Dept. of Agronomy) (1994) **Developing resource efficient wheat production systems for the future.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 192-200.* CIMMYT. 1 ref. English. (AGRIS 95-021011).

Wheat production in Eastern and Southern Africa encounters very varied conditions requiring site specific research objectives for improved technologies. These should relate to crop sequences, tillage alternatives, and use of cover crops. Consideration needs to be given to measurement of system efficiency relative to the most limiting factor wich may not be land area but rather scarce fertilizer or water or labor supply. Further fine tuning at the farm level will relate to wheat variety, fertilizer rate, weed control and water timing, requiring on-farm research and demonstration. Finally resource efficient wheat systems will require appropriate Government policies (e.g. with respect to land tenure, price support) and infrastructure.

1545 Hassan, R.M. (Centro Internacional de mejoramiento de Maiz y Trigo (CIMMYT), Nairobi (Kenya). Economics Program); Faki, H.H.M. (Agricultural Research Corporation (ARC), Wad Medani (Sudan)); Byerlee, D. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Economics Program) (1994) **Improved wheat production practices and the question of economic efficiency in the Gezira irrigation scheme.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 78-95.* CIMMYT. 5 tables; 2 graphs., 23 ref. English. (AGRIS 95-021009).

The domestic resource cost (DRC) methodology was used to evaluate the comparative advantage of existing and potential wheat technologies versus alternative crops (cotton) in Sudan's Gezira Irrigation Scheme. Results of the DRC analysis indicated that cotton dominates all wheat technologies including the full package of improved practices at 1992 trend and actual prices. Sensitivity analysis showed that for full package wheat to become the most efficient alternative in Gezira, the world wheat price must be 11 higher than 1992 trend levels. However, as wheat prices are currently below their long-run average, and since average yield levels in Gezira are much lower than potential yields under the full package of technology, at present it may not be economically efficient to expand wheat production in Gezira at the expense of cotton. Before more land is removed from cotton and sown to wheat, priority should be given to promoting faster adoption of efficient production methods to close the gap between potential and current farmers' wheat yields in Gezira. Input procurement and delivery systems should be liberalized for more efficient and timely utilization of inputs. On-farm testing of the new technology in Gezira should continue to refine research recommendations to suit the particular needs of the different locations and target farmer groups in Gezira. It is also important for Sudan to devote more resources to improving the quality and marketing of its cotton crop, given the high potential gain in cotton export prices from higher quality lint.

1546 Hassan, R.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Nairobi (Kenya). Regional Program); Mwangi, W.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program); Karanja, D.D. (KARI NPBRC, Njoro (Kenya)) (1993) **Wheat supply in Kenya: Production technologies, sources of inefficiency, and potential for productivity growth.** *CIMMYT Economics Working Paper (CIMMYT); no. 93-02 38 p.* CIMMYT. 2 maps; 23 tables; 5 graphs., 29 ref. English. (AGRIS 95-021006).

It is important to consider agro-climatic variability in evaluating wheat production in Kenya and developing research strategies. Agroclimatic

conditions in low-potential areas are less favorable for maize and dairying than for wheat. The opposite is true in high potential areas. Wheat farmers in the low potential zone, earned more than wheat farmers in high-potential zones. These results indicate the high potential for wheat production in Kenya's marginal areas, especially for large scale farmers. Wheat research, which in the past has focused on high potential areas, needs to concentrate on marginal, nontraditional wheat lands. The average experimental yield is three times the average yield obtained by farmers. Priority should be given to on-farm research. Small-scale farmers obtain the lowest yields and hence have most scope for improvement. Use of the modern inputs is low due to lack of cash and credit. Policy reforms need to improve access to inputs to small-scale wheat farmers. Research should also address cultivars and management practices that are appropriate for small-scale farmers. The farmers' ranking of priorities is consistent with this study: distinct technological and policy interventions are needed to exploit the potential of wheat in marginal areas.

1547 Herrera, A.P. de (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Economia); Gordon,R.; Franco, J.; De Gracia, N.; Martinez, L.; Gonzalez, A. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia) (1993) **[Economic analysis of N application in a maize-legume rotation under two types of tillage, Rio Hato, Panama, 1992- 93]. Analisis economico a la aplicacion de nitrogeno en maiz en rotacion con leguminosas bajo dos tipos de labranza, Rio Hato, Panama, 1992-93.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 167-169.* Programa Regional de Maiz (PRM). 3 tables; 3 ref. Spanish. (AGRIS 95-021022).

1548 Herrera, A.P. de (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Economia); Herrera, D.; Gordon, R. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia) (1993) **[Economic evaluation of maize residue utilization in maize-Canavalia ensiformis associations, Azuero, Panama, 1992-93]. Evaluacion economica de uso de rastrojo de maiz en asocio con Canavalia ensiformis, Azuero, Panama, 1992-1993.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 170-175.* Programa Regional de Maiz (PRM). 4 tables; 5 ref. Spanish. (AGRIS 95-021023).

1549 Herrera, D.; Gordon, R. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Maiz); Herrera, A.P. de; Vergara, O.; Guerrero, B. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Economia) (1993) **[Bioeconomic evaluation of maize residue utilization in maize-Canavalia ensiformis associations, Azuero, Panama, 1992-93]. Evaluacion bioeconomica del uso de rastrojo de maiz en asocio con Canavalia ensiformis, Azuero, Panama, 1992-1993.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 176-183.* Programa Regional de Maiz (PRM). 9 tables; 16 ref. Spanish. (AGRIS 95-021024).

1550 Montenegro, T. (Centro Nacional de Tecnologia Agropecuaria (CENTA), San Salvador (El Salvador). Unidad de Socio Economia); Borbon, E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia) (1993) **[National pre-adoption study of maize hybrid H-57 among 1991 trial cooperators]. Estudio de pre-aceptacion del hibrido de maiz H-57 a nivel nacional entre los cooperadores de validacion de 1991.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 141-145.* Programa Regional de Maiz (PRM). 6 tables; 2 ref. Spanish. (AGRIS 95-021018).

1551 Sain, G.; Borbon, E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia); Ponce, I. (Secretaria de Recursos Naturales de Honduras, Intubuca (Honduras). Departamento de Economia) (1993) **[Profitability of green manuring on the Atlantic Coast of Honduras]. Rentabilidad del sistema de abonera en el Litoral Atlantico de Honduras.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 146-156.* Programa Regional de Maiz (PRM). 13 tables; 7 graphs., 8 ref. Spanish. (AGRIS 95-021021).

1552 Salih, A.E.M.; Abdalla, O.A.; Sidahmed, M.; Faki, H.H.M.; Ismail, M.A. (Sudan Gezira Scheme, Wad Medani (Sudan)) (1994) **Wheat production in the Gezira Scheme.** Wheat in Hot, Dry, Irrigated Environments: Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 75-77.* CIMMYT. 2 tables. English. (AGRIS 95-021008).

In the early 1960s, wheat assumed its role as a vital and strategic commodity in Sudan due to increased consumption demand resulting from increasing population, urbanization, low prices of imported wheat, and changing food habits. This necessitated an expansion of the crop to warmer regions of the country. The Gezira Scheme was well suited to embrace the crop and, in fact, became the major contributor to wheat production. Wheat area and yield reached all time highs of about 257,000 ha during 1990-91 and about 2.24 t/ha during 1991-92. Development and adoption of a technical package recommended by the Agricultural Research Corporation for use by farmers in the Gezira Scheme are discussed. Economic evaluation, costs, and returns and constraints to increased wheat productivity in the Gezira Scheme are reviewed.

1553 Tamburrano, G. (1994) **[Morocco - Algeria and Tunisia: the nearest flours to Italy]. Marocco - Algeria e Tunisia: le farine piu' vicine all'Italia.** *Molini d'Italia (Italy) v. 45(1) p. 25-28.* 1 table; 2 graphs. Italian. (AGRIS 95-031418).

1554 Valladares, C. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Unidad/Programa de Socio economia); Sain, G.; Borbon, E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia) (1993) **[Economic analysis of introducing a legume into the maize production system in the San Diego Municipality, Zacapa, Guatemala]. Analisis economico de introducir una leguminosa en el sistema de produccion de maiz en el Municipio de San Diego, Zacapa, Guatemala.** *[Synthesis of the*

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1555 Workneh Negatu (Alemaya University of Agriculture, Debre Zeit (Ethiopia). Debre Zeit Agricultural Research Center); Mwangi, W.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa. (Ethiopia). Economics Program) (1994) **An economic analysis of the response of durum wheat to fertilizer: Implications for sustainable durum wheat production in the Central Highlands of Ethiopia.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 177-185.* CIMMYT. 9 tables; 16 ref. English. (AGRIS 95-021005).

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

E20 ORGANIZATION, ADMINISTRATION AND MANAGEMENT OF AGRICULTURAL ENTERPRISES OR FARMS

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1558 Giesler, G.G.; Heagler, A.M. (1994) **Projected costs and returns: rice, Louisiana, 1994. Projected costs and returns: soybeans, corn, milo, wheat, and wheat-soybean double crop, Southwest Louisiana, 1994.** *A.E.A. information series (USA) (no. 122) p. F/1-F/77.* English. (AGRIS 95-031587).

1559 Gumaa, Y.T. (University of United Arab Emirates, Al Ain (United Arab Emirates). Faculty of Agricultural Sciences); Faki, H.H.; Mohamed, A.B.I.; Ismail, M.A. (1994) **Profitability analysis of foodgrain in the Sudan's irrigated agricultural sector.** *Agricultural Economics (Netherlands) v. 11(2-3) p. 325-333.* 24 ref. English. (AGRIS 95-021109).

1560 Paxton, K.W. (1994) **Projected costs and returns: cotton, soybeans, corn, milo and wheat, Northeast Louisiana, 1994.** *A.E.A. information series (USA) (no. 120) p. D/1-D/64.* English. (AGRIS 95-031585).

1561 Paxton, K.W. (1994) **Projected costs and returns: cotton, soybeans, corn, milo and wheat, Red River and Central Areas, Louisiana, 1994.** *A.E.A. information series (USA) (no. 121) p. E/1-E/42.* English. (AGRIS 95-031586).

E21 AGRO-INDUSTRY

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1563 Valladares, C. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Unidad/Programa de Socio Economia); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa Regional de Economia) (1993) **[Diagnosis of the certified maize seed industry in Central America]. Diagnostico de la industria de semilla certificada de maiz en Centro America.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 223-229.* Programa Regional de Maiz (PRM). 10 tables; 14 ref. Spanish. (AGRIS 95-021250).

E40 COOPERATIVES

1564 Cummins, D.E. (1993) **How does your wheat-barley co-op measure up?** *Farmer cooperatives (USA) v. 60(4) p. 21.* English. (AGRIS 95-031751).

E70 TRADE, MARKETING AND DISTRIBUTION

1565 **Durum wheat (Triticum durum Desf.). Specification. Prepared by Technical Committee ISO/TC 34: Agricultural Food Products, Subcommittee SC 4: Cereals and Pulses** (1994) International Organization for Standardization, Geneva (Switzerland). *ISO International Standard (ISO); no. 11051 12 p.* ISO. 1. ed. ISO--11051-1994(E). English. (AGRIS 95-031983).

1566 **[Durum wheat (Triticum durum Desf.). Specification]. Ble dur (Triticum durum Desf.). Specifications. Elaboree par le Comite Technique ISO/TC 34: Produits Agricoles Alimentaires,Sous-Comite SC 4: Cereales et Legumineuses** (1994) International Organization for Standardization, Geneva (Switzerland). *Norme Internationale ISO (ISO); no. 11051 12 p.* ISO. 1. ed. ISO--11051-1994(F). French. (AGRIS 95-031984).

1567 Abidar, A. (1992) **[Estimations of the determinants of wheat flour demand : case of the Wilaya of Meknes [Morocco]]. Estimation des determinants de la demande en farine de ble (cas de la wilaya de Meknes) [Maroc].** Ministere de l'Agriculture et de la Reforme Agraire, Meknes (Maroc). Ecole Nationale d'Agriculture. 30 Tableaux 17 figs. annexes. 8 ref. 114 p. French. (AGRIS 95-021475).

1568 Lidfeldt, M.; Andersson, H. (1994) **[Futures and the European grain market]. Terminskontrakt paa en Europeisk spannmaalsmarknad.** *Rapport - Sveriges Lantbruksuniversitet, Institutionen foer Ekonomi (Sweden); no. 78 92 p.* 50 ref. SLU-EKON-R--78-SE. Swedish. (AGRIS 95-031982).

1569 Nuckton, C.F.; Gardner, B.D. (1992) **Deficiency payments more fair to some than to others?** *Choices : the magazine of food, farm and resource issues (USA) v. 7(2) p. 25.* English. (AGRIS 95-031985).

E71 INTERNATIONAL TRADE

1570 **Forecasts: production, imports, exports and utilization of wheat and coarse grains, 1992/93. Carryover stocks of cereals, 1993. Statistical tables. Previsions: production, importations, exportations et utilisation de ble et des cereales secondaires, 1992/93. Stocks de cereales, 1993. Tableaux statistiques. Pronosticos: importaciones, exportaciones y utilisacion de trigo y cereales secundarios, 1992/93. Existencias remanentes de cereales, 1993. Cuadro estadisticos.** *FAO Committee on Commodity Problems. Intergovernmental Group on Grains. Sess. 25; Comite des Produits. Groupe Intergouvernemental sur les Cereales. Sess. 25; Comite de Problemas de Productos Basicos. Grupo Intergubernamental sobre Cereales. Sess. 25; Rome (Italy); 25-28 May 1993.* FAO, Rome (Italy). Commodities and Trade Div.; FAO, Rome (Italy). Div. des Produits et du Commerce International; FAO, Rome (Italy). Direccion de Productos Basicos y Comercio. Trilingual ed. 25 p. FAO-ESC--CCP/GR/93/CRS/1. (En, Es, Fr). (AGRIS 95-032135).

1571 **Medium-term outlook for the world grains economy** (1993) *FAO Committee on Commodity Problems. Intergovernmental Group on Grains. Sess. 25; Rome (Italy); 25-28 May 1993.* FAO, Rome (Italy). Commodities and Trade Div. 19 p. FAO-ESC--CCP/GR/93/6. English. (AGRIS 95-032134).

1572 **[Medium-term outlook for the world grains economy]. Perspectives a moyen terme du secteur mondial des cereales** (1993) *Comite des Produits. Groupe Intergouvernemental sur les Cereales. Sess. 25; Rome (Italy); 25-28 May 1993.* FAO, Rome (Italy). Div. des Produits et du Commerce International. 22 p. FAO-ESC--CCP/GR/93/6. French. (AGRIS 95-032136).

1573 **[Medium-term outlook for the world grains economy]. Perspectivas a plazo medio de la economia mundial de los cereales** (1993) *Comite de Problemas de Productos Basicos. Grupo Intergubernamental sobre Cereales. Reunion. 25; Rome (Italy); 25-28 May 1993.* FAO, Rome (Italy). Direccion de Productos Basicos y Comercio. 22 p. FAO-ESC--CCP/GR/93/6. Spanish. (AGRIS 95-032137).

1574 Jayne, T.S.; Myers, R.J. (1994) **The effect of risk on price levels and margins in international wheat markets.** *Review of agricultural economics (USA) v. 16(1) p. 63-73.* references. English. (AGRIS 95-021501).

The effects of price risk on equilibrium price levels and marketing margins in U.S.-Japan wheat trade are analyzed in ths article. This issue is investigated using a bivariate generalized autoregressive conditional heteroscedastic (GARCH) mel. In both the short and long run, increased wheat price ri has little effect on U.S. export prices, but positively affcts Japanese import prices and the size of the international marketing margin. However, the impact of price risk appearsto be fairly small except during extremely volatile periods, such as during the mid-1970's.

1575 Yoo, B.S. (Sungkyunkwan University, Suwon (Korea Republic). Department of Agricultural Economics) (1993) **An analysis of structural changes of the Korea's major grain imports.** *Korean Journal of Agricultural Economics (Korea Republic) v. 34 p. 49-67.* 5 tables; 12 ref. Korean. (AGRIS 95-021502).

E90 AGRARIAN STRUCTURE

1576 Jabarin, A.S. (Jordan Univ., Amman (Jordan). Dept. of Agricultural Economics); Epplin, F.M. (1994) **Impacts of land fragmentation on the cost of producing wheat in the rain-fed region of northern Jordan.** *Agricultural Economics (Netherlands) v. 11(2-3) p. 191-196.* 27 ref. English. (AGRIS 95-021573).

F01 CROP HUSBANDRY

1577 **[The twenty-first and twenty-second international triticale yield nurseries (ITYN)]. El 21 y 22 ensayos internacionales de rendimiento de Triticale (ITYN)** (1993) Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). CIMMYT Results of the Triticale Nurseries (CIMMYT); CIMMYT Resultados de los Ensayos de Triticale (CIMMYT) p. 1-56. CIMMYT. 2 maps; 42 tables; 2 maps. p. 1-56. English. (AGRIS 95-021652).

1578 Ageeb, O.A.A. (Agricultural Research Corporation (ARC), Wad Medani (Sudan)) (1994) **Agronomic aspects of wheat production in Sudan.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 67-74.* CIMMYT. 6 tables; 30 ref. English. (AGRIS 95-021670).

Wheat is grown in Sudan under irrigation during the dry and comparatively cool and short growing season, which extends for 100 days from November to February. The crop suffers from a number of abiotic and biotic stresses, which include heat stress, low soil fertility, waterlogging, and aphid infestation. National average wheat yields are low and constitute 40 of potential yields attained in research plots, demonstration farms, and by leading farmers. The low yields are mainly associated with low crop stand, late sowing, inadequate fertilizer use, poor water management, and delayed harvests. Wheat research programs have been progressively developed to seek solutions to production problems, and to verify research findings in farmers' fields. Useful information pertinent to sowing date, crop establishment, seed rate, fertilizer requirements, irrigation needs and weed management were obtained Up to 1988, Sudan imported 75 of its annual local needs estimated at 0.8 to 1.0 million tons. Since then, the Government has launched an ambitious program to reach self-sufficiency in four years through area expansion, application of improved production technologies, and adoption of free-market policies. As a result, total wheat production from 1988 to 1992 has increased by 350 from 234,000 to 839,000 tons, which was considered adequate to satisfy current domestic demand.

1579 Ageeb, O.A.A. (Agricultural Research Corporation, Wad Medani, (Sudan)) (1992) **[Wheat cultivation in the Sudan]. zira:3at al-qamh" fi: al-su:da:n.** *[Agriculture and Development in the Arab World] (Sudan); al-zira:3ah wal-tanmiyah fi: al-wat*an al-3arabi: v. 11(3) p. 26-29.* Arabic. (AGRIS 95-021778).

1580 Alvarado, A.; Camargo, I.; Perez, D.; Gonzalez, A.; De Gracia, N.; Ruiz, J.; Moreno, M.; Quiroz, E.; Herrera, C.; Gordon, R. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Maiz) (1993) **[Evaluating yellow maize cultivars at 13 locations in Panama, 1992-93]. Evaluacion de cultivares de maiz de grano amarillo en 13 localidades de Panama, 1992-1993.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 39-43.* Programa Regional de Maiz (PRM). 4 tables; 9 ref. Spanish. (AGRIS 95-021714).

1581 Anon. (1992) **Feeding barley to cattle, swine and poultry.** *NDSU Extension Service : [publication] (USA) 32 p.* English. (AGRIS 95-032315).

1582 Badaruddin, M.; Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Siddique, A.B.; Hossain, M.A.; Ahmed, M.U.; Rahman, M.M.; Parveen, S. (Bangladesh Agricultural Research Institute, Gazipur (Bangladesh). Wheat Research Centre) (1994) **Determining yield constraints for wheat production in Bangladesh.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 265-271.* CIMMYT. 7 tables; 4 ref. English. (AGRIS 95-021672).

During 1984-85 through 1987-88, there was an apparent decline in wheat yields. Different groups (scientists, extension personnel, and Bureau of Statistics) have suggested this decline could be due to changes in climate, changes of the wheat area to more marginal areas, increase in cropping intensity accompanied by minimal input use, and increase in soil and plant pathogens. Results from agronomic experiments carried out by the Wheat Research Centre during 1983-91 indicated that planting wheat later than 1 December, less than optimal applications N, P, K, and S nutrients and virtually no use of micronutrients, low plant populations, use of old

disease-susceptible varieties, and no measures for plant protection were identified as major constraints to high wheat yields. This paper considers those factors that are causing real losses in farmers' production or are constraints to achieve the potential yields promised by the newer wheat varieties.

1583 Barasebwa, L. (Institut des Sciences Agronomiques du Rwuanda (ISAR), Butare (Rwanda)) (1994) **Wheat production and research in Rwanda: Constraints and sustainability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 37-41.* CIMMYT. 3 tables; 6 ref. English. (AGRIS 95-021661).

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

1584 Bekele Geleta; Amanuel Gorfu (Institute of Agricultural Research, Addis Ababa (Ethiopia). Kulumsa Research Center); Getinet Gebeyehu (Institute of Agricultural Research, Addis Ababa (Ethiopia). Holetta Research Center) (1994) **Wheat production and research in Ethiopia constraints and sustainability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 18-25.* CIMMYT. 4 tables; 8 ref. English. (AGRIS 95-021658).

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

1585 Beltran Fonseca, Manuel de Jesus; Valenzuela Borbon, Jesus Rafael; Delgado Talamantes, Jose Manuel (1993) **[Evaluation of sowing dates, sowing densities and tillage methods for establishing a wheat crop in saline soil: Mayo valley, Sonora]. Evaluacion de la fecha y densidad de siembra y metodo de labranza en el cultivo de trigo establecido en un suelo salino,en el Valle del Mayo, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 86-87. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 86-87. Spanish. (AGRIS 95-021774).

1586 Blaha, L. (Research Institute of Crop Production, Praha 161 06 (Czech Republic)) (1992) **Relation between yield, yield stability and complex tolerance of wheat cultivars to soil stresses.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 232-233.* European Society for Agronomy. English. (AGRIS 95-032370).

1587 Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maizl); Perez, J. (Centro Nacional de Investigacion en Granos Basicos (CNIGB), Managua (Nicaragua). Programa de Maiz); Zea, J.L.; Queme, J.L.; Fuentes, M. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Programa de Maiz); Mendoza, C.; Lopez, G. (Secretaria de Recursos Naturales de Honduras, Intubuca (Honduras). Programa de Maiz) (1993) **[Dynamics and variability of yield components in 28 maize plots in Central America]. Dinamica y variabilidad de los componentes del rendimiento en 28 campos de maiz en Centro America.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 187-197.* Programa Regional de Maiz (PRM). 2 tables; 7 graphs., 16 ref. Spanish. (AGRIS 95-021716).

1588 Bonari, E.; Mazzoncini, M.; Peruzzi, A.; Coli, A. (Pisa Univ. (Italy). Dipartimento di Agronomia e Gestione dell'Agroecosistema) (1994) **[Experiences in Tuscany [on seedbed preparation techniques]]. Esperienze in Toscana [sulle tecniche di preparazione del letto di semina].** *Terra e Vita (Italy) v. 35(42) p. 44-47.* 4 tables; 5 graphs. Italian. (AGRIS 95-021655).

1589 Bovolenta, S.; Lombardi, A. (Bologna Univ. (Italy). Istituto di Meccanica Agraria) (1994) **[Some cheaper sowings [wheat]]. Semine meno costose [frumento].** *Terra e Vita (Italy) v. 35(35) p. 49-52.* 2 graphs. Italian. (AGRIS 95-021654).

1590 Bowman, H.; Blake, T.; Riesselman, J.; Jacobsen, J.; Jensen, G.; Fay, P. (1993) **Malt barley production in Montana.** *EB (USA); no. 116 21 p.* English. (AGRIS 95-021694).

1591 Bowman, H.; Cash, D.; Carlson, G.; Blake, T. (1994) **Haybet barley.** *EB (USA); no. 121 2 p.* English. (AGRIS 95-032560).

1592 Boyles, S.L.; Anderson, V.L.; Koch, K.B. (1992) **Feeding barley to cattle.** *NDSU Extension Service : [publication] (USA) p. 3-14.* references. In the series analytic: Feeding barley to cattle, swine and poultry. English. (AGRIS 95-032316).

1593 Boyles, S.L.; Johnson, R.L.; Koch, K.B. (1992) **Feeding barley to poultry.** *NDSU Extension Service : [publication] (USA) p. 27-32.* references. In the series analytic: Feeding barley to cattle, swine and poultry. English. (AGRIS 95-032319).

1594 Boyles, S.L.; Koch, K.B. (1992) **Feeding barley to swine.** *NDSU Extension Service : [publication] (USA) p. 19-26.* references. In the series analytic: Feeding barley to cattle, swine and poultry. English. (AGRIS 95-032318).

1595 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Testing the technological package for wheat production of 2 commercial plots: Yaqui valley, Sonora (Mexico)]. Validacion del paquete tecnologico para la produccion de trigo en 2 parcelas comerciales, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 17-18. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 17-18. Spanish. (AGRIS 95-021771).

1596 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[The response of 4 wheat varieties to 2 sowing methods, 5 sowing densities and 2 sowing dates: Yaqui valley, Sonora (Mexico)]. Determinacion de la respuesta de 4 variedades de trigo, bajo 2 metodos de siembra y 5 densidades de semilla en 2 fechas de siembra, en el Valle del Yaqui, Son.** (4 exps.). Avances de la investigacion CIANO (Mexico); no. 27 p. 16-17. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 16-17. Spanish. (AGRIS 95-021770).

1597 Cattaneo, M.; Borghi, B. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)); Monotti, M. (Perugia Univ. (Italy). Istituto di Agronomia e Coltivazioni Erbacee) (1994) **[Grain yield stability of bread wheat**

(Triticum aestivum L.), barley (Hordeum vulgare L.), rye (Secale cereale L.) and triticale (Triticosecale Wittm.) in the mountainous regions of Italy]. Produttivita' e stabilita' produttiva di frumento tenero (Triticum aestivum L.), orzo (Hordeum vulgare L.), segale (Secale cereale L.) e triticale (Triticosecale Wittm.) coltivati in alta collina [Italia]. *Rivista di Agronomia (Italy) v. 28(3) p. 161-169.* 4 tables; 4 graphs; 29 ref. Italian. (AGRIS 95-032375).

1598 Chavez Duron, Juan Antonio (1993) **[Evaluation of oat, barley, secale and vetch grass lands under rainfed conditions]. Evaluacion de praderas de avena, cebada, centeno y veza bajo condiciones de temporal.** Reunion Nacional de Investigacion Pecuaria. Jalisco 1993; Guadalajara, Jal. (Mexico); 27-30 Sep 1993. *National Reunion on Animal Research. Jalisco 1993 (Summaries). Reunion Nacional de Investigacion Pecuaria. Jalisco 1993 (Resumenes) p. 32.* CENID Microbiologia. Solo sumario. Spanish. (AGRIS 95-021724).

1599 Chikura, S.; Mudhara, M.; Mombeshora, B.G.; Chinaniso Chibudu; Jeranyama, P. (Agronomy Institute, Harare,(Zimbabwe). Department of Research and Specialist Services) (1993) **Impact of on-farm research on technology adoption by farmers: A case study in Mangwende.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 288-297.* CIMMYT. 15 tables; 1 ref. English. (AGRIS 95-021718).

1600 Ekeberg, E. (Apelsvoll Forskingsstasjon, Nes Hedmark (Norway). Avd. Kise) (1994) **[Trials with different sowing dates 1985-89]. Forsoek med ulike saatider 1985-89.** *Norsk Landbruksforsking (Norway); Norwegian Agricultural Research v. 8(2) p. 155-175.* 20 tables, 2 figures; 13 ref. Norwegian. (AGRIS 95-021693).

1601 Ersboell, A.; Kristensen, K. (1994) **[SP report, 36: Experimental design, statistical analysis and methods in relation to Green Fields [long term experiments, semivariograms, geostatistics]]. SP rapport, 36: Forsoegsplanlaegning og statistiske analyser og metoder i forbindelse med Groenne Marker.** Statens Planteavlsforsoeg, Lyngby (Denmark). SP. 5 tables; 12 ref. 20 p. Danish. (AGRIS 95-021691).

1602 Faria, R.T.; Madramootoo, C.A.; Boisvert, J.; Prasher, S.O. (1992) **A comparison of the versatile soil moisture budget and SWACROP models in Brazil.** *Paper-American Society of Agricultural Engineers (USA); no. 922114 30 p.* references. Paper presented at the "1992 International Summer Meeting sponsored by the American Society of Agricultural Engineers," June 21-24, 1992, Charlotte, North Carolina. English. (AGRIS 95-032219).

1603 Fischer, R.A. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **The sustainability debate and wheat science in Australia, developing countries and CIMMYT.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Wheat Program) p. 4-17.* CIMMYT. 3 tables; 14 ref. English. (AGRIS 95-021657).

Major wheat farming systems, increasingly important for feeding mankind, provide an appropriate focus about which to pursue the sustainability issue. Over the last 130 years of wheat farming in Australia has evolved through cycles of failure and research-driven recovery towards greater sustainability. Heavy investment in basic and applied research,a good proportion of skilled farmers, and reasonably sound economics were critical. By contrast, many wheat systems in developing countries, while growing in productivity, appear to have seriously threatened sustainability. More research specifically targeting soil and water issues is needed, along with decentralized multicommodity and multidisciplinary NARS research centers having a strong commitment to regional farming systems and an all-pervading sustainability perspective. Traditionally, the CIMMYT Wheat Program has worked globally with germplasm improvement. Over time, we have inevitably become concerned about our impact upon, and the evolution of, major wheat cropping systems in the developing world. Our experience collaboratively in the rice-wheat cropping system of South Asia suggest we can play a useful role in such sustainability research, and has revealed specific complementarities with our traditional more crop-specific research activities.

1604 Foster, A.M.; Quinones, M.A.; Sicilima, N.P.; Akibo Betts, D. (Sasakawa Global 200, Arusha (Tanzania)); Nkonya, E. (Selian Agricultural Research Institute (SARI), Arusha (Tanzania)) (1993) **The management training plot technology transfer approach: Initial impact on small scale farmer production in Northern Tanzania.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 344-364.* CIMMYT. 11 tables; 4 graphs., 7 ref. English. (AGRIS 95-021721).

1605 Francis, GS.; Haynes, RJ.; Williams, PH. (1995) **EFFECTS OF THE TIMING OF PLOUGHING-IN TEMPORARY LEGUMINOUS PASTURES AND 2 WINTER COVER CROPS ON NITROGEN MINERALIZATION, NITRATE LEACHING AND SPRING WHEAT GROWTH.** *Journal of Agricultural Science. 124(Part 1):1-9.* English. [NEW ZEALAND INST CROP & FOOD RES LTD PRIVATE BAG 4704 CHRISTCHURCH NEW ZEALAND].

Two field experiments at Canterbury, New Zealand during 1991-93 investigated the effect of the timing of ploughing a 4-year-old ryegrass/white clover pasture and the effect of two winter cover crops on subsequent N mineralization, nitrate leaching and growth and N uptake of the following wheat crops. Net N mineralization of organic N (of plant and soil origin) increased with increased fallow period between ploughing and leaching. The total amount of N accumulated in the profile by the start of winter ranged from 107 to 131 and from 42 to 45 kg N/ha for fallow treatments started in March and May respectively. Winter wheat (planted in May) had no effect on mineral N contents by the start of winter, whereas greenfeed (GF) oats (planted in March) significantly reduced the mineral N content in one year. Cumulative leaching losses over the first winter after ploughing-in pasture varied markedly between years in relation to rainfall amount and distribution. Leaching losses were greater from the March fallow (72-106 kg N/ha) than the May fallow treatments (8-52 kg N/ha). Winter wheat did not reduce leaching losses in either year. GF oats did not reduce losses in 1991/92, but losses in 1992/93, when major drainage events occurred late in the winter, were only c. 40% of those under fallow. Incorporation of a large amount (> 7 t/ha dry matter) of pasture or GF oat residue in spring depressed yield and total N uptake of the following spring wheat, largely due to net N immobilization which could be overcome by the application of fertilizer N. First-year treatments had very little residual effect in the second year. Leaching losses over the second winter (mean 142 kg N/ha) were largely unaffected by the extent of first year leaching losses. Second year leaching losses were greater than first year losses, probably due to the greater amount of mineral N at depth in the soil before the start of the second winter. [References: 27].

1606 Friis, E. (1994) **[Studies of the microclimate of spring barley [plant density]]. Undersoegelser af mikroklimaet i vaarbyg.** Statens Planteavlsforsoeg, Lyngby (Denmark). *SP-Rapport (Denmark); no. 19 157 p.* SP. 69 ill., 19 tables; 67 ref. English. (AGRIS 95-021692).

1607 Gangwar, KS.; Sharma, SK.; Singh, JP. (1994) **PRODUCTIVITY OF SUGARCANE (SACCHARUM-OFFICINARUM) AND WHEAT (TRITICUM-AESTIVUM) AS AFFECTED BY MANAGEMENT PRACTICES ON FARMERS FIELD.** *Indian Journal of Agronomy. 39(3):418-420.* English. [PROJECT DIRECTORATE CROPPING SYST RES MEERUT 250110 UTTAR PRADESH INDIA].

An experiment was conducted on farmer's fields to study the effect of management practices on productivity of sugarcane (Saccharum officinarum L.) and wheat (Triticum aestivum L. emend. Fiori & Paol.). The productivity of sugarcane and wheat could be increased by 16.63 and 18.20% respectively compared with farmer's practice by adopting full package of practices. Among different management practices, need-based plant protection and recommended irrigation individually and in combination showed highest contribution than recommended NPK to sugarcane yield, whereas need-based plant-protection measures contributed highest (9.4%) to the yield of wheat, followed by chemical weed control (5.2%).

1608 Garcia Espino, Gerardo; Carrete Carreon, Francisco Oscar; Javalera Moreno, Rafael (1993) **[Evaluation of forage triticale varieties under rain fed conditions at North Durango State]. Evaluacion de variedades de triticale forrajero bajo condiciones de temporal en el norte de Durango.** Reunion Nacional de Investigacion Pecuaria. Jalisco 1993; Guadalajara, Jal. (Mexico); 27-30 Sep 1993. *National Reunion on Animal Research. Jalisco 1993 (Summaries). Reunion Nacional de Investigacion Pecuaria. Jalisco 1993 (Resumenes) p. 39.* CENID Microbiologia. Solo sumario. Spanish. (AGRIS 95-021592).

1609 Getachew Kassaye (Institute of Agricultural Research (IAR), Addis Ababa (Ethiopia)) (1993) **Impacts of on-farm research on extension and promotion of technologies in Ethiopia.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 158-166.* CIMMYT. 6 tables; 1 graph., 8 ref. English. (AGRIS 95-021608).

1610 Gilbert, E. (Serrekunda (Gambia)); Smale, M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program) (1993) **Measuring research impacts in Africa: The case of maize in Malawi.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 398-416.* CIMMYT. 6 graphs. English. (AGRIS 95-021722).

1611 Gonzalez Ochoa, Rafael Ignacio (1993) **[Evaluation of winter grasses and cereals for grassing at Cuauhtemoc area, Chihuahua]. Evaluacion de pastos y cereales de invierno para pastoreo en la region de Cuauhtemoc, Chih.** Reunion Nacional de Investigacion Pecuaria. Jalisco 1993; Guadalajara, Jal. (Mexico); 27-30 Sep 1993. *National Reunion on Animal Research. Jalisco 1993 (Summaries). Reunion Nacional de Investigacion Pecuaria. Jalisco 1993 (Resumenes) p. 35.* CENID Microbiologia. Solo sumario. Spanish. (AGRIS 95-021725).

1612 Gonzalez Silverio, Miguel Angel (1992) **[Technological features of crystalline wheat (Triticum durum L.) varieties]. Caracterizacion tecnologica de las variedades de trigos cristalinos (Triticum durum L.) mexicanos.** Universidad Autonoma Chapingo, Chapingo (Mexico). Departamento de Ingenieria Agroindustrial. 111 p. Spanish. (AGRIS 95-021775).

1613 Grisley, W. (CIAT Regional Bean Program, Kampala (Uganda). Kawanda Research Station) (1993) **An empirical investigation of factors which influence farmers' decisions to transfer seed of new crop varieties to other farmers.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 238-245.* CIMMYT. 2 tables; 11 ref. English. (AGRIS 95-021999).

1614 Gumisiriza, G.; Wagoire, W.; Bungutsiki, B. (Uganda Grain Milling Company, Jinja (Uganda). Wheat and Barley Development Project) (1994) **Wheat production and research in Uganda: Constraints and sustainability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 51-56.* CIMMYT. 7 ref. English. (AGRIS 95-021663).

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

1615 Harrington, L.W.; Fujisaka, S.; Morris, M.L.; Hobbs, P.R.; Sharma, H.C.; Singh, R.P.; Chaudhary, M.K.; Dhiman, S.D. (eds.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico)) (1993) **Wheat and rice in Karnal and Kurukshetra Districts, Haryana, India: Farmers' practices, problems, and an agenda for action.** CIMMYT. 3 maps; 18 tables; 8 ills., 3 graphs., 13 ref. 44 p. English. (AGRIS 95-021756).

Two diagnostic surveys conducted during the rice and wheat seasons in 1992 in Karnal and Kurukshetra Districts of Haryana,India, helped develop a preliminary assessment of both near-term and potential longer-term problems in the area's rice-wheat cropping pattern. The surveys obtained information on farmers' rice and wheat crop management (crops and cropping pattern, water and soil fertility management, pest and disease management, and practices from sowing to harvest). Information on interactions between rice and wheat cultivation and other enterprises in the farming system was obtained as well. The major problems affecting wheat are (in order of importance) weed competition, declining soil health, poor groundwater quality, low plant population, and late planting. In rice, insect pests and diseases were identified as problems. Leaffolder and white-backed planthopper were the most severe, followed by blast, stem borer, foot rot, and bacterial leaf blight. Increased weed pressure and changing weed species were problems that also affected rice. Problems of declining soil fertility and soil health, poor groundwater quality, and groundwater depletion are longer-term problems that have implications for the sustainability of the rice-wheat pattern. Suggested actions to address these problems include additional diagnosis, monitoring to assess the longer-term effects of farmers' practices and alternative technologies, research on alternative solutions to problems that are thought to be well understood, extension, and research on policy implications.

1616 Hobbs, P.R. (Centro Internacional de Mejoramiento de Maiz y trigo (CIMMYT), Kathmandu (Nepal). Wheat Program); Woodhead, T. (International Rice Research Institute (IRRI), Los Banos (Philippines)); Meisner, C.A. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Dhaka (Bangladesh). Wheat Program) (1994) **Soil physical factors limiting the productivity of the rice-wheat rotation and ways to reduce their impact through management.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 276-289.* CIMMYT. 8 tables; 6 graphs, 29 ref. English. (AGRIS 95-021757).

The more than 20 million hectares of the rice-wheat cropping system grown in South Asia and China have concerns of low productivity (compared to potential), lack of sustainability of system productivity, and production that may not keep pace with population expansion despite farmer use of modern varieties and inputs. Physical degradation of soils is one major hypothesis for these problems. Puddling of rice reduces soil aggregate size by breaking down soil into smaller particles and also results in the development of a plow pan. These two and other soil physical parameters are discussed in the context of a rice- upland crop system. The discussion is followed by a description of various management options that farmers could adopt to minimize the detrimental effects of these soil physical degradation processes. These include tillage and land management for rice and wheat, drainage and water management, management of crop and animal residues, and crop rotations. It is important that a concerted, integrated research effort is made to better understand this major system in the region so that farm level productivity can be increased and sustained.

1617 Hucl, P. (1995) **GROWTH RESPONSE OF FOUR HARD RED SPRING WHEAT CULTIVARS TO DATE OF SEEDING.** *Canadian Journal of Plant Science. 75(1):75-80.* English. [UNIV SASKATCHEWAN CTR CROP DEV SASKATOON SK S7N 0W0 CANADA].

An increasing number of spring wheat cultivars released for production in western Canada are daylength insensitive. In contrast, until a decade ago virtually all Canada Western Red Spring (CWRS) wheat cultivars were daylength sensitive. The impact of photoperiod response on CWRS wheat growth and yield has not been studied to date. A growth analysis study was conducted in each of 3 yr at Saskatoon. Growth and yield traits of the photoperiod-sensitive cultivars Conway and Katepwa and photoperiod-insensitive cultivars Laura and Leader were compared in early versus late plantings. Laura had the highest leaf area index at anthesis and produced more spikelets and kernels per spike than the other cultivars. Laura, however, had a higher tiller mortality, producing fewer spikes per square metre. The cultivars did not respond uniformly to delayed seeding from one year to the next. Significant crossover cultivar x seeding date interaction was detected in each of the 3 yr. The cultivar x seeding-date interactions did not appear to follow a pattern that might be ascribed to differing cultivar photoperiod sensitivity. Conway was involved in one case of significant (P = 0.10) cultivar x seeding cross-over interaction for grain yield, while Katepwa and Leader were each involved in two cases and Laura in three cases. This study failed to determine whether differing photoperiod responses would translate into gross differences in cultivar growth and yield. Thus, there is a need to develop near-isogenic lines to determine whether photoperiod insensitivity is detrimental to yield stability in CWRS wheats. [References: 21].

1618 Ishag, H.M. (Agricultural Research Corporation (ARC), Wad Medani (Sudan)) (1994) **Genotype differences in heat stress in wheat in the irrigated Gezira Scheme.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 170-174.* CIMMYT. 4 tables; 8 ref. English. (AGRIS 95-021780).

Five cultivars of bread wheat were sown on 9 and 23 November and 14 December 1991. Detailed sampling was conducted during the growing cycle and at maturity. The latest sowing date produced yields some 33 lower than the earliest date. Sowing date affected most yield components with the exception of spikelets per spike. Accumulated thermal units for the growth stage terminal spikelet to anthesis was markedly affected, reducing from 96 deg C at the earliest to 41deg C at the latest sowing date. El Nielen had the highest grain yield at all dates, perhaps associated with heavy awns and greater amounts of epicuticular wax.

1619 Jonassen, G.H. (Landvik Forskingsstasjon, Grimstad (Norway)) (1994) **[Establishment of meadow fescue (Festuca pratensis Huds.) seed crops with cereal companion crops]. Saamengder av bygg og hvete som dekkvekst til engsvingelfroeeng.** *Norsk Landbruksforsking (Norway); Norwegian Agricultural Research v. 8(1) p. 81-88.* 5 figures; 22 ref. Norwegian. (AGRIS 95-022078).

1620 Jones, R.B. (The Rockefeller Foundation, Lilongwe (Malawi)) (1993) **The development of technologies for farmers by traditional commodity research teams: The Malawi experience.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 82-88.* CIMMYT. 12 ref. English. (AGRIS 95-021717).

1621 Kaigama, B.K.; Ikwelle, M.C.; Olabanji, O.G. (Federal Ministry of Science and Technology, Maiduguri (Nigeria). Lake Chad Research Institute) (1994) **Rainfed wheat in tropical environments: the Nigerian experience.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 105-108..* CIMMYT. 3 tables; 4 ref. English. (AGRIS 95-021779).

In Nigeria, wheat research and production in the highlands under rainfed conditions is still in its infancy. Research on the Mambilla Plateau (1, 800 masl) in Taraba State has shown that wheat cultivation under rainfed conditions will not only increase total wheat area, but will also shorten the breeding cycle and development of new varieties. An average grain yield of about 2.2 t/ha has been recorded on the Mambilla Plateau. The optimum sowing date was mid to late August. Stem borer (Sesemia calamistis) is the major insect pest. Leaf spot (Septoria spp.) and foot rot (Helminthosporium spp.) are the major diseases.

1622 Karanja, D.D.; Pinto, J.M. (National Plant Breeding Research Center (NPBRC), Njoro (Kenya)) (1994) **Wheat production and research in Kenya: Constraints and sustainability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 26-31.* CIMMYT. 2 tables; 15 ref. English. (AGRIS 95-021659).

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

1623 Loss, S.P.; Siddique, K.H.M. (1994) **Morphological and physiological traits associated with wheat yield increases in Mediterranean environments.** *Advances in agronomy (USA) v. 52 p. 229-276.* references. English. (AGRIS 95-021782).

1624 Magnin, M.F. (La Quinoleine (France)); Bonnel, J.P. (1994) **[Sonis: a plant growth substance for winter soft wheat and winter barley [etephon + trinexapac -ethyl]]. Sonis: regulateur de croissance du ble tendre d'hiver, de l'orge d'hiver et de l'escourgeon [etephon + trinexapac - ethyl].** *Phytoma La Defense des Vegetaux (France) (no 457) p. 50-51.* French. (AGRIS 95-021766).

1625 Marcos Torres, C.; Rodriguez, A. (Ministerio de Agricultura y Ganaderia, La Habana (Cuba). Estacion de Granos El Tomeguin) (1993) **[Evaluating yield differences between maize (Zea mays L.) hybrids and varieties in Cuba]. Evaluacion de las diferencias de rendimiento entre hibridos y variedades de maiz (Zea mays L.) en Cuba.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 44-46.* Programa Regional de Maiz (PRM). 2 tables; 1 ref. Spanish. (AGRIS 95-021715).

1626 Mashiringwani, N.A. (Crop Breeding Institute, Harare (Zimbabwe)); Mtisi, E. (Plant Protection Research Institute, Harare (Zimbabwe). Dept. of Research and Specialist Services) (1994) **Wheat production and research in Zimbabwe: Constraints and sustainability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 65-77.* CIMMYT. 3 tables; 4 graphs., 41 ref. English. (AGRIS 95-021665).

Wheat in Zimbabwe is grown mainly as an irrigated winter crop on large-scale farms. The effect of breeding research over the period 1969 to 1991 has been the continual increase of yield potential (1.2 percent/year) and yield dependability of the new cultivars through incorporation of desirable yield responses to environmental change, resistance to lodging and disease. There was an increase in the range of adaptability of wheat especially with regards to response to irrigation management, and tolerance

of warmer areas and/or pre-harvest rain. Agronomic practices suitable for irrigated wheat have been developed Tillage management technologies that enable farmers to reduce costs were introduced More recently, deficit irrigation management practices were developed, allowing farmers to use less water per unit area and to expand total area. Work on rainfed wheat and wheat production using residual soil moisture is continuing. Promising varieties for rainfed conditions have been developed Management practices suitable for economic production of rainfed wheat now need to be emphasized Technology generation efforts have improved farm yields and total production of irrigated wheat, but the production of wheat over the period 1969 to 1991 has increased at a lower rate than consumption. It is hoped that the positive effects of research efforts, the national irrigation fund, the general drive by government to develop national water reservoirs, trade liberalization, and incentive producer prices might lead to self-sufficiency for wheat in the short to medium term. In the long term, it may not be possible to expand irrigated wheat production to match consumption. Thus, it will be necessary to supplement irrigated wheat production with production from rainfed or residual soil moisture areas.

1627 Morse, D.; Boyles, S.L. (1992) **Use of barley in diets formulated for dairy cattle.** *NDSU Extension Service : [publication] (USA) p. 15-18.* references. In the series analytic: Feeding barley to cattle, swine and poultry. English. (AGRIS 95-032317).

1628 Moyo, C.C.; Nyondo, F.K.; Magulu, K.R. (Agricultural Development Division (ADD), Karonga (Malawi). Adaptive Research Team) (1993) **Contribution of on-farm research in the evaluation and recommendation of [Chitedze Composite C] (CCC) and [Chitedze Composite D] (CCD) maize composites in Karonga Agricultural Development Division.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 311-315.* CIMMYT. 1 map; 1 table; 4 ref. English. (AGRIS 95-021719).

1629 Muyanga, S. (Mt. Makulu Central Research Station, Chilanga (Zambia)) (1994) **Wheat production and research in Zambia: Constraints and sustainability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 57-64.* CIMMYT. 4 tables; 2 graphs., 17 ref. English. (AGRIS 95-021664).

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

1630 Nivergelt, J. (1994) **[Lysimeter results from 1.4.1992-31.3.1993]. Lysimeter Ergebnisse vom 1. April 1992 - 31. Maerz 1993.** Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Reckenholz (Switzerland). *Agrar Forschung (Switzerland) v. 1(11-12) p. 496-498.* 3 tables, 3 graphs, 1 photograph, 1 ref. German. (AGRIS 95-022019).

Weighing lysimeters at Reckenholz were planted in 1992/1993 with spring wheat/oilseed-rape and sugarbeet/fallow.

1631 Nyaki, A.S. (Selian Research Institute, Arusha (Tanzania)) (1994) **Wheat production and research in Tanzania: Constraints and sustainability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 42-50.* CIMMYT. 4 tables; 11 ref. English. (AGRIS 95-021662).

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

1632 Nyamudeza, P.; Mazhangara, E. (Lowveld Research Stations, DR and SS, Chiredzi (Zimbabwe)) (1993) **Impact of on-farm research in the South East Lowveld of Zimbabwe.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 298-303.* CIMMYT. 4 tables; 7 ref. English. (AGRIS 95-021763).

1633 Ochoa Burgos, Fidel; Beltran Fonseca, Manuel de Jesus (1993) **[Establishing sowing date and density for barley in saline soil: El Jupare, Huatabampo, Sonora]. Determinacion de la fecha y densidad de siembra en cebada en suelo salino, en El Jupare, Huatabampo, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 89. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 89. Spanish. (AGRIS 95-021690).

1634 Olugbemi, L.B. (Ahmadu Bello University, Zaria (Nigeria). Institute of Agricultural Research) (1994) **Wheat production in Nigeria.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 8-11.* CIMMYT. 3 ref. English. (AGRIS 95-021624).

Wheat is presently produced commercially in Nigeria entirely under irrigation within latitudes 10 to 14 deg N where night temperatures during most of the growing period (November-March) range from 10 to 15 deg C. The mean maximum temperature ranges from 30 to 35 deg C. Recommended for cultivation are Samwhit varieties numbered 1 through 8. As a result of the ban on wheat importation into Nigeria, effective January 1987, local wheat production rose from about 50,000 t/year to an estimated 150,000-180,000 t/year within four years. This increase was due partly to the encouragement given to wheat farmers by the government and the good price received by farmers for their harvest. With the partial lifting of the ban towards the end of 1992, many farmers are shifting to other crops like vegetables and rice.

1635 P'obwoya, CH.O. (Namulonge Research Station, Kampala (Uganda). Maize Program) (1993) **The impact of on-farm trials on management practices in Cassava (Manihot esculenta) and sweet potato (Ipomoea batatas) production: A case study in Eastern Uganda.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 271-274.* CIMMYT. 2 tables; 1 ref. English. (AGRIS 95-022021).

1636 Panelia, J.R.; Bagga, A.K.; Wasnik, K.G. (Indian Agricultural Research Institute, New Delhi (India). Division of Plant Physiology) (1993) **Effect of late sown conditions on productivity and nitrogen status in wheat.** *Indian Journal of Plant Physiology (India) v. 36(3) p. 178-184.* 5 tables; 3 ill., 16 ref. English. (AGRIS 95-032374).

1637 Pierce, F.J.; Gallagher, R.S. (1993) **Direct drilling winter wheat.** *Extension bulletin (USA); no. E-2418 4 p.* references. English. (AGRIS 95-032307).

1638 Pomela, M.E. (Agricultural Research Division, Maser (Lesotho)) (1993) **Adoption of new maize production technology on small farms in Lesotho.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo*

(CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 331-337. CIMMYT. 7 tables; 4 ref. English. (AGRIS 95-021720).

1639 Rakotondramanana, J.M.; Randrianaivoarivony; Randriantsalama, R.A. (FIFAMANOR, Antsirabe (Madagascar)) (1994) **Wheat production and research in Madagascar: Constraints and sustainability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 32-36.* CIMMYT. 2 tables; 5 ref. English. (AGRIS 95-021660).

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

1640 Rout, D.; Satapathy, MR. (1994) **EFFECT OF DATE OF SOWING ON WHEAT (TRITICUM-AESTIVUM) VARIETIES IN UMERKOTE ZONE OF ORISSA.** *Indian Journal of Agronomy. 39(3):466-468.* English. [ORISSA UNIV AGR & TECHNOL NATL AGR RES PROJECT UMERKOTE 764073 INDIA].

1641 Rushalaza, V.G.; Kaliba, A.R.M. (Ministry of Agriculture, Livestock Development and Cooperatives (MALDC), Dar es Salaam (Tanzania). Research and Training Division) (1993) **Impacts on on-farm research: Experiences from semi-arid Central Tanzania.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 383-397.* CIMMYT. 3 maps; 1 table; 2 graphs., 10 ref. English. (AGRIS 95-022052).

1642 Shatadal, P.; Jayas, D.S.; Bulley, N.R. (1992) **Separating contiguous wheat kernel image regions using mathematical morphology.** *Paper - American Society of Agricultural Engineers (USA); no. 92-3577 13 p.* references. Paper presented at the "1992 International Winter Meeting sponsored by the American Society of Agricultural Engineers," December 15-18, 1992, Nashville, Tennessee. English. (AGRIS 95-032308).

1643 Stockle, C.O.; Debaeke, P. (Department of Agricultural Engineering, Washington State University, Pullman, WA 99163 (USA)) (1992) **GRANA, a simulation model of grain crops: calibration and validation in southern France.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 210-211.* European Society for Agronomy. 2 ref. English. (AGRIS 95-032306).

1644 Tandon, J.P. (Wheat Research, Karnal, Haryana (India)) (1994) **Wheat cultivation, research organization, and production technology in the hot dry regions of India.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 17-23.* CIMMYT. 5 tables. English. (AGRIS 95-021668).

Wheat production in India has always been regarded as a gamble with seasonal temperatures. Major parts of the country have tropical to subtropical climates where average winter temperatures remain high. The greatest risk of damage is in the drier areas (the Central and Peninsular Zones) where temperatures remain warm and the duration for wheat growth is rather short. Some 20 research centers are located in these two zones, which are responsible for the large range of improved varieties being sown under the various cultural situations in these regions. Recent research achievements and production technologies for these hot zones of India are discussed.

1645 Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) (1994) **Developing sustainable wheat production systems.** *8. Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993.* CIMMYT. 327 p. English. (AGRIS 95-021656).

1646 Tanner, D.G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Nairobi (Kenya). Wheat Program); Amanuel Gorfu (Institute of Agricultural Research, Addis Ababa (Ethiopia). Kulumsa Research Center); Maina, M.P. (National Plant Breeding Research Center (NPBRC), Njoro (Kenya)); Negussie Tadesse (Debre Zeit Agricultural Research Center (AUA). Debre Zeit (Ethiopia)) (1994) **A collaborative research agenda to develop sustainable wheat production technologies for East Africa.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 229-240.* CIMMYT. 6 tables; 3 graphs., 22 ref. English. (AGRIS 95-021667).

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

1647 Tekalign Mam; Teklu Erkosa (Debre Zeit Agricultural Research Center (AUA), Debre Zeit (Ethiopia)); Abate Tedla (International Livestock Centre For Africa (ILCA), Addis Ababa (Ethiopia)) (1994) **The effect of undersowing wheat with clovers on wheat yield, total crop residue yield and nutritive value of straw and fodder grown on vertisols in Ethiopia.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 201-207.* CIMMYT. 2 tables; 3 graphs., 6 ref. English. (AGRIS 95-021666).

Field studies were conducted at various vertisol sites from 1987 to 1989 to assess the effects of undersowing clover on wheat grain and straw yield, total crop residue and biomass production, and the nutritive value of straw and fodder. Clover mixtures in association with several wheat varieties did not cause significant reductions in wheat grain yield, but the system significantly increased total fodder yield compared with the straw produced by wheat grown in a pure stand. Furthermore, the growth of clover in combination with wheat significantly (P minus than 0.001) increased CP and IVOMD contents of total fodder (wheat straw plus clover), suggesting that higher quality crop residue can be achieved by growing clover with wheat. In addition, NDF content was reduced in the wheat straw/clover combination, confirming that the quality of straw from wheat varieties grown in pure stand is inferior to that of the total fodder from wheat/clover intercropping. On-farm studies are now being conducted to verify the improvement in total crop residue production and in the quality of the crop residue, and to demonstrate to peasant farmers that the undersowing system could improve livestock performance.

1648 Thilmony, A.; McKay, K.; Hoag, B. (1993) **Kernels per pound of various crops and varieties and its effect on seeding rate.** *North Dakota*

farm research (USA) v. 50(1) p. 38-40. references. English. (AGRIS 95-021688).

1649 Toni, B. (1994) **[Broadcast sowing and wheat is cheaper]. Semina a spaglio e il frumento costa meno.** *Terra e Vita (Italy) v. 35(39) p. 58-60.* Italian. (AGRIS 95-021862).

1650 Ugen Androgu, M. (National Bean Program, Kampala (Uganda). Kawanda Research Station); Wortmann, CH.S. (CIAT Regional Bean Program, Kampala (Uganda). Kawanda Research Station) (1993) **Farmers' participation in on-farm evaluation of bush bean cultivars (Phaseolus vulgaris) in Uganda: The case of Iganga District.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p 246-253.* CIMMYT. 3 tables; 9 ref. English. (AGRIS 95-022001).

1651 Valencia, J.A. (Sasakawa Global 2000, Kano (Nigeria)); Russell,N.C. (International Center for Tropical Agriculture (ICTA), Cali (Colombia)); Dowswell, C.R. (Sasakawa Global 2000, Tepetlaoxtoc (Mexico)) (1994) **Experience of the Sasakawa-Global 2000 agricultural project in supporting Sudan's wheat production.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 55-66.* CIMMYT. English. (AGRIS 95-021669).

This paper offers an account of the experience and accomplishments of the Sasakawa-Global 2000 Agricultural Project in Sudan. Between 1986 and 1992, project staff worked closely with the country's extension service within the Ministry of Agriculture to explore the possibilities for improving wheat production. The Program succeeded overwhelmingly in demonstrating the potential of extension officers for serving as agents of change in food production. It did so primarily by training and supporting them in the use of an effective tool for technology demonstration (i.e., the production test plot program). This experience, in turn, underscored the importance of establishing closer links between extension and research to ensure that innovations emerging from the agricultural sciences reach their intended beneficiaries in the countryside.

1652 Valenzuela Borbon, Jesus Rafael (1993) **[Wheat, triticale and barley demostration plots: Mayo valley, Sonora]. Parcelas demostrativas de trigo, triticale y cebada, en el Valle del Mayo, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 65. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 65. Spanish. (AGRIS 95-021772).

1653 Villanueva Avalos, Jose Francisco; Sanchez Rodriguez, Rito; Herrera C, F.; Carrete Carreon, Francisco Oscar (1993) **[Production of forage for ensiling of several selections of wheat and triticale in the monountain region of Nayarit]. Produccion de forraje para ensilar de varias selecciones de trigo y triticale en la region serrana de Nayarit.** Reunion Nacional de Investigacion Pecuaria. Jalisco 1993; Guadalajara, Jal. (Mexico); 27-30 Sep 1993. *National Reunion on Animal Research. Jalisco 1993 (Summaries). Reunion Nacional de Investigacion Pecuaria. Jalisco 1993 (Resumenes) p. 45.* CENID Microbiologia. Solo sumario. Spanish. (AGRIS 95-021776).

1654 Waddington, S. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) (1993) **The future for on-farm crop experimentation in Southern Africa.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 446-457.* CIMMYT. 2 tables; 35 ref. English. (AGRIS 95-021645).

1655 Yang Yanhua (Yunnan Academy of Agricultural Sciences, Yunnan (China). Cereals Crop Institute) (1994) **Wheat production zones and breeding objectives in Yunnan Province, China.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 228-231.* CIMMYT. 2 tables; 2 graphs. English. (AGRIS 95-021671).

This paper discusses the varied conditions for wheat-growing in Yunnan Province, and divides the wheat production into three great growing districts, on the basis of natural ecological conditions and historical growing habits. The conditions and problems existing in various growing districts are introduced and used to determine the breeding objectives.

F02 PLANT PROPAGATION

1656 Chang, K.W. (Chungsun Junior College, Goksung (Korea Republic)); Moon, 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.* 10 illus.; 6 tables; 16 ref. Korean. (AGRIS 95-022191).

1657 Ghaemi, M.; Sarrafi, A.; Morris, R. (1995) **RECIPROCAL SUBSTITUTIONS ANALYSIS OF EMBRYO INDUCTION AND PLANT REGENERATION FROM ANTHER CULTURE IN WHEAT (TRITICUM AESTIVUM L).** *Genome. 38(1):158-165.* English. [ECOLE NATL SUPER AGRON INST NATL POLYTECH TOULOUSE BIOTECHNOL & AMELIORAT PLANTES LAB F-31076 TOULOUSE FRANCE].

Reciprocal substitutions for all chromosomes between the hard red winter wheat cultivars Wichita and Cheyenne were used to investigate the effects of individual chromosomes, as well as their interactions with the genetic background, on androgenesis, Duplicate lines for each chromosome were included to check background homogeneity. Six experiments, two for each genome, were performed. In each experiment, 14 substitution lines, their 14 duplicate lines, and the two parental genotypes ('Cheyenne' and 'Wichita') were studied. The experimental design was a randomized block with three replications. 'Wichita' and 'Cheyenne' differed significantly in embryo yield and green plant regeneration (except green plant regeneration for the B-genome tests) and were equal for albino and total plant regeneration. Embryogenesis was influenced by some chromosomes of the A, B, and D genomes; green plant production was influenced by all chromosomes of the A and D genomes except 5D; albino and total plant regeneration were affected by some chromosomes of the B and D genomes. Reciprocal effects were obtained with chromosomes 1A, 7A, 1B, 5B, 1D, and 2D for embryogenesis, chromosomes 2D and 7D for green plant regeneration, and chromosome 2D for total plant regeneration. Reciprocal substitution lines revealed reciprocal effects of homologous chromosomes, as well as interactions between substituted chromosomes and their specific genetic background. [References: 22].

1658 Keller, B.; Winzeler, H.; Winzeler, M.; Fried, P. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Reckenholz (Switzerland)) (1994) **[In vitro culture of wheat embryos: possibility to select for resistance against Septoria nodorum blotch]. In vitro Selektion auf Resistenz gegen Spelzenbraeune.** *Agrarforschung (Switzerland) v. 1(1) p. 29-30.* 2 tables, 1 photograph, 8 ref. German. (AGRIS 95-032712).

1659 Psenakova, T.; Luxova, M.; Gasparikova, O. (1995) **OXYGEN UPTAKE OF GERMINATING WHEAT EMBRYOS USING SALICYLHYDROXAMIC ACID (SHAM).** *Biologia. 50(1):105-107.* English. [SLOVAK ACAD SCI INST BOT DUBRAVSKA CESTA 14 CS-84223 BRATISLAVA SLOVAKIA].

The titration curves of respiration rates throughout inbibition and germination of isolated wheat embryos (Triticum durum, cv. Appulo) were determined. From these curves the appropriate salicylhydroxamic acid (SHAM) concentrations needed to inhibit the cyanide-resistant alternative pathway, without any side effects were estimated for each stage: 5 mmol.l-1 for 30 min, 10 mmol.l-1 for 3, 6, 12 and 48 h and 15 mmol.l-1 for 24 h.

1660 Zaghmout, OMF.; Oliver, MJ. (1995) **DIFFERENTIAL MODULATION OF ROOT FORMATION IN WHEAT EMBRYOGENIC CALLUS CULTURE BY INDOLEACETIC ACID-DEGRADING COMPOUNDS.** *Journal of Experimental Botany. 46(282):155-158.* English. [USDA ARS BOX 215 ROUTE 3 LUBBOCK, TX 79401 USA].

Root overproduction in embryogenic calli of wheat cv. 'Chinese Spring' was controlled by the addition of IAA-degrading compounds (citric acid, MnSO4 or EDTA) to the culture media. In the presence of 20 g l-1 sucrose, the number of roots on calli decreased significantly when media for either callus maintenance or plant regeneration were amended with citric acid. EDTA was less effective in reducing the number of roots than citric acid. An increase in the amount of a 31 kDa (P1) polypeptide under conditions which favoured a reduction in root formation was observed. [References: 5].

F03 SEED PRODUCTION

1661 Bhullar, SS. (1995) **BIOREGULATION OF STARCH ACCUMULATION IN DEVELOPING SEEDS [Review].** *Current Science. 68(5):507-516.* English. [GURU NANAK DEV UNIV DEPT BIOTECHNOL AMRITSAR 143005 PUNJAB INDIA].

Starch is a major constituent of cereal and most legume seeds and, thus, an important determinant of yield of these seeds, This paper reviews the processes controlling starch deposition in the developing seeds, The capacity of the seed (i.e. cell and amyloplast numbers) to accommodate starch is determined during the first one-third phase of seed development and the availability of carbohydrates to the seed during this phase influences this capacity, Sucrose is the primary source of reduced carbon for starch synthesis in the seeds, In the cytosol of starch-storing cells, sucrose is catabolized to generate hexose phosphates (Glc-1-P or Glc-6-P), which are transported into the amyloplast, These are used to generate ADPGlc by ADPGlc-PPase, which is then used by starch synthase(s) and branching enzymes to produce starch, Although the regulatory role of ADPGlc-PPase (i.e. its activation by 3-PGA and inhibition by Pi) in starch metabolism in photosynthetic tissues is well documented, based on kinetic characteristics and molecular biology studies, its similar role in the developing seeds has been questioned. [References: 146].

1662 Bjarnason, M.; Pixley, K. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Maize Program) (1994) **Evaluation of Tuxpeno accessions from subtropical areas.** *The CIMMYT maize germplasm bank: Genetic resource preservation, regeneration, maintenance, and use. Taba, S. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Maize Program) p. 27-29.* CIMMYT. 2 tables. English. (AGRIS 95-022289).

1663 Butler, L.D. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico)) (1994) **Seed health at CIMMYT.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 87-96. CIMMYT. 8 tables; 1 ills., 4 ref. p. 87-96. English. (AGRIS 95-022277).

1664 Fontaine, O.; Billard, JP.; Huault, C. (1995) **EFFECT OF GLUTATHIONE ON DORMANCY BREAKAGE IN BARLEY SEEDS.** *Plant Growth Regulation. 16(1):55-58.* English. [UNIV CAEN INST RECH & BIOL APPL INRA PHYSIOL & BIOCHIM VEGETALES LAB F-14032 CAEN FRANCE].

A striking relation has been shown between the increase of glutathione levels during dormancy breakage of barley seeds and the induction of germination by exogenous glutathione. These findings suggested that glutathione may play a crucial role in dormancy breakage. [References: 16].

1665 Mathew, T. (1995) **GIBBERELLIC-ACID-INDUCED CHANGES IN ALPHA-AMYLASE ACTIVITY OF BARLEY SEEDS AND THEIR REVERSAL BY CHLORFLURENOL.** *Current Science. 68(5):539-541.* English. [BHABHA ATOM RES CTR DIV MOLEC BIOL & AGR BOMBAY 400085 MAHARASHTRA INDIA].

alpha activity was measured in barley seeds soaked in water, gibberellic acid (GA, 10(5) and 10(-3) M) and chlorflurenol (CFL, 10(-10) and 10(-5) M) for 20 h. A high background activity was observed in controls. Seeds soaked in GA inhibited the enzyme activity, probably due to an endogenous superoptimal concentration. The higher concentration of CFL (10(-5) M) reversed their inhibition. The action of CFL is attributed to interference in GA's action. [References: 7].

1666 Meisner, C.A. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Dhaka (Bangladesh). Wheat Program); Badaruddin,M. (Bangladesh Agricultural Research Institute, Dinajpur (Bangladesh). Wheat Research Centre); Saunders, D.A. (Interag, Pty. Victor Harbor, SA (Australia)); Alam, K.B. (Bangladesh Agricultural Research Institute, Dinajpur (Bangladesh). Wheat Research Centre) (1994) **Seed treatment as means to increase wheat yields in warm areas.** Wheat in Warm Area, Rice Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 360-366.* CIMMYT. 4 graphs., 15 ref. English. (AGRIS 95-022285).

Wheat production and area in Bangladesh, while having expanded since 1975, has reached a plateau in recent years. The research results of the last few years indicate that production can be increased substantially by the introduction of a few technologies without increasing the area. The Wheat Research Centre of the Bangladesh Agricultural Research Institute has conducted multi-location experiments as well as on-farm testing of various seed treatments, each having differing efficacies for differing pathogens. Results from both the researchers' plots and farmers' fields indicate a fairly consistent minimum 10 yield improvement due to seed treatment with Vitavax 200. A review of the use of carboxin and thiram (components of Vitavax 200) is presented, especially emphasizing the research and experiences from Pakistan, India, and Nepal.

1667 Moharir, AV.; Prakash, N. (1995) **MOISTURE DESORPTION AND ABSORPTION ISOTHERMS FOR SEEDS OF SOME CULTIVARS OF TRITICUM AESTIVUM AND TRITICUM DURUM WHEAT.** *Current Science. 68(3):316-326.* English. [INDIAN AGR RES INST NUCL RES LAB NEW DELHI 110012 INDIA].

Moisture desorption and absorption isotherms for 50 seeds each of cultivated varieties belonging to Triticum aestivum and Triticum durum in five replications were recorded at 30 degrees C and 85% RH (relative humidity). Hysteresis loops were established for all varieties from the average seed masses, normalized to equal curve heights for meaningful and effective comparison, It is observed that the total area enclosed under the normalized hysteresis curves for different varieties is different, Curiously enough, the hysteresis loops for seeds of well-known cultivated rainfed varieties enclose smaller area compared to the hysteresis loops for seeds of varieties cultivated under irrigated high-fertility conditions, Percentage hydration of seeds after one cycle of dehydration and rehydration indicates that seeds of well-established rainfed varieties have small negative values, whereas the values are positive and high for the seeds of irrigated varieties, Further, the rates of both dehydration and rehydration for seeds of rainfed varieties are smaller compared to those for the seeds of irrigated varieties. It is believed that this observation offers considerable potential as a laboratory test for screening, or at least short-listing, of varieties to the advantage of wheat breeders, agronomists and seed scientists, particularly working for agriculture in arid and semi-arid regions. [References: 29].

1668 Morozov, Yu.M.; Melent'ev, A.I.; Kuz'mina, L.Yu. (1994) **[Ultrastructure of wheat cells during development of bacteria Bacillus spp. - active agent bacterial inoculant bacispecin BM]. Ul'trastruktura kletok pshenitsy pri razvitii bakterij Bacillus spp. - aktivnogo nachala bakterial'nogo inokulyanta batsispetsin BM.** *Fiziologiya rastenij (Russian Federation) v. 41(1) p. 36-43.* 15 ref. Russian. (AGRIS 95-032787).

1669 Nayyar, H.; Walia, DP.; Kaistha, BL. (1995) **PERFORMANCE OF BREAD WHEAT (TRITICUM AESTIVUM) SEED PRIMED WITH GROWTH-REGULATORS AND INORGANIC SALTS.** *Indian Journal of Agricultural Sciences. 65(2):112-116.* English. [HIMACHAL PRADESH KRISHI VISHVAVIDYALAYA DEPT PLANT PHYSIOL PALAMPUR 176062 HIMACHAL PRADES INDIA].

An experiment was conducted during 1991-92 and 1992-93 to study the effect of priming the seed of bread wheat (Triticum aestivum L. emend. Fiori & Paol.) with growth-regulators and inorganic salts on its performance. Seeds of 'HD 2380' and 'VL 616' were primed for different durations of 1-24 hr at 20 degrees C in dark, with growth hormones [indole-3-acetic acid (IAA), indole-3-butyric acid (IBA), gibberellic acid (GA(3)) and abscisic acid] and inorganic salts (potassium, calcium and triadimefon). In general, seed priming with most of the treatments significantly improved the seed performance in laboratory in terms of germination (%), germination time and seedling growth (length and dry matter). Varietal response was specific to each priming treatment. In 'HD 2380' maximum germination was observed with GA(3) (20 ppm), NO3 (50 ppm) and CaSO4 (75 ppm), whereas in 'VL 16', auxins (IAA and IBA) and potassium salts

(KH2PO4 and KNO3) were most effective for germination and mean germination time. The seedling growth was highest with KNO3 (100 ppm) in 'HD 2380', whereas CaCl2 (50 and 100 ppm), indole-3-butyric acid (20 ppm) and triadimefon (20 ppm) were more effective in 'VL 616'.

1670 Ronga, G.; Ninno, G.R. de; Ninno, M. de; Gallo, A.; Platani, C. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) **[Seed dressing improves wheat yield [Italy]]. Con la concia del seme il grano produce di piu' [Italia].** *Terra e Vita (Italy) v. 35(28) p. 60-63.* 3 tables; 1 graph. Italian. (AGRIS 95-022293).

1671 Singh, S.P.; Kesavan, P.C. (School of Life Sciences, Jawarharlal Nehru University, New Delhu 110067. Delhi (India)) (1992) **Post-irradiation modification of oxygen-, nitrogen- and nitrous oxide-mediated damage in dry barley seeds by catalase and superoxide dismutase: influence of post-hydration temperature.** *Environmental and Experimental Botany (United Kingdom) v. 32(4) p. 329-342.* 39 ref. English. (AGRIS 95-032775).

1672 Winter, W.; Baenziger, I.; Krebs, H.; Ruegger, A. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Reckenholz (Switzerland)); Frei, P.; Gindrat, D. (Station federale de recherches agronomiques, Changins (Switzerland)) (1994) **[Warm water treatment: an alternative to the chemical dressing of wheat seed?]. Warmwasserbehandlung von Weizensaatgut.** *Agrar Forschung (Switzerland) v. 1(11-12) p. 492-495.* 6 tables, 4 photographs, 9 ref. German. (AGRIS 95-022284).

In Switzerland, the most important seedborne fungal pathogens of wheat are: Gerlachia nivalis, Septoria nodorum and Tilletia caries. For the warm water treatment, certified wheat seeds were dipped into water at 45 degrees C for 2 hours, then air-dried for 5 hours. This treatment should be applied only to certified seed of cultivars with low or middle susceptibility to common bunt.

F04 FERTILIZING

1673 Abrego Ruiz, Manuel Ricardo; Cervantes Mendivil, Teodoro (1993) **[Semicommercial testing of N, P fertilizer for forage barley in rotation with maize after minimum tillage: Fronteras region,Sonora]. Evaluacion a nivel semicomercial de la fertilizacion nitrofosforica en cebada forrajera establecida en rotacion con maiz en labranza minima, en la region de Fronteras, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 120-121. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 120-121. Spanish. (AGRIS 95-022395).

1674 Almetov, N.S. (1994) **[Effect of mineral fertilizers on crop yield and quality of barley under conditions of the Republic Mari El [Russian Federation]]. Vliyanie mineral'nykh udobrenij na urozhajnost' i kachestvo yachmenya v usloviyakh Respubliki Marij Ehl.** *Agrokhimiya (Russian Federation) (no.2) p. 21-24.* 6 ref. Russian. (AGRIS 95-032892).

1675 Andreasen, A.W. (1992) **Bulk blends in Western Europe: a comparison between complex and blends.** *Proceedings of the Annual Meeting Fertilizer Industry Round Table (USA) p. 171-178.* Meeting held on October 26-28, 1992, Baltimore, Maryland. English. (AGRIS 95-032921).

1676 Ascher, J.S.; Graham, R.D. (Waite Agricultural Research Institute, Glen Osmond, SA (Australia)); Elliott, D.E. (South Australian Research and Development Institute, Adelaide, SA (Australia)); Scott, J.M.; Jessop, R.S. (University of New England, Armidale, New South Wales (Australia). Department of Agronomy and Soil Science) (1994) **Agronomic value of seed with high nutrient content.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 297-308.* CIMMYT. 8 tables; 1 graph., 38 ref. English. (AGRIS 95-022401).

Seed with high mineral content has been shown to increase early seedling vigor and nutrition; similar to a starter fertilizer effect. The nutrient content of seed is dependent on soil type, nutrient availability, species, and to a lesser extent season and variety. Fertilizer applications at sowing and during grain-filling were investigated as a means of increasing nutrient content of grain kept as seed for subsequent crops. This paper describes current research designed to develop fertilizer strategies to increase the translocation of nutrients (P and Mn) to wheat and barley grain kept for seed and to evaluate the effect of this seed with high nutrient content on growth, nutrient status, disease resistance, and grain yield of the subsequent crop.

1677 Asgelil Dibabe; Andualem Taye (Institute of Agricultural Research (IAR), Addis Ababa (Ethiopia). Adet Research Center); Sahlemedhin Sertsu (National Soil Service Project, Addis Ababa (Ethiopia)) (1994) **A phosphorus calibration study on bread wheat in Northwestern Ethiopia.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 254-260.* CIMMYT. 2 tables; 4 graphs., 9 ref. English. (AGRIS 95-022441).

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

1678 Barekzai, A.; Steffens, D.; Dou, H.; Mehl, M.; Schwab, M.; Mengel, K.; Engels, T. (Institute of Plant Nutrition, Justus Liebig University, 6300 Giessen (Germany)) (1992) **Development, principle and verification of the 'Giessen model' for nitrogen fertilizer rates to winter cereals based on nitrogen soil analysis in autumn.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 228-229.* European Society for Agronomy. 2 ref. English. (AGRIS 95-032895).

1679 Barthes, L.; Deleens, E.; Bousser, A.; Hannachi, L.; Gate, P.; Prioul, JL. (1995) **VARIATIONS OF WHEAT LEAF C AND N ISOTOPE COMPOSITIONS AFTER CROP FERTILIZATION.** *Comptes Rendus de l Academie des Sciences Serie III-Sciences de la Vie-Life Sciences. 318(2):253-262.* French. [UNIV PARIS 11 INST BIOTECHNOL PLANTES STRUCT & METAB PLANTES LAB URA 1128 BATIMENT 630 F-91405 ORSAY FRANCE].

Wheat fertilization given at stage 1 cm-ear was studied at 80 and 160 kg N ha(-1) levels in comparison with a control without fertilizer. As commercial fertilizers were depleted in N-15 compared to the natural N supply of this soil, we proposed to follow the fertilizer input until flowering by the variations in natural delta(15)N of leaves at the top of the canopy. N from controls grown on unfertilized plots was enriched in N-15 whereas that from fertilized plants decreased as the supplied fertilized increased. The variations of leaf in vitro NR activity confirmed the arrival of the fertilizer. Other criteria varied with the level of fertilization and exhibited varietal differences. These concerned %N and soluble proteins for N metabolism and %C, delta(13)C and osmolarity of soluble extracts for water use efficiency and water content. Experiments with later additions of fertilizers on 80 kg N hd(-1) assays confirmed the preceding observations. Thus, soil N use by crop plants can be followed by the variations of criteria determined on the canopy of a soil. [References: 24].

1680 Carnevali, G. (Regione Emilia Romagna, Bologna (Italy). Servizio Sviluppo Agricolo) (1994) **[Controlled fertilization [hard wheat, Emilia-Romagna]]. Concimazione "disciplinata" [frumento duro, Emilia Romagna].** *Terra e Vita (Italy) v. 35(36) p. 49-52.* 6 tables. Italian. (AGRIS 95-022455).

1681 Carnevali, G. (Regione Emilia Romagna, Bologna (Italy). Servizio Sviluppo Agricolo); Stoppelli, N. (Consorzio Emiliano Romagnolo Aziende Sperimentali (CERAS), Bologna (Italy)) (1994) **[A computer for the fertilization [wheat]]. Un computer per concimare [frumento].** *Terra e Vita (Italy) v. 35(35) p. 52-54.* 2 tables. Italian. (AGRIS 95-022387).

1682 Cervantes Mendivil, Teodoro (1993) **[Determining the residual benefit of N, P fertilizer applied to buffel grass for a subsequent crop of forage barley sown at different seed densities after minimum tillage; Moctezuma river region, Sonora]. Evaluacion del efecto residual de la fertilizacion nitrofosforica en cebada forrajera sembrada con diferentes densidades de semilla bajo labranza minima en un lote establecido con zacate buffel, en la region del Rio Moctezuma, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 117-118. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 117-118. Spanish. (AGRIS 95-022393).

1683 Chaudharv, M.L.; Batra, M.L.; Kumar, N. (Haryana Agricualtural University, Hisar (India). Department of Soil Science) (1993) **Effect of P sources and their time of application on yield and P uptake in wheat.** *International Journal of Tropical Agriculture (India) v. 11(4) p. 299-302.* 4 tables; 8 ref. English. (AGRIS 95-022444).

1684 Destain, J.P. (Centre de Recherches Agronomiques, Gembloux (Belgium)); Francois, E.; Guiot, J.; Goffarti, J.P.; Vandergeten, J.P.; Bodson, B. (1993) **Fate of nitrogen fertilizer applied on two main arable crops, winter wheat (Triticum aestivum) and sugar beet (Beta vulgaris) in the loam region of Belgium.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 367-370.* 5 ref. English. (AGRIS 95-022447).

1685 Djurhuus, J. (1994) **[SP report, 35: Nitrate leaching after ploughed out of grass-clover ley]. SP rapport, 35: Kvaelstofudvaskning efter omlaegning af kloevergraesmarker.** Statens Planteavlsforsoeg, Lyngby (Denmark). SP. 4 tables; 17 ref. 12 p. Danish. (AGRIS 95-022442).

1686 Feil, B. (Eidgenoessische Technische Hochshule Zuerich (Suisse). Institute of Plant Sciences); Baenziger, M. (1993) **[Nitrogen and cultivar effects on the mineral element concentration in the grain of spring wheat]. [Effet de l'azote et du cultivar sur la concentration en elements mineraux des grains de ble de printemps].** *European Journal of Agronomy (France) v. 2(3) p. 205-212.* 22 ref., 8 tableaux. English. (AGRIS 95-022436).

1687 Fernandes, MS.; Rossiello, ROP. (1995) **MINERAL NITROGEN IN PLANT PHYSIOLOGY AND PLANT NUTRITION [Review].** *Critical Reviews in Plant Sciences. 14(2):111-148.* English. [FED UNIV RIO DE JANEIRO DEPT SOILS KM 47 BR-23851970 RIO DE JANEIRO BRAZIL].

Nitrogen (N) nutrition enhances metabolic processes that influences the physicochemical environment at the soil-root interface, modifies rhizosphere conditions, interferes with the uptake of cations and anions, and enhances or represses the activity of several enzyme systems. Also, it affects growth patterns, protein content, and protein quality of seeds. Ammonium (NH4)-N nutrition increases anion uptake, free amino-N/protein ratios, and acidity of root free space; it reduces carbohydrate levels in plant tissues. NO3-N nutrition results in higher cation uptake, higher carbohydrate content in tissues, and alkalinization of root free space. N-Assimilation interferes with the allocation of dry matter and energy, which causes different growth rates of plant parts. In this article we review the effects of mineral-N nutrition on uptake of cations and anions, activity of enzymes, growth patterns of roots and shoots, and water use efficiency, protein content, and protein quality of seeds. [References: 323].

1688 Ferri, D.; Giorgio, D. de (Istituto Sperimentale Agronomico, 5 70124 Bari (Italy)) (1992) **Yields and nitrogen dynamics in winter wheat following sunflower in southern Italy.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 248-249.* European Society for Agronomy. 1 ref. English. (AGRIS 95-032924).

1689 Giordani, G. (Bologna Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee); Pelliconi, F. (Consorzio Agrario Provinciale, Ravenna (Italy)) (1994) **[Wheat - the need of nitrogen can be read in the leaves]. Frumento - la voglia di azoto si legge nelle foglie.** *Terra e Vita (Italy) v. 35(10) p. 61-64.* 1 table; 1 graph. Italian. (AGRIS 95-022386).

1690 Giordani, G.; Guermandi, M. (Bologna Univ. (Italy). Istituto di Agronomia Generale e Coltivazioni Erbacee) (1994) **[Nitrogen. New methods to optimize the rates [Triticum aestivum, Emilia-Romagna]]. Azoto. Nuovi metodi per ottimizzare le dosi [grano tenero, Emilia Romagna].** *Agricoltura Regione Emilia Romagna (Italy) v. 22(9) p. 31-33.* 1 graph. Italian. (AGRIS 95-032927).

1691 Gordon, R.; Franco, J.; De Gracia, N.; Martinez, L.; Gonzalez, A. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama)); Herrera, A.P. de (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Economia); Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Maize response to different N application rates in Canavalia and Mucuna rotations under two types of tillage, Rio Hato, Panama, 1992-93]. Respuesta del maiz a la aplicacion de diferentes dosis de nitrogeno en rotacion con Canavalia y Mucuna bajo dos tipos de labranza, Rio Hato, Panama, 1992-93.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 106-110.* Programa Regional de Maiz (PRM). 3 tables; 3 graphs., 5 ref. Spanish. (AGRIS 95-022411).

1692 Haneklaus, S.; Murphy, DPL.; Nowak, G.; Schnug, E. (1995) **EFFECTS OF THE TIMING OF SULPHUR APPLICATION ON GRAIN YIELD AND YIELD COMPONENTS OF WHEAT.** *Zeitschrift fur Pflanzenernahrung und Bodenkunde. 158(1):83-85.* English. [FED AGR RES CTR BRAUNSCHWEIG VOLKENRODE INST PLANT NUTR & SOIL SCI BUNDESALLEE 50 D-38116 BRAUNSCHWEIG GERMANY].

Pot experiments were conducted to examine the response of wheat tot he timing of sulphur (S) application. Plants were fertilized at different stages from sowing to the end of flowering. Plants grown without a basal S supply (severe deficiency), which showed deficiency symptoms at ear emergence, required fertilization with S at the tillering stage if yield losses were to be completely avoided. Moderate and slight S deficiency, which did not result in symptoms until after ear emergence, required rectification at the second node stage for full yield to be obtained. Treatment effects on yield were closely associated with effects on the number of kernels per ear. The results show that where S deficiency occurs, fertilization is required before symptoms become evident if yield reductions are to be avoided. [References: 5].

1693 Jensen, C.R. (Agricultural Univ., Copenhagen (Denmark). Dept. of Soil and Water and Plant Nutrition); Andersen, M.N.; Loesch,R. (1993) **The effect of potassium application on leaf water relations characteristics of field grown barley plants (Hordeum distichum L.).** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 423-426.* 6 ref. English. (AGRIS 95-022399).

1694 Kamukondiwa, W. (Zimbabwe Univ., Harare (Zimbabwe). Dept. of Biological Sciences); Bergstroem, L. (1994) **Leaching and crop recovery of (15)N from ammonium sulphate and labelled maize (Zea mays) material in lysimeters at a site in Zimbabwe.** *Plant and Soil (Netherlands) v. 162(2) p. 193-201.* 31 ref. English. (AGRIS 95-022409).

1695 Kelly, J.T.; Bacon, R.K.; Wells, B.R. (1993) **Nitrogen utilization in soft red winter wheat.** *Arkansas farm research (USA) v. 42(4) p. 14-15.* English. (AGRIS 95-022454).

1696 Limon Guerrero, Jose Francisco; Cervantes Mendivil, Teodoro (1993) **[Semicommercial testing of N, P fertilizer for forage barley, sown after traditional or minimum tillage, to follow a crop of forage sorghum: Sahuaripa region, Sonora]. Evaluacion semicomercial de fertilizacion nitrofosforica en cebada forrajera sembrada en labranza tradicional y minima despues de sorgo forrajero en la region de Sahuaripa, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 119-120. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 119-120. Spanish. (AGRIS 95-022394).

1697 Lippold, H.; Muchova, H. (1995) **THE FATE OF LABELLED AMMONIUM NITRATE SPLIT-APPLIED TO WINTER WHEAT IN**

SPRING. *Rostlinna Vyroba. 41(3):97-102.* English. [VYSKUMNY USTAV ROSTLINNE VYROBY DRNOVSKA 507 CR-16106 PRAGUE 6 CZECH REPUBLIC].

In three field microplot experiments performed on orthic luvisol soil the winter wheat was fertilized by 120 kg Nka in ammonium nitrate to interrow space in the spring. The total dose was split-applied in three equal applications at the beginning of vegetative growth in spring, at the beginning of shooting and heading. Then the uptake of labelled fertilizer N and its recovery in plant and soil were traced in winter wheat milk and full ripeness. The labelled N uptake by winter wheat grain was the lowest from the first N split-applied, while in straw it was the lowest from the third one. The labelled N recovery in the winter wheat tops at full ripeness was found to be a lower for the first split-application, 36 to 39%, than from the following ones, when they were 47 to 54%. At full ripeness the total labelled N applied was recovered in winter wheat tops from 46 to 49%. The fertilizer N was the 32 to 39% in the total plant N at full ripeness. The residual fertilizer N in soil was found to be 35 to 44% of individual splits in the year 1990, and only 18 to 30% and as much as 44 to 49% in the years 1991 and 1992, resp., according to the amount of rainfall.

1698 Lukin, L.Yu.; Kosilova, A.N.; Dubanina, G.V. (1994) **[Effect of long-term application of fertilizers on soil fertility, winter hardiness and productivity of winter wheat on typical chernozem]. Vliyanie dlitel'nogo primeneniya udobrenij na plodorodie pochvy, zimostojkost' i produktivnost' ozimoj pshenitsy na tipichnom chernozeme.** *Agrokhimiya (Russian Federation) (no.1) p. 38-43.* 9 ref. Russian. (AGRIS 95-032930).

1699 Magid, HMA.; Abdelaal, SI.; Rabie, RK.; Sabrah, REA. (1995) **CHICKEN MANURE AS A BIOFERTILIZER FOR WHEAT IN THE SANDY SOILS OF SAUDI ARABIA.** *Journal of Arid Environments. 29(3):413-420.* English. [KING SAUD UNIV BRANCH COLL AGR & VET MED DEPT SOIL & WATER POB 1482 EL GASSIM BURAYDAH SAUDI ARABIA].

Two field experiments were carried out under centre-pivot irrigation in central Saudi Arabia during the winter seasons of 1990/91 and 1991/92 to examine the yield and quality responses of wheat to biofertilization with chicken manure at rates of 0, 4.1, 8.25, 16.5 and 33.0 t ha(-1). The response curves obtained for the test measurements as a function of the rate of chicken manure applied indicated that grain yield, grain quality and straw yield were promoted by the rate of chicken manure. The point of profitable grain yield (greatest economic return) corresponded to the manurial rate of 8.25 t ha(-1) (maximum biodegradation). A simplified economic analysis of the data obtained revealed that operating beyond this rate is not advisable since it does not appeal to farmers and may lead to monetary losses. N and P uptake, as a function of chicken manure application rate, increased progressively with an increasing manurial rate. The superiority of the second season over the first one in the magnitude of the test measurements studied was variously attributed to the infection by Fusarium graminearum, causing root and crown rot disease of wheat during the first season and to the higher amount of mineralizable plant nutrients during the second season. [References: 6].

1700 Marshall, B.; Ellis, R.P. (Scottish Crop Research Institute, Invergowrie, Dundee DD2 5AD (United Kingdom)) (1994) **Analysis and modelling of the effects of nitrogen on the growth, partitioning and quality of malting barley.** *HGCA Project Report (United Kingdom); no. 94 201 p.* SCRI. 64 ref. English. (AGRIS 95-032891).

1701 Mikkelsen, G. (1994) **[Strategies for use of composted household wastes in organic vegetable growing [kitchen waste]]. Strategier for anvendelse af komposteret husholdningsaffald ved oekologisk groensagsdyrkning.** Statens Planteavlsforsoeg, Lyngby (Denmark). *SP-Rapport (Denmark) (no.2) p. 7-13.* 3 ill., 3 ref. Danish. (AGRIS 95-022397).

1702 Mozafar, A. (1994) **ENRICHMENT OF SOME B-VITAMINS IN PLANTS WITH APPLICATION OF ORGANIC FERTILIZERS.** *Plant & Soil. 167(2):305-311.* English. [ETH ZENTRUM INST PLANT SCI DIV AGRON CH-8092 ZURICH SWITZERLAND].

A review of the literature showed that plants grown with organic fertilizers often contain higher concentrations of vitamins B-1 (thiamin) and B-12 (cyanocobalamin) as compared with plants grown with inorganic fertilizers. Since plant roots were recently shown to be able to absorb B-1 and B-12, it was thus suspected that organic fertilizers (such as manure of diverse sources or sewage sludges which often contain relatively high concentrations of several vitamins) introduce additional vitamins into the soil which in turn leads to increased vitamins in the plants. This possibility was studied by measuring the B-12 content in the seeds of soybean and barley and in the leaves of spinach plants grown in soils amended with pure B-12 Or COW dung (which is naturally rich in B-12) The addition of pure B-12 or cow dung did not after the B-12 content in the soybean seeds but significantly increased that in the barley kernels and in the spinach leaves. For example, the addition of cow dung at the rate of 10 g kg(-1) increased the B-12 content in barley kernels by more than threefold (from 2.6 to 9.1 ng g(-1) DW) and in spinach leaves by close to twofold (from 6.9 to 17.8 ng g(-1) DW). Long-term addition of organic fertilizers to the soil also significantly increased the soil content of this vitamin. Since plants cannot synthesize B-12 and thus plant foods are normally fully devoid of (or have very low concentrations of) this vitamin, the finding that plants grown with organic fertilizers may contain relatively higher concentrations of this vitamin may have nutritional consequences in that the consumption of these plants by humans would inadvertently increase their intake of this vitamin. This may be of special benefit to people living by choice or by necessity on strict vegetarian diets who are known to be in danger of B-12 deficiency. [References: 56].

1703 Mukatanov, A.Kh.; Khasanov, R.F.; Garipov, T.T.; Sereda, N.A. (1994) **[Humus state of common chernozem and crop yield of spring wheat under application of organic fertilizers [Bashkortostan, Russian Federation]]. Gumusnoe sostoyanie chernozema obyknovennogo i urozhajnost' yarovoj pshenitsy pri vnesenii organicheskikh udobrenij.** *Agrokhimiya (Russian Federation) (no.2) p. 58-62.* 9 ref. Russian. (AGRIS 95-032928).

1704 Najdenov, A.S.; Zakharov, B.A.; Leplyavchenko, L.I. (1994) **[Effect of soil fertility level on winter wheat yield [estimation by data of agrochemical survey]]. Otsenka vliyaniya na urozhajnost' ozimoj pshenitsy pokazatelej plodorodiya pochvy.** *Agrokhimiya (Russian Federation) (no.2) p. 13-20.* 18 ref. Russian. (AGRIS 95-032929).

1705 Oger, R. (Centre de Recherches Agronomiques, Gembloux (Belgium). Bureau d'Informatique et de Statistique Appliquees) (1994) **[Choice and interpretation of response functions of winter wheat to nitrogen]. Le choix et l'interpretation des fonctions de reponse a la fumure azotee des cereales.** *Bulletin des Recherches Agronomiques de Gembloux (Belgium) v. 29(3) p. 289-313.* 5 ill.; 5 tables; 28 ref. French. (AGRIS 95-022392).

The results of 129 experiments conducted in Belgium between 1984 and 1990 were used to investigate models of the response of cereals to different timing applications of nitrogen. Of the four response surfaces tested, the modified exponential model gave the best representation of the data. The phytotechnical and economical optimum application rates of fertilizer-N were calculated on the basis of the best fitting model. Most of these optima fell out of the fertilizer-N levels tested. When the cost of the fertilizer is taken into account only 25 per cent of the trials still need a three-way split application. The magnitude of the lower bound of the confidence intervals (alpha = 0.05) was higher than 60 kg N per ha in half of the trials. These results suggest that interpretations and recommendations of field trials on timing applications of nitrogen should always be drawn with care. New experimental designs have to be found to try to get more reliable informations.

1706 Ogola, A.H. (National Plant Breeding Research Center (NPBRC), Njoro (Kenya)); Oduor, P.O.S. (N.A.R.L., Nairobi (Kenya)) (1994) **The effects of DAP fertilizer on wheat yield in Uasin Gishu District of Kenya.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 307.* CIMMYT. English. (AGRIS 95-022389).

Diammonium phosphate (DAP) fertilizer has been suspected as a cause of low wheat yields in Uasin Gishu District due to its soil acidification property. Therefore, a study to determine the effects of DAP on grain yield and on soil properties was carried out on a farmer's field in Uasin Gishu. The treatments applied included combinations of two levels of DAP (100 and 200 kg/ha), two soil ameliorants (lime at 1 t/ha and manure at 5 t/ha wet weight), two levels of the non-acidifying fertilizer TSP (100 and 200 kg/ha), and Minjingu rock phosphate (10 t/ha). The combination of 100 kg/ha of DAP and 1 t/ha of lime significantly increased wheat grain yield.

Manure or rock phosphate applied separately had negative but non-significant effects on grain yield; lime or TSP alone had no significant effect on grain yield. Application of DAP alone did not alter soil pH. However, DAP in combination with soil ameliorants increased both soil pH and exchangeable base levels.

1707 Ortega Murrieta, Pedro Francisco; Cervantes Mendivil, Teodoro (1993) **[Testing N, P fertilizer for forage barley: Sonora river region]. Validacion de la fertilizacion nitrofosforica en cebada forrajera, en la region del Rio Sonora.** Avances de la investigacion CIANO (Mexico); no. 27 p. 121-122. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 121-122. Spanish. (AGRIS 95-022396).

1708 Ostapenko, N.V.; Nilovskaya, N.T. (1994) **[Role of split application of nitrogen fertilizers and preceding crop in forming winter wheat grain crop yield]. Rol' drobnogo vneseniya azotnykh udobrenij i predshestvennika v formirovanii urozhaya zerna ozimoj pshenitsy.** *Agrokhimiya (Russian Federation) (no.1) p. 11-15.* 11 ref. Russian. (AGRIS 95-032931).

1709 Palta, J.A. (Division of Plant Industry CSIRO, Wembley, W.A. (Australia). Dryland Crops and Soils Research Unit); Fillery, I.R.P. (1993) **Postanthesis remobilisation and losses of nitrogen in wheat in relation to applied nitrogen.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 179-181.* 7 ref. English. (AGRIS 95-022446).

1710 Rajput, RL.; Verma, OP. (1994) **EFFECT OF SPLIT AND MODIFIED SOURCE OF UREA ON THE YIELD OF IRRIGATED WHEAT (TRITICUM-AESTIVUM).** *Indian Journal of Agronomy. 39(3):403-405.* English. [JAWAHARLAL NEHRU KRISHI VISHWA VIDYALAYA ZONAL AGR RES STN MORENA 476001 MADHYA PRADESH INDIA].

A field experiment was conducted during the winter seasons of 1989-90 and 1990-91 to test the efficacy of split and modified sources of urea at 2 depths of irrigation on the yield of 'HD 1553' wheat (Triticum aestivum L. emend. Fiori & Paol.). For nitrogen-use efficiency neem oil-coated and nimin-coated urea proved superior to the other treatments. However, urea mixed with farmyard manure gave better response than split applications and the control (urea as basal). In split applications, urea applied after irrigation proved better than urea applied before irrigation. The grain yield of wheat was significantly higher with 6 cm depth of irrigation than that with 9 cm depth.

1711 Reeves, D.W.; Mask, P.L.; Wood, C.W.; Delaney, D.P. (1993) **Can chlorophyll meters predict wheat yield?** *Highlights of agricultural research (USA) v. 40(3) p. 14.* English. (AGRIS 95-022453).

1712 Romer, W.; Beissner, L.; Schenk, H.; Jungk, A. (1995) **INFLUENCE OF CULTIVAR AND, PHOSPHORUS APPLICATION ON P CONCENTRATION AND ACID PHOSPHATASE ACTIVITY IN WHEAT AND BARLEY - A CONTRIBUTION TO THE DIAGNOSIS OF P SUPPLY OF PLANTS.** *Zeitschrift fur Pflanzenernahrung und Bodenkunde. 158(1):3-8.* German. [UNIV GOTTINGEN INST AGR CHEM VON SIEBOLD STR 6 D-37075 GOTTINGEN GERMANY].

Acid phosphatase activity: compared to total P concentration was studied as a diagnostic criterion of the the phosphorus nutritional status of wheat and barley. In a field experiment with-wheat cv "Sperber" the influence of P level on P-ase activity and P concentration was monitored at four developmental stages. Significant correlations with grain yield were found for P-ase activity at all four stages whereas P concentration was significantly correlated with grain yield in the early stage (DC 26-27) only. Genetic variability and influence of P supply on P-ase activity and P concentration was studied at low and at high P supply with 9 wheat and 23 barley cultivars grown for 4 and 5 weeks in pot experiments. The variability of P-ase activity caused by cultivars was higher than that caused by P supply. It is, therefore, concluded that the acid phosphatase activity is not suitable as a generally applicable tool for diagnosing P supply. In comparison, total P concentration of the plants was influenced to a higher degree by P supply than by cultivars. Total P is, therefore, more suitable as a criterion for diagnosing P supply of plants than P-ase activity. The samples, though, have to be collected in stages before DC 27. [References: 12].

1713 Salazar G, M.; Moreno R, O.; Salazar G, R. (C.E. Valle del Yaqui, Apdo. Postal 515, Cd. Obregon, son. (Mexico)) (1994) **[Response of wheat with a low plant population density to nitrogen fertilization]. Respuesta del trigo con baja densidad de poblacion a la fertilizacion nitrogenada.** *Terra (Mexico) v. 12(2) p.259-263.* 1 cuadros; 7 ref. Spanish. (AGRIS 95-022440).

A field study was established at the Yaqui Valley Experimental Station (CEVY), Sonora, during the 1991-1992 growing season. The objective was to determine the yield response to nitrogen fertilization of wheat grown at low densities. Five plant population densities (20 000, 40 000, 80 000, 160 000 y 320 000 plants hectarea**-1) and five levels of nitrogen fertilization were studied using a modified Plan Puebla III treatment desing. The results obtained indicated a non- significant nitrogen-plant population interaction. Plant populations of 160 000 or 320 000 plants ha**-1 with 150 and 200 kg N ha**-1 had yields from 350 to 788 kg ha**-1 more than the check treatment. A quadratic model was fitted to the data with R**2 = 0.99. The optimum economic plant population was obtained at 245 000 plants ha**-1 with nitrogen level at 197 kg ha**-1.

1714 Sandoval Villa, Manuel; Alcantar Gonzalez, Gabriel; Tirado Torres, Juan Luis (Colegio de Postgraduados (Mexico). Centro de Edafologia, Montecillo, Mex. 56230) (1993) **[Opportune timing for the application of ammonium and nitrate to increase grain yield in wheat]. Momento oportuno de la aplicacion de amonio y nitrato para incrementar la produccion de grano de trigo.** *Terra (Mexico) v. 11(1) p. 61-66.* 2 fig; 4 cuadros; 18 ref. Spanish. (AGRIS 95-022437).

An experiment was conducted under greenhouse and hydroponic conditions to determine the best timing of mixed nitrogen (NH4 plus NO3) application in wheat cv Salamanca S-75. Solutions containing 3.5/3.5 or 2/5 NH4/NO3 ratio in me l*-1 were supplied to wheat plants at different growing stages; initial growth (8 days old), vegetative growth (25 days old), developing of flag leaf (44 days old), and at tasseling (56 days old). An additional treatment was tested with 7 me l*-1 of N-NO3 during all the development cycle. The results showed a decrease in grain yield when ammonium is supplied to young plants, nevertheles NH4 adition during tasseling increases dry matter of spikes compared to the plants receiving 100% N-NO3, which produced the highest ammount of aerial dry matter (leaves + stems). Ammonium utilization may improve harvest index, but in winter season no more than 2/5 NH4/NO3 ratio is recommended. Plant nutrient concentration was affected by the NH4/NO3 ratio and timing of application.

1715 Sarkar, M.C.; Uppal, K.S.; Rana, D.S.; Banerjee, N.K. (Indian Agricultural Research Institute, New Delhi (India). Division of Soil Science and Agricultural Chemistry) (1994) **Fate of 15N urea applied to wheat grown under upland irrigated condition on a typic ustochrept.** *Journal of the Indian Society of Soil Science (India) v. 42(2) p. 267-271.* 3 ill., 11 ref. English. (AGRIS 95-022443).

1716 Singh, J.; Sharma, HL.; Singh, CM. (1994) **DIRECT, RESIDUAL AND CUMULATIVE EFFECTS OF POTASSIUM FERTILIZATION IN RICE (ORYZA-SATIVA) - WHEAT (TRITICUM-AESTIVUM) CROPPING SYSTEM.** *Indian Journal of Agronomy. 39(3):345-355.* English. [HIMACHAL PRADESH AGR UNIV PALAMPUR 176062 HIMACHAL PRADES INDIA].

A field experiment was conducted during the rainy seasons of 1989-91 to study the direct, residual and cumulative effects of graded doses of potassium fertilisation in rice (Oryza sativa L.)-wheat (Triticum aestivum L. emend. Fiori & Paol.) cropping system at Palampur. The experiment was laid out in randomized block design. The treatments were all possible combinations of 4 phases (cumulative, direct, residual-1 and residual-2) and 3 levels of K [30, 60 and 90 kg K2O/ha (K30, K60 and K90)] + 1 absolute control, each replicated 4 times. Application of K significantly increased the dry matter, yield-contributing characters, yield, K content and its uptake compared with the control in both rice and wheat. The dry matter of rice could not influence in 1989, whereas it increased in 1990 and 1991 with application up to K60 and K90 respectively. Various yield-contributing characters of rice showed a increasing trend with an increase in K level up to K90. Significant increase in yield of rice was up to K60 in 1989 and up to K90 in 1990 and 1991. The K content and its uptake in rice and wheat increased significantly up to K90 during all the years. The dry matter, yield-contributing characters, yield and K content and its uptake in both rice and wheat were significantly higher under direct and cumulative phases, but differences between the 2 phases were non-significant compared with residual phases. In wheat crop, the dry matter and yield attributes except

spike length and grain weight, increased significantly with increase in K up to K60 during 1989-90 and up to K90 during 1990-91, whereas yield increased up to K60 during all the years. Production efficiency increased with increase in the age of both crops and it decreased with increase in the level of K.

1717 Tindall, TA.; Stark, JC.; Brooks, RH. (1995) **IRRIGATED SPRING WHEAT RESPONSE TO TOPDRESSED NITROGEN AS PREDICTED BY FLAG LEAF NITROGEN CONCENTRATION.** *Journal of Production Agriculture. 8(1):46-52.* English. [TWIN FALLS R&E CTR TWIN FALLS, ID 83303 USA].

Topdressed N is frequently applied to irrigated hard red spring (HRS) wheat (Triticum aestivum L.) in an effort to increase grain protein content (GPC). However, the actual need for supplemental N could be better defined if the probability of a response was referenced to some measure of plant N status. This study was conducted to determine whether flag leaf N (FLN) concentration at heading could be used to estimate the potential for increasing GPC with topdressed N. Field studies were conducted in 1989, 1990, and 1991 on a Declo silt loam (coarse loamy, mixed, mesic Xerollic Calciorthid). Two HRS wheat varieties (Copper and Pondera) received preplant applications of either 0, 60, 120, or 180 lb N/acre to produce a range of FLN concentrations at heading. Plants at each N level were topdressed with either 0, 20, or 40 lb N/acre 1 to 2 d after heading. Topdressed N had relatively little effect on grain yield or test weight. Flag leaf N concentrations and GPC were both increased by preplant and topdressed N applications, however. Grain protein contents of both varieties were positively correlated with N concentrations of flag leaves sampled prior to N topdressing. Grain protein content of low N plants (3.0 to 3.6% N) was increased by 1.0 to 1.5% with 20 lb N/acre topdress applications and 2.0 to 2.5% with 40 lb N/acre applications. Increases in GPC resulting from N topdressing decreased linearly as FLN at heading increased. Plants with FLN concentrations above 4.2% did not benefit from topdressed N. Results of this study provide preliminary evidence that FLN concentration can provide a good indication of the likelihood of a response to topdressed N.

1718 Venegas G, J.; Vazquez G, G.; Ceja T, L.F. (CIIDIR. Justo Sierra 28, Jiquilpan, Mich. (Mexico)) (1993) **[Wheat fertilization under rainfed conditions in La Lagunita, Jiquilpan, Mich]. Fertilizacion del trigo de temporal en La Lagunita, municipio de Jiquilpan, Michoacan.** *Terra (Mexico) v. 11(2) p. 211-217.* 6 cuadros; 10 ref. Spanish. (AGRIS 95-022438).

1719 Wendt, J.W. (The Rockefeller Foundation, Lilongwe (Malawi)) (1993) **On-farm evaluation of soil infertility in Malawi.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 438-445.* CIMMYT. 3 tables; 3 graphs. English. (AGRIS 95-022412).

1720 Wu, X.; Aasen, I. (Norges Landbrukshoegskole, Aas (Norway). inst. for Jordfag) (1993) **Effect of Zn application and soil pH on yield and element nutritional status of wheat (Triticum aestivum L.).** *Norwegian Journal of Agricultural Sciences (Norway) v. 7(2) p. 159-174.* 8 tables, 2 figures; 54 ref. English. (AGRIS 95-022451).

1721 Zeleny, F.; Zelena, E.; Maskova, I. (Research Institute of Crop Production, 16106 Prague 6 Ruzyne (Czech Republic)) (1992) **Effects of different manganese sulphate doses on yield and manganese concentration in barley grain.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 314-315.* European Society for Agronomy. 5 ref. English. (AGRIS 95-032890).

F06 IRRIGATION

1722 Ortiz Enriquez, Jose Eliseo (1993) **[Testing the significance of a delay in the first supplementary irrigation of wheat: Yaqui valley, Sonora (1st year)]. Validacion de la importancia de retrasar el primer riego de auxilio en trigo, en el Valle del Yaqui, Son. (1er. ano).** Avances de la investigacion CIANO (Mexico); no. 27 p. 61. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 61. Spanish. (AGRIS 95-022617).

1723 Ortiz Enriquez, Jose Eliseo (1993) **[Three different sowing dates for the wheat variety Altar C84 and how they effect its response to the final irrigation: Yaqui valley, Sonora (1st year)]. Respuesta del trigo variedad Altar C84 al ultimo riego bajo 3 fechas de siembra en suelos de barrial, en el Valle del Yaqui, Son. (1er ano).** Avances de la investigacion CIANO (Mexico); no. 27 p. 60-61. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 60-61. Spanish. (AGRIS 95-022616).

1724 Ortiz Enriquez, Jose Eliseo (1993) **[Wheat varieties Oasis F86 and Bacanora T88, row-planted in silt-clay soils, and their response under 7 different irrigation regimes: Yaqui valley, Sonora (2nd year)]. Respuesta de las variedades de trigo Oasis F86 y Bacanora T88 bajo 7 tratamientos de riego, sembrado en surcos en suelos de barrial, en el Valle del Yaqui, Son (2do. ano).** Avances de la investigacion CIANO (Mexico); no. 27 p. 58-59. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 58-59. Spanish. (AGRIS 95-022614).

1725 Ortiz Enriquez, Jose Eliseo (1993) **[Wheat varieties Oasis F86 and Bacanora T88, row-planted in silt-clay soils, and their response under 5 different irrigation regimes: Yaqui valley, Sonora (2nd year)]. Respuesta de las variedades de trigo Oasis F86 y Bacanora T88 bajo 5 tratamientos de riego, sembrado en melgas en suelos de barrial, en el Valle del Yaqui, Son. (2do. ano).** Avances de la investigacion CIANO (Mexico); no. 27 p. 59-60. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 59-60. Spanish. (AGRIS 95-022615).

1726 Palacios Sanchez, Julio Enrique (1993) **[Effect of soil moisture potential on wheat at 3 stages of phenological development: Mayo valley, Sonora]. Respuesta del trigo a diferentes potenciales de humedad en el suelo en 3 etapas fenologicas, en el Valle del Mayo, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 94. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 94. Spanish. (AGRIS 95-022618).

1727 Shiel, R.S.; Yuriwo, E.C. (Department of Agricultural and Environmental Science, The University of Newcastle upon Tyne, NE1 7RU (United Kingdom)) (1993) **Decreasing the impact of surface crusting on seedling emergence by wetting.** *Soil Use and Management (United Kingdom) v. 9(1) p. 40-45.* 22 ref. English. (AGRIS 95-033077).

1728 Yoder, R. (Associates in Rural Development, Burlington (USA)) (1994) **Organization and management by farmers in the Chhattis Mauja Irrigation System, Nepal.** IIMI. 17 fig., 23 tables, 12 ref. 163 p. English. (AGRIS 95-033079).

As part of a larger assessment of the potential for expanding food productivity by assisting existing farmer-managed irrigation systems, a year-long study was made of one of the larger systems in Nepal, the Chhattis Mauja Irrigation System. This report examines the historical development of the system, the current organization for managing its operation and maintenance, the irrigation activities observed during field work, the system-level and national-level goals and the procedures for canal desilting and emergency repairs, and reviews the findings of the performance analysis. It investigates the internal processes of the system and the methods adopted to improve its effectiveness. Further, it addresses the question of gaining farmer acceptance in reallocating irrigation to allow expansion of the areas irrigated.

F07 SOIL CULTIVATION

1729 Basso, F.; Franchi, A.S. de; Falco, E. de (Department of Crop Production, University of Basilicata, 85100 Potenza (Italy)) (1992) **Effects of soil tillage systems on growth and yield of durum wheat (Triticum turgidum L., T. durum Desf.) in a hilly area of southern Italy.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 230-231.* European Society for Agronomy. 5 ref. English. (AGRIS 95-033132).

1730 Beckett, RP.; Drennan, PM.; Botha, CEJ. (1995) **THE EFFECT OF FLUCTUATING SUBSTRATE SALINITY ON THE YIELD AND FLAG LEAF PHOTOSYNTHESIS OF WHEAT.** *South African Journal of Botany-*

Suid-Afrikaanse Tydskrif vir Plantkunde. 61(1):35-38. English. [UNIV NATAL DEPT BOT NU RES UNIT PLANT GROWTH & DEV PRIVATE BAG X01 PIETERMARITZBURG 3209 SOUTH AFRICA].

The effects of constant and fluctuating substrate salinity on flag leaf photosynthesis and grain yield of wheat were investigated. Plants exposed to salinity fluctuating around a mean integrated value of 25 mol m-3 NaCl (0-50 mol m-3) and around 50 mol m-3 NaCl (25-75 mol m-3) had yields 36 and 38% higher, respectively, than those receiving the corresponding constant salinity. Plants treated with salinity fluctuating from 50 to 100 mol m-3 NaCl had a 14% lower yield than those receiving 75 mol m-3 NaCl. Flag leaf photosynthesis did not vary between treatments and during salinity fluctuations, suggesting that differences in flag leaf longevity caused the observed differences in yeild. Results suggest plants grown under constant salinity are unlikely to behave in the same way as those in field situations, where fluctuation rather than constant salinity occurs.

1731 Hammel, JE. (1995) **LONG-TERM TILLAGE AND CROP ROTATION EFFECTS ON WINTER WHEAT PRODUCTION IN NORTHERN IDAHO.** *Agronomy Journal. 87(1):16-22.* English. [UNIV IDAHO COLL AGR DEPT PLANT SOIL & ENTOMOL SCI MOSCOW, ID 83843 USA].

Reduced tillage practices designed to control soil loss in the Palouse region of northern Idaho may adversely affect soil physical properties and decrease yields. The objective of this study was to determine the effects of long-term tillage and rotation practices on wheat (Triticum aestivum L.) yields following 10 yr of continuous management. Yields were obtained from 1984 to 1987 on a long-term tillage rotation experiment established in 1974 near Moscow, ID. Tillage treatments included conventional (CONV, moldboard plow), minimum (MIN, chisel), and no-tillage (NT). Crop rotations were a 2-yr winter wheat-spring pea (Pisum sativum L.) (WW-SP) rotation and a 3-yr winter wheat-spring barley (Hordeum vulgare L.)-spring pea (WW-SB-SP) rotation. Yields of the MIN and NT treatments averaged over the 4-yr period were 92 and 78% of the CONV treatment. Differences between yields were significant ($P < 0.05$). No-till yields were significantly less ($P < 0.05$) than both the CONV and MIN treatments during all years, whereas MIN and CONV yields were not significantly different during 1986 and 1987. Wheat grown under the WW-SB-SP rotation yielded significantly greater ($P < 0.05$) than the WW-SP rotation. Profile water extraction and N uptake were reduced in the MIN and NT treatments. The apparent decrease in root function may have resulted from higher surface layer impedance, or possibly, greater root disease pressure under MIN and NT management. Results indicate that winter wheat production under continuous no-till management in the Palouse region may not be feasible without substantial yield reductions. A reduced tillage system that utilizes some limited tillage appears to be a viable management alternative to conventional practices. [References: 34].

1732 Haneklaus, S.; Fleckenstein, J.; Schnug, E. (1995) **COMPARATIVE STUDIES OF PLANT AND SOIL ANALYSIS FOR THE SULPHUR STATUS OF OILSEED RAPE AND WINTER WHEAT.** *Zeitschrift fur Pflanzenernahrung und Bodenkunde. 158(1):109-111.* English. [FED AGR RES CTR BRAUNSCHWEIG VOLKENRODE INST PLANT NUTR & SOIL SCI BUNDESALLEE 50 D-38116 BRAUNSCHWEIG GERMANY].

Recently S deficiency became one of the most widespread nutrient disorders in North-European agriculture. Therefore precise and reliable methods for the evaluation of the S nutritional status of agricultural crops are required. For the prognosis of the plant available S soil analysis be a favourite method, however, no relation between plant S concentrations (extractable sulphate plus extractable organic S) S contents in soils could be stated. The reasons for the impracticability of soil tests seem to be related to interactions between soil water mobile S in soil, so that site specific models need to be developed for the prognosis of the S status of agricultural crops. [References: 16].

1733 Harris, PA.; Schomberg, HH.; Banks, PA.; Giddens, J. (1995) **BURNING, TILLAGE AND HERBICIDE EFFECTS ON THE SOIL MICROFLORA IN A WHEAT SOYBEAN DOUBLE-CROP SYSTEM.** *Soil Biology & Biochemistry. 27(2):153-156.* English. [KANSAS STATE UNIV AGR RES CTR 1232 240TH AVE HAYS, KS 67601 USA].

As sustainable crop management systems are developed, an assessment of the effects of these practices on the soil microflora is essential to ensure maximum productivity. A 3-year field study was established to determine the effects of crop residue burning, no-till management and four preemergence herbicides on soil microorganisms. Numbers of actinomycetes, algae, bacteria, fungi and nitrifiers were evaluated during the soybean [Glycine max (L.) Merrill] growing season in a wheat (Triticum aestivum L.)-soybean double-cropping system. Residue burning and tillage had no effect on numbers of bacteria and nitrifiers. Non-disturbed (non-burned or no-till) plots had greater numbers of actinomycetes, algae and fungi 7 days after herbicide application each year, but the increases generally did not persist through the season. Herbicide application had no effect on microbial numbers. This is particularly important with recent increased emphasis on protection of soil and water resources from pesticide contamination. As new management systems are developed, their effects on biological properties must be carefully assessed, since the soil microflora play such a vital role. [References: 24].

1734 Hekman, WE.; Heijnen, CE.; Burgers, SLGE.; Vanveen, JA.; Vanelsas, JD. (1995) **TRANSPORT OF BACTERIAL INOCULANTS THROUGH INTACT CORES OF TWO DIFFERENT SOILS AS AFFECTED BY WATER PERCOLATION AND THE PRESENCE OF WHEAT PLANTS.** *FEMS Microbiology Ecology. 16(2):143-157.* English. [DLO PLANT PROTECT RES INST POB 9060 6700 GW WAGENINGEN NETHERLANDS].

Water flow-induced transport of Burkholderia cepacia strain P2 and Pseudomonas fluorescens strain R2f cells through intact cores of loamy sand and silt loam field soils was measured for two percolation regimes, 0.9 and 4.4 mm h(-1), applied daily during 1 hour. For each strain, transport was generally similar between the two water regimes. Translocation of B. cepacia, with 4.4 mm h(-1), did occur initially in both soils. In the loamy sand soil, no change in the bacterial distribution occurred during the experiment (51 days). In the silt loam, B. cepacia cell numbers in the lower soil layers were significantly reduced, to levels at or below the limit of detection. Transport of P. fluorescens in both soils also occurred initially and was comparable to that of B. cepacia. Later in the experiment, P. fluorescens was not detectable in the lower soil layers of the loamy sand cores, due to a large decrease in surviving cell numbers. In the silt loam, the inoculant cell distribution did not change with time. Pre-incubation of the inoculated cares before starting percolation reduced B. cepacia inoculant transport in the loamy sand soil measured after 5 days, but not that determined after 54 days. Delayed percolation in the silt loam soil affected bacterial transport only after 54 days. The presence of growing wheat plants overall enhanced bacterial translocation as compared to that in unplanted soil cores, but only with percolating water. Percolation water from silt loam cores appeared the day after the onset of percolation and often contained inoculant bacteria. With loamy sand, percolation water appeared only 5 days after the start of percolation, and no inoculant bacteria were found. The results presented aid in predicting the fate of genetically manipulated bacteria in a field experiment. [References: 29].

1735 Hodson, MJ.; Evans, DE. (1995) **ALUMINIUM SILICON INTERACTIONS IN HIGHER PLANTS [Review].** *Journal of Experimental Botany. 46(283):161-171.* English. [OXFORD BROOKES UNIV SCH BIOL & MOLEC SCI GIPSY LANE OXFORD OX3 0BP ENGLAND].

Aluminium and silicon are usually abundant in soil mineral matter, but their availability for plant uptake is limited by low solubility and, in the case of Al, high soil pH causes precipitation of the element in insoluble forms. Al toxicity is a major problem in naturally occurring acid soils and in soils affected by acidic precipitation. Al has no known role in higher plants, and is generally known as a toxic element, whereas Si is generally regarded as a beneficial element. Recently, it has been suggested that Al toxicity can be ameliorated by Si in a variety of animal systems. In this review the evidence that amelioration of Al toxicity by Si can also occur in plants is assessed. At present such amelioration has been shown in sorghum, barley, teosinte, and soybean, but not in rice, wheat, cotton, and pea. Plant species vary considerably in the amounts of Al and Si that they transport into their tissues, and it seems that very high Si accumulation and very high Al accumulation are mutually exclusive. The mechanisms considered for amelioration are: solution effects; codeposition of Al and Si within the plant; effects in the cytoplasm and on enzyme activity; and indirect effects. [References: 71].

1736 Horak, V.; Dolejskova, J.; Hejtmankova, A.; Divisova, E.; Bures, R. (1995) **DISTRIBUTION OF ALUMINIUM IN SPRING BARLEY PLANTS UNDER THE CONDITIONS OF ALUMINIUM STRESS.** *Rostlinna Vyroba. 41(2):77-82.* Polish. [CZECH AGR UNIV PRAGUE CZECH REPUBLIC].

Increasing acidification of soil increases the concentrations of available, mostly toxic, forms of aluminium in the soil solution. This effect could be one of the reasons of deterioration of the health condition of plants and as a consequence this may lead to the diminishing of yields. Even the availability of the other main nutrients like those of calcium and phosphorus could be hardly influenced. In the model experiment with the spring variety of oat (Terno) the acidification of soil was realized by regular acidic watering under increased values of pH. The clayloamy soil was used (pH/H2O = 6.3, humus content 1.5%), NPK nutrients in the form of KNO3 and Ca(H2PO4)2 were added. The experimental vessels were installed in the open air under the roof. Sampling was carried out three times during the vegetation period and for the analysis the plants were divided into three parts: roots, stem-parts and ears. For the determination of calcium, aluminium and phosphorus the samples were mineralized in the dry mineralizer APION. Aluminium was determined using flame AAS (SpectraAA 300, Varian), samples with extremely low levels of aluminium were determined by the flameless atomisation (Perkin Elmer 4000). Calcium was determined using AES in the air-acetylene flame (SpectrAA 300, Varian), phosphorus was determined spectrophotometrically as the yellow complex with vanadium (Specol 11). All the results were statistically processed (Tabs I to III). The long-term massive acidification resulted in a significant increase in aluminium content in all the checked parts of the experimental plants (Figs 1 to 3). Ears showed significant increases in the aluminium levels only in the second variant at the lowest pH-level of watering. The difference in aluminium content between the second and third samplings was statistically insignificant. The analytical results of the determination of aluminium in roots and stem-parts of plants were treated by the analysis of covariance with covariate time of sampling and a categorical variable pH, as shown in Tabs I and II. Using the statistical data it was possible to explain in roots 87% of variability. From the effects and analysis of variance it was concluded, that the effect of pH value is highly significant. The Fisher LSD test showed a significant contrast between the control and the second variant and between the first variant and all the others. Analogous results as to the effects and influence of pH were obtained for the stem-parts (Tab. I). Using statistics 47% of variability was explained. The Fisher LSD test resulted in statistically significant difference between the control and the first variant and between the first variant and both the third and the fifth variants. The same percentage (47%) was possible to explain in the ear (Tab. III). From the Fisher LSD test of simple contrasts resulted significant differences between the control and the first variant and between the first variant and all the others. The level of calcium in the roots decreased with the increasing acidification of soils, especially in the second and third samplings (Fig. 4). In the stem-parts of plants the decrease was significant in the third sampling, where the acidification of the soil reached the maximum level (Fig. 5). The decrease in the calcium level in ears had a very similar trend (Fig. 6). The massive decrease in phosphorus levels was found in the roots and the stem-parts (Figs 7, 8) whereas the phosphorus content in ears was nearly without any changes during the whole experiment (Fig. 9).

1737 Jongdee, B. (Phrae Rice Research Center, Phrae (Thailand)) (1994) **Tillage methods for wheat after rice in paddy soils in Thailand.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 272-275.* CIMMYT. 4 tables; 3 ref. English. (AGRIS 95-022651).

Wheat was introduced into Thailand's lowland rice-cropping system some 10 years ago. A major factor contributing to the success of wheat under these conditions is soil management. The studies discussed in this paper indicate that wheat sown in a seedbed prepared by conventional tillage produced higher yields than with zero tillage. However, when a rice straw mulch was spread after seeding, yields from conventional and zero tillage were similar.

1738 Kanda, K.; Tsuruta, H.; Minami, K. (1995) **EMISSIONS OF BIOGENIC SULFUR GASES FROM MAIZE AND WHEAT FIELDS.** *Soil Science & Plant Nutrition. 41(1):1-8.* English. [NATL INST AGROENVIRONM SCI DEPT ENVIRONM MANAGEMENT TSUKUBA IBARAKI 305 JAPAN].

Emission rates of dimethyl sulfide (DIMS), carbonyl sulfide (COS), and carbon disulfide (CS2) to the atmosphere from maize and wheat fields were measured by using the closed chamber method. DMS was a predominant sulfur gas emitted from these fields mainly through the plants. The highest DMS fluxes occurred just before the harvest of maize plants from plots treated with nitrogen fertilizer. Annual DMS emission rates were also higher in the plots treated with nitrogen fertilizer than in the plots without nitrogen fertilizer application. Annual emission rates of CS2 were higher than those of COS, because COS was absorbed by the plants. Annual sulfur emission rates from the fields were in the range of 5.6 to 17.0 mg S m(-2) y(-1). [References: 17].

1739 Kovac, K. (1995) **THE EFFECT OF CONVENTIONAL AND PROTECTIVE SOIL CULTIVATION AT LIMITED INPUTS OF FERTILIZERS ON BIOMASS PRODUCTION OF WINTER WHEAT.** *Rostlinna Vyroba. 41(2):49-54.* Polish. [RES INST CROP PROD PIESTANY SLOVAKIA].

In the years 1991 to 1993 on chernozem fertile soil (maize-growing region, altitude of 196 m, northern latitude 48-degrees 34', eastern latitude 17-degrees 45') the effect of cultural practices has been studied in the field stationary trial with reduced inputs for biomass production of winter wheat. The average annual temperature of the site is 9.2-degrees-C, sum of precipitation for a year 625 mm and 352 mm for the growing season. Treatments of fertilization and nutrition: B1 - control (without NPK); B2 - N fertilization on the basis of diagnostics (Neuberg et al., 1990), average dose of N = 40 kg.ha-1, PK 50% from the variant B3, P = 26.5 kg.ha-1, K = 53 kg.ha-1; B3 - N fertilization on the basis of diagnostics, N = 40 kg.ha-1, P = 53 kg.ha-1, K = 106 kg.ha-1. Soil cultivation: C1 - conventional, stubble ploughing, ploughing with mouldboard, preseeding preparation with combine cultivator; C2 - protective cultivation (soil-saving cultivation), stubble ploughing, soil cultivation with the tiller Lemken-Smaragd, preseeding soil preparation with the combined rotary tiller Amazone KG in single operation with seeding (seeding machine Amazone). The Viginta cultiva of eco-stable type has been used in the trial. The sowing rate was million germinating grains per 1 ha. The width of row-spacing was 125 mm. Seeding was performed on October 1 (+ two days to October 1). Field emergence rate, grain biomass, total above-ground biomass and 1,000-kernel weight were studied in the trial. Average field emergence rate according to the years of the trial was 70; 66 and 83%. It was affected the most by weather (significantly). Higher fields emergence rate (by 10% significantly) compared with conventional soil cultivation was in the protective soil cultivation. Tested cultural practices (soil cultivation and fertilization) had no more marked effect on the biomass production. A large year variability of biomass production with lower tendency on treated variants was recorded. Weak to strong dependence was between biomass production and 1,000-kernel weight (according to the years r = 1.000++, r = 0.128, r = 0.633). Protective soil cultivation in comparison with the conventional one was more efficient in view of economy, while fertilization was running at a loss compared with the control (0 NPK).

1740 Lopezcastaneda, C.; Richards, RA. (1994) **VARIATION IN TEMPERATE CEREALS IN RAINFED ENVIRONMENTS .3. WATER USE AND WATER-USE EFFICIENCY.** *Field Crops Research. 39(2-3):85-98.* English. [CSIRO DIV PLANT IND POB 1600 CANBERRA ACT 2601 AUSTRALIA].

In rainfed environments in southern Australia the yield of both grain and biomass is greater in barley than it is for bread wheat, durum wheat, triticale and oats. Barley also has a faster leaf area development and biomass accumulation than the other species. To establish reasons for the greater biomass of barley in environments where soil water is limited, variation in the following were evaluated in field experiments: (i) water use or evapotranspiration (ET); (ii) water-use efficiency (WUE), i.e. the ratio of aboveground biomass (AGBM) to ET; (iii) transpiration efficiency (TE), of either biomass production, i.e. the ratio of AGBM to transpiration (T), or of leaf gas exchange, estimated here as the proportional variation in intercellular to external CO2 concentration using carbon isotope discrimination (Delta) as an integrated measure; and (iv) evaporation of water from the soil surface (E(s)) relative to T. Total ET in barley was not greater than in the other species. Variation in ET was largely accounted for by variation in anthesis date; long-duration cultivars used more water than short-duration cultivars. ET averaged 283 mm over 3 sites and for each day delay in anthesis water use increased by about 1 mm. However, this was offset by a decline in WUE as anthesis became later. WUE decreased by 0.67 kg ha-1 mm-1 for each day delay in anthesis whereas TE declined by 0.92 kg ha-1 mm-1. The average WUE at two sites where root mass was measured was 32 kg ha-1 mm-1 whereas TE averaged 48 kg ha-1 mm-1. When roots

were included values increased to 42 kg ha-1 mm-1 for WUe and 62 kg ha-1 mm-1 for TE. Barley, cv. O'Connor, had the greatest WUE and TE at all sites. Evaporation of water from soil surface (E(s)) was also smaller in barley. The separation of ET into T and E(s) showed that E(s) was about 20 mm smaller in barley than in the other species at all sites. Variation in leaf gas exchange among cultivars, measured as variation in Delta, was positively related to measured values of TE, not negatively as might be expected. Including root mass in the calculation of TE reduced the slope of the relationship somewhat but it remained positive and significant. Standardizing TE to correct for differences in vapour pressure of the air over the life of the crop also reduced the slope of the relationship between Delta and TE, but it remained positive. Variation in TE was also positively related to an index composed of height and anthesis date suggesting that TE was greatest in early-flowering cultivars that elongated first and this may be related to the maintenance of a cooler canopy and a greater boundary layer conductance. It is concluded that the high yield achieved by barley in this environment was due to faster leaf area growth and earlier flowering. These factors ensured that water loss from the soil surface was minimized and that growth was completed before the rapid rise in temperature and VPD. [References: 31].

1741 Malkanthi, DRR.; Yokoyama, K.; Yoshida, T.; Moritsugu, M.; Matsushita, K. (1995) **EFFECTS OF LOW PH AND AL ON GROWTH AND NUTRIENT UPTAKE OF SEVERAL PLANTS.** *Soil Science & Plant Nutrition. 41(1):161-165.* English. [KAGAWA UNIV FAC AGR MIKI KAGAWA 76107 JAPAN].

1742 Mascagni, HJ.; Keisling, TC.; Sabbe, WE.; May, M.; Oliver, LR.; Vories, ED. (1995) **WHEAT PRODUCTION ON RAISED BEDS ON CLAYEY AND SILT LOAM SOILS.** *Communications in Soil Science & Plant Analysis. 26(3-4):503-513.* English. [LOUISIANA STATE UNIV NE RES STN POB 438 ST JOSEPH, LA 71366 USA].

Winter wheat (Triticum aestivum L.) production commonly occurs on poorly-drained soils of the Mississippi River Delta region in Arkansas. Wheat has historically been planted on a conventional flat seedbed (CFS); however, the use of raised beds may improve drainage, grain yield, and nitrogen (N) fertilizer efficiency. Wheat production on (76 inch) wide raised crowned beds (CB) and raised flat beds (FB), were compared to the CFS in seven experiments. The more conventional 38 inch wide CB was compared to the CFS in four additional experiments. The eleven experiments were conducted from 1986 to 1991 at Keiser on a Sharkey silty clay (very fine, montmorillonitic, nonacid, thermic, Vertic Haplaquepts) and at Colt and Marianna on a Calloway silt loam (fine-silty, mixed, thermic, Glossaouic Fraqudalfs). Wheat grain yield was measured. Wheat in the center of the raised beds had higher yields than wheat near or in the water furrows. Increases in the number of spikes and kernels per spike is the source of the yield increases. No measurable grain yield advantage was found for raised bed wheat production in any of the experiments. Apparently, including the water furrows in the total area harvested gives an average field yield for raised seedbed production systems that is no better than CFB. [References: 18].

1743 Modestus, W.K. (Selian Agricultural Research Institute, Arusha (Tanzania)) (1994) **Minimum tillage as an alternative to conventional tillage for wheat production in Northern Tanzania.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 221-228.* CIMMYT. 5 tables; 3 ref. English. (AGRIS 95-022650).

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

1744 Negussie Tadesse; Seid Ahmed; Mengistu Hulluka (Debre Zeit Agricultural Research Center (AUA), Debre Zeit (Ethiopia)) (1994) **The effects of minimum tillage on weed management and yield of durum wheat in Central Ethiopia.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 241-246.* CIMMYT. 3 tables; 15 ref. English. (AGRIS 95-022663).

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

1745 Osaki, M.; Yamada, S.; Tadano, T. (1995) **EFFECT OF SINK MANIPULATION ON NITROGEN ACCUMULATION AND DISTRIBUTION AMONG ORGANS OF GRAMINEAE AND LEGUMINOSAE.** *Soil Science & Plant Nutrition. 41(1):33-44.* English. [HOKKAIDO UNIV FAC AGR SAPPORO HOKKAIDO 060 JAPAN].

Accumulation and distribution of dry matter and nitrogen were examined by the sink cut treatment. The results obtained were as follows. 1) In Gramineae except for maize, the amount of nitrogen in leaves decreased and nitrogen was translocated to stems regardless of the sink cut treatment, whereas the amount increased by the sink cut treatment in Leguminosae. Thus, it is assumed that leaf growth was autonomous in Gramineae, but was affected be the sink activity in Leguminosae. 2) By the sink cut treatment, no specific protein bands were detected in leaves of both Gramineae and Leguminosae, as well as in stems of Gramineae. The vegetative storage proteins (VSP) were detected in stems of soybean and field bean, and its amount increased by the sink cut treatment. However, as the amount of soluble protein fraction in the stems of soybean and field bean was not affected by the sink cut treatment, the effect of VSP on nitrogen storage was negligible even when the sink was cut. [References: 33].

1746 Reddy, DD.; Yadav, BR. (1994) **ZINC AND PHOSPHORUS NUTRITION OF WHEAT GROWN ON A HIGHLY CALCAREOUS SOIL.** *Annals of Arid Zone. 33(3):233-237.* English. [INDIAN AGR RES INST WATER TECHNOL CTR NEW DELHI 110012 INDIA].

A pot culture experiment was conducted to study the effect of different levels of P(0, 25, 50, and 100 ppm) and Zn (0, 5, 10 and 20 ppm) on their concentration and uptake by wheat biomass in a highly calcareous soil. P application decreased the concentration but increased the uptake of Zn in grain and straw parts of the plant. Zn availability in soil after crop harvest was also enhanced with application. However, Zn application did not affect either P concentration in the plant or in the soil significantly.

1747 Sembiring, H.; Raun, WR.; Johnson, GV.; Boman, RK. (1995) **EFFECT OF WHEAT STRAW INVERSION ON SOIL WATER CONSERVATION.** *Soil Science. 159(2):81-89.* English. [OKLAHOMA STATE UNIV DEPT AGRON STILLWATER, OK 74078 USA].

Soil water can be a limiting factor for dryland wheat production in Oklahoma. Five experiments on three different soils were conducted to determine the effect of placing residue (wheat straw and paper) layers beneath the soil surface on water conservation. Treatments included a control(no residue on the surface or inverted), 6 Mg ha(-1) wheat straw placed 1.5, 3, and 6 cm below the surface (wheat straw inversion), 6 Mg ha(-1) applied on the surface (simulation of zero-tillage), 6 Mg ha(-1) mixed with the surface 6 cm of soil (simulation of conventional tillage), 3 Mg ha(-1) placed 6 cm below the surface, and 6 Mg ha(-1) ground telephone book paper placed 1.5 cm beneath the surface. Water was applied to prepared pots, and water loss was determined on a daily basis. Pots were placed in

growth chambers where daytime and nighttime temperatures were ramped to 32 degrees C and 18 degrees C, respectively. Water losses in the first 10 days were greater in all wheat straw inversion treatments when compared with zero-tillage. Water losses stabilized after 15 days in the 3- and 6-cm wheat straw inversion treatments, but zero-tillage continued to show significantly higher water loss. The 3 cm to 6 Mg ha(-1) wheat straw inversion treatment had significantly lower water loss before reaching the wilting point when compared with zero-tillage in two of the three soils evaluated. Placing the wheat straw 3 cm beneath the surface reduced water loss when compared with 1.5- and 6-cm inversion. [References: 13].

1748 Slaski, JJ. (1994) **DIFFERENCES IN THE METABOLIC RESPONSES OF ROOT TIPS OF WHEAT AND RYE TO ALUMINIUM STRESS.** *Plant & Soil. 167(1):165-171.* English. [UNIV ALBERTA DEPT BOT B-414 BIOL SCI BLDG EDMONTON AB T6G 2E9 CANADA].

The effects of aluminium (Al) ions on the metabolism of root apical meristems were examined in 4-day-old seedlings of two cereals which differed in their tolerance to Al: wheat cv. Grana (Al-sensitive) and rye cv. Dahkowskie Nowe (Al tolerant). During a 24 h incubation period in nutrient solutions containing 0.15 mM and 1.0 mM of Al for wheat and rye, respectively, the activity of first two enzymes in the pentose phosphate pathway (G-6-PDH and 6-PGDH) decreased in the sensitive cultivar. In the;tolerant cultivar activities of these enzymes increased initially, then decreased slightly, and were at control levels after 24 h. In the Al-sensitive wheat cultivar a 50% reduction in the activity of 6-phosphogluconate dehydrogenase was observed in the presence of Al. Changes in enzyme activity were accompanied by changes in levels of G-6-P - the initial substrate in the pentose phosphate pathway. When wheat was exposed for 16 h to a nutrient solution containing aluminium, a 90% reduction in G-6-P concentration was observed. In the Al-tolerant rye cultivar, an increase and subsequently a slight decrease in G-6-P concentration was detected, and after 16 h of Al-stress the concentration of this substrate was still higher than in control plants. This dramatic Al-induced decrease in G-6-P concentration in the Al- sensitive wheat cultivar was associated with a decrease in both the concentration of glucose in the root tips as well as the activity of hexokinase, an enzyme which is responsible for phosphorylation of glucose to G-6-P. However, in the Al-tolerant rye cultivar, the activity of this enzyme remained at the level of control plants during Al-treatment, and the decrease in the concentration of glucose occurred at a much slower rate than in wheat. These results suggest that aluminium ions change cellular metabolism of both wheat and rye root tips. In the Al-sensitive wheat cultivar, irreversible disturbances induced by low doses of Al in the nutrient solution appear very quickly, whereas in the Al-tolerant rye cultivar, cellular metabolism, even under severe stress conditions, is maintained for a long time at a level which allows for root elongation to continue. [References: 31].

1749 Steudle, E. (1994) **WATER TRANSPORT ACROSS ROOTS.** *Plant & Soil. 167(1):79-90.* English. [UNIV BAYREUTH LEHRSTUHL PFLANZENOKOL UNIV STR 30 D-95440 BAYREUTH GERMANY].

Usually, roots are looked at as rather perfect osmometers with the endodermis being the 'root membrane' which is equivalent to the plasma membrane of cells. However, this 'single-equivalent-membrane model' of the root does not explain the findings of a variable hydraulic resistance of roots as well as of differences between hydraulic and osmotic water flow and of low reflection coefficients of roots. Recent work with the root pressure probe is reviewed and discussed which indicates that the simple osmometer model of the root has to be extended by incorporating its composite structure, i.e. the fact that there are different parallel pathways for water in the root, namely, the cell-to-cell and apoplasmic path. The new 'composite transport model of the root' readily explains the experimental findings mentioned above. Pressure probe work with roots in which the endodermus was punctured to create an additional parallel path as well as anatomical studies support the model. [References: 46].

1750 Suskevic, M. (1995) **LONG-TERM EFFECT OF VARIOUS METHODS OF SOIL CULTIVATION ON THE GRAIN YIELDS OF MAIZE AND WINTER WHEAT.** *Rostlinna Vyroba. 41(2):55-58.* Polish. [RES INST ANIM NUTR DIV BASIC SOIL MANAGEMENT HRUSOVANY BRNA CZECHOSLOVAKIA].

The effect of long-term use of minimization of soil treatment on crop yields and productivity of crop rotation were appraised on the basis of the results obtained in the years 1974 to 1993 on chernozem soil in the maize-production region. In four-plot crop rotation with 100% proportion of cereals (grain maize, grain maize, winter wheat, winter wheat) three systems of soil cultivation were tested. The first system consisted of ploughing to plants to a depth of 0.20 to 0.24 m, in the second system plot were ploughed to the maize and further, minimum soil cultivation was applied to 0.12 to 0.15 m and in the third system plots were ploughed to first maize, minimum soil cultivation was applied to the second maize and winter wheat in both cases was sown into untreated soil. Field trials showed advantage of minimization technologies above all in cultivation of winter wheat after grain maize as a forecrop when the highest grain yield, compared to conventional tillage, was gained in sowing into untreated soil. On an average for 20 years practically identical results were obtained in all three systems of soil cultivation with various intensity of loosening.

1751 Swinnen, J.; Vanveen, JA.; Merckx, R. (1995) **ROOT DECAY AND TURNOVER OF RHIZODEPOSITS IN FIELD-GROWN WINTER WHEAT AND SPRING BARLEY ESTIMATED BY C-14 PULSE-LABELLING.** *Soil Biology & Biochemistry. 27(2):211-217.* English. [DLO RES INST AGROBIOL & SOIL FERTIL AB POB 14 6700 AA WAGENINGEN NETHERLANDS].

Root decay and turnover of rhizodeposits in field-grown winter wheat and spring barley were estimated from the difference in C-14 distribution between a sampling carried out 3 wk after pulse-labelling and a sampling 15-20 days before crop harvest. Plants were labelled at tillering and at ear emergence on plots under conventional (CONV) and integrated (INT) management. The latter was characterised by reductions in nutrient input, soil tillage and use of biocides. Of the roots formed at the tillering stage, 43% had decayed by the end of crop growth in winter wheat, independent of the management practice. Root decay in spring barley was higher than in wheat, and was higher in CONV (55%) than in INT (49%). Since most of the roots were produced around tillering, these values were used as estimates of accumulated annual root decay. Of the total rhizodeposition of assimilates fixed at tillering 87% was respired by microbes by the end of the growing season with winter wheat, 69% with barley in CONV and 54% with barley in INT. Decay of roots formed at ear emergence and the associated microbial respiration of rhizodeposits was lower than that of roots produced at tillering, but the same crop and management effects were observed. The assumptions underlying the calculations are discussed and the results are compared to data from minirhizotron observations. [References: 23].

1752 Yamashita, K.; Kasai, M.; Ezaki, B.; Shibasaka, M.; Yamamoto, Y.; Matsumoto, H.; Sasakawa, H. (1995) **STIMULATION OF H+ EXTRUSION AND PLASMA MEMBRANE H+-ATPASE ACTIVITY OF BARLEY ROOTS BY AMMONIUM-TREATMENT.** *Soil Science & Plant Nutrition. 41(1):133-140.* English. [OKAYAMA UNIV BIORESOURCES RES INST KURASHIKI OKAYAMA 710 JAPAN].

H+ extrusion and the plasma membrane H+-ATPase activity were analyzed using barley roots exposed to ammonium. H+ extrusion from roots was enhanced 4 h after the addition of 5 mol m(-3) ammonium to the medium. However, the stimulation of the plasma membrane H+-ATPase activity occurred at least 8 h after the addition of ammonium. Furthermore, this stimulation was found to be caused by the increase in the content of H+-ATPase proteins based on the results of immunoassay. These results indicate that H+ was actively extruded to the medium through the increase in the amount of plasma membrane Hf ATPase proteins, when barley roots were exposed to ammonium for more than 8 h. Thus, it is assumed that in the long term exposure to ammonium nitrogen, ammonium-induced stimulation of the H+-ATPase activity may be important to maintain intracellular pH in root cells under the acidic conditions associated with the uptake of ammonium. [References: 22].

F08 CROPPING PATTERNS AND SYSTEMS

1753 Abalu, G. (Food and Agricultural Policy and Planning Economic Commission for Africa, Addis Ababa (Ethiopia). Regional Advisor) (1993) **Planning for African agricultural development: Has on-farm research made any difference?** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo*

(CIMMYT), Harare (Zimbabwe). Maize Program) p. 169-189. CIMMYT. 23 ref. English. (AGRIS 95-022695).

1754 Amanuel Gorfu; Asefa Taa; Duga Debele (Institute of Agricultural Research (IAR), Addis Ababa (Ethiopia). Kulumsa Research Center); Tanner, D.G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Nairobi (Kenya). Wheat Program) (1994) **Observations on wheat and barley based cropping sequence trials conducted for eight years in Southeastern Ethiopia.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 261-280.* CIMMYT. 13 tables; 1 graph., 19 ref. English. (AGRIS 95-022753).

Cropping sequence trials were conducted from 1984-91 at 2 research sites representative of bread wheat (Triticum aestivum L. em Thell.) and barley (Hordeum vulgare L.) production zones in southeastern Ethiopia. At each site, 7 different cropping sequences were used: continuous small grain production was compared with 3 sequences consisting of wheat or barley grown 1 year out of 2 and 3 sequences with wheat or barley grown 2 years out of 3. The break crops were faba bean (Vicia faba), rapeseed (Brassica napus L.) and an oat (Avena sativum L.) and Vicia (Vicia dasycarpa Ten.) forage mixture. Six different inorganic fertilizer levels were applied within each cropping sequence. Cropping sequence had a significant impact on the grain yields of both wheat and barley. Wheat grown after the faba bean or rapeseed break crops yielded, on average, 27 and 12 per cent more grain than continuous wheat in the first and second cycle after the break crop, respectively. However, the impact of specific break crops on the grain yield of wheat was inconsistent across years. A similar trend was observed for barley with corresponding increments of 37 and 17 per cent, respectively. The lowest response of wheat and barley to nitrogen fertilizer occurred in the first cycle after a faba bean precursor. Continuous barley exhibited the highest yield response to nitrogen fertilizer. Cropping sequence had less impact than nitrogen fertilizer level on weed density, but eyespot incidence was significantly affected by both factors. The most profitable cropping sequence in both zones was faba bean grown in a 3 year cycle with 2 crops of wheat or barley.

1755 Baya, B. (Institut National de la Recherche Agronomique, Rabat (Maroc)) (1993) **[Comparison of wheat/Medicago rotations to traditional rotations in Fes regions [Morocco]]. comparaison de la relation ble/medicago a des rotations traditionnelles dans la region de Fes [Maroc].** *Auxamia (Maroc); Revue Marocaine de la Recherche Agronomique (no 83) p. 161-178.* 7 Tableaux 16 ref. French. (AGRIS 95-022764).

1756 Cabanas Cruz, Bertoldo; Verastegui Ch, J.; Medina G, G. (C.E. Calera, Apdo. Postal 18, Calera, Zac. (Mexico)) (1993) **[Sowing systems and sowing densities in wheat under rainfed conditions. II. yield components and water consumption]. Formas y densidad de siembra en trigo de temporal II. componentes del rendimiento y consumo de agua.** *Terra (Mexico) v. 11(2) p. 141-150.* 3 fig; 7 cuadros; 22 ref. Spanish. (AGRIS 95-022750).

The perfomance of wheat cultivated under rainfed condition during 3 years using five sowing systems and four sowing densities was evaluated. The variables measured were: grain yield, yield components and water consumption. Rainfall intensity affected the grain yield and some yield components. The sowing systems: furrow, comercial machine and broadcasted were more productive. Water consumption was not influenced by the sowing system. The best sowing densities were 100, 150 and 50 kg/ha due to a larger water consumption and to an increment of the yield components.

1757 Christen, O. (Christian Albrechts University Kiel (Allemagne). Institute of Crop Science and Plant Breeding); Hanus, H. (1993) **[Single ear yield from different shoot categories of winter wheat following either wheat or rapeseed]. [Rendement d'un epi de ble selon la categorie de la tige et selon que le precedent culturel ait ete du ble ou du colza].** *European Journal of Agronomy (France) v. 2(2) p. 105-112.* 33 ref. English. (AGRIS 95-022713).

1758 Christerson, M. (Sveriges Lantbruksuniv., Uppsala (Sweden). Inst. foer Vaextodlingslaera) (1993) **[Selection criteria for varieties in ecological farming]. Urvalskriterier foer sorter i ekologisk odling. Seminariekurs mark/vaext 1993.** Sveriges Lantbruksuniv. 20 ref. 9 p. Swedish. (AGRIS 95-022737).

1759 Clements, R.O.; Asteraki, E.J. (Institute of Grassland and Environmental Research, Okehampton (United Kingdom)) (1993) **Development of a low-input bi-cropping system for growing cereals in an understorey of white clover.** REUR Technical Series (FAO); no. 29 p. 151-153. p. 151-153. English. (AGRIS 95-033196).

1760 Giri, G.S.; Acharya, G.P.; Regmi, A.P. (National Wheat Research Program (NWRP), Bhairahawa (Nepal)); Hobbs, P.R. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT),Kathmandu (Nepal). Wheat Program) (1994) **Results of a long-term rice-wheat soil fertility experiment in the Terai of Nepal.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag. Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 309-316.* CIMMYT. 1 table; 5 graphs., 8 ref. English. (AGRIS 95-022745).

A long-term rice-rice-wheat cropping pattern trial was initiated at the National Wheat Research Centre at Bhairahawa in the Terai of Nepal in 1978. The experiment started with the normal or second rice crop and has received the same treatments for the two rice crops and the one wheat crop annually since that date. Nine fertilizer treatments allowed the experiment to look at the effect P and K in factorial combination, the effect of applying P and K to just wheat and measuring the residual carryover to the two rice crops, the residual effect of incorporating crop stubbles, and the effect of applying farmyard manure only. Results showed a distinct decline in yield for both rice crops for all treatments with minus P plots being affected more drastically than two plus-P treatments. One hypothesis for the decline in rice yields even where N-P-K is applied in the reduction in available zinc to bellow critical levels. This could have alarming implications for food production in the region if the results of this experiment can be verified in farmers' fields and other areas of South Asia.

1761 Gordon, R.; De Gracia, N.; Franco, J.; Gonzalez, A. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama)); Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Maize-Canavalia association using different sowing dates and arrangements in Azuero, Panama, 1992-93]. Asocio de maiz con Canavalia a distintas epocas y arreglos de siembra en Azuero, Panama, 1992-93.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 102-105.* Programa Regional de Maiz (PRM). 2 tables; 1 graph., 5 ref. Spanish. (AGRIS 95-022729).

1762 Holm, S. (1994) **[SP report, 17: Diseases and pests in organic agriculture [swede, nutrient deficiency]]. SP rapport, 17: Sygdomme og skadedyr i oekologisk planteavl.** Statens Planteavlsforsoeg, Lyngby (Denmark). SP. 14 ill., 14 tables; 20 ref. 44 p. Danish. (AGRIS 95-022772).

1763 Indulkar, BS.; Malewar, GU. (1994) **RESPONSE OF SURGHUM (SORGHUM-BICOLOR) TO DIFFERENT ZINC SOURCES AND THEIR RESIDUAL EFFECT ON SUCCEEDING WHEAT (TRITICUM-AESTIVUM).** *Indian Journal of Agronomy. 39(3):368-372.* English. [MARATHWADA AGR UNIV COLL AGR MAHARASHTRA 413512 INDIA].

A field experiment was conducted during 1986-87 and 1987-88 on sorghum [Sorghum bicolor (L.) Moench]-wheat (Triticum aestivum L. emend. Fiori & Paol.) crop rotation for assessing the direct and residual effects of various zinc sources on Typic Chromustert of Maharashtra. The pooled data showed that inorganic and organic sources of zinc improved the direct and residual effects of zinc on sorghum-wheat yield, uptake and available zinc in soil. Comparing the effect of organic zinc sources, all inorganic zinc sources were superior when compared to direct effect of farmyard manure. Among the zinc sources, zincated suphala was found superior to other zinc sources. However, farmyard manure in combination

with inorganic sources of zinc added to the residual value of zinc compared with inorganic sources of zinc alone in the crop rotation.

1764 Itimu, O.A.; Bunderson, T.; Mbekeani, Y.; Saka, A.R. (Chitedze Research Station, Chitedze (Malawi). National Agroforestry Team) (1993) **On-farm research on smallholder maize yields under Acacia albida in Malawi: Impacts on farmers, national research end extension institutions, and donor agencies.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 148-157.* CIMMYT. 2 tables; 2 graphs., 21 ref. English. (AGRIS 95-022733).

1765 Kefi, CH. (Ministry of Agriculture, Central Province (Zambia). Adaptive Research Planning Team Central Province) (1993) **Impact of on-farm research on small-scale and traditional farmers of Central Province, Zambia.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 280-287.* CIMMYT. 1 table; 7 ref. English. (AGRIS 95-022709).

1766 Lopez, G.; Mendoza, C. (Secretaria de Recursos Naturales de Honduras, Intubuca (Honduras)); Zea, J.L.; Fuentes, M. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Programa de Maiz); Perez, J. (Centro Nacional de Investigacion en Granos Basicos (CNIGB), Managua (Nicaragua). Programa de Maiz); Gordon, R. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama). Programa de Maiz); Bolanos, J. (Centro internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Maize response to Canavalia intercropping using different sowing dates and densities]. Respuesta del maiz a la siembra intercalada con Canavalia a distintas epocas y densidades.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 97-101.* Programa Regional de Maiz (PRM). 1 table; 4 graphs., 12 ref. Spanish. (AGRIS 95-022728).

1767 Lopez, G.; Rivera, S.; Lozano, S.; Licona, S. de (Secretaria de Recursos Naturales de Honduras, Intubuca (Honduras)); Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo, (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Maize response to Mucuna association in Yoro, Honduras, 1992]. Respuesta del maiz al asocio con Mucuna en Yoro, Honduras, 1992.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 111-113.* Programa Regional de Maiz (PRM). 5 tables; 5 ref. Spanish. (AGRIS 95-022730).

1768 Lungu, O.I. (University of Zambia, Lusaka (Zambia). School of Agricultural Sciences) (1993) **Impact of farming systems research on training at the University of Zambia and on farm adoption.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 215-220.* CIMMYT. English. (AGRIS 95-022701).

1769 Minh Ta Duy; Long Tran Dinh (Vietnam Agricultural Science Institute, Hanoi (Viet Nam)) (1994) **Suitable wheat varieties in the rice-based cropping systems in Northern Vietnam.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 232-235.* CIMMYT. 2 tables; 2 graphs. English. (AGRIS 95-022744).

Two triple cropping systems--late spring rice followed by early rainfed rice then wheat or full spring rice followed by early rainfed rice and wheat--have been proposed as the most convenient patterns to include wheat in the rice-based cropping systems in northern Vietnam. Five wheat varieties have been found suitable for these rotations and another 10 advanced lines are under test.

1770 Mughogho, W.C.C.; Ndengu, J.D. (Ministry of Agriculture, Lilongwe (Malawi). Adaptive Research Team) (1993) **Introducing a maize/soyabean intercrop into mainly maize/bean intercropping system in Lilongwe agricultural development division, Malawi.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 264-270.* CIMMYT. 1 map; 5 tables. English. (AGRIS 95-022734).

1771 Papastylianou, I. (Agricultural Research Institute, Nicosia (Chypre)) (1993) **[Productivity and nitrogen fertilizer requirements of barley in rotation systems in rainfed Mediterranean conditions]. [Productivite et besoin en engrais azote de l'orge dans des rotations culturales, en culture pluviale, en zone mediterraneenne].** *European Journal of Agronomy (France) v. 2(2) p. 119-129.* 40 ref., 7 graph. English. (AGRIS 95-022716).

1772 Rasmussen, K.J.; Andersen, A. (1994) **[13 years experiments with soil tillage and incorporation of straw and catch crop on a marsh soil [long term experiments, rotary cultivation]]. Efterafgroede, halmnedmuldning, jordbearbejdning og kvaelstofgoedskning, 13 aars saedskifteforsoeg paa marskjord.** Statens Planteavlsforsoeg, Lyngby (Denmark). *SP-Rapport (Denmark); no. 13 22 p.* SP. 8 ill., 5 tables; 12 ref. Danish. (AGRIS 95-022738).

1773 Rasmussen, K.J.; Hansen, E.M. (1994) **[SP report, 33: Winter cover crops in cereal dominated crop rotations: Influence on yields, nitrogen balances and crop quality]. SP rapport, 33: Groenne marker i fastliggende kornrige saedskifter: Indflydelse paa udbytter, kvaelstofbalancer og kvalitetsegenskaber.** Statens Planteavlsforsoeg, Lyngby (Denmark). SP. 10 ill., 7 tables; 31 ref. 30 p. Danish. (AGRIS 95-022754).

1774 Ringia, O.L. (Ilonga Agricultural Research and Training Institute, Kilosa (Tanzania). PSR Eastern Zone) (1993) **Impacts of on-farm research: The adoption of "Kito" maize/cotton/cowpea intercropping technology among farmers in Kilosa, Tanzania.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 316-330.* CIMMYT. 19 tables; 12 ref. English. (AGRIS 95-022735).

1775 Sosa, H. (Centro Nacional de Tecnologia Agropecuaria (CENTA), San Salvador (El Salvador). Programa de Maiz); Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT),Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Response of the maize-millet and maize-bean system to different levels of mulching under conservation tillage]. Respuesta del sistema maiz-maicillo y maiz-frijol a distintos niveles de mantillo bajo labranza de conservacion.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz*

y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 114-118. Programa Regional de Maiz (PRM). 2 tables; 3 graphs., 7 ref. Spanish. (AGRIS 95-022731).

1776 Sosa, H. (Centro Nacional de Tecnologia Agropecuaria (CENTA), San Salvador (El Salvador). Programa de Maiz); Perez, J. (Centro Nacional de Investigacion en Granos Basicos (CNIGB), Managua (Nicaragua). Programa de Maiz); Zea, J.L.; Fuentes, M. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Programa de Maiz); Lopez, G. (Secretaria de Recursos Naturales de Honduras, Intubuca (Honduras)); Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Differential response of maize to conservation tillage using different N application rates]. Respuesta diferencial del maiz a la labranza de conservacion a distintas dosis de nitrogeno.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 119-123.* Programa Regional de Maiz (PRM). 4 tables; 6 graphs., 4 ref. Spanish. (AGRIS 95-022732).

1777 Steiner, K.G. (Institut des Sciences Agronomiques du Rwanda (ISAR), Butare (Rwanda)) (1993) **The impact of farming systems research on the orientation and methods of agricultural research in Rwanda.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 101-107.* CIMMYT. 3 graphs., 6 ref. English. (AGRIS 95-022705).

1778 Torbert, HA.; Reeves, DW. (1995) **INTERACTIONS OF TRAFFIC AND TILLAGE APPLIED TO COTTON ON N MOVEMENT BELOW THE ROOT ZONE OF A SUBSEQUENT WHEAT CROP.** *Soil & Tillage Research. 33(1):3-16.* English. [USDA ARS GRASSLAND SOIL & WATER RES LAB 808 E BLACKLAND RD TEMPLE, TX 76502 USA].

Although research has demonstrated the negative impact of traffic-induced soil compaction on crop productivity, knowledge is lacking regarding the interactive effects of equipment traffic and tillage systems, especially in regards to N management in conservation-tilled multiple-cropping systems. The objective of this study was to examine the interaction of traffic and tillage systems applied to cotton (Gossypium hirsutum L.) on N utilization and movement below the root zone of subsequent double-cropped wheat (Triticum aestivum L.). A field study was initiated in 1987 on a thermic Typic Hapludult soil complex, utilizing a wide-frame tractive vehicle (WFTV) that allows for 6.1-m wide, untrafficked research plots to double-crop cotton with wheat. The experimental design was a split-plot with three replications. Main plots were: (1) conventional traffic (simulated with tractor); (2) no traffic (WFTV only). Subplots were tillage systems for cotton: (1) complete surface tillage without subsoiling (surface); (2) complete surface tillage and annual in-row subsoiling to 40-cm depth (subsoil); (3) complete surface tillage with once-only complete disruption of the tillage pan by subsoiling to a 50-cm depth on 25-cm centers in 1987 (complete); (4) strip-till where cotton was planted with in-row subsoiling into wheat residue. All tillage treatments were applied to the cotton and residual effects were observed in the wheat. In 1990-1991, fertilizer applications were made to wheat as N-15-labeled NH4NO3, and soil solution samples were collected (90-cm depth). While previous cotton tillage had no significant effect on wheat yields, traffic reduced wheat yields from 3427 to 2981 kg ha(-1) in 1990. With no traffic, total fertilizer N recovery in the plant-soil system was increased by 20 and 10% in 1990 and 1991, respectively. The strip-till tillage treatment increased total fertilizer N recovery in wheat by 20% compared with other tillage systems in 1990. Surface tillage without subsoiling for cotton increased NO3-N concentration below the root zone of wheat (90-cm depth) in both years. The data indicate that the tillage/traffic management system used for production of one crop in a double-cropping system was a major factor in reducing N losses and increasing fertilizer N recovery in the plant-soil system of the succeeding crop. [References: 28].

1779 Warland, R.H.; Diamini, S.N.; Kuang Hua Hsieg; Malaza, M.T. (1993) **Swaziland cropping system research and extension training project: Impact assessment study.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 365-382.* CIMMYT. 1 map. 18 tables; 16 ref. English. (AGRIS 95-022706).

This report summaries the results of a series of studies that were designed to assess the rate of technology adoption by Swazi nation land farmers. The report is divided into three major sections. The first section describes the research procedures including the samples utilized, and the research design. The second section summaries the findings including 1) the rates of adoption of a series of recommended practices, 2) the percent of farmers who use the recommended rates of application of these practices, 3) the levels of homestead self-sufficiency, 4) the extent of contacts and adoption rates,6) levels of ownership of agricultural equipment, 7) an analysis of gender differences relating to the adoption of practices, and 8) the relationship of off-farm income to adoption of technology. The conclusion are reported in the third section.

1780 Yeshanew Ashagrie; Tilahun Geleto; Ramanagowda, P. (Institute of Agricultural Research (IAR), Addis Ababa (Ethiopia). Adet Research Center) (1994) **A double cropping system for bread wheat and chickpea on drained vertisols in Northwestern Ethiopia.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 301-304.* CIMMYT. 3 tables; 5 ref. English. (AGRIS 95-022752).

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

F30 PLANT GENETICS AND BREEDING

1781 **[ICARDA/CIMMYT Results of the 1989-90 barley nurseries]. ICARDA/CIMMYT Resultados de los viveros de cebada de 1989-90** (1993) Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). *ICARDA/CIMMYT Results of the Barley Nurseries (CIMMYT); ICARDA/CIMMYT Resultados de los Viveros de Cebada (CIMMYT) 79 p.* CIMMYT. (En, Es). (AGRIS 95-022937).

1782 **[Results of the eleventh elite selection wheat yield Trial (ESWYT) 1989-90]. Resultados del 11 ensayo de rendimiento de seleccion elite de trigo harinero (ESWYT) 1989-90** (1993) Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). *CIMMYT Results of the Elite Selection Wheat Yield Trial (ESWYT) CIMMYT; CIMMYT Resultados del Ensayo de Rendimiento de Seleccion Elite de Trigo Harinero (ESWYT) (CIMMYT) 114 p.* CIMMYT. 1 map; 93 tables; 3 graphs. (En, Es). (AGRIS 95-023085).

The eleventh ESWYT is a multilocation international bread wheat nursery for the identification of adaptation of patterns in elite germplasm. Attention is given to adaptation and yield stability, factors that reduce farmers' levels of risk in adopting a new varieties. The ESWYT provide

breeders access to new advanced germplasm and relevant data. This report summarizes results of the trial.

1783 **[Results of the twenty third international bread wheat screening nursery (IBWSN) 1989-90]. Resultados del 23 vivero internacional de seleccion de trigos harineros (IBWSN) 1989-90** (1994) Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). *CIMMYT Results of the International Bread Wheat Screening Nursery (IBWSN) (CIMMYT); CIMMYT Resultados del Vivero Internacional de Seleccion de Trigos Harineros (IBWSN) (CIMMYT) 74 p.* CIMMYT. 19 tables. English. (AGRIS 95-023084).

The twenty third nursery (IBWSN) consisted of a group of 197 high yielding, advanced bread wheat lines (including five long-term checks) selected out of approximately 1000 lines. This subsequent report is presented for the quick appraisal and utilization of data by cooperators in their breeding programs. Ninety-six cooperators from 47 countries returned data in time to be included in this report (Table 1). The choice of variables rests with the individual cooperator. In this summary, we report the major variables. The number of observations differs among variables and the means over all locations are given by entry in table 2. Hopefully, these lines will enrich the germplasm base of our cooperators.

1784 **[The seventeenth international barley observation nursery (IBON)]. El 17 vivero internacional de observacion de cebada (IBON)** (1993) Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). ICARDA/CIMMYT Results of the Barley Nurseries (CIMMYT); ICARDA/CIMMYT Resultados de los Viveros de Cebada (CIMMYT) p. 51-79. CIMMYT. 12 tables. p. 51-79. (En, Es). (AGRIS 95-022939).

This nursery was sent in September 1989 to be grown by cooperators in their spring season of 1990. 83 nurseries went to cooperators in 45 countries. The 139 advanced lines and checks in the nursery had been chosen from among the best materials. All had been grown and observed by scientist in a high yielding environment under pressure from major diseases at the CIANO Experimental Station in northwest Mexico. There, seed for this nursery was multiplied, cleaned, and treated with fungicides before shipment.

1785 **[The twelfth international barley yield trials (IBYT)]. El 12 ensayo internacional de rendimiento de cebada (IBYT)** (1993) Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). ICARDA/CIMMYT Results of the Barley Nurseries (CIMMYT); ICARDA/CIMMYT Resultados de los Viveros de Cebada (CIMMYT) p. 1-50. CIMMYT. 44 tables. p. 1-50. (En, Es). (AGRIS 95-022938).

This nursery was distributed in 1989 to be grown by cooperators in their spring season of 1990. 112 nurseries went to cooperators in 44 countries. The advanced lines and varieties included in the nursery had been chosen from among the best materials and nominations from plant breeders in different parts of the world. All had been grown and observed in a high yielding environment in northwestern Mexico with pressure from major diseases.

1786 Abbott, DC.; Lagudah, ES.; Brown, AHD. (1995) **IDENTIFICATION OF RFLPS FLANKING A SCALD RESISTANCE GENE ON BARLEY CHROMOSOME 6.** *Journal of Heredity. 86(2):152-154.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

We report the map location of the scald resistance gene, Rrs13, from wild barley (Hordeum vulgare ssp. spontaneum) with respect to RFLP loci on barley chromosome 6 (= 6H). The identification of two RFLP loci (Cxp3 and ABG458) flanking the Rrs 13 locus will assist selection for the resistant allele in barley breeding programs. [References: 17].

1787 AbdElGhani, A.M.; AbdElShafi Ali, A.M.; Ghanem, E.H. (Ministry of Agriculture, Giza (Egypt). Field Crops Research Institute) (1994) **Genetic variability and differential plant adaptations as indicators of wheat potential under heat stress in Upper Egypt.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 153-157.* CIMMYT. 2 tables; 1 graph., 7 ref. English. (AGRIS 95-022902).

Heat tolerance is an essential characteristic for growing wheat in Upper Egypt. Twenty-four wheat lines and varieties were evaluated for heat tolerance under two different planting dates (early and late planting) in addition to three irrigation regimes (50, 70, and 90 water soil depletion) at El-Mataana, Qena Governorate. Early planting date and the irrigation at 50 water soil depletion resulted in significantly higher grain yield than other studied treatments. Three experiments under desert conditions were carried out in the Qena Governorate in 1991-92. Four seeding rates (120, 155, 190, and 255 kg/ha) and five N levels (140, 180, 215, 250, and 285 kg N/ha) were used to evaluate grain yield of variety Giza 160 under high-temperature conditions. There was a slight effect of seeding rate on grain yield. Increasing nitrogen level up to 250 kg N/ha produced the highest grain yield. Using improved cultural practices with high yield potential cultivars can increase grain yield under high temperature conditions.

1788 AbdElShafi Ali, A.M. (Ministry of Agriculture, Giza (Egypt). Field Crops Research Institute); Ageeb, O.A.A. (Agricultural Research Corporation (ARC), Wad Medani (Sudan)) (1994) **Breeding strategy for developing heat-tolerant wheat varieties adapted to Upper Egypt and Sudan.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 33-39.* CIMMYT. 6 tables; 11 ref. English. (AGRIS 95-023080).

Following multilocational testing over the years, the Wheat Research Department released two bread wheat varieties (Giza 160 and 164) tolerant to heat stress. The results of 27 micro and macro yield trials indicated that the new variety Giza 160 had an average yield superiority of 4 and 11 over recommended varieties Giza 155 and Giza 157, respectively. Giza 164 outyielded the check variety Sakha 69 by 6 in 85 micro and macro trials in Upper Egypt. A field screening technique (based on different planting times at different locations) of durum and bread wheat germplasm has been designed for the identification of heat tolerant lines. Regression analysis, as well as grain yield per se, indicated that Giza 164 is the best adapted genotype for heat stress conditions in Upper Egypt. Introduced materials from CIMMYT were tested at Mataana Research Station in 1991-92; Debeira, Bacanora 88, Genaro 81, Fang 60, and Pavon 76 produced the highest grain yield. The reported studies indicated that multilocation testing, creating heat stress environments by using different planting times and continuous regional activities between countries having similar environments are an efficient screening for heat stress.

1789 Acevedo, E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Improving the yield potential and abiotic stress resistance of cultivated wheat.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 281-288.* CIMMYT. 3 tables; 25 ref. English. (AGRIS 95-022892).

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

1790 Anon. (1992) **[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. 4 567 p. en 2 tomos.* Centro de Investigacion Regional del Noroeste. Spanish. (AGRIS 95-023059).

1791 Arends, AM.; Fox, GP.; Henry, RJ.; Marschke, RJ.; Symons, MH. (1995) **GENETIC AND ENVIRONMENTAL VARIATION IN THE DIASTATIC**

POWER OF AUSTRALIAN BARLEY. *Journal of Cereal Science. 21(1):63-70.* English. [QUEENSLAND DEPT PRIMARY IND INT FOOD INST QUEENSLAND 19 HERCULES ST HAMILTON QLD 4007 AUSTRALIA].

Variation in the diastatic power of Australian barley, and the relationships between diastatic power and the starch-degrading enzymes contributing to diastatic power, were investigated in 11 cultivars of barley grown at six diverse locations in Australia. Diastatic power varied with genotype and location, with the levels ranging from 3.1 to 16.5 U/kg. For alpha-amylase activity, levels across cultivar and location ranged from 52 to 214 U/g, for beta-amylase activity they ranged from 201 to 1550 U/g; and, for limit dextrinase activity, they ranged from 56 to 636 U/kg. Alpha-amylase (r=0.64) and beta-amylase (r=0.77) activities were correlated more strongly with diastatic power than was limit dextrinase (r=0.37). Grain nitrogen content was correlated positively with diastatic power (r=0.71), largely because of the relationship between nitrogen content and beta-amylase activity (r=0.82). High grain nitrogen contents were also associated with small grain sizes (r=-0.76) and low hot-water extracts (r=-0.75). The levels of alpha-amylase activity were correlated more closely with limit dextrinase activity (r=0.65) than with beta-amylase activity (r=0.28). The results indicate the need to select barley cultivars separately for alpha-amylase and beta-amylase activities to achieve high levels of diastatic power. [References: 39].

1792 Austin, R.B. (John Innes Centre for Plant Science Research, Norwich (Royaume Uni). Cambridge Laboratory); Ford, M.A.; Morgan, C.L.; Yeoman, D. (1993) **[Old and modern wheat cultivars compared on the Broadbalk wheat experiment [Rothamsted Experimental Station (UK)]]. [Comparaison des varietes de ble anciennes et nouvelles dans l'essai Broadbalk [Rothamsted Experimental Station (Grande Bretagne)]].** *European Journal of Agronomy (France) v. 2(2) p. 141-147.* 10 ref., 8 graph. English. (AGRIS 95-022916).

1793 Autrique, E.; Singh, RP.; Tanksley, SD.; Sorrells, ME. (1995) **MOLECULAR MARKERS FOR FOUR LEAF RUST RESISTANCE GENES INTROGRESSED INTO WHEAT FROM WILD RELATIVES.** *Genome. 38(1):75-83.* English. [CORNELL UNIV DEPT PLANT BREEDING & BIOMETRY 252 EMERSON HALL ITHACA, NY 14853 USA].

Near-isolines carrying four different genes for resistance to leaf rust were used to find linked molecular markers for these genes. Clones used to detect polymorphism were selected on the basis of the reported chromosomal location of the resistance genes. Both Lophopyron-derived resistance genes, Lr19 and Lr24, cosegregated with eight molecular markers assigned to chromosomes 7DL and 3DL, respectively. One clone cosegregated with Lr9 and two closely linked RFLP markers were found for Lr32, mapping at 3.3 +/- 2.6 and 6.9 +/- 3.6 cM from the resistance gene. The Lophopyron-chromatin segment in isolines carrying chromosomes 7E (Lr19) and 3E (Lr24) replaced a large portion of chromosome 7D and the distal portion of chromosome 3D, respectively. Clones assigned to these chromosomes on the basis of aneuploid analysis hybridized to 7E and 3E segments, thus confirming cytological results that these introgressed segments represent homoeologous chromosomes. The linked RFLP markers could be used to identify the resistance genes and generate new combinations in breeding populations, especially in the absence of disease in the environment or when virulence is lacking. [References: 50].

1794 Avilez Peraza, Victor Manuel (1993) **[Seed multiplication for the production of foundation seed of 4 wheat varieties: Caborca region, Sonora]. Multiplicacion de la semilla de 4 variedades de trigo para producir semilla original, en la region de Caborca, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 124-125. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 124-125. Spanish. (AGRIS 95-023076).

1795 Avilez Peraza, Victor Manuel (1993) **[Yield trial of 35 bread wheat lines and varieties (ENET): Caborca region, Sonora (7th year)]. Ensayo para evaluar el rendimiento de 35 lineas y variedades de trigo harinero que integran el enet, en la region de Caborca, Son. (7mo. ano).** Avances de la investigacion CIANO (Mexico); no. 27 p. 124. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 124. Spanish. (AGRIS 95-023070).

1796 Backes, G.; Graner, A.; Foroughiwehr, B.; Fischbeck, G.; Wenzel, G.; Jahoor, A. (1995) **LOCALIZATION OF QUANTITATIVE TRAIT LOCI (QTL) FOR AGRONOMIC IMPORTANT CHARACTERS BY THE USE OF A RFLP MAP IN BARLEY (HORDEUM VULGARE L).** *Theoretical & Applied Genetics. 90(2):294-302.* English. [TECH UNIV MUNICH LEHRSTUHL PFLANZENBAU & ZUCHTUNG D-85350 FREISING GERMANY].

Two hundred and fifty doubled haploid lines were studied from a cross between two 2-row winter barley varieties. The lines were evaluated for several characters in a field experiment for 3 years on two locations with two replications. From a total of 431 RFLP probes 50 were found to be polymorphic and subsequently used to construct a linkage map. Quantitative trait loci (QTLs) were determined and localized for resistance against Rhynchosporium secalis and Erysiphe graminis, for lodging, stalk breaking and ear breaking tendency, for the physical state before harvest, plant height, heading date, several kernel parameters and kernel yield. The heritability of the traits ranged from 0.56 to 0.89. For each trait except for kernel thickness, QTLs have been localized that explain 5-52% of the genetic variance. Transgressive segregation occurred for all of the traits studied. [References: 38].

1797 Bahadur, P.; Singh, D.V.; Srivastava, K.D. (Indian Agricualtural Research Institute, New Delhi (India). Division of Mycology and Plant Pathology) (1994) **Management of wheat rusts a revised strategy for gene deployment.** *Indian Phytopathology (India) v. 47(1) p. 41-47.* 1 table; 2 ill., 22 ref. English. (AGRIS 95-033583).

1798 Balatero, CH.; Darvey, NL.; Luckett, DJ. (1995) **GENETIC ANALYSIS OF ANTHER-CULTURE RESPONSE IN 6X TRITICALE.** *Theoretical & Applied Genetics. 90(2):279-284.* English. [UNIV PHILIPPINES INST PLANT BREEDING LAGUNA 4031 PHILIPPINES].

A quantitative genetic analysis was conducted to determine the inheritance of androgenetic response in hexaploid triticale. One highly-responsive genotype (Do 1 triticale) and three low-responding advanced CIMMYT lines (Rhino, Juanillo 97 and Ira Drira) were used as parents to produce a complete set of reciprocal F-1, F-2 and backcross generations. Estimates for genetic effects were determined using a generation-mean analysis following the method of Mather and Jinks. Both embryo induction and plant regeneration potential fitted well with the simple three-parameter additive-dominance (AD) model indicating the absence of any significant epistatic effects. Highly significant additive effects were detected for embryo induction, suggesting that breeding and selection can be effective in improving the induction response of triticale. The high [d]/[h] ratio indicates dominance of the alleles causing high embryo induction. The production of regenerant plants from embryos appeared to be a more complex trait because of its high sensitivity to environmental factors. [References: 23].

1799 Banks, PM.; Larkin, PJ. (1995) **REGISTRATION OF THREE BYDV-RESISTANT WHEAT GERMPLASMS - TC5, TC6, AND TC9.** *Crop Science. 35(2):600-601.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

1800 Beltran Fonseca, Manuel de Jesus; Delgado Talamantes, Jose Manuel; Cardenas de Leon, Mario Esteban (1993) **[Measuring germination under saline conditions for wheat, triticale, barley, safflower and sunflower varieties: Mayo valley, Sonora]. Evaluacion de la nacencia de variedades de trigo, triticale, cebada, cartamo y girasol, bajo condiciones de salinidad, en el Valle del Mayo, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 87-88. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 87-88. Spanish. (AGRIS 95-023073).

1801 Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Guatemala (Guatemala). Programa de Maiz) (1993) **[Physiological basis of genetic progress in PRM cultivars]. Bases fisiologicas del progreso genetico en cultivares del PRM.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 11-19.* Programa Regional de Maiz (PRM). 4 tables; 4 graphs., 15 ref. Spanish. (AGRIS 95-022981).

1802 Bolanos, J. (Centro internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Obando, M.; Urbina, R.; Mendoza, M. (Centro Nacional de Investigacion en Granos Basicos (CNIGB), Managua (Nicaragua). Programa de Maiz) (1993) **[Response of PRM cultivars to planting density]. Respuesta a densidad en cultivares del PRM.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 20-26.* Programa Regional de Maiz (PRM). 4 tables; 3 graphs., 17 ref. Spanish. (AGRIS 95-022982).

1803 Borghi, B.; Notario, T.; Codeca, F. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) **[The new varieties of Triticum aestivum in the varietal register in 1993 [Italy]]. Le nuove varieta' di frumento tenero iscritte al registro varietale nel 1993 [Italia].** *Molini d'Italia (Italy) v. 45(7-8) p. 16-21.* 5 tables. Italian. (AGRIS 95-033588).

1804 Brancourthulmel, M.; Lecomte, C. (1994) **BREEDING AND YIELD STABILITY OF WINTER WHEAT.** *Agronomie. 14(9):611-625.* French. [INRA DOMAINE BRUNEHAUT F-80200 ESTREES MONS FRANCE].

Breeding and yield stability of winter wheat. The yield stability of 12.

1805 Brizuela, L.; Dubon, T. (Secretaria de Recursos Naturales de Honduras, Intubuca (Honduras). Programa de Maiz); Zea, J.L. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Programa de Maiz); Aguiluz, A. (Centro Nacional de Tecnologia Agropecuaria (CENTA), San Salvador (El Salvador). Programa de Maiz); Bolanos, J. (Centro internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Selecting Tuxpeno C6 x BS-19 for drought tolerance under four levels of stress in Central America]. Seleccion para tolerancia a sequia en Tuxpeno C6 x BS-19 a traves de cuatro niveles de estres en Centro America.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 63-66.* Programa Regional de Maiz (PRM). 3 tables; 1 graph., 6 ref. Spanish. (AGRIS 95-022988).

1806 Broers, L.H.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Yellow rust on bread wheat.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 37-41. CIMMYT. 6 ref. p. 37-41. English. (AGRIS 95-023088).

1807 Bucholc, M.; Buchowicz, J. (1995) **AN EXTRACHROMOSOMAL FRAGMENT OF TELOMERIC DNA IN WHEAT.** *Plant Molecular Biology. 27(2):435-439.* English. [POLISH ACAD SCI INST BIOCHEM & BIOPHYS 5A PAWINSKIEGO PL-02106 WARSAW POLAND].

A procedure developed originally for selective extraction of viral (extrachromosomal) DNA from virus-infected mammalian cells was applied to cell nuclei isolated from uninfected wheat embryos. The resulting nuclear extrachromosomal DNA (exDNA) was enriched for telomere-type sequences by isopycnic centrifugation and inserted into the Sma I site of pUC119. A cloned DNA fragment (241 bp) was found to consist primarily of tandemly repeated heptamere units of the same sequence (5'-CCCTAAA-3') that is known to predominate in telomeric DNA of Arabidopsis thaliana. Hybridization experiments indicate that extrachromosomal telomeric repeats are abundant in resting embryos and disappear rapidly during germination. [References: 20].

1808 Budak, N.; Baenziger, PS.; Eskridge, KM. (1995) **EFFECT OF REPLICATIONS ON MEASURING WHEAT PLANT HEIGHT.** *Canadian Journal of Plant Science. 75(1):171-173.* English. [UNIV NEBRASKA DEPT AGRON LINCOLN, NE 68583 USA].

Plant height is an important selection criterion in wheat (Triticum aestivum L.) breeding programs that are conducted in the ecogeographically diverse Great Plains. Despite this diversity, measuring plant height on only two replications provided a very accurate estimate of the cultivar mean in each trial and of the detectable difference between two wheat genotypes. [References: 9].

1809 Budak, N.; Baenziger, PS.; Eskridge, KM.; Baltensperger, D.; Morenosevilla, B. (1995) **PLANT HEIGHT RESPONSE OF SEMIDWARF AND NONSEMIDWARF WHEATS TO THE ENVIRONMENT.** *Crop Science. 35(2):447-451.* English. [UNIV NEBRASKA DEPT AGRON LINCOLN, NE 68583 USA].

Nonsemidwarf wheats (Triticum aestivum L.) are preferred in drought-prone dryland agriculture but are difficult to select under higher rainfall environments where early generation breeding nurseries are often located. To determine the importance of genotype differences in height and the genotype x environment interaction, a combined analysis of variance across three ecogeographic zones was performed using genotype plant height. Genotypes were significantly different and the genotype x environment interaction was significant. Similar results were obtained when the genotypes were classified as semidwarf [gibberellic acid (GA)-insensitive] or nonsemidwarf (GA-sensitive) wheats. The genotype x environment interaction was also partitioned, and the environment x (semidwarf vs. nonsemidwarf wheat), environment x semidwarf wheat, and environment x nonsemidwarf wheat were all significant. The importance of significant genotype x environment interactions is (i) plant height in the eastern Nebraska poorly predicted plant height in western Nebraska, (ii) nonsemidwarf wheats interacted differently than semidwarf wheats with the environment, (iii) plant height should be measured in each ecogeographic zone or al least the eastern zone and either the central or northwestern zone, and (iv) among nonsemidwarf and semidwarf wheats a variety of responses to the environment were found. With regression estimates of stability, semidwarf genotypes were more stable (lower b values) than nonsemidwarf genotypes. Though nonsemidwarf genotypes were on average taller than semidwarf genotypes, semidwarf genotypes with excellent stability could be identified that were not too tall in eastern Nebraska and retained their height in western Nebraska. Nonsemidwarf wheats with similar environmental responses were not identified. [References: 15].

1810 Calderon, C.A.; Pixley, A.L. (Ministerio de Agricultura y Ganaderia, San Jose (Costa Rica). Estacion Experimental Los Diamantes); Jimenez, K.; Salas, C.A. (Universidad de Costa Rica, San Jose (Costa Rica). Programa de Cereales. Estacion Experimental Fabio Baudrit M.) (1993) **[Evaluating nine synthetic varieties under improvement for ear rot at eleven locations in Central America]. Evaluacion de nueve variedades sinteticas bajo mejoramiento para pudricion de mazorca en once localidades de Centro America.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 89-92.* Programa Regional de Maiz (PRM). 5 tables; 5 ref. Spanish. (AGRIS 95-022992).

1811 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Drought testing of 38 elite lines with bread wheat and durum cultivars: Yaqui valley, Sonora (Mexico)]. Evaluacion de 38 lineas elite y variedades de trigo harinero y de duros en sequia, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 14. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 14. Spanish. (AGRIS 95-023066).

1812 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Evaluation of Yecora F70 (wheat) isolines with different sources of genetic resistance to leaf rust: Yaqui valley, Sonora (Mexico)]. Evaluacion de isolineas de trigo derivadas de la variedad Yecora F70, con diferentes fuentes de resistencia genetica para roya de la hoja, en el valle del Yaqui,**

Son. Avances de la investigacion CIANO (Mexico); no. 27 p. 10. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 10. Spanish. (AGRIS 95-023060).

1813 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Evaluation of yield and leaf-rust resistance for the wheat variety AH-88 *distributed* by American Hybrids Inc.: Yaqui valley, Sonora (Mexico)]. Evaluacion de rendimiento y resistencia a roya de la hoja de la variedad AH-88 procedente de la empresa American Hybrids, Inc., en el Valle del Yaqui, Son. (trigo).** Avances de la investigacion CIANO (Mexico); no. 27 p. 15-16. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 15-16. Spanish. (AGRIS 95-023068).

1814 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Yield trial for wheat, triticale and barley varieties with 4 sowing dates, and a leaf-rust nursery: Yaqui valley, Sonora (Mexico)]. Ensayo de rendimiento de variedades de trigo, triticale y cebada en 4 fechas de siembra, y un vivero de diferenciales de roya de la hoja, en Yecora, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 14-15. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 14-15. Spanish. (AGRIS 95-023067).

1815 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Yield trial of 35 elite lines and wheat cultivars from the 7th ENET with 5 sowing dates (5 experiments): Yaqui valley, Sonora (Mexico)]. Ensayo para evaluar el rendimiento de 35 lineas elite y variedades de trigo que integran el 7mo. ENET en 5 fechas de siembra, en el Valle del Yaqui, Son. (5 exps.).** Avances de la investigacion CIANO (Mexico); no. 27 p. 13-14. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 13-14. Spanish. (AGRIS 95-023065).

1816 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro; Rajaram, Sanjaya (1993) **[Preliminary yield trials (41) with 574 advanced bread wheat lines from the CIFAP-Son/CIMMYT cooperative program: Yaqui valley, Sonora (Mexico)]. Ensayos preliminares de rendimiento de 574 lineas avanzadas del trigo harinero (41 ensayos), programa cooperativo CIFAP-SON-CIMMYT, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 12. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 12. Spanish. (AGRIS 95-023063).

1817 Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro; Rajaram, Sanjaya (1993) **[Preliminary yield trials (47) of 658 advanced bread wheat lines from the CIFAP-Son/CIMMYT cooperative program under conditions of restricted irrigation: Yaqui valley, Sonora (Mexico)]. Ensayos preliminares de rendimiento de 658 lineas avanzadas de trigo harinero bajo condiciones de riego limitado (47 ensayos),programa cooperativo CIFAP-SON-CIMMYT, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 12-13. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 12-13. Spanish. (AGRIS 95-023064).

1818 Camargo, C.E.O.; Felicio, J.C.; Freitas, J.G. de (Campinas Agronomic Institute (IAC), Sao Paulo (Brazil). Rice and Winter Cereals Section) (1994) **Evaluation of wheat cultivars for phosphorus efficiency on acid soils and in nutrient solution.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 289-297.* CIMMYT. 7 tables; 5 ref. English. (AGRIS 95-022893).

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

1819 Cantone, F. (Ministero delle Risorse Agricole, Alimentari e Forestali, Rome (Italy). Direzione Generale della Produzione Agricola); Perenzin, M.; Minoia, C.; Pogna, N.E.; Redaelli, R.; Delogu, G.; Biancolatte, E.; Pasquini, M.; Galterio, G.; Ninno,G. de; Boggini, G.; Borghi, B. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)); Snidaro, M. (Ente Regionale di Sviluppo Agricolo per il Friuli Venezia Giulia (ERSA), Gorizia (Italy)); Padovan, S. (Istituto di Genetica e Sperimentazione Agraria N. Strampelli, Lonigo, Vicenza (Italy)); Frattini, F.; Bianchi, M. (Ente Nazionale Sementi Elette (ENSE), Milan (Italy)); Concari, L. (1994) **[The new varieties of bread wheat, durum wheat, barley and triticale registred in the Italian national catalogue in the year 1993]. Le nuove varieta' di cereali vernini iscritte al registro varietale nel 1993.** *Sementi Elette (Italy) v. 40(5) p. 3-15.* 13 tables; 5 ref. Italian. (AGRIS 95-033409).

The results of the variety trials carried out in several locations in the years 1991-92, 1992-93 are tabulated. Eight winter barley varieties evaluated in 16 locations, two spring barley evaluated in 9 locations, seven bread wheat varieties evaluated in 13 locations, five varieties of durum wheat evaluated in 15 locations and one variety of triticale evaluated in 16 locations have been inscribed in 1993 in the Italian national register.

1820 Castellanos, S.; Queme, J.L.; Fuentes, M.; Larios, L.; Perez, C. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Evaluating diallel crosses and estimating the combining ability of 10 yellow maize lines]. Evaluacion de cruces dialelicos y estimacion de aptitud combinatoria de diez lineas de maiz de grano amarillo.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 53-56.* Programa Regional de Maiz (PRM). 4 tables; 6 ref. Spanish. (AGRIS 95-022985).

1821 Castilho, A.; Heslopharrison, JS. (1995) **PHYSICAL MAPPING OF 5S AND 18S-25S RDNA AND REPETITIVE DNA SEQUENCES IN AEGILOPS UMBELLULATA.** *Genome. 38(1):91-96.* English. [JOHN INNES CTR PLANT SCI RES NORWICH NR4 7UH NORFOLK ENGLAND].

An accurate physical map of the location of the 5S and the 18S-5.8S-25S rRNA genes and a repetitive DNA sequence has been produced on Aegilops umbellulata Zhuk., (2n = 2x = 14) chromosomes by in situ hybridization. Chromosome morphology together with the hybridization pattern of pSc119.2, a DNA sequence from rye, allowed identification and discrimination of different chromosomes; pSc119.2 hybridizes with all Ae. umbellulata chromosomes at the telomeres, except for the short arm of chromosome 6U, and shows intercalary sites on the long arms of chromosomes 6U and 7U. The 5S and 18S-25S rDNA have been mapped physically only on the short arms of chromosomes 1U and 5U. On chromosome 1U the order of the genes is 5S rDNA subterminal and 18S-25S rDNA more proximal, while on chromosome 5U the position of the genes is reversed. The relative order of the genes, together with the hybridization pattern of the pSc119.2, is useful in identifying whole chromosomes or chromosome segments from Ae. umbellulata in recombinant or addition lines with wheat. The data help link the physical organization of chromosomes to the genetic map. Other members of the Triticeae vary in the presence and order of the 5S and 18S-25S rDNA sequences on groups 1 and 5, indicating multiple and complex evolutionary rearrangements of the chromosome arms. [References: 25].

1822 Changjian, S. (Guangdong Provincial Academy of Agricultural Sciences, Guangzhou (China)) (1994) **Wheat breeding objectives, yield testing system and recent progress in Southern China.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel,*

G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 224-225. CIMMYT. English. (AGRIS 95-022907).

Southern China, comprising the provinces of Guangdong, Guangxi,Fujian, and Hainan, is one of 10 agroecological wheat production zones in the country. It is climatically tropical to subtropical. Wheat breeding objectives include early maturity, high yield, good quality, and resistance to diseases,lodging, and sprouting. Since 1972, promising wheat lines have undergone multi-location testing throughout the four provinces. Twenty-eight varieties, which have been released from the program, have increased production in the region by 600,000 t. Lines have been introduced from CIMMYT, Italy, and other wheat areas in China.

1823 Corbellini, M. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) **[Triticum aestivum. Variety trials [Italy]]. Frumento tenero. Le prove varietali [Italia].** *Terra e Vita (Italy) v. 35(39) p. 61-64.* 6 tables. Italian. (AGRIS 95-023090).

1824 Cordova, H.S.; Barreto, H.J.; Crossa, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz) (1993) **[Impact of maize hybrid development in Central America: Reliability of yield gains over the H5 genotype and considerations for selecting regional checks]. Impacto del desarrollo de hibridos de maiz en Centro America: Confiabilidad de las ganancias en rendimiento sobre el genotipo H5 y consideraciones para seleccion de testigos regionales.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 3-10.* Programa Regional de Maiz (PRM). 3 tables; 5 graphs., 13 ref. Spanish. (AGRIS 95-022980).

1825 Cuzhov, YL.; Martynov, OL. (1994) **APPLICATION OF REGRESSION ANALYSIS IN SELECTION OF THE SPRING WHEAT.** *Izvestiia Akademii Nauk SSSR. Seriia Biologicheskaia. (5):836-838.* Russian. [PATRICE LUMUMBA PEOPLES FRIENDSHIP UNIV MOSCOW RUSSIA].

In order to establish the character of relationship between economically important quantitative features to be used in selection, we studied promising individuals and their hybrids in the spring hexaploid wheat. Correlation and regression relationship between the studied quantitative features was shown to be appropriate. The data obtained proved to be important for theoretical aspects of the crop selection. [References: 7].

1826 Danial, D.L.; Kirigwi, F.M. (National Plant Breeding Research Center (NPBRC), Njoro (Kenya)) (1994) **Breeding for complete resistance in bread wheat to Puccinia striiformis in Kenya: A case study.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 141-152.* CIMMYT. 7 tables; 8 ref. English. (AGRIS 95-023081).

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

1827 Danial, D.L.; Kirigwi, F.M.; Kiriswa, F.L. (National Plant Breeding Research Center (NPBRC), Njoro (Kenya)); Broers, L.H.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Sources of resistance to yellow and stem rust in CIMMYT bread wheat derivatives in Kenya.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Wheat Program) p. 171-176.* CIMMYT. 4 tables; 4 ref. English. (AGRIS 95-023082).

In Kenya, a total of 879 bread wheat cultivars and lines were screened for their reaction to yellow rust and stem rust. Fifteen entries were identified as having a high level of resistance to both rust populations. The selected entries were also observed to be highly resistant to yellow rust populations in Mexico and Ecuador. This indicates that the resistance genes to yellow rust in these cultivars and lines were effective against pathogen populations with a broad range of virulence. In addition, the selected entries were characterized by good agronomic performance and were well adapted to Kenyan growing conditions. Component yield analysis revealed that mean 1000 grain weight, head weight and number of tillers per plant of the selected entries were 43.0, 2.1 and 6.9 while the corresponding values for the check cultivar Pasa were 37.0, 2.2 and 5.8, respectively. Such resistant cultivars and lines are promising sources of resistance, and, therefore, can be recommended for use in breeding programs.

1828 Devkota, R.N. (National Wheat Research Program (NWRP), Bhairahawa (Nepal)) (1994) **Wheat breeding objectives in Nepal: The national testing system and recent progress.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 216-223.* CIMMYT. 1 table; 2 graphs., 4 ref. English. (AGRIS 95-022906).

At present, foliar blight caused by Helminthosporium spp. and post-anthesis heat and drought stresses are the major constraints in wheat production in Nepal, particularly in the terai belt. Specific breeding objectives and strategies to overcome such problems are discussed. Recent progress in terms of area and production of wheat and adoption of modern varieties to different agro-ecological regions of the country are also discussed.

1829 Devos, KM.; Bryan, GJ.; Collins, AJ.; Stephenson, P.; Gale, MD. (1995) **APPLICATION OF TWO MICROSATELLITE SEQUENCES IN WHEAT STORAGE PROTEINS AS MOLECULAR MARKERS.** *Theoretical & Applied Genetics. 90(2):247-252.* English. [JOHN INNES CTR PLANT SCI RES CAMBRIDGE LAB NORWICH RES PK NORWICH NR4 7UH NORFOLK ENGLAND].

In eukaryotes, tandem arrays of simple-sequence repeat sequences can find applications as highly variable and multi-allelic PCR-based genetic markers. In hexaploid bread wheat, a large-genome inbreeding species with low levels of RFLP, di- and trinucleotide tandem repeats were found in 22 published gene sequences, two of which were converted to PCR-based markers. These were shown to be genome-specific and displayed high levels of variation. These characteristics make them especially suitable for intervarietal breeding applications. [References: 18].

1830 Dhari, R.; Joshi, A.K. (Banaras Hindu University, Varanasi (India). Department of Genetics and Plant Breeding) (1994) **HUW 318: A disease resistant wheat variety for southern hills zone.** *Indian Farming (India) v. 44(5) p. 13-15.* 4 tables; 1 ill., English. (AGRIS 95-033586).

1831 Dolinski, R.; Tarkowski, C.; Blichta, J. (Agricultural University, Lublin (Poland). Inst. of Plant Breeding and Seed Science) (1993) **Variability and heritability of some chosen mechanical properties and morphological features of hexaploid winter triticale stalk.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 35-42. Instytut Agrofizyki. 4 tables; 24 ref.. Distributed 1994. p. 35-42. English. (AGRIS 95-033377).

Hereditability of all the studied stalk features was found to depend on the cross, thus proving the importance of the choice of components for

crossing. Such features as: stalk bending force, mean elastic properties of stalk tissue, and the productive shoot mass were highly variable, i.e. 32.2-51.7, 27.5-44.5 and 21.9-31.5 percent, respectively.

1832 Edmeades, G.O. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Maize Program) (1994) **Improving drought tolerance in tropical maize.** *The CIMMYT maize germplasm bank: Genetic resource preservation, regeneration, maintenance, and use. Taba, S. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Maize Program) p. 33-34.* CIMMYT. 2 ref. English. (AGRIS 95-022996).

1833 Edmeades, G.O.; Lafitte, H.R.; Bolanos, J.; Chapman, S.C.; Banziger, M.; Deutsch, J.A. (Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico, DF (Mexico). Programa de Maiz) (1994) **Developing maize that tolerates drought or low nitrogen conditions.** *Stress tolerance breeding: Maize that resists insects, drought,low nitrogen, and acid soils. Edmeades, G.O.; Deutsch, J.A. (eds.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz) p. 21-84.* CIMMYT. 1 map; 12 tables; 9 graphs., 61 ref. English. (AGRIS 95-023001).

1834 Elahmadi, A.B. (Agricultural Research Corporation (ARC), Wad Medani (Sudan)) (1994) **Development of wheat germplasm tolerant to heat stress in Sudan.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 48-54.* CIMMYT. 4 tables; 12 ref. English. (AGRIS 95-022900).

The majority of the area under wheat in Sudan is found in the central irrigated plains between 14-16 deg N. Heat stress is one of the main constraints of wheat production caused by high temperatures (monthly average of more than 25 deg C) at the beginning (Nov) and end of the season (Feb-March). Heat adversely affects spike and grain formation. The work reported here was directed towards early-season heat stress. The germplasm tested originated from visually selected (90-120) lines from introduced heat tolerance nurseries from ICARDA and CIMMYT and from advanced locally bred lines. Heat stress is known to cause stunted plant growth, reduced tillering, and accelerated development and to lead to small heads, shrivelled grains, and low yields. By using some of these responses (days to heading and maturity, plant height, grain yield), we are attempting to find an easily observable character to help in screening for heat tolerance. The approach used was planting the germplasm under test with three to four check cultivars of known performance with respect to heat on two sowing dates. The results indicated large variation among lines. The performance of the checks was consistent in spite of different results obtained in different seasons. Days to heading seems to be the simplest character that holds promise to aid in screening for heat tolerance.

1835 Federmann, G.R.; Goecke, E.U.; Steiner, A.M. (Institute of Plant Breeding, Seed Science and Population Genetics, University of Hohenheim, 7000 Stuttgart 70 (Germany)) (1992) **Research note: detection of adulteration of flour of spelt (Triticum spelta L.) with flour of wheat (Triticum aestivum L. emend Fiori et Paol.) by electrophoresis.** *Plant Varieties and Seeds (United Kingdom) v. 5(2) p. 123-125.* 6 ref. English. (AGRIS 95-033611).

1836 Felix Valencia, Pedro; Camacho Casas, Miguel Alfonso (1993) **[Selection of wheat for drought tolerance from F2, F3 and F5 segregating populations: Yaqui valley, Sonora (Mexico)]. Seleccion de poblaciones segregantes de trigo en F2, F3 y F5, para tolerancia a sequia, en el valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 11. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 11. Spanish. (AGRIS 95-023061).

1837 Felix Valencia, Pedro; Camacho Casas, Miguel Alfonso (1993) **[Selection of wheat for salinity tolerance from segregating populations in different generations: Yaqui valley, Sonora (Mexico)]. Seleccion en poblaciones segregantes de trigo, en varias generaciones para tolerancia a salinidad, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 11-12. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 11-12. Spanish. (AGRIS 95-023062).

1838 Fischer, R.A. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Wheat in warmer areas: An overview of CIMMYT's involvement.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Information Services) p. 208-215.* CIMMYT. 1 graph., 9 ref. English. (AGRIS 95-022905).

This paper reviews developments in wheat in warmer areas over the last decade or so during which CIMMYT has been explicitly involved in the UNDP-supported project. Also briefly reviewed is the general situation with respect to wheat in developing countries to provide a background against which to view warmer area progress and prospects. The CIMMYT/UNDP project demonstrated the potential of wheat in nontraditional climates and has accumulated a substantial body of research findings on wheat in these climates. As to the future, CIMMYT will maintain a modest commitment to selection for tolerance to hot conditions in the CIMMYT-Mexico breeding program. The Warmer Areas Wheat Screening Nursery (WAWSN) commenced in 1987 and the Heat Tolerance Wheat Yield Trial (HTWYT) started in 1992 will continue to be distributed upon request to collaborators in warmer areas. The greatest contributions in the future may come from spillovers from the CIMMYT-IRRI-national program research on the rice-wheat system under way in South Asia.

1839 Fuentes Davila, Guillermo; Rodriguez Ramos, Ricardo (CIMMYT. Lisboa 27. Mexico, D.F. 06600) (1993) **[Resistance source to Tilletia indica Mitra in genotypes derived from Triticum aestivum x Triticosecale]. Fuentes de resistencia a Tilletia indica Mitra en genotipos derivados de Triticum aestivum x Triticosecale.** *Revista Fitotecnia Mexicana (Mexico) v. 16(2) p. 172-178.* 1 tabla; 25 ref. Spanish. (AGRIS 95-023077).

Experimental lines produced from Triticum aestivum x Triticosecale have been identified to be resistant to Tilletia indica, the causal agent of the partial bunt disease of wheat. Plants were artificially inoculated at the boot stage with a sporidial suspension of 10,000 ml*-1 at three sowing dates at CIANO, Cd. Obregon, Sonora, during four wheat cycles (1988-91). The percent infection of the lines tested, based on the number of healthy and infected grains, ranged from 0.26-1.87, while the susceptible check had a mean of 63.5 %.

1840 Gallardo, M. (University of Cordoba (Espagne)); Fereres, E. (1993) **[Growth, grain yield and water use efficiency of tritordeum in relation to wheat]. [Croissance, rendement en grain et efficacite de l'utilisation de l'eau du tritordeum par rapport au ble [Hordeum chilense Roem. et Schultz x Triticum spp., nouvelle cereale]].** *European Journal of Agronomy (France) v. 2(2) p. 83-91.* 16 ref. English. (AGRIS 95-022923).

1841 Galterio, G.; Cantone, M.T.; Dottori, A. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) **[Results pertaining to technological traits of the varieties of hard wheat belonging to the Italian varietal register in 1993]. Risultati merceologici delle varieta' di grano duro iscritte al registro varietale italiano nel 1993.** *Molini d'Italia (Italy) v. 45(4) p. 16-19.* 4 tables. Italian. (AGRIS 95-033567).

1842 Ghanem, E.H. (Ministry of Agriculture, Giza (Egypt). Field Crops Research Institute) (1994) **Wheat improvement in Egypt with emphasis on heat tolerance.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 12-16.* CIMMYT. 3 tables. English. (AGRIS 95-022897).

A history of wheat varietal development in Egypt since 1914 is provided with the planting of new, heat-tolerant varieties over large areas, wheat production has almost doubled in Middle and Upper Egypt over the last 10 years. Sakha 69 has been primarily responsible for increasing yields to above the 5 t/ha level in Middle Egypt, while the highly heat-tolerant Giza 164 has resulted in increasing average wheat yield in Upper Egypt to more than 5 t/ha.

1843 Gilchrist, L. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) Research on

septoria diseases at CIMMYT. CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 42-47. CIMMYT. 1 map. p. 42-47. English. (AGRIS 95-022910).

1844 Gregersen, PL.; Christensen, AB.; Sommerknudsen, J.; Collinge, DB. (1994) **A PUTATIVE O-METHYLTRANSFERASE FROM BARLEY IS INDUCED BY FUNGAL PATHOGENS AND UV LIGHT.** *Plant Molecular Biology. 26(6):1797-1806.* English. [ROYAL VET & AGR UNIV DEPT PLANT BIOL PLANT PATHOL SECT THORVALDSENSVEJ 40 DK-1871 FREDERIKSBERG C DENMARK].

A cDNA clone, pBH72-F1 (F1), was isolated from a cDNA library prepared from barley leaves 72 h after inoculation with Erysiphe graminis f. sp. hordei. The 1388 bp nucleotide sequence of pBH72-F1 contains an open reading frame encoding a 42.3 kDa polypeptide of 390 amino acids which shows sequence similarity to O-methyltransferases (OMTs) from different plant species; the highest identity (41%) was observed with a putative OMT expressed in roots of maize. A phylogenetic analysis shows that the barley and maize sequences are distinctly different from the ortho-diphenol-OMTs involved in lignin formation. A putative S-adenosyl-L-methionine-binding motif (KELVDDSITN) determined for a rabbit protein-carboxyl OMT is partially conserved in the encoded amino acid sequence. Genomic Southern blot hybridization shows that pBH72-F1 probably represents a single copy gene. The F1 clone corresponds to a gene transcript exhibiting a relatively late accumulation in mildew-infected barley leaves compared to other pathogen-induced transcripts, such as transcripts encoding PR proteins, a peroxidase, and transcripts homologous to a maize caffeic acid OMT. No transcript was detected in plants exhibiting papilla resistance at time points when resistance is thought to be manifested. The atypical transcript accumulation pattern for Fl was also observed after infection by other pathogens and after UV-light treatment. [References: 28].

1845 Grossi. M.; Gulli, M.; Stanca, AM.; Cattivelli, L. (1995) **CHARACTERIZATION OF TWO BARLEY GENES THAT RESPOND RAPIDLY TO DEHYDRATION STRESS.** *Plant Science. 105(1):71-80.* English. [EXPTL INST CEREAL RES VIA S PROTASO 302 I-29017 FIORENZUOLA DARDA ITALY].

The present study investigates the barley cDNA clones paf93 and cdr29 which correspond to mRNAs regulated by low temperature and drought stress but not by exogenous ABA treatment. During the early stage of dehydration, these mRNAs are expressed before the induction of known ABA regulated genes such as dehydrins and when only a small increase occurs in ABA content, The cDNA clone cdr29 cross-hybridizes with two classes of mRNAs differing both in size and expression patterns, The sequence analysis revealed that paf93 encodes a protein homologous with the cold-regulated protein COR47 of Arabidopsis whereas cdr29 represents a plant gene homologous to yeast and mammalian sequences coding for acyl-coenzyme A oxidase. [References: 35].

1846 Groth, D.E.; Frey, M.; Nugent, J. (1992) **1992 wheat fungicide trial.** *Annual research report (USA) (no. 84th) p. 362-364.* English. (AGRIS 95-033569).

1847 Habetz, R.J.; Harrison, S.A. (1992) **Wheat nitrogen-fungicide test.** *Annual research report (USA) (no. 84th) p. 382-384.* English. (AGRIS 95-033571).

1848 Habetz, R.J.; Harrison, S.A. (1992) **Wheat variety test.** *Annual research report (USA) (no. 84th) p. 379-381.* English. (AGRIS 95-033570).

1849 Hagio, T.; Hirabayashi, T.; Machii, H.; Tomotsune, H. (1995) **PRODUCTION OF FERTILE TRANSGENIC BARLEY (HORDEUM VULGARE L) PLANT USING THE HYGROMYCIN-RESISTANCE MARKER.** *Plant Cell Reports. 14(5):329-334.* English. [NATL INST AGROBIOL RESOURCES 2-1-2 KANNONDAI TSUKUBA IBARAKI 305 JAPAN].

Fertile transgenic barley (Hordeum vulgare L.) plants were obtained by high velocity particle bombardment. The plasmid pBC1 was used to deliver the selectable hph gene and reporter Gus gene into immature embryo. After the selection culture 18 hygromycin resistant plants were obtained. Samples for Southern hybridization and enzymatic Gus assay were obtained from 11 plants. Southern hybridization confirmed the presence of the hph gene in the 11 hygromycin resistant plants (T-0). Enzymatic assay indicated that all the T-0 plants that showed hph positive in Southern analysis possessed detectable amount of Gus activity. To date all the 11 T-0 plants reached maturity and mature seeds were obtained Transmission of the hph gene to progeny (T-1) of two independent T-0 plants was confirmed by Southern hybridization. [References: 24].

1850 Hanchinal, R.R. (All India Coordinated Wheat Improvement Project, Dharwad (India)); Tandon, J.P. (Wheat Research, Karnal, Haryana (India)); Salimath, P.M. (Indian Agricultural Research Institute (IARI), Dharwad (India). Regional Station) (1994) **Variation and adaptation of wheat varieties for heat tolerance in Peninsular India.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 175-183.* CIMMYT. 1 map; 5 tables; 4 graphs., 15 ref. English. (AGRIS 95-022903).

In peninsular India, high temperature stress has a strong influence on wheat growth and yield. The stress intensity is severe under late planting causing the reduction in the duration of GS2 and GS3 growth phases. The genetic variability and association analysis indicated grain test weight, spikelets/spike, and grains/spike under hot (normal planting) environments and spike length and spikes/square m under very hot (late planting environment may serve as valuable selection criteria. The stability analysis for yield under normal planting over 10 locations showed the superiority of improved varieties with regards to adaptation and better response to both favorable and poor environments. Under late planting, the better adaptation of the variety HD2501 was evident in all the environments when tested over nine locations. The exploitation of landraces of durums and emmer wheats in evolving heat tolerant cultivars is suggested.

1851 Harrison, S.A.; Brown, L.P.; Caylor, J.; Colyer, P.D.; Dickson,J.I.; Habetz, R.J.; Hallmark, W.B.; Mascagni, R.; Moore, S.H.; Rabb, J. (1993) **Performance of small grain varieties in Lousiana, 1992-93.** *LAES mimeo series (USA); no. 81 74 p.* English. (AGRIS 95-033502).

1852 Herrera Gonzalez, Rene Joel (1993) **[Uniform yield trial of 35 ENET bread wheat varieties: Hermosillo coast, Sonora (7th year)]. Ensayo para evaluar el rendimiento de 35 variedades de trigo harinero que integran el ENET, en la costa de Hermosillo, Son. (7o. ano).** Avances de la investigacion CIANO (Mexico); no. 27 p. 98. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 98. Spanish. (AGRIS 95-023074).

1853 Herrera Gonzalez, Rene Joel (1993) **[Yield testing, by agreement, of hybrid wheat HA-88: Hermosillo coast, Sonora]. Evaluacion del rendimiento del hibrido de trigo HA-88, bajo convenio, en la costa de Hermosillo, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 99. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 99. Spanish. (AGRIS 95-023075).

1854 Horst, W.J. (Hannover Univ. (Germany). Inst. of Plant Nutrition); Abdou, M.; Wiesler, F. (1993) **Genotypic differences in phosphorus efficiency of wheat.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 293-296.* 15 ref. English. (AGRIS 95-023095).

1855 Huang Jiayong; Zhu Guojin (Guangxi Agricultural College, Nanning, Guangxi (China). Maize Research Institute) (1994) **Wheat breeding objectives and the provincial yield testing system in Guangxi, China.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 226-227.* CIMMYT. English. (AGRIS 95-022908).

Wheat growing in the double cropping system of rice in Guangxi Zhang Autonomous Region of southern China is described. Due to the conditions being warm, humid, and cloudy, the breeding objectives are for short stature, early maturity, powdery mildew and Bipolaris sorokiniana resistance (or tolerance), and high yield with large spikes and grain. It is emphasized that the female parent in a cross should be a disease-resistant line and the male, a high yielding one, in order for a high proportion of the progeny to have the disease resistance. The provincial testing system in Guangxi is also outlined.

1856 Hucl, P.; Baker, RJ. (1995) **LOTIL HIGH-YIELDING SPRING WHEAT.** *Canadian Journal of Plant Science. 75(1):209-210.* English. [UNIV SASKATCHEWAN CTR CROP DEV SASKATOON SK S7N 0W0 CANADA].

LOTIL spring wheat germplasm was selected on the basis of reduced tillering capacity and high grain yield from three crosses involving an oligoculm parent. This germplasm yielded up to 42% more than the free-tillering cultivar Neepawa but was later maturing. This germplasm is available to spring wheat breeders who wish to use it in their breeding programs. [References: 3].

1857 Jackson, L.F.; Qualset, C.O.; Wennig, R.L.; Vogt, H.; Gibbs, L.K.; Campbell, M.; Fulton, A.; Kearney, T.; Mauk, P.; Munier, D. (1993) **1993 regional barley, common and durum wheat, triticale, and oat performance tests in California.** *Agronomy progress report (USA); no. 236 48 p.* English. (AGRIS 95-022926).

1858 Jellen, EN.; Phillips, RL.; Rines, HW.; Rooney, WL. (1995) **MOLECULAR GENETIC IDENTIFICATION OF AVENA CHROMOSOMES RELATED TO THE GROUP 1 CHROMOSOMES OF THE TRITICEAE.** *Genome. 38(1):185-189.* English. [UNIV MINNESOTA DEPT AGRON & PLANT GENET ST PAUL, MN 55108 USA].

A collection of 19 wheat (Triticum aestivum) probes, detecting sequences in the seven homoeologous groups of chromosomes, were hybridized to DNA from the 'Kanota' series of oat monosomic lines (Avena byzantina) to investigate their use for identifying groups of homoeologous oat chromosomes. Three probes from homoeologous group 1 of wheat, psr161, psr162, and psr121, mapped among the set of oat chromosomes 1C, 14, and 17. One homoeologous group 6 probe, psr167, mapped to oat chromosomes 1C and 17. Two oat probes that had previously been shown to map to oat chromosomes 1C, 14, and 17 were then hybridized to DNA from the 'Chinese Spring' wheat ditelosomics. They localized to homoeologous group 1 wheat chromosomes, one to the short arm and one to the long arm. These results reveal that in hexaploid oat there is a group of three chromosomes that correspond at least in part to homoeologous group 1 of wheat. The remaining wheat probes identifying other wheat homoeologous sets did not detect a complete series of homoeologous chromosomes in oat. This was presumably due to the incomplete status of the 'Kanota' monosomic series, chromosomal rearrangement in Avena, weak hybridization signals owing to low probe-target sequence homology, and (or) detection of only two hybridization bands by the wheat probe. [References: 23].

1859 Jenkin, M. (Waite Agricultural Research Inst., Glen Osmond (Australia). Dept. of Plant Science); Hu, H.; Brown, P.; Graham, R.; Lance, R.; Sparrow, D. (1993) **Investigations of boron uptake at the cellular level.** Proceedings of the 12. International Plant Nutrition Colloquium: Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 143-146.* 11 ref. English. (AGRIS 95-022931).

1860 Jewell, D.C.; Bell, M.A. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Maize Program) (1994) **Use of bank accessions in breeding for tolerance to low iron and in high pH, calcareous soils.** *The CIMMYT maize germplasm bank: Genetic resource preservation, regeneration, maintenance, and use. Taba, S. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Maize Program) p. 42.* CIMMYT. English. (AGRIS 95-022998).

1861 Jewell, D.C.; Islam Faridi, N. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Maize Program) (1994) **Use of maize X Tripsacum hybrids for stress breeding in maize.** *Stress tolerance breeding: Maize that resists insects, drought,low nitrogen, and acid soils. Edmeades, G.O.; Deutsch, J.A. (eds.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz) p. 93-95.* CIMMYT. English. (AGRIS 95-023003).

CIMMYT has been involved in research on wide hybridization on maize since mid-1970s. This research has been viewed as long-term and complementary to both CIMMYT breeding objectives and to activities in genetic conservation of the wild relatives of maize. Hybrids between maize and Tripsacum have been obtained by many researchers during the last 50 years. Ten years ago CIMMYT initiated a backcross program to isolate individual chromosomes of Tripsacum in a tropical maize background (Tripsacum addition lines). Backcross 10 generation plants have now been produced. A major barrier to the utilization to this genetic resource for maize improvement has been the absence of suitable methods for obtaining maize that is introgressed with small segments of Tripsacum chromosomes. Hybrids between maize and Tripsacum can take more than 300 days to flower and progress towards obtaining maize with one additional chromosome from Tripsacum is further delayed if the hybrid and its backcross derive progeny exhibit high levels of apomixis. In 1990-91 the CIMMYT wide cross unit had isolated the first tentatively identified Tripsacum addition lines. During the first 12 months, considerable time and effort were placed on improving our ability to identify maize chromosomes cytologically at mitosis. About 50 inbreed maize lines were studied and this work has led to an increased appreciation of the variability if maize chromosomes for both relative length and arm ratio.

1862 Johnson, R. (John Innes Center, England (United Kingdom). IPSR Cambridge Laboratory) (1994) **Developments in prospects of breeding for durable resistance to the three rust diseases of wheat.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa: Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 123-140.* CIMMYT. 5 tables; 1 graph., 49 ref. English. (AGRIS 95-022891).

Breeding for durable resistance to the rusts of wheat is a worthwhile objective because it is an attainable goal, although a challenging one, and because these diseases remain as significant threats to wheat production. There is a history of failures of resistance due to the evolution of the respective pathogens for each of the three rusts. However, there is increasing evidence and knowledge about durable forms of resistance to each of the diseases and how they can be exploited The examples of durable resistance to stem rust discussed include the use of the genes Sr36, Sr2, Sr26 and Sr31. For leaf rust, the relationships of the genes Lr34, Lr13 and associated genes for durable resistance are considered For stripe rust, the potential of resistance due to Yr18 linked to Lr34, and of durable resistance in European and North American wheats are considered.

1863 Kannenberg, LW.; Falk, DE. (1995) **MODELS FOR ACTIVATION OF PLANT GENETIC RESOURCES FOR CROP BREEDING PROGRAMS.** *Canadian Journal of Plant Science. 75(1):45-53.* English. [UNIV GUELPH DEPT CROP SCI GUELPH ON N1G 2W1 CANADA].

Although plant breeders recognize that their working germplasm is constricted, most make little use of the extensive genetic variability in gene banks and other collections. This is because breeders continue to make reasonable progress in most crop species and broadening the activated genetic base generally will dilute agronomic performance. Yet new germplasm can (1) raise the genetic ceiling on improvement, (2) decrease vulnerability to biotic and abiotic stresses, and (3) add new developmental pathways and ecological adaptations. Two breeding systems - HOPE for corn and RIPE for barley - are described which can significantly broaden the genetic base deployed in breeding programs while still producing lines and cultivars with commercial potential. The Hierarchical Open-ended Population Enrichment (HOPE) breeding system consists of two complementary sets, each of four gene pools arranged in a hierarchy based on agronomic performance. Introductions are added continually and desirable genes and gene complexes can routinely move upward in the hierarchy. Increasingly stringent selection procedures at each higher level of the hierarchy shape the extensive variability at the lower levels into the quality germplasm at the Elite level, which serves as the source of inbred lines. The Recurrent Introgressive Population Enrichment (RIPE) breeding system for barley employs male sterile facilitated recurrent selection to progressively introgress new genes and gene complexes into an Elite population which serves as the source of potential new cultivars. [References: 37].

1864 Khokhlov, A.N.; Parfent'ev, M.G.; Poperelya, F.A. (1993) **[Phenotypical exhibition of genes controlling the hardiness, size, protein content, and morphological properties of wheat kernels]. O kharaktere determinatsii tverdosti,belkovosti i morfologicheskikh priznakov gibridnykh zernovok pshenitsy.** *Sel'skokhozyajstvennaya biologiya. Seriya Biologiya rastenij (Russian Federation) (no.5) p. 79-85.* 19 ref. Russian. (AGRIS 95-033592).

The correlation between the protein content, hardiness, size of kernels of various soft winter wheat hybrids and the endosperm genotype has been studied. The type of the manifestation of the "hardiness" property at early breeding stages has been observed, under the method of infrared spectrometry. It has been shown that the wheat hardiness is under the effect

of endosperm genetic factors with a partial dominance of the soft type. The dependence of this property on the gene (genes) portion is curvilinear and can be well approximated by the equations of the quadratic type. The size and the protein content in kernels as well as their form, the hull color, and the filling are under the control of the maternal (feeding) plant genotype.

1865 Kibite, S. (1995) **AC MICHAEL HARD RED SPRING WHEAT.** *Canadian Journal of Plant Science. 75(1):199-200.* English. [AGR & AGRIFOOD CANADA RES CTR BAG SERV 5000 LACOMBE AB T0C 1S0 CANADA].

AC Michael is a hard red spring wheat cultivar adapted to Alberta and western Saskatchewan. It combines high grain yield with a maturity about 1 and 2 d earlier than Neepawa and Laura, respectively, and has superior resistance to common bunt and loose smut compared to Laura.

1866 Kinyua, M.G.; Kirigwi, F.M. (National Plant Breeding Research Center, (NPBRC) Njoro (Kenya)) (1994) **Use of yield components as selection criteria for wheat varieties for the marginal areas of Kenya.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 114-122.* CIMMYT. 3 tables; 3 graphs., 18 ref. English. (AGRIS 95-022890).

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

1867 Kinyua, M.G.; Wanga, H. (National Plant Breeding Research Center (NPBRC), Njoro (Kenya)); Yiecho, P.O.; Akunda Bweni, L. (University of Nairobi, Nairobi (Kenya). Crop Science Department) (1994) **Screening for drought tolerance in Kenyan commercial wheat varieties and introduced lines.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 309.* CIMMYT. English. (AGRIS 95-022894).

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

1868 Klindworth, DL.; Williams, ND.; Duysen, ME. (1995) **GENETIC ANALYSIS OF CHLORINA MUTANTS OF DURUM WHEAT.** *Crop Science. 35(2):431-436.* English. [USDA ARS NO CROP SCI LAB STATE UNIV STN POB 5677 FARGO, ND 58105 USA].

Chlorina mutants are useful for studies of photosynthesis and as genetic markers. Three chlorophyll-deficient-durum mutants (CDd1, CDd2, and CDd6) or tetraploid wheat (Triticum turgidum L.) that have the chlorina phenotype have been identified. The objectives of this study were to determine the inheritance, chromosomal location, and allelic relationships of the CDd mutants, and to determine if the mutated locus in CDd6 was allelic to the cn-A1 locus of hexaploid wheat (T. aestivum L.). To determine the inheritance and allelic relationships of the mutant genes, the mutants were intercrossed and crossed to 'Langdon' durum. The CDd6 mutant was crossed to Chlorina-1, a chlorina mutant of hexaploid wheat. Chromosomal location of the mutant genes in CDd1 and CDd6 were determined by crossing the mutants to Group 7 aneuploids of Langdon. The F-2 segregation indicated monogenic inheritance of each CDd mutation. The mutations in CDd1 and CDd2 were allelic, and dosage effects indicated that CDd6 was homoeoallelic to CDd1 and CDd2. The mutation in CDd1 was located in chromosome arm 7BL, and the mutation in CDd6 was located in chromosome arm 7AL. The mutation in CDd6 was allelic or tightly linked to the En-Al locus of hexaploid wheat. Because the mutations in CDd1 and CDd2 were homoeoallelic to the mutation in CDd6, CDd1, and CDd2 were probably mutations of the cn-B1 locus. [References: 13].

1869 Kohli, M.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Asuncion (Paraguay). Wheat Program); Camargo, C.E.O. (Campinas Agronomic Institute (IAC), Sao Paulo (Brazil). Rice and Winter Cereals Section); Franco, F. (OCEPAR,Parana (Brazil)) (1994) **An analysis of the progress made in Brazil in breeding wheat for acid soils.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 78-98.* CIMMYT. 16 Tables; 4 graphs., 29 ref. English. (AGRIS 95-022888).

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

1870 Kyzeridis, N.; Biesantz, A.; Limberg, P. (1995) **COMPARATIVE TRIALS WITH DURUM-WHEAT LANDRACES AND CULTIVARS IN DIFFERENT ECOLOGICAL ENVIRONMENTS IN THE MEDITERRANEAN REGION.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 174(2):133-144.* English. [CEREAL INST POB 312 GR-57001 THESSALONIKI GREECE].

Durum-wheat landraces (local varieties) and cultivars (released varieties) were examined for grain yield and some qualitative traits in three environments in 1985 and 1986. The purpose of this research was the preservation of the local genetic material and its use in durum-wheat breeding programmes in mediterranean countries. It was confirmed that, during the graining period (heading to yellow ripeness), the landraces were more resistant to drought and high temperatures than the cultivars. A short graining period led to a sharp rise in the percentage of protein. On the other hand, the protein content decreased when the grain yield increased. Contrary to the cultivars, the vitrousness of some landraces was not negatively influenced by high soil moisture during the graining period. These landraces combined high grain yield with a high percentage of vitrous kernels and can be considered as valuable gene material for breeding purposes. [References: 15].

1871 Larios, L.; Castellanos, S.; Queme, J.L.; Perez, C. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Predicting white maize hybrids based on diallel crosses in six environments of Central America, 1992]. Prediccion de hibridos de maiz de grano blanco a partir de cruzas dialelicas en seis ambientes de Centro America, 1992.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 47-52.* Programa Regional de Maiz (PRM). 11 tables; 8 ref. Spanish. (AGRIS 95-022984).

1872 Laser, B.; Oettler, G.; Kuck, U. (1995) **RNA EDITING OF THE MITOCHONDRIAL ATPA/ATP9 CO-TRANSCRIPT OF TRITICALE,**

CARRYING THE TIMOPHEEVI CYTOPLASMIC MALE STERILITY CYTOPLASM FROM WHEAT. *Plant Physiology. 107(2):663-664.* English. [RUHR UNIV BOCHUM LEHRSTUHL ALLGEMEINE BOT D-44780 BOCHUM GERMANY].

1873 Lawlor, D.W. (Institute of Arable Crops Research, Harpenden, Herts. (United Kingdom). Rothamsted Experimental Station) (1994) **Physiological and biochemical criteria for evaluating genotypic responses to heat and related stresses.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 127-142.* CIMMYT. 4 graphs., 20 ref. English. (AGRIS 95-022901).

The concepts behind biochemical processes and their consequences for wheat improvement in hot, bright environments are considered. A major limitation to CO2 fixation is the wasteful oxygenase activity of Rubisco, or photorespiration, which increases greatly at higher temperatures. For efficient photosynthesis, it is essential to maintain balance between the supply of energy, CO2, and a mechanism of CO2 fixation. Imbalance in metabolism caused by large energy flux relative to CO2 assimilation results in high energy states of chlorophyll and electron transport components, accumulation of cellular reductants, and formation of reactive forms of oxygen. The latter are potentially damaging to metabolism, causing chlorophyll bleaching and lipid oxidation, and hence photo-inhibition. Protective mechanisms, particularly the carotenoid system, 'detoxify' these damaging compounds. The onset of energy imbalance can be detected by decreased CO2 assimulation and increased chlorophyll fluorescence, which indicates the energy status of the thylakoids. The use of these techniques for selection of heat and water stress tolerant genotypes is discussed.

1874 Listman, M.; Taba, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Maize Program) (1994) **History of CIMMYT's maize germplasm bank.** *The CIMMYT maize germplasm bank: Genetic resource preservation, regeneration, maintenance, and use. Taba, S. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Maize Program) p. 1-8.* CIMMYT. English. (AGRIS 95-022994).

1875 Little, R.; Wagoire, W. (Wheat and Barley Development Project Uganda Grain Milling Company, Jinja (Uganda)) (1994) **Developing wheat varieties for the lowland areas of Uganda.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 99-113.* CIMMYT. 9 tables; 1 ref. English. (AGRIS 95-022889).

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

1876 Litvinenko, N.A.; Leshin, V.N. (1993) **[On biologic concept of soft winter wheat breeding for drought resistance in steppe region [Ukraine]]. Biologicheskie aspekty selektsii ozimoj myagkoj pshenitsy na zasukhoustojchivost' v usloviyakh stepnoj zony.** *Sel'skokhozyajstvennaya biologiya. Seriya Biologiya rastenij (Russian Federation) (no.5) p. 63-70.* 9 ref. Russian. (AGRIS 95-033590).

In steppe region of Ukraine, the effect of drought upon winter wheat productivity and gross yields has been studied (Odessa region being cited as an example). Correlations were found between the productivity of varieties and lines and their drought resistance. In a correlation of soft winter wheat varieties, genotypical variability of adaptational mechanisms in respect to the drought has been revealed. Three biologic systems of drought resistance have been considered and varieties with most developed systems under study have been identified, namely, with the system of winter supply (Odesskaya 16, Odesskaya 51, Stepnyak), with the system of protection against water losses (Obrii, Mironovskaya ostistaya), and with the system of resistance to desiccation (Obrii, Odesskaya 117). Revealed correlations between the productivity and the display of various drought resistance systems allowed to draw a conclusion on the possibility to develop high-productive genotypes combining various biologic mechanisms of drought resistance.

1877 Loeb, TA.; Reynolds, TL. (1994) TRANSIENT EXPRESSION OF THE UIDA GENE IN POLLEN EMBRYOIDS OF WHEAT FOLLOWING MICROPROJECTILE BOMBARDMENT. *Plant Science. 104(1):81-91.* English. [UNIV N CAROLINA DEPT BIOL CHARLOTTE, NC 28223 USA].

Transient GUS expression levels in microprojectile bombarded, microspore-derived embryoids of bread wheat (Triticum aestivum cv. Pavon) were evaluated when varying the stage of embryoid development, time in culture, type of promoter, and other physical parameters. GUS expression was histochemically measured 48 h after delivery of the uidA gene. The maize ubiquitin 1 promoter provided a higher level of GUS expression than the CaMV 35S or pollen-specific Zm13 promoters. The stage of embryogenic development had little effect on transient expression up to 10 weeks in culture, after which efficiency dropped off dramatically. The source of calcium used to precipitate the DNA onto microcarriers had a profound influence and GUS expression was enhanced significantly when the calcium solution was at pH 10. Bombardment did not inhibit regeneration and GUS expression could be detected in embryoids producing roots, stems, and leaves 21 days after transformation. These results show that this system is useful for transient expression assays and suggests that the stable transformation of wheat using microspore-derived embryoids may be a practical alternative to methods involving prolonged tissue culture and regeneration from undifferentiated callus cultures. [References: 29].

1878 Luthra, J.K.; Prabhu, K.V.; Verma, R.P.S. (Indian Agricultural Research Institute Shimla (India). Regional Station) (1994) **HS 277 wheat is suitable for northern hills.** *Indian Farming (India) v. 44(5) p. 3-4.* 4 tables; 1 ill., English. (AGRIS 95-033585).

1879 Lutz, J.; Hsam, SLK.; Limpert, E.; Zeller, FJ. (1995) CHROMOSOMAL LOCATION OF POWDERY MILDEW RESISTANCE GENES IN TRITICUM AESTIVUM L (COMMON WHEAT) .2. GENES PM2 AND PM19 FROM AEGILOPS SQUARROSA L. *Heredity. 74(Part 2):152-156.* English. [TECH UNIV MUNICH INST PFLANZENBAU & PFLANZENZUCHTUNG D-85350 FREISING GERMANY].

Two mildew resistant accessions of diploid Aegilops squarrosa and their hexaploid synthetics derived from crosses with mildew susceptible Triticum durum cultivars were tested with differential isolates of Erysiphe graminis f. sp. tritici and their responses were compared with the response patterns of 16 wheat cultivars or lines possessing known mildew resistance genes. Resistance in the A. squarrosa accession 'Braunschweig BGRC 1458' was conditioned by the dominant gene Pm2. This gene confers the same response pattern with a set of mildew isolates when present at the diploid species level or in a hexaploid synthetic with T. durum. It was located on wheat chromosome 5D. The resistance gene in the A. squarrosa accession 'Gatersleben AE 457/78' showed a different response pattern in the hexaploid synthetic line 'XX 186' tested with mildew isolates compared with that of the diploid. Its response pattern was also different from all other wheats with named genes for resistance to powdery mildew. The gene, localized on chromosome 7D in the synthetic 'XX 186', was designated Pm19. [References: 35].

1880 Maas, C. (Max Plank Institut fuer Zuechtungsforschung, Koeln (Allemagne)); Reichel, C.; Schulze, S.; Matzeit, V.; Schell, J.; Steinbiss, H.H. (1992) **[Modular structure of monocotyledons expression vectors: a novel stimulatory element combined with Sh 1 intron 1]. Structure modulaire de vecteurs d'expression: un nouvel element de stimulation combine avec les sequences Sh 1 intron 1.** Biotechnologies'92. Rencontres internationales en Picardie. Impacts technologiques et facteurs limitants des transformations genetiques vegetales; Compiegne (France); 2-3 Dec 1992. *[Biotechnologies'92. International meeting in Picardie.] Technological impacts and limiting factors of plant genetic transformation. Compiegne (France), December 2-3, 1992. Biotechnologies'92. Rencontres internationales en Picardie. Impacts*

technologiques et facteurs limitants des transformations genetiques vegetales. Compiegne (France), 2-3 decembre 1992. Biopole Vegetal, Amiens (France) p. 78-88. Biopole Vegetal. 43 ref. English. (AGRIS 95-022925).

1881 Maheshwari, N.; Rajyalakshmi, K.; Baweja, K.; Dhir, SK.; Chowdhry, CN.; Maheshwari, SC. (1995) **IN VITRO CULTURE OF WHEAT AND GENETIC TRANSFORMATION - RETROSPECT AND PROSPECT** [Review]. *Critical Reviews in Plant Sciences. 14(2):149-178.* English. [UNIV DELHI DEPT PLANT MOLEC BIOL SOUTH CAMPUS DELHI 110007 INDIA].

This review focuses on the improvement of wheat (Triticum aestivum L.) via tissue and cell culture and its use in gene transfer techniques. Success of the latter critically depends on the ability to regenerate plants from cells or tissues cultured in vitro. Hence, we have devoted attention to the attempts made so far in obtaining regenerants from diverse explants. Although it is known that immature embryos are the best source for initiating morphogenic cultures, basic information related to the process of differentiation can also be gained by studying less responding tissues. The opportunity provided by anther and microspore culture in wheat improvement and the progress made is also presented. To enhance tissue culture responses, identification of chromosomes, gene loci, and genes is of cardinal importance. We have also surveyed the progress made in this regard by conventional but incisive plant-breeding techniques. Gene rearrangements in tissue culture leading to the appearance of somaclonal or gametoclonal variation are of interest in selection of useful cell lines. The last part of the review is devoted to work done on transient gene expression and transformation with emphasis on recent developments. [References: 306].

1882 Mann, C.E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Bangkok (Thailand). Southeast Asia Program) (1994) **Early vigor in wheat: A useful character for heat tolerance selection.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 247-250.* CIMMYT. 2 tables; 14 ref. English. (AGRIS 95-022909).

Many traits have been reported in the literature as contributing to heat tolerance 0. They are grouped into three categories: 1) easy to screen in breeding nurseries, 2) easy to screen but requiring special effort, and 3) unsuitable for mass screening because of high lab or greenhouse requirements. In the first group, visual assessment of early vigor is considered highly underused by breeders in hot environments as it integrates over a range of the less visible group 2 and group 3 factors (i.e., seminal root length, coleoptile length, leaf appearance rate, days to double ridge, terminal spikelet, low shoot/root ratio, and area of first leaf) that are of increased relevance under heat. In two experiments in Thailand phenotypic correlations of early vigor are highly significant with grain yield (.51 and 0.68), biomass (.80 and 0.79), heads/square m (.80 and 0.56), days to anthesis (ns and -.34), days to maturity (ns and -.37), and plant height (.50 and 0.46).

1883 Mann, C.E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Bangkok (Thailand). Southeast Asia Program) (1994) **Seven years of hot climate wheat screening nurseries: 1985-91.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 40-47.* CIMMYT. 9 tables; 1 ref. English. (AGRIS 95-022899).

For seven years the Hot Climate Wheat Screening Nursery served as a supplement to CIMMYT International Nurseries for exchange of wheat germplasm between breeders in hot environments. Even though testing was not the original objective, yields and frequencies of selected entries have identified suitable germplasm, useful countries of origin, and aspects for further development of heat tolerant material.

1884 Marshall, D.; Gardenhire, JH.; Sutton, RL.; Rooney, LW.; Lazar, MD.; Mcdaniel, ME.; Nelson, LR.; Worrall, WD. (1995) **REGISTRATION OF TAM 300 WHEAT.** *Crop Science. 35(2):593-594.* English. [TEXAS A&M UNIV CTR RES & EXT 17360 COIT RD DALLAS, TX 75252 USA].

1885 Martinez Santana, Jose de Jesus; Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Determining the yield contribution of a rye chromosome segment in wheat varieties at 4 levels of nitrogen fertilization: Yaqui valley, Sonora (Mexico)]. Determinacion de la contribucion del rendimiento de un segmento de cromosoma de centeno en variedades de trigo, bajo 4 niveles de fertilizacion nitrogenada, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 18. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 18. Spanish. (AGRIS 95-023069).

1886 Mccaig, TN.; Clarke, JM. (1995) **BREEDING DURUM WHEAT IN WESTERN CANADA - HISTORICAL TRENDS IN YIELD AND RELATED VARIABLES.** *Canadian Journal of Plant Science. 75(1):55-60.* English. [AGR CANADA RES BRANCH RES STN SWIFT CURRENT SK S9H 3X2 CANADA].

Canadian durum wheat (Triticum turgidum L.) production is centred in the Brown and Dark Brown soil zones, areas of limited rainfall. For more than 50 yr, lines have been evaluated in the multi-location Durum Cooperative Test. Data from this lest, over the period 1947-1992, were analyzed with the objectives of determining the advances that have been made within the Canada Western Amber Durum (CWAD) wheat class and comparing yield-related variables of recently registered cultivars with those of earlier cultivars. Canadian-developed cultivars have increased yields about 0.81% yr(-1) relative to Hercules, or approximately 22.6 kg ha(-1) yr(-1). As kernel weight has remained unchanged, the genetic yield increases have resulted entirely from an increase in the number of kernels produced. Because kernel number is determined prior to, and during, anthesis, further yield increases may depend upon selection of genotypes that produce higher numbers of kernels, thereby increasing sink demand. While plant height and hectolitre weight have been decreasing over time, neither variable was significantly ($P < 0.05$) correlated with the yield increases that have taken place over the 29-yr period. The selection pressure toward shorter cultivars may have involved other agronomic advantages, such as decreased lodging. Days to maturity did not change significantly over time and was not correlated with yield. [References: 15].

1887 Meenakumar, K.V.S.; Singh, D.V.; Srivastava, K.D. (Indian Agricultural Research Institute, New Delhi (India). Division of Mycology and Plant Pathology) (1994) **Relative tolerance of wheat cultivars to leaf rust and components responsible for yield losses.** *Indian Phytopathology (India) v. 47(1) p. 48-55.* 4 tables; 21 ref. English. (AGRIS 95-033584).

1888 Mihm, J.A. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Maize Program) (1994) **Using sources of multiple insect and disease resistance.** *The CIMMYT maize germplasm bank: Genetic resource preservation, regeneration, maintenance, and use. Taba, S. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Maize Program) p. 37-40.* CIMMYT. 10 tables. English. (AGRIS 95-022997).

1889 Mihm, J.A.; Deutsch, J.A.; Jewell, J.; Hoisington, D.; Gonzalez de Leon, D. (Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico, DF (Mexico). Programa de Maiz) (1994) **Improving maize with resistance to major insect pests.** *Stress tolerance breeding: Maize that resists insects, drought,low nitrogen, and acid soils. Edmeades, G.O.; Deutsch, J.A. (eds.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz) p. 1-20.* CIMMYT. 7 tables; 3 graphs., 6 ref. English. (AGRIS 95-023000).

The aim of this work was to identify and improve germplasm complexes with high levels of resistance to the major maize stem borer and army-worm pests. Deliberate attention was given to developing germplasm with multiple pest resistance and, to the extent possible, good agronomic characters. Our initial guide for success was to evaluate resistance levels will be assessed toward the end of the project by comparing initial and later cycles of selection.

1890 Milus, E.A. (1993) **Leaf rust, septoria leaf blotch and fungicide effects on wheat.** *Arkansas farm research (USA) v. 42(6) p. 3-5.* references. English. (AGRIS 95-033579).

1891 Molnar, SJ.; Mckay, A. (1995) **RESTRICTION FRAGMENT ANALYSIS OF HORDEIN GENES IN WESTERN CANADIAN TWO-ROWED BARLEYS.** *Canadian Journal of Plant Science. 75(1):191-193.* English.

[AGR & AGRIFOOD CANADA CTR PLANT RES CENT EXPTL FARM OTTAWA ON K1A 0C6 CANADA].

Restriction fragment length polymorphisms (RFLP) at the hordein loci were compared with hordein protein patterns for discrimination of barley cultivars. RFLP banding patterns documented extensive polymorphism for B and C hordein gene families in eight closely related western Canadian two-rowed barley cultivars, five parental cultivars and a U.K. cultivar. RFLP results were compared with published protein pattern data on the same cultivars. The power to discriminate cultivars by the two methods is similar. [References: 9].

1892 Moolsri, S. (Rice Research Institute, Chiang Mai (Thailand). Samoeng Upland Rice and Temperate Cereal Experiment Station) (1994) **Wheat breeding program in Northern Thailand.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 236-238.* CIMMYT. 2 tables; 2 ref. English. (AGRIS 95-023087).

Wheat experiments were first conducted in northern Thailand in 1934. Research, particularly breeding, has continued until the present. Most materials, until recently, have been introduced from the CIMMYT and regional National Programs as advanced lines and segregating populations. In 1983, the Rice Research Institute released two bread wheat varieties for northern Thailand, Samoeng 1 and Samoeng 2. In 1987, the Rice Research Institute released two additional bread wheat varieties, Fang 60 and Phrae 60. Wheat yields in farmers' fields are low, about 0.6-0.7 t/ha, although the yields on experimental stations are higher. We have recognized that there are two distinct environments under which farmers may grow wheat in northern Thailand-rainfed upland and irrigated lowland. With this in mind, we have changed our breeding objectives from broad adaptation to specific adaptation towards these two differing environments.

1893 Mori, S. (Tokyo Univ. (Japan). Dept. of Agricultural Chemistry); Okumura, N.; Nakanishi, H.; Umehara, Y.; Chino, M.; Nishizawa, N.K. (1993) **Expression of a gene (Ids2) induced by Fe deficiency treatment in the roots of Hordeum vulgare L.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 135-138.* 7 ref. English. (AGRIS 95-022930).

1894 Mornhinweg, DW.; Porter, DR.; Webster, JA. (1995) **REGISTRATION OF STARS-9301B BARLEY GERMPLASM RESISTANT TO RUSSIAN WHEAT APHID.** *Crop Science. 35(2):603.* English. [USDA ARS 1301 N WESTERN ST STILLWATER, OK 74075 USA].

1895 Mosaad, M.G. (International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo (Syria)); Ortiz Ferrara, G.; Nachit, M.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Aleppo (Syria). Wheat Program) (1994) **Role of photoperiod and vernalization in the adaptation of wheat under heat and moisture stresses.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 146-152.* CIMMYT. 6 tables; 13 ref. English. (AGRIS 95-023086).

Breeding for earliness while maintaining stabilized productivity of wheat is a major concern of plant breeders, especially for its important escape mechanism from terminal heat and drought stresses, and for cropping intensification. Vernalization requirement, photoperiod response, and temperature are the main determining factors in crop earliness. Four bread wheat (BW) and four durum wheat (DW) genotypes were evaluated for their responsiveness to vernalization, photoperiod, and heat stress under field conditions. A plastic house screening technique was evaluated for its suitability to differentiate drought resistance traits. The basal vegetative period of the six insensitive cultivars to photoperiod (P) and vernalization (V) was approximately the same as their days to heading under heat stress field conditions. The P-insensitive and V-sensitive BW cultivar Dorghal headed very late, while P- and V-sensitive DW cultivar Kabir 1 failed to reach heading stage under heat stress field conditions. Grain yield under the driest regime was closely and positively correlated with biological yield, kernels/spike, main stem grain yield, and water use efficiency (in relation to grain and biological yield). This supports the view that selection for these traits under drought conditions will be efficient for developing high yielding cultivars for moisture-limited areas.

1896 Nedel, JL. (1994) **GENETIC IMPROVEMENT ON GRAIN YIELD OF WHEAT CULTIVARS RELEASED BETWEEN 1940 AND 1992.** *Pesquisa Agropecuaria Brasileira. 29(10):1565-1570.* Portuguese. [UNIV FED PELOTAS FAC AGRON DEPT FITOTECN CAIXA POSTAL 354 BR-96001970 PELOTAS RS BRAZIL].

In 1992 and 1993, at the National Wheat Research Center (CNPT-EMBRAPA), this study was carried out to evaluate the genetic improvement of wheat (Triticum aestivum, L.) cultivars. Fifteen genotypes released between 1940 acid 1992 were evaluated on two nitrogen levels. Linear regression of grain yield means on number of years elapsed since 1940, showed increases of 17 kg/ha(-1)/year(-1) in grain yield, and the newer genotypes showed to be more responsive to higher nitrogen fertilization. The newer genotypes showed a slight increase in the biological yield over the old ones, but the harvest index contributed with 83.6% of the overall yield. There was a significant and positive correlation between grain yield, spikes/m(-2), grain/spike(-1), biological yield and plant dry weight at anthesis. The newer genotypes were shorter in height and grain filling period and had a longer emergence-anthesis period.

1897 Nogues, S.; Alegre, L.; Araus, JL.; Perezaranda, L.; Lannoye, R. (1994) **MODULATED CHLOROPHYLL FLUORESCENCE AND PHOTOSYNTHETIC GAS EXCHANGE AS RAPID SCREENING METHODS FOR DROUGHT TOLERANCE IN BARLEY GENOTYPES.** *Photosynthetica. 30(3):465-474.* English. [UNIV BARCELONA DEPT BIOL VEGETAL UNITAT FISIOL VEGETAL DIAGONAL 645 E-08028 BARCELONA SPAIN].

Determination of modulated chlorophyll fluorescence coupled to measurements of the net photosynthetic rate (P(N)) and leaf water potential has been assessed as a screening method to score a set of twenty genotypes of barley (Hordeum vulgare L.) for drought tolerance. These methods can be used as rapid screening tests for water stress tolerance in barley, although applied alone they are appropriate indicators for a severe water stress. For genotypes growing under a mild water stress, it is necessary to use several screening tests simultaneously. Drought tolerant genotypes show smaller variations of photochemical quenching, P(N), water use efficiency and leaf temperature than the drought sensitive ones. [References: 25].

1898 Obando, M.; Urbina, R. (Centro Nacional de Investigacion en Granos Basicos (CNIGB), Managua (Nicaragua). Programa de Maiz) (1993) **[Response of Population 76 full-sib families to maize stunt]. Reaccion de familias de hermanos completos de la poblacion 76 al achaparramiento de maiz.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 73-75.* Programa Regional de Maiz (PRM). 3 tables; 4 ref. Spanish. (AGRIS 95-022990).

1899 Ortiz Ferrara, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Aleppo (Syria). Regional Program; ICARDA, Aleppo (Syria)); Rajaram, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program); Mosaad, M.G. (International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo (Syria)) (1994) **Breeding strategies for improving wheat in heat-stressed environments.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 24-32.* CIMMYT. 7 tables; 17 ref. English. (AGRIS 95-022898).

Wheat has the largest cultivation area among crop plants. Traditionally, wheat has been grown at low latitudes only in high-altitude (more than 1000 m) environments (e.g., Central Mexico, Ecuador, Kenya). During the last several years, there has been interest in wheat as an irrigated winter crop in tropical environments. Terminal heat stress is a common abiotic factor responsible for reducing yields in certain areas of West Asia and

North Africa. There is a need to identify heat-tolerant germplasm and suitable agronomic practices for those stressed areas. This paper describes two current breeding strategies for improving wheat in heat-stressed environments. We discuss the genetic variability for heat tolerance, update the progress that has been made in breeding for tolerance to this abiotic stress, and point out some of the current empirical and analytical criteria being applied in the CIMMYT and CIMMYT/ICARDA wheat breeding programs.

1900 Ortiz, J.; Navarro, F. (Centro Sur de Desarrollo Agropecuario (CESDA), San Cristobal (Republica Dominicana). Programa de Maiz y Sorgo) (1993) **[Improving Populations 36 and CESDA-88 for stunt resistance, 1992-93]. Mejoramiento genetico de las poblaciones 36 y CESDA-88 para resistencia al achaparramiento 1992-1993.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 79-81.* Programa Regional de Maiz (PRM). 4 tables; 1 graph., 5 ref. Spanish. (AGRIS 95-033467).

1901 Ortiz, J.; Navarro, F.; Celado, R. (Centro Sur de Desarrollo Agropecuario (CESDA), San Cristobal (Republica Dominicana). Programa de Maiz y Sorgo) (1993) **[Improving cycle 4 of Population 36 for stunt resistance]. Mejoramiento genetico del ciclo 4 de la Poblacion 36 para resistencia al achaparramiento.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 76-78.* Programa Regional de Maiz (PRM). 2 tables; 8 ref. Spanish. (AGRIS 95-033466).

1902 Ortiz, J.; Navarro, F.; Celado, R.; Pierre, R.; Guerra, F. (Centro Sur de Desarrollo Agropecuario (CESDA), San Cristobal (Republica Dominicana). Programa de Maiz y Sorgo) (1993) **[Evaluating and improving yellow maize (Zea mays L.) cultivars for stunt]. Evaluacion y mejoramiento de cultivares amarillos de maiz (Zea mays L.) para achaparramiento.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 82-82.* Programa Regional de Maiz (PRM). 5 tables; 3 ref. Spanish. (AGRIS 95-033468).

1903 Owuoche, J.O.; Mwangi, H.; Ooro, P.; Lelo, T. (National Plant Breeding Research Center (NPBRC), Njoro (Kenya)) (1994) **Characterization of Kenyan wheat (Triticum aestivum L.) cultivars for tolerance to acidic soil.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 310-311.* CIMMYT. English. (AGRIS 95-023102).

Pot experiments were conducted to screen Kenyan wheat (Triticum aestivum L 0.) genotypes on an acidic Ferralsol (pH 4.1 KCl) on the basis of root weight (RW) and shoot weight (SW). In the first experiment, cvs. Mbuni, K. Nyumbu, Kwale and Paka showed significantly higher mean RW 20 days after sowing, while the lowest root weights were observed on cvs. K. Leopard and Paa. In the second experiment, the main toxicity symptom observed was chlorosis on the first and the second leaves of cultivars Mbuni and Paa. However, symptoms on cv. Paa were also noted for the treatments with 4.15, 8.30, 12.45, and 16.6 meq CACO3/100 g soil, suggesting its sensitivity to acidic soil. Significant (P minus than 0.01) effects due to lime on SW and RW were observed on cv. Mbuni (tolerant) and Paa (sensitive). In addition, significant (P minus than 0.01) cultivar effects were observed for RW indicating differences in root weight between cultivars. At the rate of 8.30 meq/100 g soil (6.9 t/ha), cv. Mbuni increased RW by 150 per cent of the control compared to a 250 per cent increment observed on Paa. At the rate of 29.05 meq CACO3/100 g soil (24.1 t/ha), cv. Paa was capable of increasing RW by 300 per cent of the control while cv. Mbuni increased RW by 83.3 per cent. The result indicated that cv. Paa was sensitive to acidic Ferrolic soils. Moreover, the two cultivars tested required different rates of lime to correct soil acidity. From the symptoms observed, toxicity emanating from the acidic soil could be due to manganese (Mn).

1904 Pandey, S.; Ceballos, H.; Granados, G.; Knapp, E. (Centro Internacional de Mejoramiento de Maiz y Trigo, Mexico, DF (Mexico). Programa de Maiz) (1994) **Developing maize that tolerates aluminum toxic soils.** *Stress tolerance breeding: Maize that resists insects, drought,low nitrogen, and acid soils. Edmeades, G.O.; Deutsch, J.A. (eds.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz) p. 85-92.* CIMMYT. English. (AGRIS 95-023002).

1905 Pavlova, N.A. (1993) **[On effectivity of a complex use of experimental mutagenesis [gamma-rays] and hybridization in the winter wheat breeding]. Ob ehffektivnosti sovmestnogo ispol'zovaniya ehksperimental'nogo mutageneza i gibridizatsii v selektsii ozimoj pshenitsy.** *Sel'skokhozyajstvennaya biologiya. Seriya Biologiya rastenij (Russian Federation) (no.5) p. 71-78.* 7 ref. Russian. (AGRIS 95-033591).

The possibilities of a complex use of hybridization and radiation in the soft winter wheat breeding for the increase of the frequency of promising forms has been studied. The genotypical variability in the seed set, the germination level and the survival of plants has been shown on the basis of the family and individual analysis of parental varieties and F1 hybrids grown in various ecological zones. It has been shown that by the hybridization, the radiation affects the frequency of promising forms, the type of this effect being modified both by the growth regime for F1 and the ecological zone where the breeding evaluation of the material had been performed. Various reaction of the hybrid and non-hybrid material (the F1 and P1 preembryos, respectively) on the radiation which could be observed by the frequency of promising forms has been shown.

1906 Peacock, J.M. (International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo (Syria)); Mahalaksmi, V. (International Crops Research Institute for Semi Arid Tropics (ICRISAT), Patancheru (India)); Ortiz Ferrara, G. (Centro Internacional de Mejoramiento de Maiz y Trigo, (CIMMYT), Aleppo (Syria). Wheat Program); Howarth, C.J. (Institute of Grassland and Environmental Research (IGER), Aberystwyth (United Kingdom)); Nachit, M.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Aleppo, (Syria). Wheat Program); Hamblin, J. (International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo (Syria)) (1994) **Physiologists' approaches to screening for high temperature tolerance in cereals: The Indian experience.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 158-169.* CIMMYT. 1 map; 1 table; 4 graphs., 39 ref. English. (AGRIS 95-022843).

In India, although wheat production has been expanding by around 2.5-3.0 per year, there has been a dramatic shift from rainfed to irrigated wheat; of the total area the share of rainfed wheat land has decreased from 67 in 1961 to 25 in 1986,or from around 9 million hectares in the early 1960s to 6 million by 1984. However, this area, along with Turkey, is still the largest in the world. The wheat, which is sown in the post-rainy (rabi) season, depends largely on residual water. Its productivity and stability depend on the development of material that is able to germinate well. To ensure good germination, farmers tend to plant in late October or even later because the high soil surface temperatures earlier in the season severely reduce germination and establishment. However, when sowing is delayed, the valuable water, which is lost from the profile, is not available to the plant. The problem is, therefore, very clear: to develop germplasm that will germinate at the high soil temperatures that prevail at the onset of the rabi season. A proven method of improving crop establishment under high soil

temperatures in India is described A laboratory method that simulates this field heat damage and can be used to verify the field performance of selected genotypes is also described The importance of an integrated approach using techniques as diverse as field screening and molecular biology for the understanding and improvement of wheat under heat stress is emphasized In conclusion, the authors outline what the future approach of physiologists and breeders could be at ICARDA for these hot marginal regions.

1907 Pecetti, L.; Boggini, G.; Gorham, J. (1994) **PERFORMANCE OF DURUM WHEAT LANDRACES IRE A MEDITERRANEAN ENVIRONMENT (EASTERN SICILY).** *Euphytica. 80(3):191-199.* English. [IST SPERIMENTALE COLTURE FORAGGERE VIALE PIACENZA 29 I-20075 LODI ITALY].

The evaluation aimed at identifying landrace genotypes adapted to the rather unfavourable growing conditions of durum wheat in Sicily, to be used as parental material in a breeding programme. The trial was carried out in three seasons experiencing varying climatic conditions, and included 75 landraces, 25 of which were selected under severe drought in Syria. Wide differences were observed for most traits among genotypes and seasons of evaluation. Yields of the best performing entries identified in each season never significantly differed from that of the best check variety. The top-yielding landraces were consistently better than the remaining entries for the three yield components, viz. number of spikes per plant, number of kernels per spike and mean kernel weight. In the driest season they were also significantly earlier in heading, confirming the importance of earliness under drought. An analytical breeding approach relying on an array of morpho-physiological traits as selection criteria did not seem appropriate for the given environment, as the variable stress level enhanced the importance of specific traits under specific situations. The genotypic response was largely season-specific. Nonetheless, five landraces were in the best group in all seasons. The selection made in Syria also appeared somewhat effective in Sicily, particularly in the less favourable seasons. [References: 24].

1908 Perez, C.; Larios, L.; Queme, J.L.; Fuentes, M.; Castellanos, S. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Evaluating yellow maize lines in six environments of Central America, 1992]. Evaluacion de lineas de maiz de grano amarillo en seis ambientes de Centro America, 1992.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 61-62.* Programa Regional de Maiz (PRM). 2 tables; 1 ref. Spanish. (AGRIS 95-022987).

1909 Peterson, CJ.; Allan, RE.; Morris, CF.; Miller, BC.; Moser, DF.; Line, RF. (1995) **REGISTRATION OF ROD WHEAT.** *Crop Science. 35(2):594.* English. [WASHINGTON STATE UNIV USDA ARS WHEAT GENET QUAL PHYSIOL & DIS RES UNIT 201 JOHNSON HALL PULLMAN, WA 99164 USA].

1910 Pinto, J.M. (National Plant Breeding Research Center (NPBRC), Njoro (Kenya)) (1994) **Screening of Kenyan wheat (Triticum aestivum L.) varieties with two races of stripe rust (Puccinia striiformis).** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 308.* CIMMYT. English. (AGRIS 95-023101).

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

1911 Pixley, A.L.; Calderon, C.A. (Ministerio de Agricultura y Ganaderia, San Jose (Costa Rica). Estacion Experimental Los Diamantes); Salas, C.A.; Jimenez, K. (Universidad de Costa Rica, San Jose (Costa Rica). Programa de Cereales. Estacion Experimental Fabio Baudrit M.) (1993) **[Evaluating the third cycle of recurrent selection in two maize populations (Zea mays L.) for ear rot tolerance]. Evaluacion del tercer ciclo de seleccion recurrente en dos poblaciones de maiz (Zea mays L.) para tolerancia a pudricion de mazorca.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 85-88.* Programa Regional de Maiz (PRM). 4 tables; 12 ref. Spanish. (AGRIS 95-022991).

1912 Queme, J.L.; Perez, C.; Larios, L.; Fuentes, M.; Castellanos, S. (Instituto de Ciencia y Tecnologia Agricolas (ICTA), Ciudad de Guatemala (Guatemala). Programa de Maiz) (1993) **[Selecting white maize (Zea mays L.) lines across six locations in Central America, 1992]. Seleccion de lineas de grano blanco de maiz (Zea mays L.) a traves de seis localidades en Centro America, 1992.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 57-60.* Programa Regional de Maiz (PRM). 3 tables; 1 graph., 2 ref. Spanish. (AGRIS 95-022986).

1913 Razzaque, M.A.; Hossain, A.B.S.; Ahmed, S.M.; Sarkar, A.K.D.; Rahman, M.M.; Barma, C.D.; Amin, M.R. (Bangladesh Agricultural Research Institute, Dinajpur (Bangladesh). Wheat Research Centre) (1994) **Wheat breeding strategies in the rice farming system of Bangladesh.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 239-246.* CIMMYT. 2 tables; 1 graph., 17 ref. English. (AGRIS 95-023049).

The wheat breeding program in Bangladesh is designed to develop varieties suitable for farmers' situations in the rice-wheat system. Considerable emphasis has been given to high yield potential, disease resistance, and yield stability. Research in new areas such as tolerance to heat, drought, waterlogging, and sterility have been initiated. In addition, experiments for morpho-physiological trait identification for heat and drought tolerance and studies on root physiology and grain quality have begun. Sixteen varieties have been released so far for commercial cultivation. In 1992, two advanced lines were submitted to the National Seed Board for release as varieties. New varieties released by the Centre have 15 to 20 higher yield than the older ones. Nearly 100 of the country's wheat area is sown with recommended high yielding varieties.

1914 Redaelli, R.; Morel, MH.; Autran, JC.; Pogna, NE. (1995) **GENETIC ANALYSIS OF LOW M(R) GLUTENIN SUBUNITS FRACTIONATED BY TWO-DIMENSIONAL ELECTROPHORESIS (A-PAGEXSDS-PAGE).** *Journal of Cereal Science. 21(1):5-13.* English. [IST SPERIMENTALE CEREALICOLTURA VIA MULINO 3 I-20079 SAN ANGELO LODIGIANO ITALY].

Alkylated glutenin subunits of F-7 progenies from the cross between the Italian bread wheat cultivar Costantino and the Canadian cultivar Neepawa were fractionated by one-dimensional A-PAGE and SDS-PAGE and by two-dimensional A-PAGE x SDS-PAGE. Each gliadin allele at the Gli-1 loci of the parental cultivars was shown to be associated with a specific allele at each

of the Glu-3 loci, at which low M(r) glutenin subunits are encoded. The Glu-A3 locus was found to code for two low M(r) subunits in Neepawa and three in Costantino. In this latter cultivar, eight low M(r) subunits were assigned to each of the Glu-B3 and Glu-D3 loci, whereas seven subunits were attributed to the Glu-B3 locus and seven to the Glu-D3 locus in Neepawa. A-PAGE x SDS-PAGE can be employed for a detailed description of low M(r) subunits of glutenin in different cultivars following a genetic approach based on the correspondence between the alleles at the Gli-1 and Glu-3 loci. [References: 25].

1915 Rees, D.; Ruis Ibarra, L.; Acevedo, E.; Mujeeb Kazi, A.; Villareal, R.L. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Photosynthetic characteristics of synthetic bread wheats.** *CIMMYT Wheat Special Report (CIMMYT); no. 28 40 p.* CIMMYT. 23 tables; 2 graphs., 36 ref. English. (AGRIS 95-023083).

This wheat special report presents the first efforts at CIMMYT to alter wheat biomass by increasing maximum photosynthetic rate (Pmax). It seems there is potential for using synthetic hexaploids, developed by our wide crosses laboratory, as a "bridge" to transfer the higher photosynthetic rate found in the diploid ancestor, Triticum tauschii, to bread wheat. The results are not definitive, but they are encouraging and certainly point to exploring this route further. The chlorophyll a/b ratio is discussed as a potential screening tool for Pmax.

1916 Reynolds, M.P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Summary of data from the 1st and 2nd international heat stress genotype experiments.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 184-192.* CIMMYT. 10 tables; 17 ref. English. (AGRIS 95-022904).

The International Heat Stress Genotype Experiment (IHSGE) is designed to look closely at a small number of traits that seem to have potential value as predictors of yield at high temperature. The main objectives of the IHSGE include: 1) basic studies on plant characteristics, 2) developing faster screening methodologies for heat tolerance, and 3) increasing international cooperation. The target environment includes 50 countries currently importing more than 20 million tons of wheat per year. The hot environments studied seem to show some grouping. In particular, a number of sites show reasonable yield correlations with CIMMYT's hot dry environment at Tlaltizapan, Mexico. These are Sudan, India, and Brazil, while Syria and Thailand are clearly the environments most unlike the rest. Two physiological traits, canopy temperature and membrane thermostability, look promising and require further investigation and protocol development if they are to be incorporated into breeding programs.

1917 Roder, MS.; Sorrells, ME.; Tanksley, SD. (1995) **PULSED FIELD GEL ANALYSIS OF 5S AND SATELLITE DNA IN BARLEY.** *Genome. 38(1):153-157.* English. [INST PLANT GENET & CROP PLANT RES CORRENSSTR 3 D-06466 GATERSLEBEN GERMANY].

Pulsed-field gel electrophoresis was used to study the variability of clustered tandemly repeated sequences in barley. Twelve spring barley cultivars were investigated with a heterologous 5S DNA probe and the 118 base pair barley satellite DNA probe HVT01. On a per fragment basis, the 5S probe was 5 times and the barley satellite probe 6.7 times more variable than single-or low-copy RFLP markers, demonstrating their usefulness for cultivar distinction. [References: 27].

1918 Rowe, DE. (1995) **CHARACTERISTICS OF ELITE POPULATION SELECTED ON RATIO CRITERION .1. TRAITS WITH EQUAL GENETIC VARIANCES.** *Crop Science. 35(2):425-430.* English. [USDA ARS MISSISSIPPI STATE, MS 39762 USA].

In breeding, multiple trait selection is often a complex problem. One straightforward possibility when selecting for two traits is to base selection on the ratio of two trait values, particularly if the ratio has a biological or economic interpretation. In this study, selection was simulated on the ratio of two polygenically inherited Traits X and Y which were normally distributed and had genetic variances of one. The criterion for selection was the ratio (X/Y). The research objectives were to determine in the selected elite population (i) the responses of the numerator and denominator traits and the ratio, per se, to increasing selection pressure, (ii) the effect of genetic correlation between two traits on ratio selection, and (iii) the selection differentials of ratio trait for estimation of realized heritability. When the two traits had equal variances and means, selection to increase the ratio caused a greater decrease in the mean value of the denominator trait than an increase in the numerator trait. Conversely, selection to decrease the ratio always decreased the mean of the numerator trait more than it increased the denominator trait. For a highly negative genetic correlation (-0.75) between traits, the selection response of the ratio was maximized. When genetic correlation was 0.50 or 0.75, the response of one component trait was near zero. The standardized selection differential for the ratio trait, in comparison with the normally distributed trait, was biased upwards with selection for increased ratio and biased downwards with selection for decreased ratio. [References: 16].

1919 Rufyikiri, E. (ISABU, Bujumbura (Burundi)) (1993) **The impact of on-farm trials on the adoption of maize by farmers: The Burundese experience.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 338-343.* CIMMYT. 2 maps; 4 tables; 6 ref. English. (AGRIS 95-023004).

1920 Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico)) (1994) **Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems.** *Wheat in Hot, Dry, Irrigated Environments; Wheat in Warm Area, Rice-Wheat Farming Systems; Wad Medani (Sudan); Dinajpur (Bangladesh); 1-4 Feb 1993.* CIMMYT. Conference cont'd 13-15 Feb 1993. 402 p. English. (AGRIS 95-022896).

1921 Sheppard, J.A. (Queensland Dept. of Primary Industries, Toowoomba (Australia). Div. of Crop Science) (comp.) (1992) **Queensland wheat variety trials 1991 Queensland Wheat Research Institute, Toowoomba.** *Project Report - Queensland Department of Primary Industries (Australia); no. QO92012 84 p.* Department of Primary Industries. 2 fig., 40 tables. English. (AGRIS 95-033378).

Wheat cultivar trials were carried out by Queensland Dept. of Primary Industries during the 1991 winter growing season. Characteristics trialled were agronomic factors including time to maturity lodging, height, shattering and yield (in various parts of central and southern Queensland), disease reactions and quality characteristics.

1922 Songstad, DD.; Somers, DA.; Griesbach, RJ. (1995) **ADVANCES IN ALTERNATIVE DNA DELIVERY TECHNIQUES [Review].** *Plant Cell Tissue & Organ Culture. 40(1):1-15.* English. [PIONEER HI BRED INT INC 7300 NW 62ND AVE POB 1004 JOHNSTON, IA 50131 USA].

This review describes recent advances in alternative DNA delivery techniques with particular emphasis on silicon carbide fibers, intact tissue electroporation, electrophoresis and microinjection. The advantages/disadvantages of each method along with a historical overview and theory of practice are discussed. [References: 125].

1923 Stanko, SA. (1994) **INTENSE INTERRUPTED WHITE LIGHT AS A FACTOR OF INCREASED ADAPTIVE INTRODUCTION AND MUTAGENESIS OF THE WHEAT.** *Izvestiia Akademii Nauk SSSR. Seriia Biologicheskaia. (5):788-801.* Russian. [RUSSIAN ACAD SCI NN SEMENOV CHEM PHYS INST MOSCOW RUSSIA].

Illumination of seeds and apical meristems of short-day dwarf wheat by intense interrupted white light changes the adaptive basis of their photoperodic responsiveness and provides for adaptive introduction in regions with a long photoperiod. Intense interrupted while light activates structural-metabolic, photoenergetic and mutation processes and induced photodestruction and photoinactivation of the endogenous inhibitors and favors formation of photoinduced free radicals. Some free radicals form peroxide and hydroxyl radicals in the aqueous phase of cells, which a strong mutagens inducing point (genic) mutations. About 65% of morphogenetically constant highly productive photomutant forms having an improved quality of grain and well adapted to a long photoperiod have been selected in the 2nd - 5th generations. [References: 32].

1924 Sun, GL.; Yen, C.; Yang, JL.; Wu, BH. (1995) **PRODUCTION AND CYTOGENETICS OF INTERGENERIC HYBRIDS BETWEEN TRITICUM DURUM - DASYPYRUM VILLOSUM AMPHIDIPLOID AND PSATHYROSTACHYS HUASHANICA.** *Euphytica. 81(1):7-11.* English. [SICHUAN AGR UNIV TRITICEAE RES INST DUJIANGYAN 611830 PEOPLES REPUBLIC OF CHINA].

Intergeneric crosses between Triticum durum - Dasypyrum villosum (2n = 42, AABBVV), and Psathyrostachys huashanica (2n = 14, (NNh)-N-h) were made, the seed set was 1.67%. Intergeneric hybrid were successfully obtained by means of embryo culture for first time. The average chromosome pairing in the hybrid (ABVN(h)) was 26.61% univalents, and 0.69 bivalents. The chiasmata per cell was 0.69. The chiasmata was higher than that in Triticum durum dihaploid (AB), and lower than that in T. durum-Dasypyrum villosum trihaploid (ABV). The result indicated that the N-h genome of Psathyrostachys huashanica has no homology with the V genome of Dasypyrum villosum, and the A and B genomes of Triticum durum. The coenocytism, micronuclei cell and variation in chromosome numbers were also observed. The F-1 hybrid was crossed with Triticum aestivum (AABBDD), and resulted in seed set. The hybrid of T. durum - D. villosum amphidiploid x P. huashanica showed partial fertility. It made the possibility for chromosome manipulation among Triticum aestivum, Dasypyrum villosum and Psathyrostachys huashanica. [References: 21].

1925 Suzuki, T.; Nakamura, C.; Mori, N.; Kaneda, C. (1995) **OVEREXPRESSION OF MITOCHONDRIAL GENES IN ALLOPLASMIC COMMON WHEAT WITH A CYTOPLASM OF WHEATGRASS (AGROPYRON TRICHOPHORUM) SHOWING DEPRESSED VIGOR AND MALE STERILITY.** *Plant Molecular Biology. 27(3):553-565.* English. [KOBE UNIV GRAD SCH SCI & TECHNOL DIV BIOL RESOURCES NADA KU KOBE 657 JAPAN].

An alloplasmic hybrid (nucleus-cytoplasm hybrid) of common wheat (Triticum aestivum) with a cytoplasm of wheatgrass (Agropyron trichophorurz) shows highly depressed vigor and complete male sterility. The presence of one short-arm telocentric homeologous group 1 chromosome (telosome) of the cytoplasm donor, however, restores normal vigor and male fertility of the hybrid. To study role(s) of the telosome on vigor/fertility restoration, mitochondrial genome organization and gene expression were compared among seedlings of the alloplasmic line showing depressed vigor, the corresponding restored line having a pair of the telosomes, and a euplasmic nuclear donor as control. No differences were detected in the mitochondrial genome structure between the depressed line and the restored line. Northern blot analysis using ten mitochondrial genes as probes showed no differences in transcript size and number between the depressed and restored lines, although clear differences were found in size of the major transcripts of two genes (cob and orf25) between the alloplasmic lines and the euplasmic control. Steady-state transcript levels were higher in the depressed line than in the other lines for all the mitochondrial genes analyzed including rrn18&5 when the same amount of mitochondrial RNA was loaded. The amount of rrn18&5 transcript in the total cellular RNA, however, did not differ among the lines. Run-on transcription analysis demonstrated markedly elevated transcriptional activities of all the mitochondrial genes analyzed in the depressed line based on unit amount of mitochondrial DNA, RNA and protein. The presence of Agropyron telosomes apparently normalized the level of mitochondrial transcription. These observations suggest either direct or indirect association of the observed mitochondrial gene overexpression with the depressed vigor and male sterility of the alloplasmic hybrid. [References: 46].

1926 Tandon, J.P. (Wheat Research, Karnal, Haryana (India)) (1994) **National testing system, breeding strategies, and recent progress in wheat research for warmer area rice farming systems in India.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 251-256.* CIMMYT. 3 tables. English. (AGRIS 95-023050).

Wheat is grown in rotation with rice on more than 9 million hectares in India. A number of problems are associated with the system and its sustainability is feared to be under threat. The Indian wheat program divides the country into five main zones, differentiated mainly by latitude and altitude. Wheat varieties are developed for each of these zones. A national cooperative testing program is well developed The breeding objectives are to obtain varieties with high, stable yield, with resistance to diseases, particularly leaf and stem rusts and leaf blights, and tolerance to abiotic stresses. More specific varietal and management recommendations, based on the particular requirements of the rice-wheat cropping system, have recently been developed.

1927 Terada, R.; Nakayama, T.; Iwabuchi, M.; Shimamoto, K. (1995) **A TYPE I ELEMENT COMPOSED OF THE HEXAMER (ACGTCA) AND OCTAMER (CGCGGATC) MOTIFS PLAYS A ROLE(S) IN MERISTEMATIC EXPRESSION OF A WHEAT HISTONE H3 GENE IN TRANSGENIC RICE PLANTS.** *Plant Molecular Biology. 27(1):17-26.* English. [NARA INST SCI & TECHNOL PLANT MOLEC GENET LAB 8916-5 TAKAYAMA NARA 63001 JAPAN].

Type I element (CCACGTCACCGATCCGCG) is a well-conserved regulatory element found in proximal promoter region of a certain class of plant histone genes, that is composed of two independent cis-acting elements of the hexamer (ACGTCA) and the reverse-oriented octamer (GATCCGCG) motifs. To investigate functional role(s) of the type I element in regulation of a wheat histone H3 gene (TH012) promoter activity in vivo, base substitution mutations were introduced into the element and activities of the mutated promoters were examined in cultured rice cells, and in regenerated roots and anther walls of transgenic rice plants by employing a GUS reporter system. Mutations of each or both of the hexamer and the octamer motifs caused a reduction in the promoter activity in protoplasts transfected transiently or stably transformed calli. The mutation of the octamer motif with or without the mutation of the hexamer motif caused a marked reduction of the promoter activity in the root meristem of transgenic rice although the mutation of the hexamer motif alone caused a weak reduction. In contrast to these results, no effect of the mutations of either the hexamer or the octamer motif was found in the anther wall in which replication-independent activity of the H3 promoter was observed. Our results suggested that the hexamer and the octamer motifs may play important role(s) in regulation of replication-dependent but not of replication-independent expression of the wheat histone H3 gene. [References: 32].

1928 Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Managua (Nicaragua)) (1993) **[Evaluating white and yellow maize (Zea mays L.) hybrids in environments of Central America and Mexico]. Evaluacion de hibridos de grano blanco y amarillo de maiz (Zea mays L.) en ambientes de Centro America y Mexico.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 27-38.* Programa Regional de Maiz (PRM). 12 tables; 20 graphs., 6 ref. Spanish. (AGRIS 95-022983).

1929 Urbina, R.; Obando, M. (Centro Nacional de Investigacion en Granos Basicos (CNIGB), Managua (Nicaragua). Programa de Maiz); Aguiluz, A. (Centro Nacional de Tecnologia Agropecuaria (CENTA), San Salvador (El Salvador). Programa de Maiz); Alvarado, A. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama)) (1993) **[Stability and stunt response of maize cultivars across six environments of Central America]. Estabilidad y reaccion al achaparramiento de cultivares de maiz a traves de seis ambientes de Centro America.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 67-72.* Programa Regional de Maiz (PRM). 5 tables; 3 graphs., 9 ref. Spanish. (AGRIS 95-022989).

1930 Vaccino, P.; Metakovsky, EV. (1995) **RFLP PATTERNS OF GLIADIN ALLELES IN TRITICUM AESTIVUM L - IMPLICATIONS FOR ANALYSIS OF THE ORGANIZATION AND EVOLUTION OF COMPLEX LOCI.** *Theoretical & Applied Genetics. 90(2):173-181.* English. [IST SPERIMENTALE CEREALICOLTURA I-20079 SAN ANGELO LODIGIANO ITALY].

A correspondence between RFLP patterns and gliadin alleles at the Gli-1 and Gli-2 loci was established in a set of 70 common wheat (T.aestivum L.) cultivars using gamma-gliadin (K32) and alpha-gliadin (pTU1) specific probes. All Gli-B1 and Gli-D1 alleles which differed in encoded gamma-gliadins showed definite RFLP patterns after hybridization with the K32 probe. Two groups of Gli-B1 alleles, Gli-B1b-like and Gli-B1e-like, were identified, and these could originate from distinct genotypes of the presumptive donor of the B-genome. Intralocus recombination and/or gene conversion as well as small deletions, gene silencing and gene amplification were assumed to be responsible for the origin of new gliadin alleles. Silent gamma-gliadin sequences were shown to exist in all of the genotypes studied. K32 also differentiated Gli-A1a from all other Gli-A1 alleles as well as the Gli-B1l allele in cultivars carrying the 1B/1R (wheat/rye) translocation. pTU1 was shown to recognize several Gli-A2 alleles, but not the Gli-B2 or Gli-D2 alleles. Moreover, this probe hybridized to chromosome 1R sequences suggesting the existence of rye gene(s), probably silent, for alpha-gliadin-like proteins on chromosome 1R. [References: 40].

1931 Valenzuela Borbon, Jesus Rafael (1993) **[Evaluating 35 wheat materials (ENET): Mayo valley, Sonora]. Evaluacion de 35 materiales de trigo (ENET), en el Valle del Mayo, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 64-65. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 64-65. Spanish. (AGRIS 95-023072).

1932 Vandeynze, AE.; Dubcovsky, J.; Gill, KS.; Nelson, JC.; Sorrells, ME.; Dvorak, J.; Gill, BS.; Lagudah, ES.; Mccouch, SR.; Appels, R. (1995) **MOLECULAR-GENETIC MAPS FOR GROUP 1 CHROMOSOMES OF TRITICEAE SPECIES AND THEIR RELATION TO CHROMOSOMES IN RICE AND OAT.** *Genome. 38(1):45-59.* English. [CORNELL UNIV DEPT PLANT BREEDING & BIOMETRY 252 EMERSON HALL ITHACA, NY 14853 USA].

Group 1 chromosomes of the Triticeae tribe have been studied extensively because many important genes have been assigned to them. In this paper, chromosome 1 linkage maps of Triticum aestivum, T. tauschii, and T. monococcum are compared with existing barley and rye maps to develop a consensus map for Triticeae species and thus facilitate the mapping of agronomic genes in this tribe. The consensus map that was developed consists of 14 agronomically important genes, 17 DNA markers that were derived from known-function clones, and 76 DNA markers derived from anonymous clones. There are 12 inconsistencies in the order of markers among seven wheat, four barley, and two rye maps. A comparison of the Triticeae group 1 chromosome consensus map with linkage maps of homoeologous chromosomes in rice indicates that the linkage maps for the long arm and the proximal portion of the short arm of group 1 chromosomes are conserved among these species. Similarly, gene order is conserved between Triticeae chromosome 1 and its homoeologous chromosome in oat. The location of the centromere in rice and oat chromosomes is estimated from its position in homoeologous group 1 chromosomes of Triticeae. [References: 57].

1933 Vasal, S.K. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Maize Program) (1994) **The development of general purpose and hybrid-oriented source germplasm for the tropical lowlands.** *The CIMMYT maize germplasm bank: Genetic resource preservation, regeneration, maintenance, and use. Taba, S. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Maize Program) p. 21-24.* CIMMYT. 2 tables. English. (AGRIS 95-022995).

1934 von Wettstein, D. (Carsberg Laboratory, Copenhagen (Danemark). Department of Physiology) (1992) **[Genetic transformation of cereals in the breeding of grains for alternative uses of malting technology]. Transformation genetique des cereales par selection des graines en vue d'utilisations alternatives en malterie.** Biotechnologies'92. Rencontres internationales en Picardie. Impacts technologiques et facteurs limitants des transformations genetiques vegetales; Compiegne (France); 2-3 Dec 1992. *[Biotechnologies'92. International meeting in Picardie.] Technological impacts and limiting factors of plant genetic transformation. Compiegne (France), December 2-3, 1992. Biotechnologies'92. Rencontres internationales en Picardie. Impacts technologiques et facteurs limitants des transformations genetiques vegetales. Compiegne (France), 2-3 decembre 1992. Biopole Vegetal, Amiens (France) p. 47-55.* Biopole Vegetal. 40 ref. English. (AGRIS 95-022924).

1935 Vongburi, K. (Phrae Rice Research Center, Phrae (Thailand)) (1994) **Using phasic development differences in wheat to overcome heat stress in Northern Thailand.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 257-264.* CIMMYT. 2 tables; 5 graphs., 13 ref. English. (AGRIS 95-023051).

In Thailand wheat is grown during the cool and dry season from late October to late February following rice in the preceding hot and wet (monsoon) season, under either rainfed or irrigated production systems. The former, in highland and upland areas, is dependent on stored soil moisture reserves. Planting has to occur on selected soil types and under supra-optimal temperatures if grain development is to occur before soil moisture is depleted Under irrigated production, seeding has to be delayed until the harvest of the later flowering paddy rice. Temperatures are more favorable for wheat at that time although still above the optimum. Temperature increases after December, and together with a rapid increase in vapor pressure deficits, contribute to increasing environmental stress over the concluding stages of the life cycle. Based on the finding that the duration of the stem/ear growth and grain development periods are relatively constant over genotypes, location and seeding dates, it is possible to predict when the vegetative phase would have to occur and when maturity should occur. The duration of the vegetative phase varies with genotype and seeding date. With the exception of Chiang Rai, considered the most suitable environment for both production systems, the appropriate genotypes would include those that do not respond to vernalization and are intermediate in their basic vegetative period (BVP). At Phrae, considered to be marginal for either production system, genotypes combining a zero response to vernalization with a short vegetative period represent the only prospect.

1936 Wang, S. (1995) **ASSOCIATION OF THE CHLORINA GENE F3 WITH CHROMOSOME ARM 5S IN BARLEY.** *Journal of Heredity. 86(2):151-152.* English. [SEEDEX INC 1350 KANSAS AVE LONGMONT, CO 80501 USA].

A recessive chlorina gene f3 was previously associated with chromosome 5 by primary trisomic analysis. When f3 was subjected to telotrisomic analysis with line 5L, a disomic ratio was observed, indicating that this gene is not associated with the long arm of chromosome 5. In contrast, the genetic segregations of f3 in Triple 5S and Triple 5S(5L) fit trisomic ratios, clearly indicating that f3 is associated with the short arm of chromosome 5. The gene f3 is the first "good" conventional marker locus to be localized in the short arm of chromosome 5 since most of the genes so far mapped in 5S are powdery mildew resistance genes and hordein genes. [References: 15].

1937 Wedzony, M. (1992) **POLYTENIZATION IN THE ANTIPODAL NUCLEI OF WHEAT (TRITICUM-AESTIVUM L), TRITICALE (XTRITICOSECALE WITTM) AND THEIR RECIPROCAL CROSSES.** *Acta Biologica Cracoviensia Series Botanica. 34-5:43-57.* English. [AGR UNIV CRACOW DEPT PLANT BREEDING & SEED PROD GRODZKA 52 PL-31044 KRAKOW POLAND].

The antipodals of the mature embryo sacs of wheat (Triticum aestivum L.) and triticale (x Triticosecale Wittm.), as well as those of the embryo sacs developing after reciprocal cross pollination of these taxa were investigated. In a single embryo sac there were on average 14 antipodals in triticale and 18,5 in wheat. The endoreduplication cycles were stated in the antipodal nuclei. Before the pollination they led to a maximum degree of ploidy 8n in triticale and 16n in wheat. Within three days after the pollination a number of the antipodal nuclei reached 256n in the triticale female x wheat male cross and 512n in the reciprocal cross. The polytene chromosomes resulted from a gradual condensation of chromatin with the increasing degree of ploidy. They were the only type of the chromatin organization found in all the antipodal nuclei over 32 n degree of ploidy. In both crosses the first signs of disintegration of the antipodal apparatus were found three days after the pollination. At that time the cellularization of the initially coenocitic endosperm was starting in the triticale female x wheat male cross. By contrast, the latter process was withheld in the reciprocal cross, which together with other disturbances of the endosperm development

caused almost complete kernels sterility. The possibility of improper interaction of the mother derived antipodal apparatus with the hybrid endosperm was discussed.

1938 Wolfe, RI.; Faris, DG.; Davidson, JGN.; Clarke, PJ. (1995) **JACKSON BARLEY.** *Canadian Journal of Plant Science. 75(1):207-208.* English. [AGR & AGRIFOOD CANADA CTR FIELD CROP DEV BAG SERV 47 LACOMBE AB T0C 1S0 CANADA].

Jackson (Hordeum vulgare L.) is an early-maturing, hulled, six-row feed barley. It was developed at the Northern Agriculture Research Centre, Beaverlodge, Alberta from the cross BT607/Pomo. It is short in height, moderately strong strawed, and adapted to western Alberta and the Peace River region of British Columbia.

1939 Worland, AJ.; Appendino, ML.; Sayers, EJ. (1994) **THE DISTRIBUTION, IN EUROPEAN WINTER WHEATS, OF GENES THAT INFLUENCE ECOCLIMATIC ADAPTABILITY WHILST DETERMINING PHOTOPERIODIC INSENSITIVITY AND PLANT HEIGHT.** *Euphytica. 80(3):219-228.* English. [CAMBRIDGE LAB CTR JI COLNEY LANE NORWICH NR4 7UJ NORFOLK ENGLAND].

The adaptability of wheat varieties to precise environmental conditions is known to be influenced to a large extent by photoperiod sensitive genes determining ear emergence time and by the gibberelic acid insensitive dwarfing genes that are regularly used to reduce plant height. A range of European winter wheat varieties were examined to establish whether breeders in different countries have selected genotypes carrying allelic variants of photoperiodic and dwarfing genes that would be expected to provide the best levels of adaptability. In most areas modern cultivars were seen to carry the genotypes predicted to promote good levels of adaptability. Varieties cultivated in Germany however are still predominately of conventional height and late flowering lacking genes that would be expected to enhance adaptability and yield. [References: 26].

1940 Yang Zhuping (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Visiting Scientist) (1994) **Breeding for resistance to Fusarium head blight of wheat in the mid-to lower Yangtze River Valley of China.** *CIMMYT Wheat Special Report (CIMMYT); no. 27 16 p.* CIMMYT. 4 tables; 43 ref. English. (AGRIS 95-022895).

Fusarium head blight (FHB) of wheat or scab is an important fungal disease in many areas of the world, especially where humid moist conditions prevail from heading to maturity. It is a particularly troublesome disease in China where more than 6.7 million hectares of wheat are affected. primarily in the mid to lower Yangtze River Valley. In this special report, CIMMYT visiting scientist Yang Zhuping provides an overview of the effort in China to breed for FHB resistance. I believe the information will be of interest to those concerned with Chinese wheat research. An earlier installment in this series (Special Report No. 2: He and Chen 1991) provides an excellent general background about wheat and wheat breeding in China.

1941 Yau, SK. (1995) **REGRESSION AND AMMI ANALYSES OF GENOTYPE X ENVIRONMENT INTERACTIONS - AN EMPIRICAL COMPARISON.** *Agronomy Journal. 87(1):121-126.* English. [INT CTR AGR RES DRY AREAS GERMPLASM PROGRAM POB 5466 ALEPPO SYRIA].

Joint regression analysis (JRA) is a popular method for analyzing genotype x environment (G x E) interactions, but multivariate techniques such as AMMI (additive main effects and multiplicative interaction) analysis have been recently advocated, The objective of this study was to investigate and compare empirically the effectiveness of the two techniques under differing environmental diversity and numbers of environments, and when log-transformed data were used for JRA, I analyzed grain yield data from three seasons of a regional bread wheat (Triticum aestivum L.) yield trial, grown at 30 to 40 sites. Sites were split into irrigated-high rainfall and rainfed-low rainfall groups. Three equal-size samples differing in environmental diversity and three similar-diversity samples differing in numbers of sites were also formed. Both raw and log(10)-transformed data were used for JRA. The fitting made of the MATMODEL program (version 2.0) was used on raw data for AMMI analysis. Percentages of interaction sum of squares (SS) accounted for by heterogeneity of regression in JRA were generally low (mean = 11%) and unaffected by diversity of the samples, but inversely related to number of sites in the similar-diversity samples, In contrast, percentages of interaction SS accounted for by first principal components in AMMI analyses were generally high (mean = 37%) and unaffected by diversity or number of sites in the samples. These percentages were always higher for AMMI than for JRA, regardless of whether log-transformed data were used for JRA. The use of AMMI is recommended for detailed studies of G x E effects, especially for large regional or international trials. [References: 28].

1942 Zhong, GY.; Dvorak, J. (1995) **CHROMOSOMAL CONTROL OF THE TOLERANCE OF GRADUALLY AND SUDDENLY IMPOSED SALT STRESS IN THE LOPHOPYRUM ELONGATUM AND WHEAT, TRITICUM AESTIVUM L, GENOMES.** *Theoretical & Applied Genetics. 90(2):229-236.* English. [UNIV CALIF DAVIS DEPT AGRON & RANGE SC DAVIS, CA 95616 USA].

The facultatively halophytic Lophopyrum elongatum, closely related wheat, Triticum aestivum, and their amphiploid tolerate salt stress better if they are gradually exposed to it than if they are suddenly stressed. Lophopyrum elongatum has greater tolerance of both forms of salt stress than wheat, and its genome partially confers this tolerance on their amphiploid. Chromosomal control of the tolerance of both stress regimes in the L. elongatum and wheat genomes was investigated with disomic and ditelosomic addition lines and disomic substitution lines of L. elongatum chromosomes in wheat and with wheat tetrasomics. The tolerance of the sudden salt stress is principally controlled by L. elongatum chromosomes 3E and 5E and less by 1E, 2E, 6E, and 7E and the tolerance of gradually imposed salt stress principally by chromosomes 3E, 4E, and 5E, and less by chromosome 1E and 7E. Ditelosomic analysis indicated that genes conferring the tolerance of sudden stress are on chromosome arms IEL, 5ES, 5EL, 6EL, 7ES and 7EL and those controlling the gradual stress regime are on 1ES, 1EL, 5ES, 5EL, 6ES, 7ES, and 7EL. In wheat, chromosomes in homoeologous groups 1, 3, and 7 and chromosomes in homoeologous groups 1, 4, and 6 were shown to enhance the tolerance of suddenly and gradually imposed stress, respectively. The arms of chromosome 3E individually conferred tolerance to neither stress regime. Chromosome 2E and wheat chromosomes 2B and 2D reduce the tolerance of both stress regimes in a hyperploid state. In 2E this effect was associated with arm 2EL. A potential relationship between the tolerance of these stress regimes and the expression of the early-salt-induced genes is examined. [References: 25].

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1943 Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa Regional); Edmeades, G.O. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz) (1993) **[Maize phenology]. La fenologia del maiz.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 251-261.* Programa Regional de Maiz (PRM). 3 tables; 4 graphs., 22 ref. Spanish. (AGRIS 95-023664).

1944 Boudra, H.; Lebars, P.; Lebars, J. (1995) **THERMOSTABILITY OF OCHRATOXIN A IN WHEAT UNDER TWO MOISTURE CONDITIONS.** *Applied & Environmental Microbiology. 61(3):1156-1158.* English. [INRA PHARMACOL TOXICOL LAB F-31931 TOULOUSE FRANCE].

The decomposition of ochratoxin A (OTA) was examined, under different temperature and moisture conditions, The calculated half-lives, corresponding to 50% values, were 707, 201, 12, and 6 min, respectively, at 100, 150, 200, and 250 degrees C for dry wheat and 145, 64 and 19 min, respectively, at 100, 150, and 200 degrees C for wheat heated under wet conditions. The presence of water (50%) increased the decomposition of OTA at 100 and 150 degrees C; the opposite was observed at 200 degrees C. Complete destruction of OTA within the limits of this study (100 to 250 degrees C) was not obtained. [References: 20].

1945 Chapman, S.C. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz) (1993) **[Use of simulation models for studying phenological variation of CIMMYT maize germplasm: I. Variation in time and space]. Uso de modelos de**

simulacion para examinar la variacion fenologica del germoplasma de maiz de CIMMYT: I variacion en tiempo y espacio. *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 262-267.* Programa Regional de Maiz (PRM). 1 map; 2 tables; 4 graphs., 2 ref. Spanish. (AGRIS 95-023665).

1946 Chapman, S.C. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz) (1993) **[Use of simulation models for studying phenological variation of CIMMYT maize germplasm: II. Genetic variation]. Uso de modelos de simulacion para examinar la variacion fenologica del germoplasma de maiz de CIMMYT: II variacion genetica.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 268-272.* Programa Regional de Maiz (PRM). 2 tables; 2 graphs., 2 ref. Spanish. (AGRIS 95-023666).

1947 Conroy, JP.; Seneweera, S.; Basra, AS.; Rogers, G.; Nissenwooller, B. (1994) **INFLUENCE OF RISING ATMOSPHERIC CO2 CONCENTRATIONS AND TEMPERATURE ON GROWTH, YIELD AND GRAIN QUALITY OF CEREAL CROPS.** *Australian Journal of Plant Physiology. 21(6):741-758.* English. [UNIV WESTERN SYDNEY SCH HORT BOURKE ST RICHMOND NSW 2753 AUSTRALIA].

A possible scenario for the end of the 21st century is that the atmospheric CO2 concentration will be in the range of 510-760 mu L L(-1) and that the mean global temperature will be 1.5-4.5 degrees C higher. Further, there may be greater incidences of extreme climatic events, which together with the CO2 and temperature changes will influence development, growth and grain yield of cereals such as rice and wheat. For these C-3, plants, the driving force for the growth response to elevated CO2 is higher leaf CO2 assimilation rates (4). However, the response of A to CO2 depends on temperature with maximum absolute increases occuring at temperatures which do not cause flower abortion, while negligible increases are observed at low temperatures. At high temperatures, where A is reduced because of partial inactivation of photosynthetic enzymes, the increase in A due to CO2 enrichment is still observed. Other factors, such as changes in shoot water relations or hormone concentrations, may influence growth at elevated CO2 concentrations. Wheat and rice development is accelerated by high temperature and consequently grain yield is reduced because there is less time for radiation to be intercepted during the vegetative phase. Although high CO2 also accelerates development in rice and, to a lesser extent in wheat, the extra carbohydrate produced by increases in A results in at least a 40% increase in grain yield at temperatures which do not cause flower abortion. This is due mainly to increased tiller numbers rather than increases in the number or weight of individual grains. However, the yield enhancement due to high CO2 will not necessarily compensate for decreases in yield caused by accelerated development at high temperatures. As predicted by the response of A to high CO2, the relative increase in yield, due to rising CO2 concentrations, is smaller at lower temperatures. Elevated atmospheric CO2 may improve the tolerance of plants to heat-induced drought stress by facilitating the maintenance of cell volume and photosynthetic function in the leaves. Increased carbohydrate storage in the stems may also be an advantage during grain filling if the flag leaves senesce prematurely. However, it is unlikely that the effect of very high temperatures on newer abortion will be ameliorated by high CO2. For bread making, the quality of flour produced from grain developed at high temperatures is poorer. High CO2 may also have an effect through a reduction in the protein content of wheat grain. For rice, the amylose content of the grain, a major determinant of cooking quality is increased under elevated CO2. [References: 68].

1948 Wahid, A.; Maggs, R.; Shamsi, SRA.; Bell, JNB.; Ashmore, MR. (1995) **AIR POLLUTION AND ITS IMPACTS ON WHEAT YIELD IN THE PAKISTAN PUNJAB.** *Environmental Pollution. 88(2):147-154.* English. [UNIV LONDON IMPERIAL COLL SCI TECHNOL & MED CTR ENVIRONM TECHNOL 48 PRINCES GARDENS LONDON SW7 2PE ENGLAND].

A study using open-top chambers ventilated with ambient or charcoal-filtered air in the vicinity of Lahore, Pakistan, has demonstrated a reduction of 46.7% and 34.8% in the grain yield for two cultivars of winter wheat (Triticum aestivum L.). The 6-h daily mean O-3 concentrations were 25-45 nl litre(-1) and on the basis of experience in North America and Europe, reductions in yield in the present study are substantially greater than might be predicted The reasons for this discrepancy are discussed, together with implications for the suitability of a simple, relatively cheap, open-top chamber system for developing-country studies on the effects of air pollution on crops. [References: 19].

F50 PLANT STRUCTURE

1949 Akin, DE.; Rigsby, LL.; Gamble, GR.; Morrison, WH.; Kimball, BA.; Pinter, PJ.; Wall, GW.; Garcia, RL.; Lamorte, RL. (1995) **BIODEGRADATION OF PLANT CELL WALLS, WALL CARBOHYDRATES, AND WALL AROMATICS IN WHEAT GROWN IN AMBIENT OR ENRICHED CO2 CONCENTRATIONS.** *Journal of the Science of Food & Agriculture. 67(3):399-406.* English. [USDA ARS RICHARD B RUSSELL AGR RES CTR POB 5677 ATHENS, GA 30604 USA].

Mature internodes from wheat (Triticum aestivum L) grown in control (ambient at c 370 mu mol mol(-1)) or enriched (to 550 mu mol mol(-1)) concentrations of atmospheric CO2 in the free-air CO2 enrichment (FACE) system were analyzed for potential changes in biodegradation of constituents due to predicted increases in atmospheric levels of CO2. The first internodes below the grain were incubated with the lignocellulose-degrading white rot fungus, Phanerochaete chrysosporium K-3, or incubated without microorganisms. Plant samples were then analyzed for dry weight loss, disposition of specific cell types to biodegradation using electron microscopy, carbohydrates and lignin using solid state NMR spectroscopy, and ester- and ether-linked aromatics using gas chromatography. Phanerochaete chrysosporium extensively degraded stems cells (c 75%) and both carbohydrate and aromatic portions of the wheat stems proportionately more carbohydrates were removed by the fungus from the stems. Enriched CO2 did not affect the chemical composition of wheat stems or the biodegradation by P chrysosporium of plant cell walls or wall components for the most part. Data from various methods all indicated that enriched CO2 did not substantially alter the biodegradation of wheat cell wall internodes or wall components. Evidence was not found for an influence on C cycling due to CO2 concentrations in this study. [References: 25].

1950 Barchacki, S.; Koper, R. (Agricultural University, Lublin (Poland)); Szot, B. (Polish Academy of Sciences, Lublin (Poland). Inst. of Agrophysics) (1993) **Assessment of the variability of wheat stalk density.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 7-11. Instytut Agrofizyki. 4 fig., table; 5 ref.. Distributed 1994. p. 7-11. English. (AGRIS 95-034360).

The density of the stalks of four different varieties of wheat in successive phases of their biological maturity was determined. By means of two methods: with the help of pycnometer, and using diameter and length gauges and an analytical balance. The results obtained indicate that the density of wheat stalk is a variable value and depends on moisture and the phase of biological maturity.

1951 Kurzyp, T. (Agricultural University, Lublin (Poland). Dept. of Physics) (1993) **Application of the ultrasonic method in determining moisture and linear density in wheat stalks.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 135-138. Instytut Agrofizyki. 7 fig., 1 table. Distributed 1994. p. 135-138. English. (AGRIS 95-034361).

Three wheat varieties were examined: Jara, Henika and Kadett in four successive stages. The measurements were made on 10 cm segments cut from the middle part of the second intermode of wheat stalk. The high correlations between parameters of ultrasonic wave propagation and basic

physical properties of wheat stalks make it possible to use the ultrasonic method in determining stalk's moisture content and linear density.

1952 Reynolds, MP.; Balota, M.; Delgado, MIB.; Amani, I.; Fischer, RA. (1994) **PHYSIOLOGICAL AND MORPHOLOGICAL TRAITS ASSOCIATED WITH SPRING WHEAT YIELD UNDER HOT, IRRIGATED CONDITIONS.** *Australian Journal of Plant Physiology. 21(6):717-730.* English. [CIMMYT LISBOA 27 MEXICO CITY 06600 DF MEXICO].

Sixteen spring wheat genotypes were grown under hot, irrigated, low latitude conditions, during the 1990-1991 and 1991-1992 winter cropping cycles in Mexico, Egypt, India and the Sudan, and in the 1990 and 1991 winter cycles in Brazil. The genotypes were chosen to represent a range of genetic diversity within modern wheat varieties. In addition to grain yield, in Mexico a number of morphological and physiological traits were measured throughout the growing season on two sowing dates (December and February), to evaluate their correlation with yield in the other countries. The morphological traits - above-ground biomass at maturity, grains m(-2), days to anthesis and days to maturity - measured on both sowing dates in Mexico showed generally significant correlations with yields measured at the other sites. Moreover, gr ound-cover estimates early in establishment, and at anthesis, also showed some association with performance at these sites, but only when measured on the hotter, February sowing date in Mexico. Membrane thermostability (MT), measured on field-acclimated flag leaves showed generally significant correlations with performance at all sites, and with MT measurements made on heat-acclimated seedlings of the same genotypes grown in growth chambers. Flag-leaf photosynthesis measured at boating, anthesis and during grain filling on both sowing dates, was generally significantly correlated with grain yield at all sites, as was rate of loss of leaf chlorophyll content during grain filling. Stomatal conductance was also significantly correlated with performance at all three stages. Canopy temperature depression (CTD) measured with an infrared thermometer was significantly positively correlated with performance at the international sites when measured between 1200 and 1600 hours, after full canopy establishment. The correlation of CTD with yield was not affected by the irrigation status of the crop under well-watered conditions. The possible use of these traits in selection for yield under hot conditions is discussed. [References: 22].

F60 PLANT PHYSIOLOGY AND BIOCHEMISTRY

1953 Achouak, W.; Demot, R.; Heulin, T. (1995) **PURIFICATION AND PARTIAL CHARACTERIZATION OF AN OUTER MEMBRANE PROTEIN INVOLVED IN THE ADHESION OF RAHNELLA AQUATILIS TO WHEAT ROOTS.** *FEMS Microbiology Ecology. 16(1):19-24.* English. [USDA ARS BELTSVILLE AGR RES CTR INST PLANT SCI BLDG 011A 10300 BALTIMORE AVE BELTSVILLE, MD 20705 USA].

A 38 kDa major outer membrane protein isolated from the nitrogen-fixing enterobacterium Rahnella aquatilis CF3 showed high affinity for wheat roots in an in vitro adhesion assay. Antibodies directed against the 38 kDa protein were able to bind to whole cells of R. aquatilis and strongly reduced attachment to wheat roots, suggesting a role in adhesion to and colonization of plant roots. The N-terminal sequence of the 38 kDa protein revealed a strong homology with enterobacterial porins. [References: 38].

1954 Allen, GJ.; Jones, RGW.; Leigh, RA. (1995) **SODIUM TRANSPORT MEASURED IN PLASMA MEMBRANE VESICLES ISOLATED FROM WHEAT GENOTYPES WITH DIFFERING K+/NA+ DISCRIMINATION TRAITS.** *Plant Cell & Environment. 18(2):105-115.* English. [UNIV YORK DEPT BIOL YORK YO1 5DD N YORKSHIRE ENGLAND].

Right-side-out plasma membrane vesicles were isolated from wheat roots using an aqueous polymer two-phase system, The purity and orientation of the vesicles were confirmed by marker enzyme analysis, Membrane potential (Delta Psi)-dependent Na-22(+) influx and sodium/proton (Na+/H+) antiport-mediated efflux across the plasma membrane were studied using these vesicles, Membrane potentials were imposed on the vesicles using either K+ gradients in the presence of valinomycin or H+ gradients, The Delta Psi was quantified by the uptake of the lipophilic cation tetraphenylphosphonium. Uptake of Na+ into the vesicles was stimulated by a negative Delta Psi and had a K-m for extravesicular Na+ of 34.8+/-5.9 mol m(-3). The Delta Psi-dependent uptake of Na+ was similar in vesicles from roots of hexaploid (cv, Troy) and tetraploid (cv, Langdon) wheat differing in a K+/Na+ discrimination trait, and was also unaffected by growth in 50 mol m(-3) NaCl. Inhibition of Delta Psi-dependent Na+ uptake by Ca2+ was greater in the hexaploid than in the tetraploid. Sodium/proton antiport was measured as Na+-dependent, amiloride-inhibited pH gradient formation in the vesicles, Acidification of the vesicle interior was measured by the uptake of C-14-methylamine. The Na+/H+ antiport had a K-m for intravesicular Na+ of between 13 and 19 mol m(-3). In the hexaploid, Na+/H+ antiport activity was greater when roots were grown in the presence of 50 mol m(-3) NaCl, and was also greater than the activity in salt-grown tetraploid wheat roots, Antiport activity was not increased in a Langdon 4D chromosome substitution line which carries a trait for K+/Na+ discrimination, It is concluded that neither of the transport processes measured is responsible for the Na+/K+ discrimination trait located on the 4D chromosome of wheat. [References: 51].

1955 Astwood, JD.; Hill, RD. (1995) **BARLEY SPIKELET CULTURE - AN EFFECTIVE TOOL FOR THE ANALYSIS OF BIOCHEMICAL EVENTS IN FLOWER DEVELOPMENT.** *Plant Cell Tissue & Organ Culture. 40(1):93-96.* English. [WASHINGTON STATE UNIV DEPT HORT & LANDSCAPE ARCHITECTURE PULLMAN, WA 99164 USA].

Immature detached barley spikelets were cultured in wheat spikelet medium. Fertility of cultured barley spikelets was similar to that of cultured wheat spikelets. Barley anther development within cultured spikelets was retarded relative to in planta, but viability of developing pollen, as determined by a fluorochromatic reaction, was similar in vitro and in planta. Protein synthesis by anthers in developing barley spikelets in vitro was maximal during stage 2, when pollen grains were bicellular, and declined as pollen matured. Barley spikelet culture is an effective tool for the analysis of biochemical events in flower development. [References: 12].

1956 Avkhadieva, GI.; Khokhlova, LP.; Karasev, GS. (1995) **POLYPEPTIDE COMPOSITION OF MITOCHONDRIA AS AFFECTED BY THE COLD ACCLIMATION OF WINTER WHEAT.** *Russian Journal of Plant Physiology. 42(1):87-93.* English. [KAZAN VI LENIN STATE UNIV DEPT PLANT PHYSIOL UL LENINA 18 KAZAN 420008 RUSSIA].

Changes in the polypeptide composition of winter wheat mitochondria (Triticum aestivum L., cvs. Mironovskaya 808 and Bezostaya 1) during cold acclimation were studied by SDS-PAGE and densitometry. At the first stage of hardening to low temperature (2 degrees C for seven days), newly synthesized polypeptides differing in mol wt were found in mitochondrial protein patterns of both cultivars, namely, polypeptides with mol wts of 85, 62, 55, 49, and 42 kD (cv. Mironovskaya 808) and 83, 82, 56, 50, 45, and 43 kD (cv. Bezostaya 1). At the second stage of hardening (-5 degrees C for three days), no newly synthesized proteins were observed. The freezing (-13 degrees, -16 degrees, and -18 degrees C) of plants resulted in decreased frost resistance and was accompanied by mitochondrial protein degradation, which was reflected in the reduction of content of high mol wt polypeptides. This process was more pronounced in nonresistant wheat cultivar Bezostaya 1. Freesing/thawing cycle experiments with mitochondria isolated from hardened and nonhardened plants showed that hardening prevented protein solubilization from the organelles. The conclusion was made that during hardening, stronger protein-lipid interactions in mitochondrial membranes prevented protein degradation at low temperatures. Newly synthesized proteins could play an important role in this process. [References: 23].

1957 Chirdo, FG.; Fossati, CA.; Anon, MC. (1995) **METACHROMATIC EFFECT IN HOMOLOGOUS GROUPS OF WHEAT, BARLEY AND RYE PROLAMINS.** *Journal of Food Biochemistry. 18(3):185-197.* English. [NATL UNIV LA PLATA CTR INVEST & DESARROLLO CRIOTECNOL ALIMENTOS CONICET CIC CALLE 47 & 116 RA-1900 LA PLATA ARGENTINA].

The metachromatic behavior of wheat, barley and rye prolamins, separated by polyacrylamide gel electrophoresis (PAGE) and staining with Coomassie Brilliant Blue R-250, is described. Metachromasia was detected both visually and by double beam densitometric analysis of sodium dodecyl sulfate-PAGE and acidic-PAGE (A-PAGE) at pH 3.1. Differential readings were recorded at 525 nm, with reference at 625 nm. Metachromatic components were found in the homologous groups, (a) S-poor prolamins: omega-gliadins, C-hordeins, omega-secalins and (b) high molecular weight (HMW)-prolamins: HMW-glutenins, D-hordeins and HMW-secalins, in wheat, barley and rye, respectively. In contrast, proteins having this characteistic have not been found in oat. [References: 25].

1958 Clark, TA.; Zeyen, RJ.; Carver, TLW.; Smith, AG.; Bushnell, WR. (1995) **EPIDERMAL CELL CYTOPLASMIC EVENTS AND RESPONSE GENE TRANSCRIPT ACCUMULATION DURING ERYSIPHE GRAMINIS ATTACK IN ISOGENIC BARLEY LINES DIFFERING AT THE ML-O LOCUS.** *Physiological & Molecular Plant Pathology. 46(1):1-16.* English. [UNIV MINNESOTA DEPT PLANT PATHOL ST PAUL, MN 55108 USA].

Patterns in the accumulation of six host response gene transcripts were determined al various time intervals, 0-48 h after inoculation of leaves with Erysiphe graminis f.sp. hordei in two near-isogenic barley lines, RISO 5678 R (RISO-R) (resistant) and RISO 5678 S (RISO-S) (susceptible), differing at the ml-o locus for resistance. At each time interval, leaf tissue was fixed and stained for light microscopy of fungal development and host epidermal cell response to E. graminis. Resistance in the recessive ml-o line was expressed by failure of fungal germlings to penetrate host epidermal cells fully and produce haustoria and was correlated with deposition of papillae at sites of attack. Transcripts of the six host response genes usually accumulated in a biphasic pattern, as determined by quantitative radioanalysis of northern blots. The initial peak of activity was observed at 4-6 h (the time of cytoplasmic aggregation and papilla deposition beneath tips of the primary germ tubes). The second peak was observed at 12-15 h (the time of cytoplasmic aggregation and papilla deposition beneath the tips of the appressoria). The time and magnitude of peaks of cytoplasmic aggregation and papilla deposition was the same in RISO-R and RISO-S as were patterns of response gene transcript accumulation. There were no pattern differences in transcript accumulation that could be directly attributed to differences at the Ml-o locus. The results indicate that the response genes were activated and transcribed as a general defence response to attempted penetration by the fungus because they occur in both isolines. [References: 49].

1959 Cross, JW.; Herzmark, P.; Guilford, WL.; Patterson, TG.; Labovitz, JN. (1995) **TRANSPORT AND METABOLISM OF POLLEN SUPPRESSANT SC-2053 IN WHEAT.** *Journal of Agricultural & Food Chemistry. 43(2):548-556.* English. [NATL SCI FDN 4201 WILSON BLVD SUITE 615 ARLINGTON, VA 22230 USA].

SC-2053, 1-(4-chlorophenyl)-4-oxo-5-(methoxyethoxy)cinnoline-3-carboxylic acid, is a pollen suppressant (chemical hybridizing agent) in wheat. Metabolism of this compound was studied using [C-14]SC-2053 labeled uniformly in the chlorophenyl ring. Wheat plants were treated when the spike was 2-4 cm in length. The floral spike contained about 10% of the label taken up into the plant 4 days after treatment, 15% 14 days after treatment. Unchanged [C-14]SC-2053 plus two more polar metabolites were 90-95% of the total C-14 extracted from the plants 14 days after treatment. The more polar metabolite was a glycoside of the other. Treated wheat plants and wheat callus cultures metabolized [C-14]SC-2053 by a similar route. The aglycon purified from a callus culture filtrate was identified as 1-(4-chlorophenyl)-4-oxo-5-(2-hydroxyethoxy)cinnoline-3-carboxylic acid. This alcohol results from demethylation of the 5-methoxyethoxy group. In plants this metabolite is glycosylated, but in callus cultures only the initial demethylated compound accumulated in the medium. The major metabolite in mature straw was the glycoside. [References: 23].

1960 Cuello, J.; Quiles, MJ.; Albacete, ME.; Sabater, B. (1995) **PROPERTIES OF A LARGE COMPLEX WITH NADH DEHYDROGENASE ACTIVITY FROM BARLEY THYLAKOIDS.** *Plant & Cell Physiology. 36(2):265-271.* English. [UNIV MURCIA FAC BIOL DEPT BIOL VEGETAL E-30100 MURCIA SPAIN].

When assays for NAD(P)H-ferricyanide oxidoreductases were performed, activities specific for NADH (0.23 unit (mg protein)(-1)) and NADPH (0.68 unit (mg protein)(-1)) were detected in chloroplasts isolated from leaves of barley (Hordeum vulgare L.). Activities of chloroplast NADH- and NADPH-ferricyanide oxidoreductase were 5-fold and 25-fold higher, respectively, than the maximum activity that could be attributed to mitochondrial contamination. Moreover, most of the chloroplast NADH-ferricyanide oxidoreductase (60 to 80%) was solubilized by deoxycholate (DOC) from thylakoids as a single, high-molecular-mass complex that was distinguishable from the mitochondrial complex by its lower electrophoretic mobility in 3% polyacrylamide, as revealed by reduction of nitro blue tetrazolium (NET) in the presence of NADH or NADPH on gels after electrophoresis. The stroma yielded a single band of a dehydrogenase (66 kDa) that used NADH as its electron donor. Several NADPH-dependent activities were detected after electrophoresis of the stromal fraction. Moreover, chloroplast-specific activities could be distinguished from mitochondrial activities on the basis of the specificity of the donor and the acceptor of electrons, the dependence of the activities on pH, and the sensitivity to various inhibitors. K-m values for NADH (26 mu M) and NADPH (75 mu M) were in the same range as those of mitochondrial activities. Most of the NADPH-dependent activity probably corresponds to the chloroplast ferredoxin-NADP(+) oxidoreductase. The possibility is discussed that thylakoid NADH dehydrogenase(s) might be the product of chloroplast ndh genes and that this activity is involved in chlororespiration. [References: 24].

1961 Demothes, MAG.; Knoppik, D. (1994) **EFFECTS OF LONG-TERM ENHANCED CO2 PARTIAL PRESSURE ON GAS EXCHANGE PARAMETERS AND SACCHARIDE POOLS OF WHEAT LEAVES.** *Photosynthetica. 30(3):435-445.* English. [TECH UNIV MUNCHEN WIEHENSTEPHAN VOTTINGERSTR 40 D-85350 FREISING GERMANY].

Wheat plants were cultivated in a growth chamber at normal (35 Pa, c35 plants) and enhanced (70 Pa, c70 plants) CO2 partial pressure. In C35 plants the net photosynthetic rate (P(N)) of flag leaves and the concentrations of saccharides such as sucrose, glucose, fructose and starch were increased. The c70 plants possessed higher chlorophyll (Chl) a and Chl b contents. The CO2 response of P(N) at saturating photosynthetically active radiation (PAR) was very similar for both variants. At the highest CO2 concentration saccharides accumulated in both variants as a consequence of decreased export rate. The response of P(N) to PAR at saturating CO2 concentrations was similar in the two variants. On the other hand, the response of water vapour pressure conductance (gH2O) to PAR in c35 plants followed a hyperbolic response to PAR, while in the c70 plants it was linearly related to PAR up to the mean PAR used for growth. In this variant gH2O seemed to change parallelly to changes in the mesophyll demand for CO2 caused by PAR. [References: 37].

1962 Garstang, J.R.; Vaughan, J. (ADAS, Cambridge CB2 2BL (UK)) (1992) **The relationship of soil mineral nitrogen and soil clay content to grain yield and nitrogen content of malting barley.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 254-255.* European Society for Agronomy. 1 ref. English. (AGRIS 95-034666).

1963 Hansch, R.; Koprek, T.; Mendel, RR.; Schulze, J. (1995) **AN IMPROVED PROTOCOL FOR ELIMINATING ENDOGENOUS BETA-GLUCURONIDASE BACKGROUND IN BARLEY.** *Plant Science. 105(1):63-69.* English. [TECH UNIV CAROLO WILHELMINA BRAUNSCHWEIG INST BOT HUMBOLDTSTR 1 D-38106 BRAUNSCHWEIG GERMANY].

Scutella of immature barley embryos were found to exhibit high activity of endogenous beta-glucuronidase which interferes with the expression of bacterial beta-glucuronidase that was transferred into the scutella by biolistic transformation, The amount of intrinsic activity was strongly genotype dependent and could be detected with both the histochemical and fluorimetrical assay. This interfering activity could not be eliminated by performing the assay at pH 7.0 nor using additional methanol in the incubation buffer. Only pretreatment of the bombarded scutella for 60 min at 55 degrees C followed by staining at the same temperature in a modified buffer was found to completely suppress barley-endogenous beta-glucuronidase, In addition to the spots of strong GUS activity, these improved conditions made it possible to observe high numbers of smaller GUS-spots that became visible on the white scutellum, being no longer masked by a previous non-specific blue staining pattern. Further, this protocol can be used for unequivocally differentiating between transgenic and non-transgenic barley plants. [References: 21].

1964 Holaday, A.S.; Ritchie, S.W.; Nguyen, H.T. (Department of Biological Sciences, Texas Tech University, Lubbock, TX 79409 (USA)) (1992) **Effects of water deficit on gas-exchange parameters and ribulose 1, 5-bisphosphate carboxylase activation in wheat.** *Environmental and Experimental Botany (United Kingdom) v. 32(4) p. 403-410.* 18 ref. English. (AGRIS 95-034465).

1965 Hurry, VM.; Keerberg, O.; Parnik, T.; Gardestrom, P.; Oquist, G. (1995) **COLD-HARDENING RESULTS IN INCREASED ACTIVITY OF ENZYMES INVOLVED IN CARBON METABOLISM IN LEAVES OF WINTER RYE (SECALE CEREALE L).** *Planta. 195(4):554-562.* English. [AUSTRALIAN NATL UNIV RES SCH BIOL SCI COOPERAT RES CTR PLANT SCI BOX 475 CANBERRA ACT 2601 AUSTRALIA].

Light- and CO2-saturated photosynthesis of nonhardened rye (Secale cereale L. cv. Musketeer) was reduced from 18.10 to 7.17 mu mol O-2.m(-2).s(-1) when leaves were transferred from 20 to 5 degrees C for 30 min. Following cold-hardening at 5 degrees C for ten weeks, photosynthesis recovered to 15.05 mu mol O-2.m(-2).s(-1), comparable to the non-hardened rate at 20 degrees C. Recovery of photosynthesis was associated with increases in the total activity and activation of enzymes of the photosynthetic carbon-reduction cycle and of sucrose synthesis. The total hexose-phosphate pool increase by 30% and 120% for nonhardened and cold-hardened leaves respectively when measured at 5 degrees C. The large increase in esterified phosphate in cold-hardened leaves occurred without a limitation in inorganic phosphate supply. In contrast, the much smaller increase in esterified phosphate in nonhardened leaves was associated with an inhibition of ribulose-1,5-bisphosphate carboxylase/oxygenase and sucrose-phosphate synthase activation. It is suggested that the large increases in hexose phosphates in cold-hardened leaves compensates for the higher substrate threshold concentrations needed for enzyme activation at low temperatures. High substrate concentrations could also compensate for the kinetic limitations imposed by product inhibition from the accumulation of sucrose at 5 degrees C. Nonhardened leaves appear to be unable to compensate in this fashion due to an inadequate supply of inorganic phosphate. [References: 47].

1966 Ishitani, M.; Nakamura, T.; Han, SY.; Takabe, T. (1995) **EXPRESSION OF THE BETAINE ALDEHYDE DEHYDROGENASE GENE IN BARLEY IN RESPONSE TO OSMOTIC STRESS AND ABSCISIC ACID.** *Plant Molecular Biology. 27(2):307-315.* English. [NAGOYA UNIV CTR BIOSCI CHIKUSA KU NAGOYA AICHI 46401 JAPAN].

When subjected to salt stress or drought, some vascular plants such as barley respond with an increased accumulation of the osmoprotectant glycine betaine (betaine), being the last step of betaine synthesis catalyzed by betaine aldehyde dehydrogenase (BADH). We report here cloning and characterization of BADH cDNA from barley, a monocot, and the expression pattern of a BADH transcript. An open reading frame of 1515 bp encoded a protein which showed high homology to BADH enzymes present in other plants (spinach and sugar-beet) and in Escherichia coli. Transgenic tobacco plants harboring the clone expressed high levels of both BADH protein and its enzymatic activity. Northern blot analyses indicated that BADH mRNA levels increased almost 8-fold and 2-fold, respectively, in leaves and roots of barley plants grown in high-salt conditions, and that these levels decreased upon release of the stress, whereas they did not decrease under continuous salt stress. BADH transcripts also accumulate in response to water stress or drought, indicating a common response of the plant to osmotic changes that affect its water status. The addition of abscisic acid (ABA) to plants during growth also increased the levels of BADH transcripts dramatically, although the response was delayed when compared to that found for salt-stressed plants. Removal of plant roots before transferring the plants to high-salt conditions reduced only slightly the accumulation of BADH transcripts in the leaves. [References: 38].

1967 Jolivet, P.; Bergeron, E.; Zimierski, A.; Meunier, JC. (1995) **METABOLISM OF ELEMENTAL SULPHUR AND OXIDATION OF SULPHITE BY WHEAT AND SPINACH CHLOROPLASTS.** *Phytochemistry. 38(1):9-14.* English. [INRA CTR BIOTECHNOL AGROIND CHIM BIOL LAB F-78850 THIVERVAL GRIGNON FRANCE].

Wheat or spinach chloroplasts were fed with S-35-labelled elemental sulphur (S-0). S-35-labelled compounds appearing thereafter were analysed. Five S-35-compounds were recovered, thiosulphate, sulphite, sulphate, cysteine and glutathione. The effect of environmental conditions was also studied. The measurement of S-0 metabolism rate was compared to the recovery of the introduced S-0 into other S compounds. The specific radioactivity of thiosulphate and sulphate was determined. The results obtained have permitted the elucidation of the precise biochemical pathway of S-0 oxidation. The oxidation of sulphite in wheat and spinach chloroplasts occurs via both non-enzymatic (in particular the operation of the photosynthetic electron transport chain) and enzymatic processes (sulphite oxidase activity). [References: 19].

1968 Keeling, PL.; Banisadr, R.; Barone, L.; Wasserman, BP.; Singletary, GW. (1994) **EFFECT OF TEMPERATURE ON ENZYMES IN THE PATHWAY OF STARCH BIOSYNTHESIS IN DEVELOPING WHEAT AND MAIZE GRAIN.** *Australian Journal of Plant Physiology. 21(6):807-827.* English. [IOWA STATE UNIV SCI & TECHNOL EXSEED GENET LLC 1573 FOOD SCI BLDG AMES, IA 50011 USA].

Soluble starch synthase (SSS) is shown to be a major site of control of flux through the pathway of starch synthesis in developing wheat and maize grain. Temperatures above 25 degrees C adversely affect flux, and therefore limit yield. This process is linked to SSS which is heat sensitive. Two apparently different properties of SSS can be identified which differ in the period required before full activity is restored after brat treatment. First, enzyme rate is adversely affected by elevated temperature, an effect which is reversible on returning to a lower temperature. The effect on enzyme rate was quantified using enzyme Q(10) which was found to begin to be sub-optimal above 20 degrees C. Second, with a prolonged period of exposure to elevated temperature there is a loss of enzyme activity which is not freely reversible which we have termed thermal inactivation. Although this occurs at temperatures in excess of 20 degrees C in wheat, higher temperatures of more than 30 degrees C are needed in maize SSS. Elevated temperature did not affect the inherent stability or Q(10) characteristics of other enzymes in the pathway of starch synthesis except for branching enzyme which we believe has minimal flux-control strength. SSS thermal inactivation may not be a major problem in field conditions for developing maize grain, because temperatures rarely are high enough. However, we suggest that the effect on enzyme Q(10) is more physiologically relevant, since maize SSS is operating sub-optimally as temperatures exceed 20 degrees C. Calculations of the reductions in maize US corn-belt yield showed that significant yield improvement might be obtained by a 5 degrees C shift in the temperature optimum. Thus selections for a more temperature tolerant form of maize SSS were conducted using enzyme Q(10) as a selection tool. Of several hundred maize specimens screened, two were found to be significantly different. However, attempts to use backcross breeding to transfer this trait from the tropical donor to another line have not yet succeeded. Transgenic approaches to altering relations of starch deposition are now underway. [References: 66].

1969 Kraus, TE.; Mckersie, BD.; Fletcher, RA. (1995) **PACLOBUTRAZOL-INDUCED TOLERANCE OF WHEAT LEAVES TO PARAQUAT MAY INVOLVE INCREASED ANTIOXIDANT ENZYME ACTIVITY.** *Journal of Plant Physiology. 145(4):570-576.* English. [UNIV GUELPH DEPT ENVIRONM BIOL GUELPH ON N1G 2W1 CANADA].

The damage caused by active oxygen generated by paraquat was investigated in two wheat cultivars, Triticum aestivum L. Frederick and Glenlea, which differed in their sensitivity to heat and chilling stress. Application of paraquat induced photoinhibition and loss of fresh mass, protein, and membrane integrity in the leaves. The photosynthetic pigments were lost after paraquat treatment, with Chlb declining the least and carotenoids declining the most. Paclobutrazol, a triazole plant growth regulator, reduced these symptoms and induced a 2-fold increase in paraquat tolerance in both cultivars. This study tested the hypothesis that paclobutrazol protects wheat from oxidative stress by enhancing antioxidant enzyme activity. The enzymes investigated were superoxide dismutase, ascorbate peroxidase, glutathione reductase, as well as cytosolic catalase and guaiacol peroxidase. Paclobutrazol stimulated an overall increase in antioxidant enzyme activities on both a fresh-mass and protein basis in the winter wheat cultivar Frederick, but only on a fresh-mass basis in Glenlea. The spring wheat, Glenlea, which is more sensitive to temperature stress, had lower antioxidant enzyme activity than the tolerant winter cultivar Frederick. Irrespective of the natural difference in the two cultivars to stress, paclobutrazol elevated the plants to a higher level of oxidative stress tolerance. [References: 36].

1970 Kraus, TE.; Pauls, KP.; Fletcher, RA. (1995) **PACLOBUTRAZOL- AND HARDENING-INDUCED THERMOTOLERANCE OF WHEAT - ARE HEAT SHOCK PROTEINS INVOLVED.** *Plant & Cell Physiology. 36(1):59-67.* English. [UNIV GUELPH DEPT ENVIRONM BIOL GUELPH ON N1G 2W1 CANADA].

The present report describes the effects of paclobutrazol and heat hardening treatments on the protein synthesis patterns in imbibing and germinating wheat seedlings (Triticum aestivum L. cv Frederick) during heat stress. A heat hardening treatment given during the imbibition period induced the transient expression of 118, 90, 70 and 18 kDa heat shock proteins (HSPs). However, the hardening and paclobutrazol treatments did not enhance the thermotolerance of imbibed seeds or etiolated seedlings. By contrast, the hardening and paclobutrazol treatments enhanced the thermotolerance of light-grown seedlings. While, both hardened and

unhardened control seedlings synthesized several HSPs during a high temperature stress period, these proteins were not synthesized by the paclobutrazol-treated, light-grown seedlings. Thus, HSP synthesis during heat shock may have been a manifestation of stress perception by the seedlings and may not have mediated the thermotolerance induced by the triazole treatments. Since differential thermotolerance was only apparent in light-grown seedlings, it is suggested that chloroplasts may be required for the expression of paclobutrazol- and hardening-induced thermoprotection. Additional evidence indicating that chloroplasts are an important site of injury during high temperature stress was obtained from chlorophyll fluorescence measurements. [References: 33].

1971 Krol, M.; Spangfort, MD.; Huner, NPA.; Oquist, G.; Gustafsson, P.; Jansson, S. (1995) **CHLOROPHYLL A/B-BINDING PROTEINS, PIGMENT CONVERSIONS, AND EARLY LIGHT-INDUCED PROTEINS IN A CHLOROPHYLL B-LESS BARLEY MUTANT.** *Plant Physiology. 107(3):873-883.* English. [UMEA UNIV DEPT PLANT PHYSIOL S-90187 UMEA SWEDEN].

Monospecific polyclonal antibodies have been raised against synthetic peptides derived from the primary sequences from different plant light-harvesting Chl a/b-binding (LHC) proteins. Together with other monospecific antibodies, these were used to quantify the levels of the 10 different LHC proteins in wild-type and chlorina 12 barley (Hordeum vulgare L.), grown under normal and intermittent light (ImL). Chlorina 12, grown under normal light, lacked Lhcb1 (type I LHC II) and Lhcb6 (CP24) and had reduced amounts of Lhcb2, Lhcb3 (types II and III LHC II), and Lhcb4 (CP 29). Chlorina f2 grown under ImL lacked all LHC proteins, whereas wild-type ImL plants contained Lhcb5 (CP 26) and a small amount of Lhcb2. The chlorina f2 ImL thylakoids were organized in large parallel arrays, but wild-type ImL thylakoids had appressed regions, indicating a possible role for Lhcb5 in grana stacking. Chlorina f2 grown under ImL contained considerable amounts of violaxanthin (2-3/reaction center), representing a pool of phototransformable xanthophyll cycle pigments not associated with LHC proteins. Chlorina f2 and the plants grown under ImL also contained early light-induced proteins (ELIPs) as monitored by western blotting. The levels of both ELIPs and xanthophyll cycle pigments increased during a 1 h of high light treatment, without accumulation of LHC proteins. These data are consistent with the hypothesis that ELIPs are pigment-binding proteins, and we suggest that ELIPs bind photoconvertible xanthophylls and replace "normal" LHC proteins under conditions of light stress. [References: 55].

1972 Lee, ALC.; Thornber, JP. (1995) **ANALYSIS OF THE PIGMENT STOICHIOMETRY OF PIGMENT-PROTEIN COMPLEXES FROM BARLEY (HORDEUM VULGARE) - THE XANTHOPHYLL CYCLE INTERMEDIATES OCCUR MAINLY IN THE LIGHT-HARVESTING COMPLEXES OF PHOTOSYSTEM I AND PHOTOSYSTEM II.** *Plant Physiology. 107(2):565-574.* English. [UNIV CALIF LOS ANGELES DEPT BIOL LOS ANGELES, CA 90095 USA].

The carotenoid zeaxanthin has been implicated in a nonradiative dissipation of excess excitation energy. To determine its site of action, we have examined the location of zeaxanthin within the thylakoid membrane components. Five pigment-protein complexes were isolated with little loss of pigments: photosystem I (PSI); core complex (CC) I, the core of PSI; CC II, the core of photosystem II (PSII); light-harvesting complex (LHC) IIb, a trimer of the major light-harvesting protein of PSII; and LHC IIa, c, and d, a complex of the monomeric minor light-harvesting proteins of PSII. Zeaxanthin was found predominantly in the LHC complexes. Lesser amounts were present in the CCs possibly because these contained some extraneous LHC polypeptides. The LHC IIb trimer and the monomeric LHC II a, c, and d pigment-proteins from dark-adapted plants each contained, in addition to lutein and neoxanthin, one violaxanthin molecule but little antheraxanthin and no zeaxanthin. Following illumination, each complex had a reduced violaxanthin content, but now more antheraxanthin and zeaxanthin were present. PSI had little or no neoxanthin. The pigment content of LHC I was deduced by subtracting the pigment content of CC I from that of PSI. Our best estimate for the carotenoid content of a LHC IIb trimer from dark-adapted plants is one violaxanthin, two neoxanthins, six luteins, and 0.03 mol of antheraxanthin per mol trimer. The xanthophyll cycle occurs mainly or exclusively within the light-harvesting antennae of both photosystems. [References: 30].

1973 Lee, Y.T. (Korea Food Research Institute, Sungnam (Korea Republic)); Lee, C.K. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station) (1994) **Effects of varietal variation in barley on beta-glucan and malting quality characteristics.** *Korean Journal of Food Science and Technology (Korea Republic) v. 26(2) p. 172-177.* 1 illus.; 3 tables; 21 ref. Korean. (AGRIS 95-023814).

1974 Malibari, A.A. (King Abdulaziz University, Jeddah (Saudi Arabia). Department of Biology) (1993) **The interactive effects between salinity, abscisic acid and kinetin on transpiration, chlorophyll content and growth of wheat plant.** *Indian Journal of Plant Physiology (India) v. 36(4) p. 232-235.* 4 tables; 20 ref. English. (AGRIS 95-034746).

1975 Mantovani, E.C.; Villalobos, F.J.; Orgaz, F.; Berengena, J.; Fereres, E. (Departamento de Agronomia, Universidad de Cordoba,Cordoba (Spain)) (1992) **A comparison of methods to calculate evapotranspiration of field crops.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 186-187.* European Society for Agronomy. 3 ref. English. (AGRIS 95-034817).

1976 Marttila, S.; Jones, BL.; Mikkonen, A. (1995) **DIFFERENTIAL LOCALIZATION OF TWO ACID PROTEINASES IN GERMINATING BARLEY (HORDEUM VULGARE) SEED.** *Physiologia Plantarum. 93(2):317-327.* English. [UNIV JYVASKYLA DEPT BIOL & ENVIRONM SCI POB 35 SF-40351 JYVASKYLA FINLAND].

A cathepsin D-like aspartic proteinase (EC 3.4.23) is abundant in ungerminated barley (Hordeum vulgare) seed while a 30 kDa cysteine endoproteinase (EC 3.4.22) is one of the proteinases synthesized de novo in the germinating seed. In this work, the localization of these two acid proteinases was studied at both the tissue and subcellular levels by immunomicroscopy. The results confirm that they have completely different functions. The aspartic proteinase was present in the ungerminated seed and, during germination, it appeared in all the living tissues of the grain, including the shoot and root. Contrary to previous suggestions, it was not observed in the starchy endosperm. By immunoblotting, the high molecular mass form of the enzyme (32+16 kDa) was found in all the living tissues, whereas the low molecular mass form (29+11 kDa) was not present in the shoot or root, indicating that the two enzyme forms have different physiological roles. The aspartic proteinase was localized first in the scutellar protein bodies of germinating seed, and later in the vacuoles which are formed by fusion of the protein bodies. In contrast to the aspartic proteinase, the expression of the 30 kDa cysteine proteinase began during the first germination day, and it was secreted into the starchy endosperm; first from the scutellum and later from the aleurone layer. It was not found in either shoots or roots. The 30 kDa cysteine proteinase was detected in the Golgi apparatus and in the putative secretory vesicles of the scutellar epithelium. These results suggest that the aspartic proteinase functions only in the living tissues of the grain, as opposed to the 30 kDa cysteine proteinase which is apparently one of the proteases initiating the hydrolysis of storage proteins in the starchy endosperm. [References: 34].

1977 Panwar, J.D.S. (Indian Agricultural Research Institute, New Delhi (India). Division of Plant Physiology) (1993) **Response of vam and azospirillum inoculation to water status and grain yield in wheat under waterstress condition.** *Indian Journal of Plant Physiology (India) v. 36(1) p. 41-43.* 1 table; 20 ref. English. (AGRIS 95-023842).

1978 Pineros, M.; Tester, M. (1995) **CHARACTERIZATION OF A VOLTAGE-DEPENDENT CA2+-SELECTIVE CHANNEL FROM WHEAT ROOTS.** *Planta. 195(4):478-488.* English. [UNIV CAMBRIDGE DEPT PLANT SCI CAMBRIDGE CB2 3EA ENGLAND].

A new mechanism for calcium flux in wheat (Triticum aestivum L.) root cells has been characterized. Membrane vesicles were enriched in plasma membrane using aqueous-polymer two-phase partitioning and incorporated into artificial lipid bilayers, allowing characterization of single channels under voltage-clamp conditions, Membrane marker activities showed 74% and 83% purity in plasma membrane when expressed in terms of membrane area and activity, respectively. Since membrane vesicles obtained by aqueous-polymer two-phase partitioning yield a population of membrane vesicles of regular orientation, and vesicle fusion into planar lipid bilayers occurs in a defined manner, the orientation of the channel upon vesicle incorporation could be determined. Thus ionic activities and potentials could be controlled appropriately on what we propose to be the

cytosolic (trans) and extracellular (cis) faces of the channel. The unitary conductance in symmetrical 1 mM CaCl2 was 27 +/- 0.4 (pS). The correlation between the theoretical and observed reversal potentials in asymmetrical conditions showed that the channel was highly selective for Ca2+ over Cl-. Experiments simulating physiological ionic conditions showed a P-Ca(2+)/P-K+ of 17-26, decreasing in this range as the extracellular CaCl2 concentration increased from 0.1 to 1 mM. The channel was also permeable to the essential nutrient ions, Mg2+ and Mn2+. The open probability of the channel was strongly dependent on the membrane potential. Inactivation with time was observed at more negative membrane potentials, and was immediately reversed as soon as the membrane potential was decreased. At membrane potentials more negative than -130 mV, the channel remained mainly in the closed state, suggesting that in vivo the channel would remain largely closed and would open only upon membrane depolarization. The channel was blocked by micromolar concentrations of extracellular verapamil and trivalent cations, Al3+ being the most effective of those tested. Exposure of the cytosolic and extracellular sides of the channel to inositol 1,4,5-trisphosphate had no effect on the channel activity. We suggest a plasma-membrane origin for the channel as shown by biochemical and electrophysiological evidence, and discuss possible physiological roles of this channel, both in Ca2+ uptake into roots and in signal transduction. [References: 50].

1979 Polisetty, R.; Chandra, R.; Khetarpal, S. (Indian Agricultural Research Institute, New Delhi (India). Division of Plant Physiology) (1993) **Physiological analysis of barley (Hordeum vulgare l.) genotypes differing in harvest index.** *Indian Journal of Plant Physiology (India) v. 36(2) p. 90-93.* 1 table; 5 ill., 10 ref. English. (AGRIS 95-034669).

1980 Polya, GM.; Stapleton, D.; Morrice, N. (1995) **PURIFICATION, N-TERMINAL SEQUENCING AND PROPERTIES OF WHEAT EMBRYO ACIDIC RIBOSOMAL A PROTEINS WITH SEQUENCE SIMILARITY TO CALMODULIN.** *Plant Science. 105(2):177-188.* English. [LA TROBE UNIV SCH BIOCHEM BUNDOORA VIC 3083 AUSTRALIA].

A calmodulin-like protein (CALF) was purified from wheat embryo by a procedure successively involving precipitation by trichloroacetic acid and chromatography on DEAE-Sephacel, phenyl-Sepharose CL-4B and Ultrogel AcA44. The CALF preparation elutes on gel filtration at a peak elution volume corresponding to a molecular weight of 100 000 and contains two major polypeptides P14 and P16 with molecular weights of 14 000 and 16 000, respectively, P14 and P16 were dissociated, purified by reversed phase HPLC and subjected to amino acid sequencing. The two subunits are structurally distinct, but nevertheless, have a high degree of identity with respect to each other and to acidic ribosomal 'A' proteins from wheat and other eukaryote sources, P14 and P16 both contain amino acid sequences similar to sequences in wheat embryo calmodulin (CaM) and related Ca2+-binding proteins, P14, P16 and similar eukaryotic acidic ribosomal 'A' proteins have N-terminal sequences that can be exactly aligned with the second half of CaM. The greatest similarity observed is with sequences of the amphipathic CaM F- and G-helices, the corresponding P14, P16 and ribosomal 'A' protein sequences also having the potential to form amphipathic helices. CALF and the isolated P14 and P16 polypeptides can mimic CaM in reactivating histone-inhibited wheat embryo Ca2+-dependent protein kinase, However, CALF does not substitute for CaM in activating avian myosin light chain kinase and does not bind Ca2+. [References: 37].

1981 Qiu, QS.; Liang, HG. (1995) **LIPID PEROXIDATION CAUSED BY THE REDOX SYSTEM OF PLASMA MEMBRANES FROM WHEAT ROOTS.** *Journal of Plant Physiology. 145(3):261-265.* English. [ACAD SINICA INST BIOPHYS BEIJING 100101 PEOPLES REPUBLIC OF CHINA].

The formation of malondialdehyde by plasma membranes purified by two-phase partitioning from wheat (Triticum aestivum) roots was studied. MDA was produced when plasma membranes were incubated with NADH in the reaction medium. SHAM stimulated MDA formation by plasma membrane, which was dependent on the plasma membrane protein and NADH. SOD, catalase, AsA and mannitol partially inhibited MDA generation. Water stress enhanced MDA formation by plasma membranes and the stimulating effect by SHAM was more pronounced. Further studies showed that the oxygen consumption by plasma membranes was enhanced under water stress. EPR studies indicated that the superoxide production of plasma membranes was stimulated by water stress. These results suggest that the generation of the oxygen radicals by the redox system of plasma membranes could be an important contribution to cellular radical concentration and could play a key role in the membrane damage through lipid peroxidation under water stress. [References: 22].

1982 Rawson, H.M. (CSIRO (Australia). Division of Plant Industry) *(1993)* **Prediction of heading time in wheat grown under high temperatures: effects of temperature, vernalisation and photoperiod.** *Indian Journal of Plant Physiology (India) v. 36(4) p. 239-245.* 2 tables; 4 ill., 10 ref. English. (AGRIS 95-034747).

1983 Sembdner, G.; Atzorn, R.; Schneider, G. (1994) **PLANT HORMONE CONJUGATION [Review].** *Plant Molecular Biology. 26(5):1459-1481.* English. [INST BIOCHEM PFLANZEN WEINBERG 3 D-06018 HALLE GERMANY].

1984 Sharma, J.C.; Acharya, C.L. (Himachal Pradesh Agricultural University, Palampur (India). Department of Soil Science) (1994) **Effect of tillage on water stress in wheat in relation to nitrogen.** *Journal of the Indian Society of Soil Science (India) v. 42(2) p. 185-189.* 2 tables; 2 ill., 21 ref. English. (AGRIS 95-023843).

1985 Shaw, G.; Minski, M.J.; Bell, J.N.B. (Centre for Analytical Research in the Environment, Imperial College at Silwood Park, Ascot, Berks. SL5 7TE (United Kingdom)) (1992) **Retention, loss and translocation of radionuclides applied to foliar surfaces of wheat.** *Environmental and Experimental Botany (United Kingdom) v. 32(4) p. 391-401.* 24 ref. English. (AGRIS 95-034639).

1986 Suk, H.M.; Hong, H.D.; Kim, S.S.; Kim, K.T. (Korea Food Research Institute, Sungnam (Korea Republic)); Kim, J.S. (Inje University, Pusan (Korea Republic). Department of Food Science and Nutrition) (1993) **Change in chemical composition of maturing barley kernels.** *Journal of the Korean Agricultural Chemical Society (Korea Republic) v. 36(6) p. 449-455.* 5 illus.; 4 tables; 21 ref. Korean. (AGRIS 95-023815).

1987 Takeuchi, TS.; Thornber, JP. (1994) **HEAT-INDUCED ALTERATIONS IN THYLAKOID MEMBRANE PROTEIN COMPOSITION IN BARLEY.** *Australian Journal of Plant Physiology. 21(6):759-770.* English. [UNIV CALIF LOS ANGELES DEPT BIOL LOS ANGELES, CA 90024 USA].

Biochemical and spectroscopic studies on the effects of high temperatures (45-47 degrees C) over a 1 h period on the protein composition, fluorescence and photochemical activities of the barley thylakoid membrane were made. Photosystem II (PS II) activity decreased as expected, and photosystem I (PS I) activity also unexpectedly decreased. Our data support previous conclusions that the decrease in PS I activity is largely due to inactivation (or loss) of a component between the two photosystems. A two-dimensional electrophoretic system permitted first the separation of the thylakoid pigment-protein complexes of unstressed and stressed plants, followed by a determination of their subunit composition. The changes in the protein composition of each pigment-protein complex in response to elevated temperatures were monitored. Heat changed the quaternary structure of PS II and resulted in removal of the oxygen-evolving enhancer proteins from the thylakoid, but did essentially no damage to the PS I complex. The PS II core complex dissociated from a dimeric form to a monomeric one, and the major LHC II component (LHC IIb) changed from a trimeric to a monomeric form. The pigments that are lost from thylakoids during heat stress are mainly removed from the PS II pigment-proteins. [References: 33].

1988 Walmsley, J.; Adamson, H. (1995) **CHLOROPHYLL TURNOVER IN ETIOLATED GREENING BARLEY TRANSFERRED TO DARKNESS - ISOTOPIC (1-C-14 GLUTAMIC ACID) EVIDENCE OF DARK CHLOROPHYLL SYNTHESIS IN THE ABSENCE OF CHLOROPHYLL ACCUMULATION.** *Physiologia Plantarum. 93(3):435-444.* English. [MACQUARIE UNIV SCH BIOL SCI N RYDE NSW 2109 AUSTRALIA].

Synthesis of chlorophyll was initiated in 5- to 6-day-old dark-grown barley (Hordeum vulgare L. cv. Clipper) seedlings by exposing them to light in the presence of 1-C-14 glutamic acid supplied via the roots. The plants were then returned to darkness. At the end of light treatment (T-0) and after 7 or 18 h dark treatment chlorophylls a and b were extracted, quantified (mu g leaf(-1)), purified by HPLC to their magnesium-free derivatives (pheophytin a and b) and their molar radioactivities determined. After 2 h exposure to light followed by 6 h illumination in the presence of 1-C-14

glutamic acid, seedlings had accumulated 4-7 nmol chlorophyll leaf(-1) and had incorporated between 900-1350 Bq (g fresh weight)-' of radioactive label into the chlorophyll pool. When seedlings were transferred to darkness, label continued to be incorporated and after 18 h the radioactivity of the chlorophyll pool had increased by 300-700 Bq (g fresh weight)(-1). Net chlorophyll content, however, remained constant during dark treatment. The increase in radioactivity of the chlorophyll pool in darkness represented the difference between a net increase of label incorporated into chlorophyll a and a small loss of label from chlorophpll b. The absence of measurable radioactivity in the phytol moiety of labelled chlorophyll a, extracted at the end of dark treatment, demonstrated that incorporation of label was into the tetrapyrrole moiety of chlorophyll and not into the phytol chain. Light-independent incorporation of 1-C-14 glutamic acid into chlorophyll of greening barley seedlings transferred to darkness indicates that chlorophyll synthesis continues when light is withheld. We interpret the net gain in radioactivity of chlorophyll in darkness, in the absence of a net gain in chlorophyll content, to chlorophyll turnover i.e. to simultaneous synthesis and breakdown of chlorophyll when etiolated greening barley seedlings are transferred to darkness. [References: 41].

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1989 Angus, J.F. (Division of Plant Industry CSIRO, Canberra (Australia)); Bowden, J.W.; Keating, B.A. (1993) **Modelling nutrient responses in the field.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 57-66.* 31 ref. English. (AGRIS 95-024088).

1990 Aramowicz, B.; Adamczyk, B.; Musur, A. (Maria Curie Sklodowska University, Lublin (Poland). Inst. of Physics); Styk, B. (Agricultural University, Lublin (Poland)) (1993) **Investigations of the moisture sorption process in the wheat grain using D2O as the labelled water.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 1-6. Instytut Agrofizyki. 10 fig., 3 tables; 4 ref.. Distributed 1994. p. 1-6. English. (AGRIS 95-035346).

The paper presents methods and results of studies on the parameters of water transport in wheat kernels in three varieties: Jara, Kadett and Henika coming from different nitrogen fertilization levels (50 and 150 kg N/ha).

1991 Barraclough, P.B. (Rothamsted Experimental Station, Harpenden, Herts. (United Kingdom). Inst. of Arable Crops Research) (1993) **Nutrient storage pool concentrations in plants as diagnostic indicators of nutrient sufficiency.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 175-178.* 30 ref. English. (AGRIS 95-024089).

1992 Batten, G.D. (Yanco Agricultural Inst., Yanco, NSW (Australia)); Fettell, N.A.; Mead, J.A.; Khan, M.A. (1993) **Sowing date and phosphorus utilization by wheat.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 297-300.* 21 ref. English. (AGRIS 95-024090).

1993 Beauregard, M. (Chemistry Department, University of Prince Edward Island, Charlottetown, PEI C1A 4P3 (Canada)) (1992) **Modelling of the photosystem II 33 kDa protein: structure, functions and possible sulfate-sensitive sites derived from sequence-encoded information.** *Environmental and Experimental Botany (United Kingdom) v. 32(4) p. 411-423.* 54 ref. English. (AGRIS 95-035426).

1994 Brady, D.J. (Division of Plant Industry CSIRO, Wembley, WA (Australia)); Gregory, P.J.; Fillery, I.R.P. (1993) **The contribution of different regions of the seminal roots of wheat to uptake of nitrate from soil.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 155-158.* 9 ref. English. (AGRIS 95-024128).

1995 Brune, A.; Dietz, KJ. (1995) **A COMPARATIVE ANALYSIS OF ELEMENT COMPOSITION OF ROOTS AND LEAVES OF BARLEY SEEDLINGS GROWN IN THE PRESENCE OF TOXIC CADMIUM, MOLYBDENUM, NICKEL, AND ZINC CONCENTRATIONS.** *Journal of Plant Nutrition. 18(4):853-868.* English. [UNIV WURZBURG JULIUS VON SACHS INST BIOWISSENSCH MITTLERER DALLENBERGWEG 64 D-97082 WURZBURG GERMANY].

Barley seedlings were grown in hydroponic culture in the presence of toxic concentrations of cadmium (Cd), molybdenum (Mo), nickel (Ni), and zinc (Zn) and analyzed for element composition [boron (B), calcium (Ca), Cd, iron (Fe), potassium (K), magnesium (Mg), manganese (Mn), molybdenum (Mo), nickel (Ni), phosphorus (P), and Zn]. In a first survey, heavy metal concentrations were selected which resulted in a similar inhibition of root growth. Toxic concentrations of Cd, Mo, Ni, and Zn revealed both similar and distinct effects on specific leaf and root element contents. Examples for such responses were decreasing contents in root Mn and Mg at elevated levels of all heavy metals, including Mo, in the medium. In contrast, changes in root contents of B were specific for the applied type of heavy metal stress. The heavy metal dependent changes in B, Ca, Mg, and Mn contents were studied in more detail. In some cases, severe heavy metal toxicity caused excessive accumulation or depletion of nutrient elements that may be deleterious to the plants in addition to other primary damages caused by the heavy metal ions. [References: 25].

1996 Causin, H.F. (Buenos Aires Univ., Nunez (Argentina). Facultad de Ciencias Exactas y Naturales, Catedra de Fisiologia Vegetal); Barneix, A.J. (1994) **The effect of glutamine and asparagine on net NH(4)(+) uptake in young wheat plants.** *Plant and Soil (Netherlands) v. 161(2) p. 257-265.* 30 ref. English. (AGRIS 95-024125).

1997 Ceccon, P.; Costa, L. dalla; Fasan, T.; Giovanardi, R. (Dipartimento di Produzione Vegetale e Tecnologie Agrarie, Universita' di Udine, Udine (Italy)) (1992) **Nitrogen use efficiencies in barley and maize.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 236-237.* European Society for Agronomy. 5 ref. English. (AGRIS 95-035316).

1998 Dang, Y.P. (Queensland Wheat Research Inst., Toowoomba, Qld. (Australia)); Dalal, R.C.; Edwards, D.G.; Tiller, K.G. (1993) **Understanding zinc reactions in vertisols to predict zinc responses by wheat.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 247-250.* 14 ref. English. (AGRIS 95-024130).

1999 Fernandez Rivera, Marcial; Martinez Menes, Mario R. (Colegio de Postgraduados. Montecillo, Texcoco, Mex. 56230) (1993) **[Water use efficiency of five species in dryland conditions]. Eficiencia en uso de agua de cinco especies bajo condiciones de secano.** *Revista Fitotecnia Mexicana (Mexico) v. 16(2) p. 134-142.* 2 ilus.; 3 tablas; 23 ref. Tambien como tesis (MC) Colegio de Postgraduados. Spanish. (AGRIS 95-024100).

In the Mexican highlands, which cover areas of the states of San Luis Potosi and Zacatecas, from the total agricultural area, 93 % is dryland agriculture, with 350 to 600 mm annual precipitation. This study was carried out under rainfed conditions, in order to evaluate the following crops: oat (cv. Tarahumara), barley (cv. Cerro Prieto), bean (landrace Bayo Gordo) and maize (landrace Pipitillo); and maize-squash (landrace de Castilla) and maize-bean intercropping. Crops were evaluated by their water use efficiency (WUE) and income yield capacity, under two population densities. The results showed that the bean crop was the most outstanding in WUE expressed as net gain in money, with $348/ha/mm of water evapotranspiration and a profit of $34,566/ha. Oat and barley showed the higher value of WUE in terms of grain production/ha and dry matter production (DMP)/ha/mm of water, with values of 6.14 and 16.03 for oat and 6.13 and 16.77 for barley, respectively. The lower plant stands surpassed the higher stands in terms of grain production and WUE expressed as grain production.

2000 Gromova, Z.; Polacek, M. (1995) **UPTAKE OF NUTRIENTS IN TRITICALE.** *Rostlinna Vyroba. 41(2):71-75.* Polish. [UNIV AGR NITRA NITRA SLOVAKIA].

There are reported the results of three-years' investigations of climatic conditions and fertilization influence on the nutrient balance in triticale grain and straw. The field polyfactorial trials were based by the Department of Plant Production (University of Agriculture, Nitra). From the climatic aspect they were located in warm, moderately arid region with slightly acid, loamy brown soil, rich in P and K. Three levels of fertilization were investigated: A - without fertilization (control variant); B - 50% NPK in mineral fertilizers and 50 % NPK in manure were applied (according to the

normative counted for 8 t yield of above soil biomass per hectare); C - fertilization according to the complex diagnostic methodology (Michalik, Lozek, 1985). From 1991 to 1993 the average content of macronutrients was: 2.376% N, 0.479% P, 0.477% K, 0.042% Ca, 0.216% Mg in grain and 0.466% N, 0.064% P, 1.146% K, 0.275% Ca, 0.133% Mg in straw. In 1991 Mg content was the lowest in grain and especially in straw. In 1993 P content was the lowest in straw. In this year Ca and K contents were the lowest in grain. The smallest changes were observed in N content. One t of biomass exploited 24.4 kg N, 4.7 kg P, 13.9 kg K, 2.7 kg Ca and 3 kg Mg. The fertilization had no considerable influence on the consumption of nutrients by 1 t biomass. The consumption of nutrients by yield was significant and high significant according to the cultivation and climatic conditions. The considerable decrease in the yield and macronutrients consumption was observed in very and 1993 year. The yield (4.4 t per hectare) was about 40 % lower as in 1991 and 1992. The results confirm that the climate conditions during the year and in individual years are ones of the factors that have an influence on the yield and consumption of nutrients by biomass.

2001 Huang, C. (Waite Agricultural Research Inst., Glen Osmond, SA (Australia)); Webb, M.J.; Graham, R.D. (1993) **Effect of pH on Mn absorption by barley genotypes in a chelate-buffered nutrient solution.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 437-440.* 11 ref. English. (AGRIS 95-024099).

2002 Jungk, A. (Georg August Univ., Goettingen (Germany). Inst. of Agricultural Chemistry); Seeling, B.; Gerke, J. (1993) **Mobilization of different phosphate fractions in the rhizosphere.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 91-94.* 17 ref. English. (AGRIS 95-024192).

2003 Justes, E. (INRA, Laboratoire d'Agronomie, 78850 Thiverval Grignon (France)) (1992) **Diagnosis of nitrogen nutrition status of a winter wheat crop by 'nitrate test': relationship with the nitrogen dilution curve during the growth.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 262-263.* European Society for Agronomy. 8 ref. English. (AGRIS 95-035286).

2004 Leifert, C.; Murphy, KP.; Lumsden, PJ. (1995) **MINERAL AND CARBOHYDRATE NUTRITION OF PLANT CELL AND TISSUE CULTURES [Review].** *Critical Reviews in Plant Sciences. 14(2):83-109.* English. [UNIV ABERDEEN DEPT PLANT & SOIL SCI CRUICKSHANK BLDG ST MACHAR DR ABERDEEN AB9 2UD SCOTLAND].

Recent advances in our understanding of the mineral (and carbohydrate) nutrition of cultured plant cells and tissues are reviewed. The methods used for empirical selection of nutrient composition of culture media for different plant general species and types of culture are critically evaluated. The acquisition of nutrients is discussed in terms of their physical availability in the culture medium and uptake from the medium. The effect on uptake of factors such as pH and water potential and the relationship with growth rates and medium depletion am examined in detail. Finally, some effects of nutrients on morphogenesis of plants are reviewed. [References: 179].

2005 Lindberg, S. (1995) **IN-SITU DETERMINATION OF INTRACELLULAR CONCENTRATIONS OF K+ IN BARLEY (HORDEUM VULGARE L CV KARA) USING THE K+-BINDING FLUORESCENT DYE BENZOFURAN ISOPHTHALATE.** *Planta. 195(4):525-529.* English. [SWEDISH UNIV AGR SCI DEPT PLANT PHYSIOL BOX 7047 S-75007 UPPSALA SWEDEN].

The tetra[acetoxymethyl] ester of the K+-binding fluorescent dye benzofuran isophthalate (PBFI-AM) was used to determine changes in intracellular potassium (K+) concentrations and to measure net transport of K+ in barley (Hordeum vulgare L. cv. Kara) root and leaf protoplasts. When this dye binds to free K+ inside the cytoplasm, the fluorescence intensity ratio 340/380 nm increases in direct relation to the K+ concentration. Because of a delay in the uptake of dye into the vacuoles, it is possible to determine K+ concentrations in the vacuoles and transport of K+ from the cytoplasm into the vacuole. The uptake of PBFI-AM in root and leaf protoplasts of barley differed in the absence or presence of external K+ and was faster at pH 5.5 than at pH 7.0. The fluorescence intensity of the dye was stable for at least 20 h when the protoplasts were kept at 4 degrees C. In the presence of nigericin, the fluorescence intensity of both cells and protoplasts was linearly related to the external concentration of K+ (up to 100 mM). [References: 26].

2006 Masse, J.; Robert, D.; Crosson, P. (Institut Technique des Cereales et de Fourrages, 75116 Paris (France)) (1992) **Effect of soil compaction on growth and nutrient uptake of winter wheat.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 266-267.* European Society for Agronomy. 4 ref. English. (AGRIS 95-035288).

2007 Mimura, T. (1995) **HOMEOSTASIS AND TRANSPORT OF INORGANIC PHOSPHATE IN PLANTS [Review].** *Plant & Cell Physiology. 36(1):1-7.* English. [HITOTSUBASHI UNIV BIOL LAB NAKA 2-1 KUNITACHI TOKYO 186 JAPAN].

In this review, homeostasis of inorganic phosphate (P-i) in plants is discussed in terms of membrane transport of P-i. Phosphate homeostasis is observed in plant systems at various levels. The cytoplasmic level of P-i is kept almost constant by exploitation of the vacuole as a reservoir of P-i. The vacuole also seems to maintain the apoplastic level of P-i at a quasi-constant level. During P-i deficiency, P-i is re-translocated from the older to the younger leaves. The concentration of P-i in young leaves, thus, is kept at a higher level without a supply of P-i from the root. The phenomenon can be referred to as leaf-level P-i homeostasis. All these phenomena are related to membrane P-i transport activities. P-i uptake activities of both the plasma membrane and the tonoplast change in response to the supply of P-i. P-i transport across the plasma membrane is controlled by the activities of both the P-i transporter and the H+ pump, the activity of which is modulated by P-i itself. [References: 48].

2008 Nooman, H.J.; Fuleky, G.; Czinkota, I. (Department of Soil Science and Agricultural Chemistry, University of Agricultural Sciences, 2103 Godollo (Hungary)) (1992) **Simplification and field application of the seedling biotest method.** *Proceedings second congress of the European Society for Agronomy, Warwick University 23-28 August 1992. Scaife, A. (ed.) p. 276-277.* European Society for Agronomy. 3 ref. English. (AGRIS 95-035287).

2009 Osaki, M. (Hokkaido Univ., Sapporo (Japan). Faculty of Agriculture) (1993) **Carbon-nitrogen interaction model in field crop production.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 203-206.* 5 ref. English. (AGRIS 95-024111).

2010 Osborne, L.D. (Western Australian Univ., Nedlands, WA (Australia). Dept. of Soil Science and Plant Nutrition); Robson, A.D. (1993) **What is the significance of herbicide-nutrient interactions on wheat?** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 529-532.* 22 ref. English. (AGRIS 95-024091).

2011 Pettersson, S. (1995) **LOW ROOT ZONE TEMPERATURE EFFECTS ON NET MINERAL NUTRIENT UPTAKE AND DISTRIBUTION IN BARLEY (HORDEUM VULGARE).** *Journal of Plant Physiology. 145(4):459-464.* English. [SWEDISH UNIV AGR SCI DEPT PLANT PHYSIOL POB 7047 S-75007 UPPSALA SWEDEN].

The influence of low root zone temperature (RZT) on net uptake and transport to shoots of potassium (K), magnesium (Mg), nitrogen (N), and phosphorus (P) was investigated in young plants of barley (Hordeum vulgare L. cv. Kara). The plants were subjected to 3 different levels of general nutrient deficiency stress and to 2 additional nutrient regimes with K supplied at relatively higher rates. Low RZT (10 degrees C as compared with 25 degrees C) did not negatively affect net uptake or transport of any of the elements. In shoots, the concentrations of K, N, and Mg were related to the rate of nutrient supply but unrelated to RZT. The concentration of P in shoots was similar in all treatments. In the roots, all elements were concentrated at low RZT. If deprived of external supply, K, previously accumulated in the roots at low RZT, could sustain normal growth of the plants for several days. It was concluded that with limited nutrient supply the net ion uptake rate into or transport from barley roots are not related to RZT in the temperature interval 10 degrees C to 25 degrees C. [References: 31].

2012 Rao, N.R. (Oklahoma State Univ., Stillwater, OK (USA). Dept. of Botany); Ownby, J.D. (1993) **Development of an ELISA for estimation of**

the copper nutritional status of wheat and cotton. Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 453-456.* 8 ref. English. (AGRIS 95-024149).

2013 Rogers, G.S. (Western Sydney Univ., Richmond, NSW (Australia)); Payne, L.; Milham, P.; Conroy, J. (1993) **Nitrogen and phosphorus requirements of cotton and wheat under changing atmospheric CO(2) concentrations.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 231-234.* 13 ref. English. (AGRIS 95-024148).

2014 Samuelson, ME.; Campbell, WH.; Larsson, CM. (1995) **THE INFLUENCE OF CYTOKININS IN NITRATE REGULATION OF NITRATE REDUCTASE ACTIVITY AND EXPRESSION IN BARLEY.** *Physiologia Plantarum. 93(3):533-539.* English. [UNIV STOCKHOLM DEPT BOT S-10691 STOCKHOLM SWEDEN].

The responses of nitrate reductase (NR) activity and levels of NR-mRNA to environmental nitrate and exogenous cytokinins are characterised in roots and shoots of barley (Hordeum vulgare L., cv. Golf), using a chemostate-like culture system for controlling nitrate nutrition. Experiments were mainly performed with split root cultures where nitrate-N was supplied at a constant relative addition rate of 0.09 day(-1), and distributed between the subroots in a ratio of 20%:80%. The subroot NR-mRNA level and NR activity, as well as the endogenous level of zeatin riboside (ZR), increased when the local nitrate supply to one of the subroots was increased 4-fold by reversing the nitrate addition ratio (i.e. from 20%:80% to 80%:20%). Also shoot levels of ZR, NR-mRNA and NR activity increased in response to this treatment: even though the total nitrate supply remained unaltered. External supply of ZR at 0.1 mu M caused an approximately 3-fold increase in root ZR levels within 6 h, which is comparable to the nitrate-induced increase in root ZR. External application of ZR, zeatin, isopentenyl adenine or isopentenyl adenosine at 0.1 mu M caused from insignificant to 25% increases in NR-mRNA and activity in roots and up to 100% stimulation in shoots, whereas adenine or adenosine had no effect. No synergistic effects of perturbed nitrate supply and cytokinin application were detected in either roots or shoots. The translocation of nitrate from the root to the shoot was unaffected by application of ZR or switching the nitrate distribution ratio between subroots. The data give arguments for a physiological role of cytokinins in the response of root and shoot NR to environmental nitrate availability. The nature and limitations of the physiological role of cytokinins are discussed. [References: 25].

2015 Sattelmacher, B. (Christian Albrechts Univ., Kiel (Germany). Inst. of Plant Nutrition and Soil Science); Heinecke, I.; Muehling, K.H. (1993) **Influence of minerals on cytoplasmic streaming in root hairs of intact wheat seedlings (Triticum aestivum L.).** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 107-110.* 23 ref. English. (AGRIS 95-024127).

2016 Shinano, T. (Hokkaido Univ., Sapporo (Japan). Faculty of Agriculture); Osaki, M.; Tadano, T. (1993) **Comparison of production efficiency among field crops related to nitrogen nutrition and application.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 207-210.* 7 ref. English. (AGRIS 95-024129).

2017 Veneklaas, E.J. (Utrecht Univ. (Netherlands). Dept. of Plant Ecology and Evolutionary Biology); Peacock, J.M. (1994) **Growth, biomass allocation and water use efficiency of two wheat cultivars in a Mediterranean environment; a pot experiment under field conditions.** *Plant and Soil (Netherlands) v. 162(2) p. 241-247.* 9 ref. English. (AGRIS 95-024126).

2018 Welch, RM. (1995) **MICRONUTRIENT NUTRITION OF PLANTS [Review].** *Critical Reviews in Plant Sciences. 14(1):49-82.* English. [USDA ARS N ATLANTIC AREA US PLANT SOIL & NUTR LAB TOWER RD ITHACA, NY 14853 USA].

Currently, there are eight trace elements considered to be essential for higher plants, Fe, Zn, Mn, Cu, Ni, B, Mo, and Cl. Possibly, other elements will be discovered to be essential because of recent advances in nutrient solution culture techniques and in the commercial availability of highly sensitive analytical instrumentation for elemental analysis. Much remains to be learned about the physiology of micronutrient absorption, translocation and deposition in plants, and about the functions they perform in plant growth and development. This review briefly summarizes the current knowledge of micronutrients in plants and than presents some new speculations on the mechanisms of micronutrient uptake and translocation in plants. [References: 201].

2019 Yuzbekov, A.K.; Shmat'ko, I.G. (1994) **[Tissue-specific activity of some enzymes of C4-acid metabolism and Calvin cycle in wheat under water deficit]. Tkanespetsificheskaya aktivnost' nekotorykh fermentov metabolizma S4-kislot i tsikla Kal'vina u pshenitsy pri vodnom defitsite.** *Fiziologiya rastenij (Russian Federation) v. 41(1) p. 107-113.* 29 ref. Russian. (AGRIS 95-035347).

2020 Zhang, F.S. (Beijing Agricultural Univ. (China). Dept. of Plant Nutrition) (1993) **Mobilisation of iron and manganese by plant-borne and synthetic metal chelators.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 111-114.* 11 ref. English. (AGRIS 95-024098).

F62 PLANT PHYSIOLOGY-GROWTH AND DEVELOPMENT

2021 Aude, MI.; Marchezan, E.; Mairesse, LA.; Bisognin, DA.; Cima, RJ.; Zanini, W. (1994) **DRY MATTER ACCUMULATION RATE AND DURATION OF GRAIN FILLING PERIOD IN WHEAT.** *Pesquisa Agropecuaria Brasileira. 29(10):1533-1539.* Portuguese. [UNIV FED SANTA MARIA CTR CIENCIAS RURAIS DEPT FITOT BR-97119900 SANTA MARIA RS BRAZIL].

Wheat (Triticum aestivum, L.) crops grown in Santa Maria region, RS, Brazil, are often subjected to high temperatures during the grain filling period, which may reduce grain yield. Rate and duration of grain filling period were determined for 25 wheat cultivars in four environments to evaluate genotypic variation for this two traits. The duration (days) mean of four environments, from anthesis to physiological maturity was 39 days, while the duration of the life cycle from seeding to physiological maturity was 137 days, corresponding to 592 and 1.621 accumulated growin/degree days respectively. Grain filling rate was 0,925 mg/day, and the mean grain dry weight estimated at physiological maturity was 35 mg. No genetic variability was found for rate of dry matter accumulation and accumulated growing degree days from anthesis to physiological maturity of the grain, among wheat cultivars evaluated.

2022 Batten, G.D. (Yanco Agricultural Inst., Yanco, NSW (Australia)); Blakeney, A.B.; McGrath, V.B.; Ciavarella, S. (1993) **Non-structural carbohydrate: analysis by near infrared reflectance spectroscopy and its importance as an indicator of plant growth.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 243-246.* 21 ref. English. (AGRIS 95-024267).

2023 Biehler, K.; Fock, H. (1995) **ESTIMATION OF NON-CYCLIC ELECTRON TRANSPORT IN VIVO OF TRITICUM USING CHLOROPHYLL FLUORESCENCE AND MASS SPECTROMETRIC O-2 EVOLUTION.** *Journal of Plant Physiology. 145(4):422-426.* English. [UNIV KAISERSLAUTERN FB BIOL POSTFACH 3049 D-67653 KAISERSLAUTERN GERMANY].

A mass spectrometric O-16(2)/O-18(2) technique was used to determine the rate of gross O-2 evolution in attached leaves of Triticum aestivum under several environmental conditions. Simultaneously, fluorescence emission was determined from the upper and the lower sides of the leaf. The rate of non-cyclic electron now derived from gross O-2 evolution deviated from the rates predicted from fluorescence measurements. This deviation varies depending on environmental conditions and on the side on which the leaf fluorescence is being measured. Our data clearly indicate that fluorescence measurements provide trends in electron transport but do not yield accurate electron transport rates of the entire leaf. [References: 17].

2024 Bingham, IJ.; Stevenson, EA. (1995) **CAUSES AND LOCATION OF NON-SPECIFIC EFFECTS OF SHAM ON O-2 UPTAKE BY WHEAT ROOTS.** *Physiologia Plantarum. 93(3):427-434.* English. [SAC ABERDEEN DEPT CROP BIOL 581 KING ST ABERDEEN AB9 1UD SCOTLAND].

Uptake of O-2 by whole, detached, root systems of wheal (Triticum aestivum L. cv. Alexandria) was titrated with salicylhydroxamic acid (SHAM) in the presence and absence of cyanide. The resulting rho(alt) plot was non-linear indicating that SHAM was acting non-specifically. The nature of the non-specific effects was investigated in reverse titration experiments. Uptake of O-2 was titrated with KCN in the presence and absence of SHAM at 1 mM and 25 mM, which yielded rho(cyt) values of <1 and <1, respectively. The results suggest that at 25 mM, SHAM inhibits the cytochrome pathway, but at 1 mM it stimulates an O-2-consuming process which is likely to be a peroxidase. A SHAM-stimulated peroxidase could easily be washed from these roots. In vitro, the peroxidase was stimulated to a similar extent by low (1 mM) and high (25 mM) concentrations of SHAM. Failure to inhibit with high concentrations of SHAM distinguishes this peroxidase from those hitherto eluted from root tissue. Reverse titration experiments in the presence and absence of 1 mM SHAM indicated that there were no significant side effects of SHAM in root tips. These data are supported by the negligible peroxidase activity that was washed from this root fraction. In contrast, significant side effects occurred in vivo, and substantial peroxidase activity was measured in vitro, from sections 4-6 cm and 18-20 cm behind the seminal root apex. The greatest activity was found with the 4-6 cm section which may be associated with high rates of cell wall lignification. The implications of these results for measurements of root respiration are discussed. [References: 22].

2025 Bishnoi, OP.; Singh, M.; Singh, S. (1994) **BEHAVIOUR OF OBSERVED AGRO-METEOROLOGICAL STRESS INDICES WITH SOIL-WATER AVAILABILITY IN WHEAT TRITICUM-AESTIVUM).** *Indian Journal of Agronomy. 39(3):406-409.* English. [CHAUDHARY CHARAN SING HARAYANA AGR UNIV HISAR 125004 INDIA].

A field experiment conducted during the winters of 1990-91 and 1991-92 on wheat (Triticum aestivum L. emend. Fiori & Paol.) with 5 dates of sowing under 3 moisture levels showed differences in behaviour of predawn leaf-water potential, canopy temperature, stomatal resistance and transpiration rate with soil-moisture availability in the crop. Due to interdependence between these stress parameters either predawn leaf-water potential or stomatal resistance may be used for internal moisture status of the plant and either canopy temperature or transpiration rate may also be used for the influence of external atmosphere condition on the plant for soil-plant-atmospheric relations. Response functions were developed to understand the behaviour of these indices of different levels of soil moisture in wheat.

2026 Bishnoi, OP.; Singh, S.; Niwas, R. (1995) **EFFECT OF TEMPERATURE ON PHENOLOGICAL DEVELOPMENT OF WHEAT (TRITICUM AESTIVUM).** *Indian Journal of Agricultural Sciences. 65(3):211-214.* English. [HARYANA AGR UNIV DEPT AGR METEOROL HISAR 125004 HARYANA INDIA].

2027 Blum, A.; Sinmena, B.; Mayer, J.; Golan, G.; Shpiler, L. (1994) **STEM RESERVE MOBILISATION SUPPORTS WHEAT-GRAIN FILLING UNDER HEAT STRESS.** *Australian Journal of Plant Physiology. 21(6):771-781.* English. [VOLCANI CTR INST FIELD CROPS POB 6 BET DAGAN ISRAEL].

The grain filling of wheat (Triticum aestivum L.) is seriously impaired by heat stress due to reductions in current leaf and ear photosynthesis at high temperatures. An alternative source of carbon for grain filling is stored stem reserves. Two spring wheat cultivars (V5 and V2183) of very similar phenology and plant stature, which had previously been found to differ in grain shrivelling under drought and heat stress conditions in the field, were used to evaluate the hypothesis that the mobilisation of stored stem reserves into the growing grain is an important source of carbon for supporting grain filling under heat stress. In two experiments in Israel (1990 and 1991), the rates of stem dry matter (DM) and stem total non-structural carbohydrates (TNC) loss, grain growth and leaf senescence were monitored under optimal (control) and high (stressed) temperatures in the glasshouse (1990) and the growth chamber (1991). Cultivar V5 always sustained a smaller reduction in grain dry weight under heat stress, than V2183. Irrespective of temperature, V5 had a higher stem DM and TNC content at the onset of grain filling, greater depletion of stem dry matter (or TNC) during grain fining, and longer duration of grain filling, than V2183. During grain filling V5 generally exported about two to three times more DM from the stems than V2183, under both non-stressed and stressed conditions. On the other hand, V5 was more heat-susceptible than V2183 in terms of leaf longevity, in vivo chlorophyll stability and grain abortion under heat stress. In a third experiment (1992) five cultivars (including V5 and V2183) were subjected to chemical desiccation (0.3% potassium iodide) of the canopy in the field in order to destroy the photosynthetic source of the plant after anthesis. The same cultivars were subjected to heat stress (35/25 degrees C) or non-stressed (25/15 degrees C) conditions after anthesis in the growth chamber. It was found that grain dry weight reduction by chemical desiccation was highly correlated with grain dry weight reduction by heat stress (r(2) = 0.89). Therefore, the superior capacity of V5 for grain filling from mobilised stem reserves is a constitutive trait which supports grain filling under heat stress which can be tested for by chemical desiccation of plants under non-stressed conditions. [References: 17].

2028 Blumenthal, C.; Wrigley, CW.; Batey, IL.; Barlow, EWR. (1994) **THE HEAT-SHOCK RESPONSE RELEVANT TO MOLECULAR AND STRUCTURAL CHANGES IN WHEAT YIELD AND QUALITY.** *Australian Journal of Plant Physiology. 21(6):901-909.* English. [CSIRO DIV PLANT IND GRAIN QUAL RES LAB N RYDE NSW 2113 AUSTRALIA].

When wheat coleoptiles or plants are subjected to a period of heat stress (e.g. at > 35 degrees C for 1 h or more), there is a reduction in normal protein synthesis, accompanied by de nova synthesis of the classical range of heat-shock proteins (based on radioactive tracer experiments) in virtually all parts of the plant. Study of coleoptile elongation rates indicates that this synthesis is related to a protective effect, whereby a preliminary heat shock provides a degree of protection against a later lethal shock. This thermotolerance is also associated with the appearance in coleoptiles and roots of a small peptide (detected without radioactive labelling) whose amino acid sequence (12 residues) is the same as the N-terminal sequence of the alpha- and beta-gliadin proteins of the endosperm. Heat stress during grain filling lends to important changes in the synthesis of gluten proteins with reduced synthesis of the high molecular weight (HMW) subunits of glutenin, and continuing synthesis of other gluten proteins, particularly various gliadin proteins. This latter group of polypeptides is thus presumed to be acting as heat-shock proteins, and indeed, multiple heat-shock elements are present in the published sequences of representative genes, up-stream of the coding regions. HPLC analysis (with or without radioactive labelling) shows that there is a resulting change from the normal balance of gluten polypeptides immediately after the shock as well as in the mature grain. As a result, there is a lower proportion of large-sized aggregates of glutenin and weaker dough properties. This scenario indicates that it should be possible to identify genotypes that would be tolerant to stress-related variations in quality by analysis of gluten composition and, at the gene level, by screening for heat-stress elements in the genes encoding HMW-glutenin subunits. In addition, heat stress modifies the particle size distribution of the starch fraction of mature grain, producing an increase in the proportion of large (A-type) starch granules. No change in chemical structure was detectable as a result of heat stress. [References: 24].

2029 Bringloe, DH.; Dyer, TA.; Gray, JC. (1995) **DEVELOPMENTAL, CIRCADIAN AND LIGHT REGULATION OF WHEAT FERREDOXIN GENE EXPRESSION.** *Plant Molecular Biology. 27(2):293-306.* English. [UNIV CAMBRIDGE DEPT PLANT SCI DOWNING ST CAMBRIDGE CB2 3EA ENGLAND].

A genomic clone encoding the precursor of wheat leaf ferredoxin has been isolated and characterised. The uninterrupted PetF gene encodes a polypeptide of 143 amino acid residues, consisting of an N-terminal presequence of 46 amino acid residues and a mature polypeptide of 97 amino acid residues. Southern blot analysis suggests that six copies of the PetF gene are present in the wheat haploid genome. Northern blot analysis has shown that the genes are both developmentally and light regulated in wheat seedlings and provides evidence that a circadian rhythm regulates the steady-state levels of ferredoxin transcripts. The intact wheat gene and several chimeric constructs, containing portions of the 5'-upstream region fused to the beta-glucuronidase reporter gene, have been introduced into tobacco plants, but levels of beta-glucuronidase activity above background were not detected; suggesting that the 5'-upstream region is unable to function as a promoter in tobacco plants. [References: 61].

2030 Choudhury, NK.; Aslam, M.; Huffaker, RC. (1994) **PHOTOCHEMICAL ACTIVITIES IN WHEAT CHLOROPLASTS INCUBATED UNDER IRRADIATION AND POSSIBLE PHOTOPROTECTION BY ZEAXANTHIN.** *Photosynthetica. 30(3):397-405.* English. [SAMBALPUR UNIV SCH LIFE SCI JYOTI VIHAR 768019 INDIA].

Chloroplasts isolated from the primary leaves of wheat seedlings lost 22 % of their chlorophyll and 35 % of the carotenoids after 4 h of incubation under a medium irradiance (MI) (400 mumol m-2 s-1, PAR). After a 3 h MI exposure, the photosystem (PS) 2 activity was completely lost while photosystem 1 (PS1) activity was reduced to 32 % of that, found initially. Chloroplasts isolated from the leaves of seedlings exposed to a high irradiance (1500 mumol m-2 s-1) contained a higher concentration of zeaxanthin (z) and lost pigments and photochemical activities at a relatively slower rate. When the z concentration in chloroplasts incubated under MI was enhanced several times by ascorbate (Asc), the losses of pigment contents and photosystem activities were significantly reduced. However, when the Asc-induced synthesis of z was inhibited by dithiothreitol, protection of the pigment contents and photochemical activities disappeared. Thus, z can photoprotect the chloroplasts during incubation under irradiation. [References: 27].

2031 Clausnitzer, V. (California Univ., Davis, CA (USA). Dept. of Land, Air and Water Resources); Hopmans, J.W. (1994) **Simultaneous modeling of transient three-dimensional root growth and soil water flow.** *Plant and Soil (Netherlands) v. 164(2) p. 299-314.* Bibliography (52 ref.). English. (AGRIS 95-024258).

2032 Correll, R.; Butler, J.; Spouncer, L.; Wrigley, C. (1994) **THE RELATIONSHIP BETWEEN GRAIN-PROTEIN CONTENT OF WHEAT AND BARLEY AND TEMPERATURES DURING GRAIN FILLING.** *Australian Journal of Plant Physiology. 21(6):869-873.* English. [CSIRO BIOMETR DIV SOILS PMB 2 GLEN OSMOND SA 5064 AUSTRALIA].

This paper compares the relationship between temperatures at grain filling and grain-protein content for wheat and barley. Two similar statistical models have been developed using historical grain and climate data to reliably predict the protein content of wheat and barley at grain receival sites. Protein levels were predicted using multiple regressions with the same regression coefficients for all sites. The locality effect is absorbed in the regression intercept derived for each site. Australian Standard White (ASW) wheat data for 109 silos throughout South Australia for the years 1971-1991 were analysed in relation to rainfall and temperatures at the closest weather station. Rainfall from May to September was associated with a decrease in ASW wheat grain protein, and more importantly, the number of days in October above 30 degrees C were positively associated with an increase in wheat grain-protein levels. Analysis of protein data from malting varieties of barley (1982-1991) from 160 South Australian hundreds (districts of about 260 km(2)) again showed that increased rainfall between July and September was associated with decreased grain protein. However, the dominating influence was the number of days in a row in November above 35 degrees C, which was consistently associated with increased grain protein. This makes an interesting comparison with wheat where October temperatures were more important despite barley being harvested earlier than wheat. [References: 7].

2033 Debrunner, N.; Feller, U. (1995) **SOLUTE LEAKAGE FROM DETACHED PLANT PARTS OF WINTER WHEAT - INFLUENCE OF MATURATION STAGE AND INCUBATION TEMPERATURE.** *Journal of Plant Physiology. 145(3):257-260.* English. [UNIV BERN INST PLANT PHYSIOL ALTENBERGRAIN 21 CH-3013 BERN SWITZERLAND].

Plant pans from field-grown wheat were detached and immersed in distilled water for several hours in the dark at 4 degrees C (very low metabolic activities) and at 20 degrees C. The release of amino acids, potassium, sodium, calcium and magnesium was measured repeatedly throughout the incubation period of 48 h. Such leakage experiments were started at four different maturation stages between ear emergence and harvest. Cations (except sodium, which was retained in the plant parts) were released immediately from senesced plant material, regardless of the temperature. In the incubation medium of green or yellowing plant parts, cations appeared only after several hours at 20 degrees C, but essentially no release was detected at 4 degrees C. Major quantities of amino acids were released only from green leaves or those in an early phase of senescence after incubation for several hours at 20 degrees C. At 4 degrees C. hardly any amino acids leaked out, regardless of the senescence stage. Consequently, metabolic activities were relevant for the delayed leakage at 20 degrees C. Our results suggest that changing properties of the leaf surface, the intactness of membranes, and compartmentation play an import role in the leakage of solutes. Leakage of solutes from senescing organs during a rain period must be considered as a relevant factor for the nutrient balance of crop plants. [References: 15].

2034 Delhaize, E.; Ryan, PR. (1995) **ALUMINUM TOXICITY AND TOLERANCE IN PLANTS.** *Plant Physiology. 107(2):315-321.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

2035 Demchenko, NP. (1994) **THE COMPLETION OF CELL PROLIFERATION AND GROWTH IN WHEAT RADICLE.** *Plant & Soil. 167(1):43-49.* English. [RUSSIAN ACAD SCI VL KOMAROV BOT INST PROF POPOV STR 2 ST PETERSBURG 197376 RUSSIA].

The pattern of proliferation and growth of cortical and central metaxylem cells in a radicle and the transitional zone of a wheat embryo was studied during the final stages of embryogenesis. Cell divisions finished nearer the root tip in the central metaxylem than was the case in the cortex. After divisions ceased the cells of both tissues maintained the ability to synthesize DNA and the cells began DNA endoreduplication. The maximal levels of endoreduplication were 4C and 8C in cortical and central metaxylem cells, respectively. As a result of nonsimultaneous cessation of divisions, the metaxylem cells were two or three times longer than cortical cells. The proportion of cells with the maximal DNA content was smaller in the transitional zone than in the radicle. During the final embryonal stages cell growth rate was decreased. It was established that the transition of cells to DNA synthesis was inhibited in all sites of the radicle during the completion of embryogenesis. The cell growth was stopped in proximal sites of the radicle. In the division zone the cells which had already begun DNA synthesis were able to complete it and divided. Cell growth stopped simultaneously with completion of proliferation in this zone. [References: 24].

2036 Denyer, K.; Hylton, CM.; Smith, AM. (1994) **EFFECT OF HIGH TEMPERATURE ON STARCH SYNTHESIS AND THE ACTIVITY OF STARCH SYNTHASE.** *Australian Journal of Plant Physiology. 21(6):783-789.* English. [JOHN INNES INST NORWICH RES PK COLNEY NORWICH NR4 7UH NORFOLK ENGLAND].

The decrease in yield which is observed when developing storage organs such as cereal grains or potato tubers are exposed to high temperatures is due to a lower final starch content. The rate of starch synthesis during the development of these storage organs at high temperature, is either reduced or fails to increase sufficiently to compensate for the shorter developmental period. This effect on the rate of starch synthesis does not seem to be due to a reduction in the supply of photosynthate. One of the enzymes in the pathway of starch synthesis, soluble starch synthase, is susceptible to heat inactivation at unusually low temperatures and may also have a low optimum temperature for maximum activity. In some storage organs, the maximum catalytic activity of soluble starch synthase is not very much greater than the rate of starch synthesis. A decrease in the activity of this enzyme is therefore, likely to affect the rate of starch synthesis. Thus, the effect of high temperature on the rate of starch synthesis may be due, at least in part, to the properties of this enzyme. This review discusses the unusual heat-sensitivity of starch synthase in the context of the effects of high temperature on starch synthesis in storage organs. [References: 25].

2037 Dofing, SM. (1995) **PHENOLOGICAL DEVELOPMENT-YIELD RELATIONSHIPS IN SPRING BARLEY IN A SUBARCTIC ENVIRONMENT.** *Canadian Journal of Plant Science. 75(1):93-97.* English. [UNIV ALASKA FAIRBANKS AGR & FORESTRY EXPT STN 533 E FIREWEED PALMER, AK 99645 USA].

Barley (Hordeum vulgare L.) producers in northern, marginal agricultural areas require cultivars that are both early maturing and high yielding. However, negative relationships between these two characteristics limit their simultaneous improvement. A better understanding of the relative contribution of the developmental stages to grain yield would assist breeders' selection. This study was undertaken to assess the relationships between patterns of phenological development and grain yield in barley grown in a subarctic environment. Sixteen genetically diverse spring barley cultivars were grown for 3 yr at Palmer, Alaska, and evaluated for grain fill rate, grain full period, growing degree days (GDD) to heading, GDD from heading to physiological maturity, and GDD from physiological maturity to ripe maturity. Cultivars developed in temperate regions tended to have slower grain fill rates than those developed in subarctic regions. Rapid grain fill rate was associated with high kernel weight, but not with grain fill

duration or grain yield. Increasing GDD to heading would result in higher grain yield, while increasing grain fill duration would have little effect. These results indicate that northern-adapted cultivars should have pre-heading periods lasting as long as possible, followed by short grain-fill periods. Simultaneous selection for early maturity and relatively long time to heading is recommended for the development of early-maturing, high-yielding cultivars adapted to northern conditions. [References: 15].

2038 Dreier, W.; Schnarrenberger, C.; Borner, T. (1995) **LIGHT- AND STRESS-DEPENDENT ENHANCEMENT OF AMYLOLYTIC ACTIVITIES IN WHITE AND GREEN BARLEY LEAVES - BETA-AMYLASES ARE STRESS-INDUCED PROTEINS.** *Journal of Plant Physiology. 145(3):342-348.* English. [HUMBOLDT UNIV BERLIN LEHRSTUHL PFLANZLICHE BIOCHEM INVALIDENSTR 43 D-10115 BERLIN GERMANY].

Amylolytic activity was extracted from green and white primary leaves of the barley (Hordeum vulgare L.) mutant line albostrians (variety Haisa) and from normally green and Norflurazon-bleached leaves of the non-mutant variety Maresi. In each case it could be resolved into three fractions (I, II, III) by anion-exchange chromatography on DEAE-Fractogel, each of which represented exe- or beta-amylases (EC 3.2.1.2). In green leaves of light-grown plants, the activities of enzymes I and II increased to maximum values at 9 to 10 days, whereby that of enzyme III attained a maximum Value at 4 to 5 days and decreased thereafter to a value amounting to 20%. White leaves exhibited 3- to 5-fold higher activities respective in all three fractions than did the green leaves upon growth in light. In dark-grown white leaves the amylolytic activity was slightly lower than that of the green leaves upon growth in light, but was distributed in a similar manner among the three fractions. Illumination (10 W m(-2)) of 8 day old dark-grown green mutant leaves resulted in a 1.5-fold activity enhancement over the dark control while the activity in white mutant tissue increased 4-fold. High light intensity (100 W m(-2)), an increase in growth temperature from 25 degrees C to 35 degrees C, or growth in the presence of 300 mM sorbitol or 200 mM NaCl all stimulated the amylolytic activity of both white and green leaf tissues, due in particular to selective increase of the fraction III activity. It is proposed that the activity stimulations due to strong illumination, elevated temperatures and decreased water potential are general responses to stress, and that the stress response of white mutant and bleached non-mutant tissues to light is considerably higher than that of green leaf tissue due to the lack of light-absorbing pigments. [References: 28].

2039 Duff, SMG.; Chollet, R. (1995) **IN VIVO REGULATION OF WHEAT-LEAF PHOSPHOENOLPYRUVATE CARBOXYLASE BY REVERSIBLE PHOSPHORYLATION.** *Plant Physiology. 107(3):775-782.* English. [UNIV NEBRASKA DEPT BIOCHEM EAST CAMPUS LINCOLN, NE 68583 USA].

Regulation of C-3 phosphoenolpyruvate carboxylase (PEPC) and its protein-serine/threonine kinase (PEPC-PK) was studied in wheat (Triticum aestivum) leaves that were excised from low-N-grown seedlings and subsequently illuminated and/or supplied with 40 mM KNO3. The apparent phosphorylation status of PEPC was assessed by its sensitivity to L-malate inhibition at suboptimal assay conditions, and the activity state of PEPC-PK was determined by the in vitro P-32 labeling of purified maize dephospho-PEPC by [gamma-P-32]ATP/Mg. Illumination (+/-NO3-) for 1 h led to about a 4.5-fold increase in the 50% inhibition constant for L-malate, which was reversed by placing the illuminated detached leaves in darkness (minus NO3-). A 1-h exposure of excised leaves to light, KNO3, or both resulted in relative PEPC-PK activities of 205, 119, and 659%, respectively, of the dark/0 mM KNO3 control tissue. In contrast, almost no activity was observed when a recombinant sorghum phosphorylation-site mutant (S8D) form of PEPC was used as protein substrate in PEPC-PK assays of the light plus KNO3 leaf extracts. In vivo labeling of wheat-leaf PEPC by feeding P-32-labeled orthophosphate showed that PEPC from light plus KNO3 tissue was substantially more phosphorylated than the enzyme in the dark minus-nitrate immunoprecipitates. Immunoblot analysis indicated that no changes in relative PEPC-protein amount occurred within 1 h for any of the treatments. Thus, C-3 PEPC activity in these detached wheat leaves appears to be regulated by phosphorylation of a serine residue near the protein's N terminus by a Ca2+-independent protein kinase in response to a complex interaction in vivo between light and N. [References: 41].

2040 Ericsson, T. (1995) **GROWTH AND SHOOT - ROOT RATIO OF SEEDLINGS IN RELATION TO NUTRIENT AVAILABILITY.** *Plant & Soil. 169:205-214.* English. [SWEDISH UNIV AGR SCI DEPT ECOL & ENVIRONM RES POB 7072 S-75007 UPPSALA SWEDEN].

The influence of mineral nutrient availability, light intensity and CO2 on growth and shoot:root ratio in young plants is reviewed. Special emphasis in this evaluation is given to data from laboratory experiments with small Betula pendula plants, in which the concept of steady-state nutrition has been applied. Three distinctly different dry matter allocation patterns were observed when growth was limited by the availability of mineral nutrients: 1, Root growth was favoured when N, P or S were the major growth constraints. 2, The opposite pattern obtained when K, Mg and Mn restricted growth. 3, Shortage of Ca, Fe and Zn had almost no effect on the shoot:root ratio. The light regime had no effect on dry matter allocation except at very low photon flux densities (< 6.5 mol m(-2) day(-1)), in which a small decrease in the root fraction was observed. Shortage of CO2 on the other hand, strongly decreased root development, while an increase of the atmospheric CO2 concentration had no influence on dry matter partitioning. An increased allocation of dry matter to below-ground parts was associated with an increased amount of starch in the tissues. Depletion of the carbohydrate stores occurred under all conditions in which root development was inhibited. It is concluded that the internal balance between labile nitrogen and carbon in the root and the shoot system determines how dry matter is being partitioned in the plant. The consistency of this statement with literature data and existing models for shoot:root regulation is examined. [References: 76].

2041 Falbel, TG.; Staehelin, LA.; Adams, WW. (1994) **ANALYSIS OF XANTHOPHYLL CYCLE CAROTENOIDS AND CHLOROPHYLL FLUORESCENCE IN LIGHT INTENSITY-DEPENDENT CHLOROPHYLL-DEFICIENT MUTANTS OF WHEAT AND BARLEY.** *Photosynthesis Research. 42(3):191-202.* English. [UNIV COLORADO DEPT ENVIRONM POPULAT & ORGAN BIOL BOULDER, CO 80309 USA].

Three light intensity-dependent Chl b-deficient mutants, two in wheat and one in barley, were analyzed for their xanthophyll cycle carotenoids and Chl fluorescence characteristics under two different growth PFDs (30 versus 600 mu mol photons m(-2) s(-1) incident light). Mutants grown under low light possessed lower levels of total Chls and carotenoids per unit leaf area compared to wild type plants, but the relative proportions of the two did not vary markedly between strains. In contrast, mutants grown under high light had much lower levels of Chl, leading to markedly greater carotenoid to Chl ratios in the mutants when compared to wild type. Under low light conditions the carotenoids of the xanthophyll cycle comprised approximately 15% of the total carotenoids in all strains; under high light the xanthophyll cycle pool increased to over 30% of the total carotenoids in wild type plants and to over 50% of the total carotenoids in the three mutant strains. Whereas the xanthophyll cycle remained fairly epoxidized in all plants grown under low light, plants grown under high light exhibited a considerable degree of conversion of the xanthophyll cycle into antheraxanthin and zeaxanthin during the diurnal cycle, with almost complete conversion (over 90%) occurring only in the mutants. 50 to 95% of the xanthophyll cycle was retained as antheraxanthin and zeaxanthin overnight in these mutants which also exhibited sustained depressions in PS II photochemical efficiency (F-V/F-m), which may have resulted from a sustained high level of photoprotective energy dissipation activity. The relatively larger xanthophyll cycle pool in the Chl b-deficient mutant could result in part from the reported concentration of the xanthophyll cycle in the inner antenna complexes, given that the Chl b-deficient mutants are deficient in the peripheral LHC-II complexes. [References: 38].

2042 Fomina, IR.; Bil, KY.; Gerts, SM.; Ladygina, ON.; Komarova, VP.; Biryukov, SV. (1995) **EFFECT OF LINURON ON THE UPTAKE OF EXOGENOUS C-14-SUCROSE BY THE DETACHED EARS OF TWO WHEAT GENOTYPES.** *Russian Journal of Plant Physiology. 42(1):58-63.* English. [RUSSIAN ACAD SCI INST SOIL SCI & PHOTOSYNTHESIS PUSHCHINO 142292 RUSSIA].

The effect of a low concentration of linuron (2 x 10(-8) M) on the uptake of exogenous C-14-sucrose by ears of wheat (Triticum aestivum L.) cut below the internode of the flag leaf was studied on intensive (Obrii) and extensive farming (Kooperatorka) cultivars of wheat under different light conditions. At certain stages of maturation, linuron stimulated the uptake of exogenous C-14-sucrose from the nutrient solution into detached ears when the plants were continuously illuminated. In the dark, this effect was not observed. The ears of the intensive cultivar accumulated C-14-sucrose in the presence of linuron more actively than those of the extensive one. It was

concluded that the action of linuron on the C-14-sucrose uptake by the ear was related to the effect of herbicide on the photosynthesis of the flag leaf. [References: 18].

2043 Gantar, M.; Kerby, NW.; Rowell, P.; Obreht, Z.; Scrimgeour, C. (1995) **COLONIZATION OF WHEAT (TRITICUM VULGARE L) BY N-2-FIXING CYANOBACTERIA .4. DARK NITROGENASE ACTIVITY AND EFFECTS OF CYANOBACTERIA ON NATURAL N-15 ABUNDANCE IN THE PLANTS.** *New Phytologist. 129(2):337-343.* English. [UNIV DUNDEE DEPT BIOL SCI DUNDEE DD1 4HN SCOTLAND].

Two cyanobacterial soil isolates, Nostoc 2S9B and Anabaena C5, that had previously been shown to form different types of association with the roots of wheat plants grown in liquid culture, were tested for heterotrophic nitrogenase activity and the ability to colonize the roots of plants grown in sand. Nostoc 2S9B showed substantial nitrogenase activity when associated with the roots of plants grown in liquid culture in medium free of combined N, even with the roots maintained and with assays performed in the dark (29% of the rate shown by root-associated Nostoc 2S9B grown and assayed in the light). When grown heterotrophically in the dark, at the expense of fructose, free-living Nostoc 2S9B showed a similar nitrogenase activity to root-associated Nostoc 2S9B in the dark. In contrast, Anabaena C5 showed no nitrogenase activity in the dark, under these conditions. When three different wheat cultivars were grown in sand that had previously been surface-inoculated with Nostoc 2S9B or with the cultured symbiotic cyanobacterium Nostoc LBG1, isolated from the bryophyte Anthoceros, there was colonization of the plant roots; there was no colonization of roots by Anabaena C5 under these conditions. Some increases in plant biomass and nitrogen content were observed, but these were dependent on the wheat cultivar and cyanobacterial inoculum used. Wheat plants grown in sand that had been pre-inoculated with Nostoc 2S9B, Nostoc LBG1 or Anabaena C5 in medium free of combined N had lower delta(15)N values in both roots and shoots than plants grown under identical conditions without a cyanobacterial inoculum. The observed N-15/N-14 fractionation indicates that N, fixed by the cyanobacteria contributed to the nitrogen economy of the wheat plants, irrespective of whether they were closely associated with the plant roots. [References: 25].

2044 Giorgio, D. de; Rinaldi, M.; Rizzo, V. (Istituto Sperimentale Agronomico, Bari (Italy)) (1994) **[Growth analysis and radiation use efficiency to estimate the production responses of durum wheat (Triticum durum Desf.) to increasing nitrogen rates [Apulia]]. Analisi dell'accrescimento - efficienza di utilizzazione dell'energia luminosa e produzione di cultivar di frumento duro (Triticum durum Desf.) concimate con dosi crescenti di azoto [Puglia].** *Rivista di Agronomia (Italy) v. 28(3) p. 170-178.* 1 table; 10 graphs; 18 ref. Italian. (AGRIS 95-035529).

2045 Gorshkova, TA.; Tyuleneva, NM.; Lozovaya, VV. (1995) **CELL WALLS OF INTACT WHEAT SEEDLINGS IN PHOTOSYNTHETIC PULSE-CHASE EXPERIMENTS.** *Russian Journal of Plant Physiology. 42(1):75-81.* English. [RUSSIAN ACAD SCI KAZAN SCI CTR KAZAN INST BIOL POB 30 KAZAN 420503 RUSSIA].

Label incorporation into the cell wall fractions of wheat seedling organs was followed after 40-min exposure to (CO2)-C-14 in the light and subsequent growth for eight hours in the dark. Eight hours following the exposure to the label, the cell wall radioactivity equalled 3.6% of the total mature leaf radioactivity and 23% of the total culm radioactivity. Different leaf zones varied in the portion of the label found in the cell wall fraction and in the ratios of radioactivity of cell wall fractions. The label distribution among the fractions of structural polysaccharides changed with time; the radioactivity in cellulose increased in all organs of the seedling, especially in its growing tissues. Changes in radiolabel distribution among the fractions of matrix polysaccharides were also observed. When the effect of low temperature (+4 degrees C) on the synthesis of structural polysaccharides was studied in the seedlings, the label incorporation into the cell wall fraction was lower than in the untreated seedlings and the drop of the label incorporation into the cellulose fraction was the most drastic. The results indicated a rapid cleavage of a considerable amount of the nascent polysaccharide molecules of the matrix, which was likely to be related to a cell wall formation mechanism. [References: 22].

2046 Hussain, A.; Lukow, OM. (1995) **TRANSIENT CHANGES IN WHEAT ENDOSPERM POLYMERIC PROTEINS DURING THE LATER STAGES OF GRAIN DEVELOPMENT.** *Canadian Journal of Plant Science. 75(1):195-198.* English. [AGR & AGRIFOOD CANADA WINNIPEG RES CTR 195 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

End-use quality of wheat depends mainly on the composition of the storage proteins. These proteins undergo changes during grain development. This study was carried out to examine modifications in the polymeric protein fraction at different days post anthesis (DPA) and to determine whether these changes are cultivar dependent. Endosperm proteins of three hexaploid wheat cultivars harvested at different stages of maturity and extracted sequentially from distal half kernels showed quantitative and qualitative changes when separated in a 7.5-9.0% gradient polyacrylamide gel system. Sudden qualitative changes were observed at a later stage of seed development (35 DPA) in all tested cultivars. Most qualitative changes occurred in proteins of molecular weight 60-90 kDa and least in proteins above 90 kDa. An intense 60-kDa band appeared in the 35-DPA sample of Columbus; this band faded as the grain approached full maturity (40 DPA). [References: 15].

2047 Jenner, CF. (1994) **STARCH SYNTHESIS IN THE KERNEL OF WHEAT UNDER HIGH TEMPERATURE CONDITIONS.** *Australian Journal of Plant Physiology. 21(6):791-806.* English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

As temperature rises above 18-22 degrees C, the observed decrease in the duration of deposition of dry matter in the kernel is not accompanied by a compensating increase in the l ate of grain filling with the result that grain weight (and yield) is diminished at high temperature. Reduced starch content accounts for most of the reduction in grain dry matter at high temperature. Responses to temperature in the low temperature range, 20-30 degrees C (the LTR), could possibly be ascribed to the temperature response characteristics of the reaction catalysed by soluble starch synthase (SSS), the enzyme synthesising starch. However, the rate of cell enlargement and the rate of accumulation of nitrogen in the grain also do not increase much as temperature rises, so other explanations are conceivable for the temperature responses in the LTR. Variation amongst cultivars of wheat in tolerance of high temperature is evident in the LTR. At temperatures above 30 degrees C (in the high temperature range (HTR) between 30 and 40 degrees C), even for short periods, the rate of starch deposition is slower than that observed at lower temperatures, an effect which is carried over after transfer from high to lower temperatures. This response is attributable to a reduction in the activity, possibly due to thermal denaturation, of SSS. Several forms of SSS are found in cereal endosperm. and some forms may be more tolerant of high temperature than others. Loss of enzyme activity at high temperature is swift, but is partly restored some time after transfer from hot to cool conditions. There appear to be two distinct mechanisms of response to elevated temperature, both resulting in a reduced grain weight through reduced starch deposition, but one of them is important only in the range of temperature above 30 degrees C. [References: 40].

2048 Kameli, A.; Losel, DM. (1995) **CONTRIBUTION OF CARBOHYDRATES AND OTHER SOLUTES TO OSMOTIC ADJUSTMENT IN WHEAT LEAVES UNDER WATER STRESS.** *Journal of Plant Physiology. 145(3):363-366.* English. [UNIV SHEFFIELD DEPT ANIM & PLANT SCI POB 601 SHEFFIELD S10 2UQ S YORKSHIRE ENGLAND].

Changes in the concentrations of organic and inorganic solutes in leaves of durum wheat (Triticum durum) under water stress have been quantified and compared in growing and expanded leaves. Sugars, particularly glucose, made the largest contribution to osmotic adjustment (Delta pi), which occurred to a much greater degree in the youngest leaf than in the first fully expanded leaf. Inorganic ions, especially K+, accounted for a major proportion of the total osmotic potential (pi(100)) in leaves of unstressed plants, where the amount of organic solutes was relatively low, but did not contribute significantly to the stress-induced change in Delta pi. The role of sugars and other solutes is discussed in relation to Delta pi, water conservation and survival under conditions of water deficit. [References: 36].

2049 Karrou, M.; Maranville, JW. (1995) **RESPONSE OF WHEAT CULTIVARS TO DIFFERENT SOIL NITROGEN AND MOISTURE REGIMES .3. LEAF WATER CONTENT, CONDUCTANCE, AND PHOTOSYNTHESIS.** *Journal of Plant Nutrition. 18(4):777-791.* English. [INRA CTR ARIDOCULTURE BP 290 SETTAT MOROCCO].

Two greenhouse studies were conducted with contrasting patterns of soil water availability and nitrogen (N) supply to extend our knowledge of the

combined effect of these environmental factors on cultivar response of wheat (Triticum aestivum L.). Several parameters of water relations and photosynthesis were measured. Results showed that at the beginning of stem elongation and before imposing water stress, the low N treatment decreased leaf conductance and carbon dioxide (CO2) exchange rate (CER). This effect was more significant in the case of the cultivar Nesma than the other cultivars. Leaf conductance was a much better indicator of CER than chlorophyll content. Overall, water stress decreased leaf conductance. Under mild stress, Nesma and Merchouch 8 behaved similarly, but Nesma was more sensitive to water stress. Increased N decreased CER under water stress but tended to have no effect on chlorophyll concentration. Under well watered conditions, N application helped the plants maintain greater leaf conductance, CER, and chlorophyll concentration than low N supply. Cultivar and N effects on relative water content (RWC) were not significant. Under severe water stress, Nesma tended to keep its stomata more open under N stress, while stomata of Merchouch 8 were not sensitive to N level variation. High N decreased leaf RWC of Nesma and Merchouch 8 but had no effect on Saada. From this study we concluded that under non-water stressed conditions, added N increased leaf water conductance, CER, and chlorophyll. Under water stress, the cultivars responded differently to N application. High N decreased leaf conductance and relative water content. These results indicated that careful cultivar selection can complement good N management of wheat in areas prone to soil moisture stress. [References: 17].

2050 Kenjebaeva, S.; Rakova, N. (1995) **MULTIPLE FORMS OF NITRATE REDUCTASE AND THEIR ROLE IN NITRATE ASSIMILATION IN ROOTS OF WHEAT AT LOW TEMPERATURE OR HIGH SALINITY.** *Physiologia Plantarum. 93(2):249-252.* English. [KAZAKH ACAD SCI INST PHYSIOL GENET & BIOENGN PLANTS TIMIRYAZEV 45 ALMATY 70 KAZAKHSTAN].

NADPH-, NADH-, and KNO3-eluted fractions of nitrate reductase (NR) were isolated from roots of winter wheat (Triticum aestivum L. cv. Mironovskaya 808) grown under low temperature or high salinity. All three fractions exerted activity with either NADPH or NADH as electron donor. The NADPH-eluted Fraction showed the highest activity with NADPH, whereas the NADH- and KNO3-eluted fractions were most active with NADH. The NADH- and NADPH-dependent activities in the NADH- and KNO3-eluted fractions were the ones that changed the most in response to low temperature. The inhibitory effect of salt stress was the same for both activities in each of the NADH- and KNO3-eluted fractions. The NADPH-eluted NR was the one least affected by the growth conditions. [References: 15].

2051 Kramell, R.; Atzorn, R.; Schneider, G.; Miersch, O.; Bruckner, C.; Schmidt, J.; Sembdner, G.; Parthier, B. (1995) **OCCURRENCE AND IDENTIFICATION OF JASMONIC ACID AND ITS AMINO ACID CONJUGATES INDUCED BY OSMOTIC STRESS IN BARLEY LEAF TISSUE.** *Journal of Plant Growth Regulation. 14(1):29-36.* English. [INST PLANT BIOCHEM WEINBERG 3 D-06120 HALLE GERMANY].

The effect of osmotically active substances on the alteration of endogenous jasmonates was studied in barley (Hordeum vulgare L. cv. Salome) leaf tissue. Leaf segments were subjected to solutions of D-sorbitol, D-mannitol, polyethylene glycol 6000, sodium chloride, or water as a control. Alterations of endogenous jasmonates were monitored qualitatively and quantitatively using immunoassays. The structures of jasmonates isolated were determined on the basis of authentic substances by capillary gas chromatography-mass spectrometry. The stereochemistry of the conjugates was confirmed by high performance liquid chromatography with diastereoisomeric references. In barley leaves,jasmonic acid and its amino acid conjugates, for example, with valine, leucine, and isoleucine, are naturally occurring jasmonates. In untreated leaf segments, only low levels of these native jasmonates were found. After treatment of the leaf tissues with sorbitol, mannitol, as well as with polyethylene glycol, an increase of both jasmonic acid and its conjugates could be observed, depending on the stress conditions used. In contrast, salt stress was without any stimulating effect on the levels of endogenous jasmonates. From barley leaf segments exposed to sorbitol (1 M) for 24 h, jasmonic acid was identified as the major accumulating compound. Jasmonic acid-amino acid conjugates increased likewise upon stress treatment. [References: 37].

2052 Liang, YL.; Richards, RA. (1994) **COLEOPTILE TILLER DEVELOPMENT IS ASSOCIATED WITH FAST EARLY VIGOUR IN WHEAT.** *Euphytica. 80(1-2):119-124.* English. [CSIRO DIV PLANT IND POB 1600 CANBERRA ACT 2601 AUSTRALIA].

Faster canopy development in temperate cereals can result in more efficient utilization of water, light and nutrients if these are in limited supply. It can also result in more competitive plants and less use of herbicides. The possible importance of the coleoptile tiller for increasing early vigour in wheat (Triticum aestivum L.) was determined for twelve F4 lines in two experiments. Each F4 line was chosen for variation in the presence and absence of a coleoptile tiller in plants in the previous generation; each F4 line was traced to a single F2 plant from a multiple convergent cross of sixteen parents. Eight plants of each of the F4 lines were grown in a single row in both experiments. Just after the coleoptile tiller appeared, plants within each line were classified into one of two groups: one group contained plants with large coleoptile tillers whereas the other group had either small coleoptile tillers or none at all. Leaf expansion rates were determined non-destructively at regular intervals, and plants were harvested to determine leaf and tiller characteristics when there were about five mainstem leaves. There was substantial variation in the leaf area of the coleoptile tiller both between groups and among lines. In both experiments plants with a large coleoptile tiller had 24-30% more leaf area and dry weight than plants selected with a small or absent coleoptile tiller up to the final harvest. Leaf expansion rates (increase in leaf area per day) were 25 to 35% greater in the large coleoptile tiller selections from the time tillers first appeared to the time of harvest, whereas the relative leaf expansion rate (increase in leaf area per unit of leaf area present per day) of the large selections was significantly greater than the small selections only at the time of appearance of the coleoptile tiller and just after. There was no evidence that the early appearance of a coleoptile tiller was associated with the largest seedlings or that it inhibited the growth of later tillers. It is concluded that selection for the appearance of a large coleoptile tiller should improve the early vigour of temperate cereals. [References: 17].

2053 Lopezcastaneda, C.; Richards, RA.; Farquhar, GD. (1995) **VARIATION IN EARLY VIGOR BETWEEN WHEAT AND BARLEY.** *Crop Science. 35(2):472-479.* English. [CSIRO DIV PLANT IND POB 1600 CANBERRA ACT 2601 AUSTRALIA].

In dryland Mediterranean-Like climates, barley (Hordeum vulgare L.) generally has higher grain and biomass yields than other temperate cereals. The advantage of barley compared with wheat (Triticum aestivum L.) is associated with barley's faster leaf area growth during vegetative development. Experiments were conducted in a glasshouse (average 25/15 degrees C) and outdoors (average 17/5 degrees C) to determine the traits associated with barley's greater early growth. Five cultivars each of barley and wheat were grown in large pots. Five harvests were made from the time there were about 2 leaves on the main stem to the time plants had about 4.5 leaves on the main stem. The weight of the caryopsis of all seeds sown was 35 mg. Barley produced approximate to 40% more aboveground biomass and two times greater leaf area than wheat by the two-leaf stage. Barley had a 17% faster average leaf appearance rate and a 35% faster average tiller appearance Fate than wheat but there was no evidence that either contributed to the differences in vigor between the two species. The relative growth rates for biomass and leaf area were also similar in the two species, although it was achieved in different ways. The average net assimilation rate (NAR) was 25% greater in wheat than in barley in both experiments, whereas the average leaf area ratio (LAR) was 23% higher in barley. Variation in specific leaf area (SLA) was largely responsible for the variation in NAR and LAR in both the glasshouse and outside. Factors between germination and the appearance of the second main stem leaf must be responsible for the greater early vigor in barley compared with that of wheat. [References: 30].

2054 Matejka, F.; Huzulak, J. (1995) **ANALYSIS OF RELATIONSHIPS BETWEEN WINTER WHEAT LEAF WATER POTENTIAL AND ATMOSPHERIC FACTORS.** *Biologia. 50(1):109-114.* English. [SLOVAK ACAD SCI INST GEOPHYS DUBRAVSKA 9 CS-84228 BRATISLAVA SLOVAKIA].

A mathematical model of relationships between the leaf water potential (LWP) and atmospheric factors for winter wheat is described. The input data for the model are: global radiation, air temperature, air humidity, soil moisture and wind speed. With this model one is able to calculate LWP, leaf resistance, actual evapotranspiration and canopy temperature. The verification of the model was carried out through experimental measurements performed during five consecutive years. Partial

relationships between the LWP and parameters of the soil-plant-atmosphere continuum were simulated. The main atmospheric factors influencing the LWP are vapour pressure deficit and global radiation. Finally the model quantifies the degree of root system development (by means of parameter beta) and expresses its influence on the LWP.

2055 Morita, S.; Okuda, H. (1995) **ELONGATION AND BRANCHING OF SEMINAL AND NODAL ROOTS IN WHEAT GROWN UNDER FIELD CONDITION** [Japanese]. *Japanese Journal of Crop Science. 64(1):14-18.* Japanese. [UNIV TOKYO FAC AGR BUNKYO KU TOKYO 113 JAPAN].

Growth and development of seminal and nodal roots in wheat were examined. After the experimental site was plowed and fertilized, a Japanese wheat cultivar was planted. Root system distributed in the top 30 cm of soil was taken using the monolith method every 2 weeks throughout the growing season. In each sampling, all seminal and nodal roots of three selected plants with normal size were identified and the number of root axes were recorded. Then the length of the root axes and the total root length including all lateral roots were measured, and the branching degree was examined as well. The total number and length of root axes in the seminal roots increased and almost reached a constant value soon after planting. The total root length of seminal roots, on the other hand, increased thereafter due to well-developed root branching, reached a maximum value and then decreased becouse of possible loss of lateral roots. On the contrary, the total number and length of nodal roots on main stems increased in the later growth stages followed by development of nodal roots emerged from tillers. Root branching of nodal roots was poorly developed compared with seminal roots. In the former growing period, most shallow roots consisted of seminal roots with well-developed laterals, whereas nodal roots increased to occupy a large portion in the later stages because of the increase in the total number of nodal roots as well as the decrease in the total length of seminal roots.

2056 Moustakas, M.; Ouzounidou, G.; Lannoye, R. (1995) **ALUMINUM EFFECTS ON PHOTOSYNTHESIS AND ELEMENTAL UPTAKE IN AN ALUMINUM-TOLERANT AND NONTOLERANT WHEAT CULTIVAR.** *Journal of Plant Nutrition. 18(4):669-683.* English. [ARISTOTELIAN UNIV THESSALONIKI DEPT BOT GR-54006 THESSALONIKI GREECE].

The effects of aluminum (Al) on photosynthesis and elemental uptake were studied in two wheat cultivars (Triticum aestivum L. cvs Yecora E, Nestos) differing in their tolerance to Al. Concentrations of calcium (Ca), magnesium (Mg), potassium (K), and iron (Fe) in the plant tissues of both cultivars grown in nutrient solutions (pH 4.5) decreased at all Al levels (0, 37.1, 74.1, and 148 mu M). The tolerant cultivar Yecora E retained larger concentrations of all elements measured in roots and above ground parts compared with the non tolerant cultivar Nestos. Concentrations of Ca and Mg in leaves of the cultivar Nestos under high Al treatment were within the deficiency range. Changes in the shape of the chlorophyll fluorescence induction curves showed that Al-stress altered thylakoid photofunctioning even in the more tolerant cultivar. Aluminum stress resulted in partial inhibition of photosynthetic electron transport at photosystem II and closure of photosystem II reaction centers. Chloroplast elemental loss and concomitant intrathylakoid acidification are postulated as mediating mechanisms for Al stress-induced inhibition of photosynthesis. [References: 38].

2057 Nguyen, HT.; Joshi, CP.; Klueva, N.; Weng, J.; Hendershot, KL.; Blum, A. (1994) **THE HEAT-SHOCK RESPONSE AND EXPRESSION OF HEAT-SHOCK PROTEINS IN WHEAT UNDER DIURNAL HEAT STRESS AND FIELD CONDITIONS.** *Australian Journal of Plant Physiology. 21(6):857-867.* English. [TEXAS TECH UNIV DEPT PLANT & SOIL SCI PLANT MOLEC GENET LAB LUBBOCK, TX 79409 USA].

The occurrence of heat-shock proteins (HSPs) in response to high temperature stress is a universal phenomenon in higher plants and has been well documented. However, in agriculturally important species, less is known about the expression of HSPs under natural environments. A review of the heat-shock response in wheat (Triticum aestivum L.) is presented and recent results on the expression of wheat HSPs under diurnal stress and field conditions are reported. In the field experiment, nag leaf blade temperatures were obtained and leaf blades collected for northern blot analysis using HSP 16.9 cDNA as a probe. Temperatures of leaf blades ranged from 32 to 35 degrees C under the tested field conditions at New Deal near Lubbock, Texas. Messenger RNAs encoding a major class of low molecular weight HSPs, HSP 16.9, were detected in all wheat genotypes examined. The results suggested that HSPs are synthesised in response to heat stress under agricultural production, and furthermore, that HSPs are produced in wheats differing in geographic background. In the controlled growth chamber experiment, HSP expression in two wheat cultivars, Mustang (heat tolerant) and Sturdy (heat susceptible) were analysed to determine if wheat genotypes differing in heat tolerance differ in in vitro HSP synthesis (translatable HSP mRNAs) under a chronic, diurnal heat-stress regime. Leaf tissues were collected from seedlings over a time-course and poly (A)(+) RNAs were isolated for in vitro translation and 2-D gel electrophoresis. The protein profiles shown in the 2-D gel analysis revealed that there were not only quantitative differences of individual HSPs between these two wheat lines, but also some unique HSPs which were only found in the heat tolerant line. This data provides evidence of a correlation between HSP synthesis and heat tolerance in wheat under a simulated field environment and suggests that further genetic analysis of HSPs in a segregating population is worthy of investigation. In conclusion, the results of this study provide an impetus for the investigation of the roles of HSP genes in heat tolerance in wheat. [References: 32].

2058 Olien, CR.; Clark, JL. (1995) **FREEZE-INDUCED CHANGES IN CARBOHYDRATES ASSOCIATED WITH HARDINESS OF BARLEY AND RYE.** *Crop Science. 35(2):496-502.* English. [MICHIGAN STATE UNIV DEPT CROP & SOIL SCI USDA ARS E LANSING, MI 48824 USA].

Deficiencies in winter hardiness of barley (Hordeum vulgare L.) with respect to osmotic and adhesive components of freeze stress might be improved by genetic transfer of specific traits from rye (Secale cereale L.). These protective traits may include the hydrolysis of fructan for accumulation and secretion of sugars. The objectives of this research were (i) to measure total and intercellular water soluble carbohydrates (CHO), sucrose, glucose, fructose, and fructan, in 'Hudson' barley and 'Rosen' rye by ethanol/water extraction of plants and by perfusion of crowns; and (ii) to estimate relief of freeze stress caused by adhesive and osmotic energies. Carbohydrates were detected and quantified by refractometry after high pressure liquid chromatography (HPLC). Freezing (-3 degrees C, 4 d) caused a greater change in the molar concentration of CHOs in rye than in barley extracts (26 vs. 16% increase, respectively), which would proportionally decrease freeze dehydration. The sugars perfused from frozen plants consisted of a higher proportion of monosaccharides in rye than barley, which would result in a greater potential for relief of adhesion. These mechanisms involve increase of sugar content in locations which relieve critical freeze stress. [References: 21].

2059 Ono, K.; Hashimoto, H.; Katoh, S. (1995) **CHANGES IN THE NUMBER AND SIZE OF CHLOROPLASTS DURING SENESCENCE OF PRIMARY LEAVES OF WHEAT GROWN UNDER DIFFERENT CONDITIONS.** *Plant & Cell Physiology. 36(1):9-17.* English. [UNIV TOKYO FAC SCI DEPT BIOL BUNKYO KU TOKYO 113 JAPAN].

Changes in the number and size of chloroplasts in mesophyll cells were investigated in primary leaves of wheat from full expansion to yellowing under different growth conditions. The number of chloroplasts per cell decreased slowly, although the decrease was steady and statistically significant, until the last stage of leaf senescence, when rapid degradation of chloroplasts took place. Rates of leaf senescence, or the decline in the number of chloroplasts, varied greatly among plants grown at different seasons of the year, but about 20% of chloroplasts always disappeared during the phase when steady loss of chloroplasts occurred. The area of chloroplast disks also decreased gradually but significantly, with a rapid decrease late in senescence. Thus, the total quantity of chloroplasts per mesophyll cell decreased substantially during leaf senescence. Yellowed leaves contained numerous structures that resemble oil drops but no chloroplasts. Decreases in rates of photosynthesis that occur during senescence may, therefore, be largely due to decreases in the quantity of chloroplasts. However, a better correlation was found between the decrease in the maximum capacity for photosynthesis and the degradation of RuBP carboxylase. When plants had been grown with a sufficient supply of nutrients, the number of chloroplasts decreased steadily but at a reduced rate and the reduction in the area of chloroplast disks was strongly suppressed. Thus, the quantitative decrease in chloroplasts in senescing leaves appears to be regulated by the requirements for nutrients (nitrogen) of other part of the plant. [References: 29].

2060 Paolillo, DJ. (1995) **PROTOXYLEM MATURATION IN THE SEEDLING LEAF OF WHEAT.** *American Journal of Botany. 82(3):337-345.* English. [CORNELL UNIV PLANT BIOL SECT ITHACA, NY 14853 USA].

Protoxylem (PX) maturation was followed in vascular bundles of the first foliage leaf (L#1) of wheat seedlings, using clearings and sectioned materials to assess development changes. L#1 contained seven to 11 longitudinal bundles. The seven bundles with largest diameters contained PX vessels, but the number of bundles with PX varied with leaf length. Repeated vessel maturation maintained PX continuity as older vessels collapsed due to leaf extension. Thus, the number of PX vessels in each bundle was also a function of leaf length, and the PX content of a bundle was a function of the stage of leaf development and how soon during leaf development the bundle attained mature PX. Distance from the leaf tip to the start point for PX was greater for bundles later to mature. Thus, the pattern of distal start points in mature leaves reflected the progression of PX maturation from the midrib to bundles of lower rank. It is suggested that the involvement of more and more bundles in PX maturation as the leaf ages is a general occurrence in grass leaves, and that assessing how many bundles will have PX requires observations late in leaf development. [References: 24].

2061 Parker, DK.; Proudlove, MO. (1995) **STUDIES ON THE MECHANISMS OF ROOTLET INHIBITION IN DEVELOPING BARLEY EMBRYOS.** *Journal of Cereal Science. 21(1):71-78.* English. [BRF INT LYTTEL HALL SURREY RH1 4HY ENGLAND].

Rootlet growth in developing barley embryos can be inhibited using various compounds. Little is known about the mechanism of action of these compounds, however. The inclusion of low concentrations of ethanol in the steep water inhibited rootlet growth markedly without affecting proteolytic activity in the endosperm. Bromate inhibited both rootlet growth and proteolysis. This suggests that separate mechanisms exist for the control of root growth and proteolysis. Root growth was inhibited progressively when alcohols of increasing carbon chain length were used, and similar concentrations of the corresponding aldehydes had even greater inhibitory effects. It is possible that the action of alcohols and aldehydes is on the membranes of the embryo root primordia. This is supported by the observation that compounds able to disrupt membranes, such as biological detergents and hop compounds, inhibit barley rootlet growth. [References: 14].

2062 Porter, J.R. (University of Bristol (Royaume Uni). Department of Agricultural Sciences) (1993) **[AFRCWHEAT2: A model of the growth and development of wheat incorporating responses to water and nitrogen].** [AFRCWHEAT2: Un modele de la croisance et le developpement du ble integrant les reponses a l'eau et a l'azote]. *European Journal of Agronomy (France) v. 2(2) p. 69-82.* 43 ref., 9 graph. English. (AGRIS 95-024254).

2063 Preiss, S.; Thornber, JP. (1995) **STABILITY OF THE APOPROTEINS OF LIGHT-HARVESTING COMPLEX I AND II DURING BIOGENESIS OF THYLAKOIDS IN THE CHLOROPHYLL B-LESS BARLEY MUTANT CHLORINA F2.** *Plant Physiology. 107(3):709-717.* English. [UNIV CALIF LOS ANGELES DEPT BIOL LOS ANGELES, CA 90095 USA].

Transcription and translation of Lhc (cab) genes have been compared in the chlorina f2 mutant of barley (Hordeum vulgare) and its wild type to study the effect of chlorophyll b's absence on the regulation of assembly of the light-harvesting complexes (LHC). All tested genes were transcribed and the amount of their respective mRNAs increased rhythmically upon illumination of etiolated mutant plants. The synthesis of individual LHC apoproteins also had a rhythmic pattern when total leaf protein extracts were examined, whereas they increased gradually in the thylakoid. Only some LHC pigment-proteins present in wild-type thylakoids were found in mature mutant membranes. Thus, only the 25-kD (type 3) apoprotein of the three apoproteins of the major LHC IIb complex survived. The amount of the minor LHC II pigment-proteins was considerably reduced but not to zero. Photosystem I had some of the two LHC Ia apoproteins but had little of those of LHC Ib. This was reflected in a shift of the 77-K emission maximum of whole leaves from 741 to 732 nm. It is concluded that the two largest LHC IIb and the LHC Ib apoproteins need chlorophyll b for stable integration into the membrane and that posttranslational regulation plays a major role in LHC assembly. [References: 50].

2064 Rao, MV.; Dekok, LJ. (1994) **INTERACTIVE EFFECTS OF HIGH CO2 AND SO2 ON GROWTH AND ANTIOXIDANT LEVELS IN WHEAT.** *Phyton-Annales Rei Botanicae Austria. 34(2):279-290.* English. [UNIV GUELPH DEPT HORT SCI GUELPH ON N1G 2W1 CANADA].

The impact of elevated CO2 and/or SO2 on the growth and antioxidant levels of wheat (Triticum aestivum L. cv. Urban) plants has been studied. High CO2 (0.7 ml l-1) significantly enhanced shoot biomass and photosynthetic capacity, while exposure to SO2 (0.14 mul l-1) resulted in a decreased shoot biomass and in an injured photosynthetic aparatus, illustrated by a loss of chlorophyll and a decreased ratio of variable to maximal fluorescence (F(v)/F(m)) and A(max). However, combined exposure of plants to high CO2 and SO2 eliminated the negative effects of SO2. Sulfate accumulation was almost equal in plants exposed to SO2 and, high CO2 and SO2. A significant increase in ascorbate, glutathione and their redox state was observed in plants exposed to high CO2 and SO2, compared to that of plants exposed to solely SO2. The absence of the negative efects of SO2 in the presence of high CO2 might be related to a high redox state of ascorbate and glutathione. Abbreviations: A(max), maximum rate of oxygen evolution at saturated light and CO2 (mumol m-2 s-1); ASA, reduced ascorbic acid; DHA, dehydroascorbic acid; F(m), maximum emission of photosystem-II chlorophyll fluorescence; F(v), variable component of F(m); GSH, reduced glutathione; GSSG, oxidized glutathione.

2065 Rawson, HM. (1995) **YIELD RESPONSES OF TWO WHEAT GENOTYPES TO CARBON DIOXIDE AND TEMPERATURE IN FIELD STUDIES USING TEMPERATURE GRADIENT TUNNELS.** *Australian Journal of Plant Physiology. 22(1):23-32.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

Clear, plastic-coated, temperature gradient tunnels (TGTs), 8 X 1.25 X 1.25 m were designed and built to examine how temperature and CO2 affect the yield of wheat in the field. Each of the three modules of each TGT was maintained at a different temperature above the ambient temperature using solar heating during the day and electric heating at night. The maximum day-time increment above ambient for the warmest module was 5 degrees C and full-season averages were close to 2 degrees C. TGTs were paired, with air in one being enriched to 700 mu L L(-1) CO2, and in the other being maintained at ambient CO2. Crops were planted in the TGTs at two sites in either summer (December) or winter (April and July) and they remained there until maturity. CO2 enrichment increased the yield in summer plantings by up to 36%. In winter plantings, with mean temperatures between sowing and anthesis of around 10 degrees C, the responses to CO2 were small averaging only 7% (range 1-12%). Though yield declined with increasing temperature in the TGTs in summer, there was a clear trend for an increasing response to CO2 at these higher temperatures, i.e. yield declined less. In summer, there was no convincing evidence for a different relative response to CO2 in two isolines which differed in maturity date, though the later line yielded more under the highest temperature regime (mean of 22-24 degrees C between sowing and anthesis). In winter there was a strong trend for the isoline requiring less vernalisation to respond more to CO2. It is suggested that early progress towards flowering might predispose wheat to a greater CO2 response. Overall, the data indicated that the positive response to CO2 in grain yield is likely to increase at approximately 1.8% per 1 degrees C in wheat crops that are not limited by water. Extrapolation indicated that the temperature at which there was no response to CO2 was 5 degrees C. All yield responses reflected biomass responses as harvest index was unchanged by CO2. [References: 37].

2066 Reggiani, R.; Bozo, S.; Bertani, A. (1995) **THE EFFECT OF SALINITY ON EARLY SEEDLING GROWTH OF SEEDS OF THREE WHEAT (TRITICUM AESTIVUM L) CULTIVARS.** *Canadian Journal of Plant Science. 75(1):175-177.* English. [CNR IST BIOSINTESI VEGETALI VIA BASSINI 15 I-20133 MILAN ITALY].

We studied the effects of three salinity levels (50, 100 and 150 mM NaCl) on the early seedling growth of three wheat (Triticum aestivum L.) cultivars of Albanian origin characterized by different sensitivities to salt. Sodium accumulation was similar in seedlings of different cultivars and, in general, Na+ was confined to the root. Chloride accumulated at high levels in both the root and the shoot but least so in Daity. No appreciable differences were observed in K+ content. The most salt-tolerant cultivar showed a higher capacity for osmoregulation than the other two cultivars. [References: 8].

2067 Samarakoon, AB.; Muller, WJ.; Gifford, RM. (1995) **TRANSPIRATION AND LEAF AREA UNDER ELEVATED CO2 - EFFECTS OF SOIL WATER STATUS AND GENOTYPE IN WHEAT.** *Australian Journal of Plant*

Physiology. 22(1):33-44. English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

Transpiration rate, leaf area expansion, water use and water-use efficiency (WUE) of spaced plants of wheat (cvv. Matong and Quarrion), were examined at ambient and twice ambient CO2 concentrations in wet and drying soil regimes. A hypothesis tested was that both stomatal conductance (g(s)) and leaf area development are so regulated by the plant in relation to soil water status that the reduction of approximately 40% in g(s) in high CO2 has no permanent impact on whole-plant water use. Whereas, during a soil drying cycle, leaf area increase under elevated CO2 counterbalanced closely for reduced g(s) in terms of soil water depletion as reported elsewhere, this counterbalance was neither exact at all times, nor did it apply when the soil was continuously wet. In wet soil, leaf area was not enhanced much by elevated CO2, probably because, under the high radiation and nutritional conditions used, the tillering rate was almost maximal anyway. Quarrion, having a 40% lower g(s) than Matong genetically, did not counterbalance a reduced transpiration rate with a larger leaf area under either drying or wet soil conditions. These results support rejection, for wheat, of the hypothesis posed; elevated CO2 increased leaf area mainly by virtue of the direct photosynthetic increase rather than changed soil water status. In wet soil, low g(s) Quarrion had a higher CO2 effect on WUE (+ 73 to 82%) than did Matong (+ 54 to 65%). In drying soil, both cultivars had a similar increase in WUE at high CO2 (+ 60 to 68%). [References: 31].

2068 Seligman, NG.; Sinclair, TR. (1995) **GLOBAL ENVIRONMENT CHANGE AND SIMULATED FORAGE QUALITY OF WHEAT .2. WATER AND NITROGEN STRESS.** *Field Crops Research. 40(1):29-37.* English. [UNIV FLORIDA USDA ARS AGRON PHYSIOL LAB GAINESVILLE, FL 32611 USA].

Forage crops are frequently subjected to stress conditions resulting from inadequate supplies of water and N. Because forages grown under these stress conditions constitute an important resource in animal agriculture, this study was undertaken to assess possible changes in the nutritive value and productivity of forage crops as a consequence of global environment change. A relatively simple, mechanistic model of wheat was extended to simulate growth and important determinants of feed quality ([N], leaf:stem, dry matter digestibility) in an annual, temperate climate C-3 forage grass. Weather data for a semiarid region and different levels of applied N were used to examine the response of forage productivity to various levels of water and N availability. Not surprisingly, responses to global environment change were highly dependent on the availability of both water and N. When either resource was available at low levels, production of digestible dry matter was nearly unchanged by elevated [CO2] or increased temperature. When compared at equivalent development stages, small increases in forage quality were simulated, mainly because higher temperature resulted in achievement of the initiation of grain fill at an earlier date. As N availability increased, differences in forage characteristics and productivity became more prominent. Elevated ambient [CO2] increased vegetative mass, digestible dry matter, and concentration of digestible dry matter but decreased leaf:stem and [N]. Increased temperature generally had an effect on forage traits that was opposite to the elevated [CO2] response. The combined effects of both factors sometimes cancelled each other, but usually one of the factors was dominant. Negative effects of temperature tended to be aggravated by dry conditions. At crop maturity, positive effects of elevated atmospheric [CO2] on forage productivity and quality were severely decreased by nutrient and physiological constraints. These simulations indicate that when forage crops are grown under irrigation in semiarid regions, there may be substantial and complex changes in productivity and feed quality as a consequence of warmer temperature and elevated atmospheric [CO2]. Under rainfed conditions, these differences could be quite erratic and virtually unpredictable within the current range of interannual variation in forage productivity and quality. [References: 29].

2069 Semenov, MA.; Porter, JR. (1995) **CLIMATIC VARIABILITY AND THE MODELLING OF CROP YIELDS.** *Agricultural & Forest Meteorology. 73(3-4):265-283.* English. [UNIV BRISTOL INST ARABLE CROPS RES DEPT AGR SCI LONG ASHTON RES STN BRISTOL BS18 9AF AVON ENGLAND].

Crop simulation models are used widely to predict crop growth and development in studies of the impact of climatic change. An important problem is the uncertainty inherent in the construction of the future weather scenarios used as inputs to models. In seeking to couple meteorological information to crop-climate models it must be remembered that many interactions between crops and weather are non-linear. Non-linearity of response means it is necessary to preserve the variability of weather sequences to estimate the effect of climate on agricultural production and to assess agricultural risk. To date, only changes in average weather parameters derived from general circulation models (GCMs) and then applied to historical data have been used to construct climatic change scenarios and in only a few studies were changes in climatic variability incorporated. Accordingly, a computer system, AFRCWHEAT 3S, was designed to couple the simulation crop model for wheat, AFRCWHEAT2, with a stochastic weather generator based on the series approach. AFRCWHEAT 3S provides flexible construction of climatic scenarios and allows changes not only in mean values but also in the variance or type of distribution for a wide variety of weather parameters. Analyses of sensitivity to changes in the variability of temperature and precipitation, as compared with changes in their mean values, were made for locations in the UK and France for winter wheat. Results indicated that changes in climatic variability can have a more profound effect on yield and its associated risk than changes in mean climate. [References: 33].

2070 Sinclair, TR.; Seligman, NG. (1995) **GLOBAL ENVIRONMENT CHANGE AND SIMULATED FORAGE QUALITY OF WHEAT .1. NONSTRESSED CONDITIONS.** *Field Crops Research. 40(1):19-27.* English. [UNIV FLORIDA USDA ARS AGRON PHYSIOL LAB GAINESVILLE, FL 32611 USA].

Projected changes in the global environment may affect both the quantity and quality of grain and forage mass produced and harvested in that environment. Quality is a major factor in determining the value of a forage crop as feed for ruminants. The objective of this study was to make a preliminary assessment of potential changes in the quantity and quality of forage as measured by [N] and leaf:stem of an annual, temperate climate C-3 forage crop grown under nonstressed conditions. Starting with a relatively simple, well-checked mechanistic model of wheat, adaptations were added to estimate changes in forage attributes. Increased temperature influenced both yield and nutritive value, mainly through changes in ontological development rates. Elevated,atmospheric [CO2] resulted in greater mass accumulation, but with lower leaf:stem and [N]. The combined effect of increased temperature and elevated [CO2] was to decrease slightly forage yield and to increase the forage nutritive value. These compensating effects of higher temperature and elevated [CO2] could be modified by interactions between [CO2] and the chemical composition and cell wall structure of forage plants. Analysis of such subtle interaction requires considerable experimental amplification. [References: 43].

2071 Slafer, GA.; Halloran, GM.; Connor, DJ. (1995) **INFLUENCE OF PHOTOPERIOD ON CULM LENGTH IN WHEAT.** *Field Crops Research. 40(2):95-99.* English. [UNIV MELBOURNE DEPT AGR CTR CROP IMPROVEMENT PARKVILLE VIC 3052 AUSTRALIA].

The effects of photoperiod on culm length (CL) were examined in a semi-dwarf (Condor) and a standard-height (Thatcher) wheat cultivar under five photoperiod regimes (natural photoperiod, two constant photoperiods, and two under which photoperiod was artificially increased over natural photoperiod by 9.8 and 13.1 min/d). The five photoperiod treatments were randomly assigned at sowing and re-randomised at terminal spikelet initiation (TS) to give five different photoperiod treatment combinations before and after TS. The cultivars differed significantly in final CL, Thatcher being taller than Condor. Culm length was related to the average photoperiod during the period between seedling emergence (SE) and double ridge (DR). There appeared to be an indirect effect of photoperiod during the vegetative phase on subsequent culm elongation, which was much stronger in Thatcher than in Condor, but the differences in CL between the two cultivars were smaller under long compared with short photoperiods. The effect of photoperiod on CL appeared to be closely related to the final number of leaf primordia on the main culm and to the number of elongated internodes, both increasing with short photoperiods. In contrast, differences in CL between cultivars were mainly due to the lengths of the internodes. [References: 28].

2072 Slafer, GA.; Rawson, HM. (1994) **DOES TEMPERATURE AFFECT FINAL NUMBERS OF PRIMORDIA IN WHEAT.** *Field Crops Research. 39(2-3):111-117.* English. [UNIV MELBOURNE DEPT AGR CTR CROP IMPROVEMENT PARKVILLE VIC 3052 AUSTRALIA].

Photoperiod and vernalisation both affect the number of leaf and spikelet primordia and, hence, the duration of the early phases of development in wheat. Temperature also affects duration of developmental phases but it is not clear whether temperature-related changes in duration are similarly associated with final numbers of primordia. The objective of this study was to examine these temperature-related associations. A phytotron study was conducted in naturally-lit cabinets with four cultivars (Sunset, Condor, Rosella and Cappelle Desprez) and six temperature regimes between 10 and 25-degrees-C. Seedlings were vernalised for 50 days and then grown under a photoperiod of 18 h to avoid confounding the responses to vernalisation and photoperiod with those to temperature. The duration of the period to terminal spikelet initiation was reduced by increases in temperature from 10 to 19-degrees-C, but extended at temperatures above 19-degrees-C. Cultivars differed in the time taken to the terminal spikelet stage. However, final numbers of leaf and spikelet primordia were affected only marginally by temperature. Final leaf number increased slightly with temperature, but this trend was only significant in Cappelle Desprez, and in that case accounted for only 1 leaf over the 15-degrees-C range. There was a curvilinear association between final spikelet number and temperature, with an optimum at about 19-degrees-C. However, temperature changed spikelet number by a maximum of only 3 per ear. Although significant correlation was only found for leaf number, there was a general trend for a reduction in number of primordia with longer duration to terminal spikelet initiation. However, these trends were all very small. This suggests that the effects of temperature on the rate of apex development towards terminal spikelet initiation and on the rate of primordia initiation are similar. Cultivar differences in duration of primordia initiation were translated directly to differences in number of primordia initiated. The relative impact of temperature and other factors on the rates of primordia initiation and apex development towards terminal spikelet initiation were assessed using a simple model. [References: 28].

2073 Snowden, KC.; Richards, KD.; Gardner, RC. (1995) **ALUMINUM-INDUCED GENES - INDUCTION BY TOXIC METALS, LOW CALCIUM, AND WOUNDING AND PATTERN OF EXPRESSION IN ROOT TIPS.** *Plant Physiology. 107(2):341-348.* English. [UNIV AUCKLAND SCH BIOL SCI CTR GENE TECHNOL PRIVATE BAG 92019 AUCKLAND NEW ZEALAND].

We have investigated the response of four Al-induced genes (wali1, -3, -4, and -5) from wheat (Triticum aestivum L.) to other stresses. The relative transcript levels of wali1 (encoding a plant metallothionein-like protein), wali3 and wali5 (putative Bowman-Birk proteinase inhibitors), and wali4 (phenylalanine ammonialyase) increased in root tips of wheat after 2-d treatments with toxic levels of all other metals tested (Cd, Fe, Zn, Cu, Ga, In, and La). The expression levels of wali1, -3, -4, and -5 also increased in the root tips of plants grown in the presence of low levels of Ca (10 mu M). The transcript levels of wali1, -3, and -5 increased in wounded leaf and root tissue, whereas the transcript levels of wali4 increased only in wounded leaves. The site of expression of wali1, -3, and -5 in root tips was identified using in situ hybridization. wali1 was expressed predominantly in the meristematic tissue of the root tip, whereas wali3 and wali5 were expressed predominantly in the cortical tissue of the root. Some changes in the site of expression of these genes were evident in the roots of Al-treated plants. [References: 25].

2074 Stone, PJ.; Nicolas, ME. (1994) **WHEAT CULTIVARS VARY WIDELY IN THEIR RESPONSES OF GRAIN YIELD AND QUALITY TO SHORT PERIODS OF POST-ANTHESIS HEAT STRESS.** *Australian Journal of Plant Physiology. 21(6):887-900.* English. [UNIV MELBOURNE CTR CROP IMPROVEMENT DEPT AGR PARKVILLE VIC 3052 AUSTRALIA].

Short periods of high temperature (> 35 degrees C) are common during the post-anthesis period in Australian wheat crops and have recently been shown to significantly reduce grain yield and quality. In view of this, 75 cultivars of wheat were screened for tolerance to 3 days of high temperature (max. 40 degrees C). Detailed results for grain yield and quality are presented for Five wheat cultivars in order to illustrate the wide range of responses to short periods of high temperature. Individual kernel mass decreased by up to 23%, depending on variety, and the gliadin:glutenin ratio altered in the range -9 to +18% in response to high temperature treatment, also depending on variety. Noodle swelling power was significantly affected by heat in two cultivars, but there was no significant change due to heat in the apparent amylose content in any variety. The marked response of several yield and quality components to a heat treatment lasting only ca 5% of the grain-filling period suggests that starch and protein synthesis do not immediately and/or fully recover from short, severe heat stress. In addition, we conclude that wheat shows considerable genetic variability in tolerance to short periods of high temperature for both grain yield and quality. [References: 47].

2075 Toure, A.; Major, DJ.; Lindwall, CW. (1995) **COMPARISON OF FIVE WHEAT SIMULATION MODELS IN SOUTHERN ALBERTA.** *Canadian Journal of Plant Science. 75(1):61-68.* English. [AGR & AGRIFOOD CANDA RES CTR POB 3000 MAIN LETHBRIDGE AB T1J 4B1 CANADA].

Increasing concentrations of greenhouse gases are expected to result in global warming which will affect crop production. Crop modelling is a useful tool for assessing the impact of climate change on crop production. The objective of this study was to select an appropriate model for climate change studies. Five simulation models, EPIC, CERES, Century, Sinclair and Stewart, were assessed using data from a long-term experiment begun in 1911 on a day loam (Dark Brown Chernozem) soil at Lethbridge, AB. Yields predicted by the five models were compared with actual spring wheat yields in continuous wheat, fallow-wheat and fallow-wheat-wheat rotations. The EPIC model gave the best simulation results over all rotations and the most accurate predictions of mean yields during droughts. It was concluded that the EPIC model had the greatest potential for assessing the impact of climate change on wheat yield. The Stewart model was the most accurate for unfertilized continuous wheat and fallow-wheat. The Sinclair model was most accurate for fertilized fallow-wheat and CERES was the most accurate model for fertilized continuous wheat. The Century model simulated average yield accurately but did not account for year-to-year variability. [References: 23].

2076 Toure, A.; Major, DJ.; Lindwall, CW. (1995) **SENSITIVITY OF FOUR WHEAT SIMULATION MODELS TO CLIMATE CHANGE.** *Canadian Journal of Plant Science. 75(1):69-74.* English. [AGR & AGRIFOOD CANADA RES CTR POB 3000 MAIN LETHBRIDGE AB T1J 4B1 CANADA].

Crop simulation models may be valuable in anticipating crop production under a changed climate. We compared four computer simulation models of wheat, crop estimation through resources and environment synthesis (CERES), erosion productivity impact calculator (EPIC), Stewart and Sinclair, for evaluating the impact of climate change on dryland spring wheat yield for continuous rotation in southern Alberta. To a varying extent, the four models showed decreases in dryland spring wheat yields due to high temperature and low precipitation. All the models except Stewart had similar sensitivity to low precipitation; however, they showed differences to high-moisture conditions. Within the range considered, the Sinclair model was the most sensitive to temperature, followed by CERES and Stewart. Only EPIC indicated optimum temperature and precipitation levels, while CERES had the most pronounced precipitation optimum. Although the CERES, Stewart and Sinclair models have different phenology submodels, they predicted similar phenological response to a doubled CO2 climate scenario generated from the Canadian Climate Center General Circulation Model for Lethbridge, AB. Growing seasons shortened by 19 d were predicted using CERES and 18 d by using the Sinclair and Stewart models. The CERES, Stewart and Sinclair models were modified to include the effect of CO2 on radiation-use-efficiency. With current atmospheric CO2 concentration in the future climate scenario, the EPIC and Stewart models predicted significant (25%) and non-significant (3%) yield increases for dryland wheat and Sinclair and CERES predicted yield losses. Higher CO2 levels may compensate for the effect of global warming; doubling CO2 from present levels in a warmer climate scenario resulted in yield increase predictions at different amplitudes using EPIC, Stewart and CERES and a slight yield decrease with Sinclair. [References: 21].

2077 Tripathy, BC.; Brown, CS. (1995) **ROOT-SHOOT INTERACTION IN THE GREENING OF WHEAT SEEDLINGS CROWN UNDER RED LIGHT.** *Plant Physiology. 107(2):407-411.* English. [NASA MAIL CODE MD RES KENNEDY SPACE CTR, FL 32899 USA].

Wheat seedlings grown with roots exposed to constant red light (300-500 mu mol m(-2) s(-1)) did not accumulate chlorophyll in the leaves. In contrast, seedlings grown with their roots shielded from light accumulated chlorophylls. Chlorophyll biosynthesis could be induced in red-light-grown chlorophyll-deficient yellow plants by either reducing the red-light intensity at the root surface to 100 mu mol m(-2) s(-1) or supplementing with 6% blue light. The inhibition of chlorophyll biosynthesis was due to impairment of

the Mg-chelatase enzyme working at the origin of the Mg-tetrapyrrole pathway. The root-perceived photomorphogenic inhibition of shoot greening demonstrates root-shoot interaction in the greening process. [References: 22].

2078 Vanoverbeek, LS.; Vanelsas, JD. (1995) **ROOT EXUDATE-INDUCED PROMOTER ACTIVITY IN PSEUDOMONAS FLUORESCENS MUTANTS IN THE WHEAT RHIZOSPHERE.** *Applied & Environmental Microbiology. 61(3):890-898.* English. [RES INST PLANT PROTECT IPO DLO POB 9060 6700 GW WAGENINGEN NETHERLANDS].

Tn5-B20 (lacZ as reporter gene) transcriptional fusion mutants of Pseudomonas fluorescens R2f were screened for their response to wheat root exudate. Several mutants showed beta-galactosidase activity under the influence of wheat root exudate. In one such mutant, RIWE8, gene expression was specifically induced by proline but not by 125 other substrates. This mutant also showed reporter gene induction, albeit to a lesser extent, by exudate of maize and grass roots but not by that of clover roots. In situ promoter activity of RIWE8 was found in Flevo silt loam soil amended with proline but not in water-, arginine-, glutamic acid-, or malic acid-amended soils. Reporter gene expression in RIWE8 was triggered in a model rhizosphere-soil system in the presence of wheat, maize, and grass roots but not in the presence of clover roots or in root-free (bulk) soil. The induction of expression of the reporter gene in soil, using this approach, is suggestive that promoter activity in RIWE8 may be useful for the construction of organisms with rhizosphere-controlled beneficial genes. [References: 62].

2079 Veneciano, J.; Cerda, R. (1993) **[Growth curves of fodder cereals. II. Barley (Hordeum vulgare L.)]. Curvas de crecimiento de cerales forrajeros de invierno. II. Cebada (Hordeum vulgare L.).** *Revista de la Facultad de Agronomia. Universidad Nacional de La Pampa (Argentina) v. 7(1) p.13-20.* Spanish. (AGRIS 95-024255).

2080 Volkmar, K.M. (Agriculture Canada Research Station, Lethbridge, Alta. (Canada)) (1994) **Pre-germination effects on mechanically impeded root growth of barley (Hordeum vulgare L.).** *Plant and Soil (Netherlands) v. 163(2) p. 197-202.* 23 ref. English. (AGRIS 95-024257).

2081 Waines, JG. (1994) **HIGH TEMPERATURE STRESS IN WILD WHEATS AND SPRING WHEATS.** *Australian Journal of Plant Physiology. 21(6):705-715.* English. [UNIV CALIF RIVERSIDE DEPT BOT & PLANT SCI RIVERSIDE, CA 92521 USA].

The effect of high temperature stress on wild and spring wheats is reviewed. Wild wheats include species in the genera Aegilops L. and Triticum L. Species exist in a polyploid series, diploid, tetraploid and hexaploid, based on the genome formula, n = x = 7 chromosomes. Commercial durum wheat is tetraploid with the genome formula BBAA, while bread wheat is hexaploid (BBAADD). Wheats grown at Riverside, California, from June to October exhibit heat stress at the vegetative and reproductive stages. Under high temperatures (28/15 degrees C day/night) during the vegetative stage, many diploid species do not grow well. Wild diploid T. urartu (AA) and T. monococcum ssp. boeoticum (AA) exhibited more effects of heat stress than the goat grasses A. speltoides (SS = BB?) or A. tauschii (DD). Wild tetraploid T. turgidum L. ssp. dicoccoides Korn (BBAA) exhibited more vegetative-phase stress tolerance than the diploid wheats. Modern Mexican cultivars of durum and bread wheats showed good establishment under high field temperatures, but often tiller number was reduced, and the developmental stages were reduced in time. All the spring durum and bread wheats tested flowered and set seed. They produced anthers with fertile pollen, and they had reproductive heat tolerance. Many wild Aegilops and Triticum accessions did not boot for lack of vernalisation, or they showed reproductive heat stress. Ten wild accessions, including A. speltoides, A. Longissima and A. searsii, showed normal vegetative and reproductive development and were considered heat tolerant. They came from the same geographic area in Palestine which should be searched for landraces of wheats that show heat tolerance. [References: 33].

2082 Wang, M.; Heimovaaradijkstra, S.; Vanduijn, B. (1995) **MODULATION OF GERMINATION OF EMBRYOS ISOLATED FROM DORMANT AND NONDORMANT BARLEY GRAINS BY MANIPULATION OF ENDOGENOUS ABSCISIC ACID.** *Planta. 195(4):586-592.* English. [TNO DEPT PLANT MOLEC BIOTECHNOL CTR PHYTOTECHNOL RUL WASSENAARSEWEG 64 2333 AL LEIDEN NETHERLANDS].

Dormant and non-dormant barley (Hordeum distichum L.) grains with identical genetic backgrounds were obtained by maturing grains under different climate conditions. When isolated embryos from dormant grains were incubated in a well containing a fixed volume of water (300 mu l), the germination rate and percentage were dependent on the embryo number per well. A higher embryo number per well was correlated with a lower germination rate and percentage. However, this was not the case for the embryos isolated from nondormant grains. During germination, the endogenous cis-abscisic acid (ABA) in isolated embryos from both dormant and non-dormant grains was analyzed. The inhibitory effect on germination of a higher number per well of isolated dormant embryos was due to diffusion of endogenous ABA out of the embryos and accumulation of ABA in the incubation medium. Moreover, there was de-novo synthesis of ABA in embryos isolated from dormant grains during incubation but not in embryos isolated from nondormant grains. The inhibitory effect of ABA on germination of embryos isolated from dormant grains could be mimicked by addition of ABA or the medium in which dormant embryos had been placed. Embryos isolated from nondormant grains were insensitive to addition of ABA and medium from dormant embryos. Our results demonstrate that diffusion of endogenous ABA, de-novo ABA synthesis and ABA sensitivity play a role in the control of germination. It is proposed that dormancy-breaking treatments act via changes to these processes. [References: 31].

2083 Wardlaw, IF. (1994) **THE EFFECT OF HIGH TEMPERATURE ON KERNEL DEVELOPMENT IN WHEAT - VARIABILITY RELATED TO PRE-HEADING AND POST-ANTHESIS CONDITIONS.** *Australian Journal of Plant Physiology. 21(6):731-739.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

In wheat, mean temperatures greater than 15-18 degrees C following anthesis can result in a decrease in kernel weight at maturity, and breeding for high temperature tolerance during kernel filling could provide a significant increase in yield in large parts of the Australian wheat belt. The response of kernel filling to high temperature, however, varies from planting to planting and this variation has been shown to be related to both pl e-heading and post-anthesis conditions. Thus high temperature (27/22 degrees C) or law light (50% shade) during ear development can reduce the response of the developing grain to high temperature (30/25 degrees C) following anthesis. In contrast, low light during kernel filling enhances the response to high temperature, resulting in a relatively greater reduction in kernel size. The latter response suggests that the slightly greater sensitivity to high temperature of grains from plants allowed to tiller freely in comparison with the responses observed using single culms, may be related to differences in light penetration of the canopy. This Variation in response to high temperature, although not appearing to change the order of tolerance across cultivars, can create difficulties in selecting for high temperature tolerance over a number of generations, and can account for the apparent low heritability (h(2) = 0.2) of high temperature tolerance determined here from a cross between the cultivars Kalyansona and Pinnacle. [References: 15].

2084 Wardlaw, IF.; Wrigley, CW. (1994) **HEAT TOLERANCE IN TEMPERATE CEREALS - AN OVERVIEW.** *Australian Journal of Plant Physiology. 21(6):695-703.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

2085 White, LM. (1995) **PREDICTING FLOWERING OF 130 PLANTS AT 8 LOCATIONS WITH TEMPERATURE AND DAYLENGTH.** *Journal of Range Management. 48(2):108-114.* English. [USDA ARS SO PLAINS RANGE RES STN 2000-18TH ST WOODWARD, OK 73801 USA].

An improved plant phenological method is needed to accurately predict flowering of a large array of plant species at locations with a wide range of latitude. Degree days or degree days times daylength cannot be used to accurately predict flowering of both early and late flowering species when grown at locations with wide range of latitude. Published flowering dates of 130 plant species from among 8 locations in central North America ranging in latitude from 39 to 50 degrees N and longitude 84 to 108 degrees W were used to develop a degree days times daylength factor to predict flowering dates. Plants flowering in late June flowered at the same time at all 8 locations regardless of latitude. Species flowering earlier than late June flowered earlier at southern locations than those at Treesbank, Manitoba.

Species flowering after late June flowered later at southern locations than those at Treesbank. Flowering of 124 species divided among 8 locations was most accurately predicted by the accumulation of degree days (threshold=2 degrees C) times daylength factor (1/(0.259-0,0140 star daylength) from the first of December. This method slightly discounts daylength below 13 hours and greatly increased its weight for every hour over 13 hours. This method predicted flowering dates with a standard deviation of 0.1, 0.5, -1.7, 2.4, -0.1, 6.0, -1.8, and -1.1 days for Swift Current, Saskatchewan; Treesbank, Manitoba; Sidney, Mont.; Fargo, N.D.; Sauk and Dane Co., Wise.; Wauseon, Ohio; and Manhattan, Kans.; respectively. Degree days or degree days times daylength had a standard deviation of 10 and 18 days in predicting flowering dates at Manhattan, Kans. [References: 24].

2086 Wrigley, CW.; Blumenthal, C.; Gras, PW.; Barlow, EWR. (1994) **TEMPERATURE VARIATION DURING GRAIN FILLING AND CHANGES IN WHEAT-GRAIN QUALITY.** *Australian Journal of Plant Physiology. 21(6):875-885.* English. [CSIRO DIV PLANT IND GRAIN QUAL RES LAB N RYDE NSW 2113 AUSTRALIA].

There have been a few notable occasions when the Australian wheat segregation system (mainly based on specification of variety and protein content) has failed to produce grain which gives dough properties expected for the wheat grade. The reasons for this are likely to relate to growing and storage conditions; of these, variations in temperature during grain filling appear to be a major factor. Observations of crop statistics, field and glasshouse experiments indicate that as growth temperatures increase up to 30 degrees C, there is a general increase in dough strength (as indicated by Extensograph maximum resistance, R(max), and as Farinograph development time and stability). However, a decline in dough strength is observed following periods of heat stress (e.g. a few days with maxima of over 35 degrees C). Increasing temperatures during grain filling have also been observed to produce grain with a higher protein content, but this observation is not as consistent nor as marked as the effects on dough strength. We have sought to identify genotypes that do not follow this general trend in response to heat stress, and thus could be used as parents to breed for heat tolerance and greater stability of dough quality. A glasshouse experiment involving 45 genotypes has indicated that there is some variation in the response to heat stress, with a few genotypes being promising sources of tolerance. A second important approach to minimising the effects of heat stress is to develop a model to predict grain-quality changes, thus enabling a marketing authority to be forewarned of significant variation from the quality attributes normally expected for a wheat grade, and assisting breeders to better interpret the results of quality testing of lines grown at various sites. [References: 16].

2087 Xu, QA.; Paulsen, AQ.; Guikema, JA.; Paulsen, GM. (1995) **FUNCTIONAL AND ULTRASTRUCTURAL INJURY TO PHOTOSYNTHESIS IN WHEAT BY HIGH TEMPERATURE DURING MATURATION.** *Environmental & Experimental Botany. 35(1):43-54.* English. [KANSAS STATE UNIV AGR & APPL SCI DEPT AGRON MANHATTAN, KS 66506 USA].

Wheat (Triticum aestivum L. cv. Len) plants were exposed to 15/10, 25/20, and 35/30 degrees C day/night temperature regimes after anthesis until plants grown at 25/20 degrees C reached physiological maturity. Increasing temperature during maturation enhanced leaf senescence, accentuated the loss of chloroplast integrity, increased thylakoid luminal volume and decreased extent of appressed thylakoid membrane area, and accelerated the decline of PSII-mediated electron transport. Stomatal conductance declined slower than other photosynthetic processes at high temperature. Lability of PSII and stability of PSI activities to prolonged high temperature contrasted with measurements of Chi-binding proteins, such as LHCII, type-II LHCI and the PsaA-PsaB polypeptides. While the activity of PSII declined rapidly, the LHCII polypeptides remained as prominent thylakoid membrane components. Activity of PSI, in contrast, was sustained despite a diminished 735:685 nm fluorescence emission ratio and severe damage to the Chi-binding proteins, such as PsaA-PsaB and type-II LHCI. The dissimilar responses of LHCII and type-II LHCI to high temperature injury may be related to their localization in the thylakoid membrane; LHCII predominantly in the appressed membrane regions, may be relatively shielded from proteolytic activity as compared with type-II LHCI in the exposed membrane regions. [References: 42].

2088 Yasseen, BT.; Almaamari, BKS. (1995) **FURTHER EVALUATION OF THE RESISTANCE OF BLACK BARLEY TO WATER STRESS - PRELIMINARY ASSESSMENT FOR SELECTING DROUGHT RESISTANT BARLEY.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 174(1):9-19.* English. [AL AL BAYT UNIV FAC ART & SCI DEPT BIOL SCI MAFRAQ JORDAN].

Some parameters for screening drought resistance in barley were examined during various stages of plant development using two contrasting cultivars (local Iraqi cv. Black and Australian cv. Clipper). These parameters include leaf growth, tiller number, relative water content (RWC), proline accumulation and ionic composition. More pronounced drought resistance in Black was expressed by significantly lower reduction in leaf area, cell and tiller numbers compared with Clipper: proline concentration, RWC and ionic (N, P, K) concentration in expanded leaves, on the other hand, did nor clearly distinguish the cultivars. Black was particularly drought tolerant at the post-flowering stage. [References: 24].

H01 PROTECTION OF PLANTS-GENERAL ASPECTS

2089 Assmus, B.; Hutzler, P.; Kirchhof, G.; Amann, R.; Lawrence, JR.; Hartmann, A. (1995) **IN SITU LOCALIZATION OF AZOSPIRILLUM BRASILENSE IN THE RHIZOSPHERE OF WHEAT WITH FLUORESCENTLY LABELED, RRNA-TARGETED OLIGONUCLEOTIDE PROBES AND SCANNING CONFOCAL LASER MICROSCOPY.** *Applied & Environmental Microbiology. 61(3):1013-1019.* English. [GSF FORSCHUNGSZENTRUM UNWELT & GESUNDHEIT INST BODENOKOL INGOLSTADTER LANDSTR 1 D-85764 OBERSCHLEISSHEIM GERMANY].

The colonization of wheat roots by Azospirillum brasilense was used as a model system to evaluate the utility of whole-cell hybridization with fluorescently labeled, rRNA-targeted oligonucleotide probes for the in situ monitoring of rhizosphere microbial communities. Root samples of agar- or soil-grown 10- and 30-day-old wheat seedlings inoculated with different strains of A. brasilense were hybridized with a species-specific probe for A. brasilense, a probe hybridizing to alpha subclass proteobacteria, and a probe specific for the domain Bacteria to identify and localize the target bacteria. After hybridization, about 10 to 25% of the rhizosphere bacteria as visualized with 4',6-diamidino-2-phenylindole (DAPI) gave sufficient fluorescence signals to be detected with rRNA-targeted probes. Scanning confocal laser microscopy was used to overcome disturbing effects arising from autofluorescence of the object or narrow depth of focus in thick specimens. This technique also allowed high-resolution analysis of the Spatial distribution of bacteria in the rhizosphere. Occurrence of cells of A. brasilense Sp7 and Wa3 was restricted to the rhizosphere soil, mainly to the root hair zone, C-forms of A. brasilense were demonstrated to be physiologically active forms in the rhizosphere. Strain Sp245 also was found repeatedly at high density in the interior of root hair cells. In general, the combination of fluorescently labeled oligonucleotide probes and scanning confocal laser microscopy provided a very suitable strategy for detailed studies of rhizosphere microbial ecology. [References: 59].

2090 Saari, E.E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Overview of the wheat crop protection subprogram.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p.1-18. CIMMYT. 8 ref. p.1-18. English. (AGRIS 95-024524).

2091 Saari, E.E.; Hettel, G.P. (eds.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico)) (1994) **Guide to the CIMMYT wheat crop protection subprogram.** *CIMMYT Wheat Special Report (CIMMYT); no. 24 132 p.* CIMMYT. English. (AGRIS 95-024523).

This wheat special report provides an introduction to the CIMMYT Wheat Program's Crop Protection Subprogram. It is designed to help acquaint donors, visiting scientists, and other interested persons with the Subprogram's structure, activities, objectives involving the major wheat diseases, and philosophies. Specific Crop Protection projects and their respective investigators are listed in appendix 1 on page 102. The updated details on these projects can be found in the 1993 version of the Wheat Program's annual project documentation. Appendix 2 contains a listing of publications by Crop Protection staff.

H10 PESTS OF PLANTS

2092 Archer, TL.; Bynum, ED.; Onken, AB.; Wendt, CW. (1995) **INFLUENCE OF WATER AND NITROGEN FERTILIZER ON BIOLOGY OF THE RUSSIAN WHEAT APHID (HOMOPTERA, APHIDIDAE) ON WHEAT.** *Crop Protection. 14(2):165-169.* English. [TEXAS AGR EXPTL STN RT 3 BOX 219 LUBBOCK, TX 79401 USA].

The effect of water and nitrogen (N) fertilizer on densities of Russian wheat aphid, Diuraphis noxia (Mordvilko), on field-grown wheat was determined. Aphid densities were not significantly different ($p < 0.05$) among fertilizer rates (0-134 kg N ha(-1)). There were significantly ($p < 0.05$) more aphids from 22 March to 4 April 1988 on wheat that was not irrigated than on wheat irrigated four times during the growing season. More than 60 cm of rain fell during April and aphid numbers were not significantly different ($p < 0.05$) between irrigation treatments until 17 May 1988. By then, plants were stressed in the plots that were not irrigated and aphid densities were again higher than on plants in the plots that had been irrigated four times. Significantly ($p < 0.05$) more Russian wheat aphids were found on wheat plants grown in lysimeters maintained at 15% soil water holding capacity (SWHC) in a rainout shelter than on plants in lysimeters maintained at 50 and 100% SWHC. [References: 15].

2093 Bailey, SM.; Irwin, ME.; Kampmeier, GE.; Eastman, CE.; Hewings, AD. (1995) **PHYSICAL AND BIOLOGICAL PERTURBATIONS - THEIR EFFECT ON THE MOVEMENT OF APTEROUS RHOPALOSIPHUM-PADI (HOMOPTERA, APHIDIDAE) AND LOCALIZED SPREAD OF BARLEY YELLOW DWARF VIRUS.** *Environmental Entomology. 24(1):24-33.* English. [UNIV KENTUCKY DEPT ENTOMOL S-225 AGR SCI BLDG N LEXINGTON, KY 40546 USA].

Apterous adult and nymphal Rhopalosiphum padi (L.), previously reared on plants infected with barley yellow dwarf virus (BYDV), were subjected to eight perturbations (wind, rain, herbicide, coccinellid predators, crowding, mechanical disturbance, drought, and virus-infected plants) to determine effects on aphid dispersal and pattern of local spread of BYDV to oats in greenhouse experiments. Viruliferous aphids, caged overnight on oat plants in a 25-plant area (infection focus) in the center of each 625-plant plot, were subjected to a given perturbation after cages were removed and then allowed to move freely within the plot for 2 d. Presence of virus-infected plants outside the infection focus provided indirect evidence of aphid movement and direct evidence of virus spread. All types of disturbances except rain caused movement of apterous aphids and spread of BYDV. For all except the rain perturbation, controls were pooled and compared by paired t-tests with means of three indices of infection pattern (incidence, total distance, and average distance) for each experimental treatment. Incidence of infection (number of infected plants located outside the infection focus) in treated plots was significantly greater than pooled controls for the crowding, predator, wind, and herbicide perturbations. Total distance of infection (the sum of distances from the central plant in the infection focus to each infected plant outside the focus) was significantly greater in mechanical disturbance, crowding, predator, drought, wind, and herbicide perturbations than in controls. Average distance of infection (total distance divided by incidence) in treated plots was significantly greater than in the pooled controls for the drought, wind, and virus-infected oat treatments. [References: 50].

2094 Dedryver, C.A. (Institut National de la Recherche Agronomique, Le Rheu (France). Lab. de Recherches de la Chaire de Zoologie de l'ENSAR); Bournoville, R. (1992) **[Evaluation and the forecasting of the risks in entomology applied to agriculture: case of the field cultures]. L'appreciation et la prevision des risques en entomologie appliquee a l'agriculture: cas des grandes cultures.** Memoires de la Societe Royale Belge d'Entomologie (Belgium); Memoires van de Koninklijk Belgische Vereniging voor Entomologie; v. 35(1) p. 267-274. Societe Royale Belge d'Entomologie. 4 ill.; 23 ref. p. 267-274. French. (AGRIS 95-024729).

2095 Defarias, AMI.; Hopper, KR.; Leclant, F. (1995) **DAMAGE SYMPTOMS AND ABUNDANCE OF DIURAPHIS NOXIA (HOMOPTERA, APHIDIDAE) FOR FOUR WHEAT CULTIVARS AT THREE IRRIGATION LEVELS.** *Journal of Economic Entomology. 88(1):169-174.* English. [UNIV FED PERNAMBUCO DEPT ZOOL AV PROF MORAES REGO S-N CIDADE UNIV BR-50000 RECIFE PE BRAZIL].

In Montpellier, France, the effects of wheat cultivar and irrigation level on damage symptoms and Diuraphis noxia (Mordvilko) abundance were tested in screenhouse and field experiments. Four cultivars were used: 'Mondur' and 'Arcour', which are drought susceptible, and 'Agathe' and 'Ardente', which are drought tolerant. Previous preliminary observations had also indicated that 'Arcour' might be more susceptible to D. noxia than 'Ardente'. Each cultivar was irrigated at three levels in the screenhouse (25, 50, and 75% soil saturation) and in the held (sheltered from rain, rainfall, and irrigation plus rainfall). In the screenhouse, D. noxia density increased throughout the experiment, but did not vary with cultivar. In the field, although D. noxia density increased initially densities were much lower than in the screenhouse, perhaps because of natural enemy impact. 'Arcour' and 'Agathe' tended to have higher densities in the field than 'Mondur' and 'Ardente'. Although aphid densities were lower with lowest level of irrigation in the screenhouse, irrigation level did not affect aphid density in the field. Irrigation level did not significantly affect damage symptoms in the screenhouse or field. Although cultivar did not affect leaf streaking in the screenhouse or field, 'Ardente' and 'Agathe' showed significantly greater leaf rolling than 'Mondur' and 'Arcour' in the screenhouse, despite lack of differences in aphid density. Tile results of these experiments suggest that neither irrigation nor drought tolerance directly reduce density or impact of D. noxia, and one must look at other mechanisms to explain the negative correlation between high rainfall and D. noxia abundance. [References: 20].

2096 Givovich, A.; Niemeyer, HM. (1995) **COMPARISON OF THE EFFECT OF HYDROXAMIC ACIDS FROM WHEAT ON FIVE SPECIES OF CEREAL APHIDS.** *Entomologia Experimentalis et Applicata. 74(2):115-119.* English. [UNIV CHILE FAC CIENCIAS DEPT CIENCIAS ECOL CASILLA 653 SANTIAGO CHILE].

Feeding behaviour of five species of cereal aphids in wheat seedlings differing in hydroxamic acid (Hx) levels, was monitored via electrical penetration graphs (EPG). Aphid species could be grouped as sensitive to the feeding deterrent effect of Hx in the seedlings (Rhopalosiphum padi, Schizaphis graminum, Sitobion avenae, and Metopolophium dirhodum) or insensitive to them (Rhopalosiphum maidis). However, when feeding behaviour was studied in artificial diets containing Hx, all species were equally sensitive to Hx. The behaviour of R. maidis was further compared with that of R. padi through detailed EPG analysis. It was found that the insensitivity of R. maidis to Hx in seedlings may be due to a feeding strategy avoiding contact with the compounds by decreasing the number of cellular punctures in live tissues other than sieve elements during its way to the phloem. [References: 23].

2097 Hein, GL.; Elliott, NC.; Michels, GJ.; Kieckhefer, RW. (1995) **A GENERAL METHOD FOR ESTIMATING CEREAL APHID POPULATIONS IN SMALL GRAIN FIELDS BASED ON FREQUENCY OF OCCURRENCE.** *Canadian Entomologist. 127(1):59-63.* English. [UNIV NEBRASKA CTR PANHANDLE RES & EXTENS 4502 AVE I SCOTTSBLUFF, NE 69361 USA].

Similarities in population parameters among aphid species led us to investigate the potential for a single set of parameters that can be used to develop a 'generic' sampling plan for multiple small grain aphid species. A weighted average for the slope and intercept used to relate the proportion of infested tillers to the number of aphids per tiller was determined from the data in 15 published reports. These average parameter estimates were used to predict the number of aphids per tiller in 48 wheat fields sampled for four aphid species. The predicted estimates were regressed on the observed estimates with neither slopes nor intercepts differing significantly from one or zero, respectively. Therefore, it appears the single model is adequate for predicting aphid density for the aphid species tested. [References: 9].

2098 Miller, R.H. (International Center for Agricultural Research in the Dry Areas (ICARDA), Aleppo (Syria)) (1994) **Integrated pest management of cereal aphids in the Nile Valley: Problems and potential.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 109-120.* CIMMYT. 5 tables; 11 graphs., 18 ref. English. (AGRIS 95-024643).

There is a considerable amount of information on the pest and natural enemy complexes in wheat in the Nile Valley countries of Egypt and Sudan. Similarly, various projects have led to the development of chemical and

cultural control techniques, including resistant varieties, that may be incorporated into an integrated pest management (IPM) program for wheat. Research is needed on the economics of pest control in wheat, on the effectiveness of endemic natural enemies, and on the potential for introducing new natural enemies or augmenting populations of those in the field. A pilot IPM project, which is based on the use of aphid-resistant varieties, the preservation or augmentation of natural enemies, and minimal use of chemical pesticides, is feasible in the future.

2099 Pantone, DJ. (1995) **REPLACEMENT SERIES ANALYSIS OF THE COMPETITIVE INTERACTION BETWEEN A WEED AND A CROP AS INFLUENCED BY A PLANT PARASITIC NEMATODE.** *Fundamental & Applied Nematology. 18(1):93-97.* English. [TEXAS A&M UNIV BLACKLAND RES CTR TEMPLE, TX 76502 USA].

Methods for evaluating the influence of a plant parasitic nematode on plant competition were developed for a nematode-weed-crop system. The interrelationships between the fiddleneck flower gall nematode [Anguina amsinckiae (Steiner & Scott, 1935) Thorne, 1961], its weed host, fiddleneck (Amsinckia intermedia Fischer & Meyer) and wheat (Triticum aestivum L.) were investigated. Replacement series experiments were conducted in a greenhouse with ratios (weed : crop) of 0 : 1, 3 : 1, 1 : 1, 1 : 3, and 1 : 0. Experiments were replicated both in the presence and absence of the nematode. Results showed that the nematode reduced the dry weight of the weed by 25%, but had no significant effect on the dry weight of the crop. Competitive indices implied that the crop was the dominant competitor both in the presence and absence of the nematode. Measurements of niche differentiation indicated that the two plant species did not fully share the same limiting resources in the absence of the nematode, and that competition for limited resources intensified when the nematode was present. [References: 23].

2100 Poprawski, T.J. (United States Dept. of Agriculture, New York (USA). Agricultural Research Service. Plant, Soil and Nutrition Laboratory); Mercadier, G.; Gruber, F. (1992) **[Biology of the Russian wheat aphid, Diuraphis noxia (Mordvilko)]. Biologie du puceron russe du ble, Diuraphis noxia (Mordvilko).** Memoires de la Societe Royale Belge d'Entomologie (Belgium); Memoires van de Koninklijk Belgische Vereniging voor Entomologie; v. 35(1) p. 337-342. Societe Royale Belge d'Entomologie. 4 ref. p. 337-342. French. (AGRIS 95-024748).

2101 Poprawski, T.J. (United States Dept. of Agriculture, New York (USA). Agricultural Research Service. Plant, Soil and Nutrition Laboratory); Rey, E.; Gruber, F. (1992) **[Natural enemies of the Russian wheat aphid, Diuraphis noxia (Mordvilko)]. Ennemis naturels du puceron russe du ble, Diuraphis noxia (Mordvilko).** Memoires de la Societe Royale Belge d'Entomologie (Belgium); Memoires van de Koninklijk Belgische Vereniging voor Entomologie; v. 35(1) p. 343-346. Societe Royale Belge d'Entomologie. 12 ref. p. 343-346. French. (AGRIS 95-024749).

2102 Seco Fernandez, M.V. (Leon Univ., (Spain). Dept. de Ingenieria Agraria); Nieto Nafria, J.M. (1992) **[About the capture of winged aphids - Metopolophium dirhodum, Rhopalosiphum padi and Sitobion avenae (Homoptera Aphidoidea) in Leon (Spain)]. A propos des captures de pucerons ailes Metopolophium dirhodum, Rhopalosiphum padi et Sitobion avenae (Homoptera Aphidoidea) a Leon (Espagne).** Memoires de la Societe Royale Belge d'Entomologie (Belgium); Memoires van de Koninklijk Belgische Vereniging voor Entomologie; v. 35(1) p. 347-352. Societe Royale Belge d'Entomologie. 3 ill.; 2 tables; 5 ref. p. 347-352. French. (AGRIS 95-024730).

The results of the winged aphids capture of three very important species of aphids in winter cereal cultivation in Europe: Metopolophium dirhodum, Rhopalosiphum padi and Sitobion avenae are reported here. The captures were carried out using Rothamsted suction traps and Moericke water traps installed in Leon (Spain) over several years. The efficiency of each trap system is analyzed and the overall structure of their aerial population, taking into account their respective flight activities are also reported.

2103 Sedivy, J. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyne (Czech Republic)) (1994) **The occurrence of Contarinia tritici and Sitodiplosis mosellana on selected wheat varieties (Diptera, Cecidomyidae).** *Ochrana Rostlin - UZPI (Czech Republic) v. 30(4) p. 293-303.* 1 graph, 5 tables; 7 ref. English. (AGRIS 95-036262).

2104 Sharaf Eldin, N. (Agricultural Research Corporation (ARC), Wad Medani (Sudan)); Omer Kannan, H. (Rahad Research Station, El Fau (Sudan)) (1994) **Pest problems of wheat in Sudan.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 121-126.* CIMMYT. 3 tables; 8 ref. English. (AGRIS 95-024732).

In Sudan, wheat aphids, termites, and the spotted sorghum stem borer are the main insect pests of wheat. Considerable research has been conducted in close collaboration with the ICARDA/Nile Valley Regional Program. All programs were oriented towards an integrated pest management approach and addressed its important components. Intensive work was carried out on population dynamics, relative distribution, and abundance of the natural enemies of aphids during both the growing and off-seasons. Investigations were initiated to investigate the possibility of early augmentation with natural enemies for biological control. Screening of a great number of breeding lines against aphids showed some promise, but a closer cooperation by all relevant disciplines is still needed In the area of chemical aphid control, the economic threshold level was established as 35 infested plants. The search for lower rates and safer chemical and botanical insecticides continued with emphasis on seed-dressing materials and granulated insecticides. A breakthrough in protection of wheat is anticipated through the use of a new seed-dressing material in the next few years. For termites, cultural measures have been successfully utilized for control with outstanding results.

2105 White, NDG.; Jayas, DS.; Sinha, RN. (1994) **IMPACT OF PIRIMIPHOS-METHYL AND COLD TEMPERATURES ON ARTHROPOD POPULATIONS IN STORED WHEAT.** *Phytoprotection. 75(2):79-90.* English. [AGR & AGRIFOOD CANADA RES CTR 195 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

The insecticide pirimiphos-methyl applied at a mean concentration of 6.4 mg a.i. kg(-1) to 5 t of wheat (Triticum aestivum) in a farm granary in southern Manitoba remained active over 24 mo. Most insects and mites in the treated grain could not survive except a psocid, Liposcelis sp., and the mites Tarsonemus granarius and Aeroglyphus robustus, and their populations were sharply reduced relative to those in a bulk of untreated wheat. Insecticide residues at a l-m depth decreased ca. 52% in 12 mo from 8.1 mg kg(-1) to 4.0 mg kg(-1), then remained constant until 24 mo. Grain moisture content (MC) at this depth was consistently higher (over 14% MC) than at the top of the wheat bulk where residues remained near 4.5 mg kg(-1) over 24 mo. Grain temperatures fluctuated from summer maxima near 23 degrees C to winter minima near -40 degrees C at the bulk surface. Bioassay of treated wheat with adult Tribolium castaneum after 24 mo of storage resulted in about 80% mortality. Populations of T. castaneum or Rhyzopertha dominica introduced into 5 t of untreated wheat did not become established; small populations of Cryptolestes ferrugineus were established but were eliminated by winter cold. Populations of Liposcelis sp. and the mites A. robustus, T. granarius, Blattisocius keegani and Cheyletus eruditus were highest in late summer and autumn. Seed germination and microflora were not directly affected by pirimiphos-methyl. The slow rate of degradation of this insecticide in grain would prevent communities of arthropods from developing to the same extent as in an untreated stored-wheat ecosystem over 24 mo. [References: 25].

H20 PLANT DISEASES

2106 Alam, K.B.; Shaheed, M.A. (Bangladesh Agricultural Research Institute, Dinajpur (Bangladesh). Wheat Research Centre); Ahmed, A.U. (Bangladesh Agricultural Research Institute, Jamalpur (Bangladesh). Regional Agricutural Research Station); Malakar, P.K. (Bangladesh Agricultural Research Institute, Jessore (Bangladesh). Regional Agricutural Research Station) (1994) **Bipolaris leaf blight (Spot blotch) of wheat in Bangladesh.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 339-342.* CIMMYT. 1 table; 1 graph., 9 ref. English. (AGRIS 95-025218).

Bipolaris leaf blight (Bipolaris sorokiniana) or spot blotch is currently the number one disease of wheat in Bangladesh. The disease starts at the

seedling stage and increases with age. Almost all commercial cultivars are either moderately susceptible or susceptible to this disease. During 1991-92, the yield loss was estimated to 29.0 in the variety Kanchan. While Kanchan is slightly more tolerant to the disease than earlier released varieties, there has been little progress made in the further development of resistance due to a lack of resistance sources. Recently, new sources have been identified and will be used in the breeding program.

2107 Andrade, O.A. (Montana State Univ., Bozeman, MT (USA). Dept. of Plant Pathology); Mathre, D.E.; Sands, D.C. (1994) **Natural suppression of take-all disease of wheat in Montana soils.** *Plant and Soil (Netherlands) v. 164(1) p. 9-18.* 36 ref. English. (AGRIS 95-025301).

2108 Angus, J.F. (Division of Plant Industry CSIRO, Canberra (Australia)); Gardner, P.A.; Kirkegaard, J.A.; Desmarchelier, J.M. (1994) **Biofumigation: isothiocyanates released from Brassica roots inhibit growth of the take-all fungus.** *Plant and Soil (Netherlands) v. 162(1) p. 107-112.* 12 ref. English. (AGRIS 95-025350).

2109 Bai, D.; Scoles, GJ.; Knott, DR. (1995) **RUST RESISTANCE IN TRITICUM CYLINDRICUM CES (4X, CCDD) AND ITS TRANSFER INTO DURUM AND HEXAPLOID WHEATS.** *Genome. 38(1):8-16.* English. [AGR CANADA LONDON RES CTR 1391 SANDFORD ST LONDON ON N5V 4T3 CANADA].

In order to counteract the effects of the mutant genes in races of leaf rust (Puccinia recondita f.sp. tritici Rob. ex Desm.) and stem rust (P. graminis f.sp. tritici Eriks. and Henn.) in wheat, exploration of new resistance genes in wheat relatives is necessary. Three accessions of Triticum cylindricum Ces. (4x, CCDD), Acyl, Acy9, and Acy11, were tested with 10 races each of leaf rust and stem rust. They were resistant to all races tested. Viable F-1 plants were produced from the crosses of the T. cylindricum accessions as males with susceptible MP and Chinese Spring phlb hexaploid wheats (T. aestivum, 6x, AABBDD), but not with susceptible Kubanka durum wheat (T. turgidum var. durum, 4x, AABB), even with embryo rescue. In these crosses the D genome of hexaploid wheat may play a critical role in eliminating the barriers for species isolation during hybrid seed development. The T. cylindricum rust resistance was expressed in the F-1 hybrids with hexaploid wheat. However, only the cross MP/Acyl was successfully backcrossed to another susceptible hexaploid wheat, LMPG-6. In the BC2F2 of the cross MP/Acyl//LMPG-6/3/MP, monosomic or disomic addition lines with resistance to either leaf rust race 15 (infection types (IT) 1(=), 1, or 1(+); addition line 1) or stem rust race 15B-1 (IT 1 or 1(+); addition line 2) were selected. Rust tests and examination of chromosome pairing of the F-1 hybrids and the progeny of the disomic addition lines confirmed that the genes for rust resistance were located on the added T, cylindricum C-genome chromosomes rather than on the D-genome chromosomes. The T. cylindricum chromosome in addition line 2 was determined to be chromosome 4C through the detection of RFLPs among the genomes using a set of homoeologous group-specific wheat cDNA probes. Addition line 1 was resistant to the 10 races of leaf rust and addition line 2 was resistant to the 10 races of stem rust, as was the T. cylindricum parent. The added C-genome chromosomes occasionally paired with hexaploid wheat chromosomes. Translocation lines with rust resistance (2n = 21 II) may be obtained in the self-pollinated progeny of the addition lines through spontaneous recombination of the C-genome chromosomes and wheat chromosomes. Such translocation lines with resistance against a wide spectrum of rust races should be potentially valuable in breeding wheat for rust resistance. [References: 12].

2110 Bertschinger, L. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **BYD viruses and activities at CIMMYT.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 75-86. CIMMYT. 3 maps; 1 illus., 19 ref. p. 75-86. English. (AGRIS 95-025185).

2111 Bocquet, G. (Ciba Agriculture, Rueil (France)); Sylvestre, M.; Speich, J. (1994) **[Cyprodinil: a fungicide for cereal crops [CGA 219417, Unix; Pseudocercosporella herpotrichoides, Erysiphe graminis]]. Le cyprodinil: fongicide cereales [CGA 219417, Unix; Pseudocercosporella herpotrichoides, Erysiphe graminis].** *Phytoma La Defense des Vegetaux (France) (no 458) p. 53-55.* French. (AGRIS 95-025237).

2112 Borovkova, IG.; Steffenson, BJ.; Jin, Y.; Rasmussen, JB.; Kilian, A.; Kleinhofs, A.; Rossnagel, BG.; Kao, KN. (1995) **IDENTIFICATION OF MOLECULAR MARKERS LINKED TO THE STEM RUST RESISTANCE GENE RPG4 IN BARLEY.** *Phytopathology. 85(2):181-185.* English. [N DAKOTA STATE UNIV DEPT PLANT PATHOL FARGO, ND 58105 USA].

The gene rpg4 in barley confers resistance to pathotype QCC of Puccinia graminis f. sp. tritici. To facilitate the efficient transfer of rpg4 into breeding lines, an investigation was initiated to identify molecular markers linked to the gene. A doubled haploid population (125 individuals) derived from Q21861, the source of rpg4, was subjected to bulked segregant analysis by using random amplified polymorphic DNAs (RAPDs) and restriction fragment length polymorphisms (RFLPs). From 500 10-mer primers evaluated, only three reliably amplified fragments in one of the DNA bulks and not in the other. Linkage of the three RAPD markers, OPP-05 (900), OPH-13 (1600), and OPH-15 (1000), with rpg4 was confirmed by segregation analysis of the doubled haploid progeny. Primer OPH-15 generated the most closely linked (0.8 centimorgans [cM]) marker to rpg4. RFLP probes were used to map rpg4 and associated RAPD markers to chromosome 7M. The RFLP markers, ABG390 and MWG740, mapped 5.7 and 4.9 cM distal and proximal to the resistance gene, respectively. The RAPD and RFLP markers identified for rpg4 in this study should facilitate the efficient transfer of stem rust resistance in barley germ plasm. [References: 33].

2113 Boyacioglu, D.; Hettiarachchy, NS. (1995) **CHANGES IN SOME BIOCHEMICAL COMPONENTS OF WHEAT GRAIN THAT WAS INFECTED WITH FUSARIUM GRAMINEARUM.** *Journal of Cereal Science. 21(1):57-62.* English. [ISTANBUL TECH UNIV FAC CHEM MET ENGN DEPT FOOD ENGN ISTANBUL 80626 TURKEY].

Wheat kernels that were lightly and moderately infected by Fusarium graminearum were analyzed in terms of their carbohydrate, lipid, and protein contents to determine any compositional changes. The significant compositional changes in lightly infected wheat were increases in reducing sugars (24%), non-starch lipids (5%), and decreases in cellulose (17%) and hemicellulose (20%) components. In moderately infected wheat, the increases in protein (6%), total sugars (26%), reducing sugars (14%), non-starch (20%) and starch (8%) lipids, and decreases in apparent and total amylose (11-20%), cellulose (43%) and hemicellulose (37%) components were also significant. Furthermore, infection with F. graminearum decreased the proportions of water-extractable protein (albumin) and storage protein (glutenin) by 33 and 80%, respectively, in moderately infected wheat. [References: 23].

2114 Boyetchko, SM.; Tewari, JP. (1995) **SUSCEPTIBILITY OF BARLEY CULTIVARS TO VESICULAR-ARBUSCULAR MYCORRHIZAL FUNGI.** *Canadian Journal of Plant Science. 75(1):269-275.* English. [AGR & AGRI FOOD CANADA RES STN POB 440 REGINA SK S4P 3A2 CANADA].

The relative susceptibility of selected barley cultivars produced in western Canada to vesicular-arbuscular mycorrhizal (VAM) fungi under field and greenhouse conditions was evaluated in this study. Cultivars tested under field conditions at the University of Alberta and Lacombe research stations showed no significant differences in VAM colonization of barley roots; colonization was light. Greenhouse trials at the University of Alberta with eight cultivars inoculated with individual mycorrhizal species illustrated significant differences among the barley cultivars in their reactions to Glomus dimorphicum, G. intraradices, and G. mosseae. Distinct differences were observed in the ability of each Glomus species to colonize the barley cultivars. The VAM fungi increased growth and yield in some cultivars, depending on the Glomus species. This study indicates that a degree of host-specificity exists in VAM fungi and that the host-mycorrhizal fungus genotypes may influence the effectiveness of the symbiosis. [References: 27].

2115 Bragard, C. (Universite Catholique de Louvain, Louvain la Neuve (Belgique). Unite de Phytopathologie); Maraite, H. (1994) **[Pathogenic variation in Xanthomonas campestris pv. undulosa [bacterial leaf stripe]]. [Variation du pouvoir pathogene de Xanthomonas campestris pv. undulosa [strie bacterienne de l'orge]].** Colloques de l'INRA (France); no. 66 p. 807-812. INRA. 7 ref. p. 807-812. English. (AGRIS 95-025290).

2116 Bragard, C.; Verdier, V.; Maraite, H. (1995) **GENETIC DIVERSITY AMONG XANTHOMONAS CAMPESTRIS STRAINS PATHOGENIC FOR SMALL GRAINS.** *Applied & Environmental Microbiology. 61(3):1020-*

1026. English. [UNIV CATHOLIQUE LOUVAIN UNITE PHYTOPATHOL 2 BTE 3 PL CROIX SUD B-1348 LOUVAIN BELGIUM].

A collection of 51 Xanthomonas campestris strains from throughout the world was studied to detect and assess genetic diversity among pathogens of small grains. Isolates from barley, bread wheat, bromegrass, canary grass, cassava, maize, orchard grass, rice, rough-stalked meadow grass, rye, timothy, and triticale were analyzed by pathogenicity tests on bread wheat cv. Alondra and barley cv. Corona, indirect immunofluorescence, and restriction fragment length polymorphism (RFLP). Three probes were used for the RFLP analysis. They were an acetylaminofluorene-labelled 16S+23S rRNA probe from Escherichia coli and two P-32-labelled restriction fragments from either plasmidic (pBSF2) or chromosomal (pBS8) DNA of X. campestris pv. manihotis. Strains clustered in 9 and 20 groups with the rRNA probe and the pBSF2 DNA probe, respectively. Strains of X. campestris pv. graminis, X. campestris pv. phleipratensis, and X. campestris pv. poae are shown to be related but are also distinguishable by RFLP patterns, serology, and pathogenicity on bread wheat. Strains pathogenic only for barley and not for wheat grouped together. Another group is temporarily designated deviant X. campestris pv. undulosa. These South American isolates from bread wheat did not react by indirect immunofluorescence and produced atypical lesions in pathogenicity tests. The results stress the need to perform pathogenicity tests before strains are named at the pathovar level. The importance of the different probes used for epidemiological studies or phylogenetic studies of closely related strains is underlined. [References: 27].

2117 Broers, LHM.; Lopezatilano, RM. (1995) **EFFECT OF INTERPLOT INTERFERENCE ON THE ASSESSMENT OF PARTIAL RESISTANCE TO STEM RUST IN DURUM WHEAT.** *Phytopathology. 85(2):233-237.* English. [AGR UNIV WAGENINGEN DEPT PLANT BREEDING POB 386 6700 AJ WAGENINGEN NETHERLANDS].

Two experiments were carried out in which different plot designs were compared to assess the level of interplot interference of stem rust (Puccinia graminis f. sp. tritici) on durum wheat (Triticum turgidum var. durum). The resistance levels of the most resistant genotypes were on average a factor of 17.3 (experiment 1) to 31.6 (experiment 2) lower in adjacent plots than in isolated plots, which were assumed to represent the true level of resistance of a genotype (no interplot interference). According to Spearman's rank correlation coefficients, ranging from 0.88 to 0.99, the ranking of genotypes was not affected by the presence or absence of interplot interference. Thus, selection for partial resistance in adjacent small plots is not affected by interplot interference. Using standard control cultivars with known levels of partial resistance will correct the under-estimation of true levels of partial resistance and will help breeders determine the levels of disease that are still acceptable for selecting durum wheat genotypes for partial resistance to stem rust. [References: 17].

2118 Choi, K.J.; Lee, J.K.; Kim, B.S.; Cho, K.Y. (Korea Research Institute of Chemical Technology, Taejon (Korea Republic). Screening and toxicology Center) (1993) **Storage of urediospores of Puccinia recondita and the reaction of stored spores against fungicides.** *Korean Journal of Plant Pathology (Korea Republic) v. 9(4) p. 243-247.* 3 illus.; 1 table; 12 ref. Korean. (AGRIS 95-025212).

2119 Chung, YS.; Griffey, CA. (1995) **POWDERY MILDEW RESISTANCE IN WINTER WHEAT .1. GENE NUMBER AND MODE OF INHERITANCE.** *Crop Science. 35(2):378-382.* English. [VIRGINIA POLYTECH INST & STATE UNIV DEPT CROP & SOIL ENVIRONM SCI BLACKSBURG, VA 24061 USA].

Few widely effective sources of resistance to powdery mildew, caused by Blumeria graminis (DC) E. O. Speer f. sp. tritici Em. Marchal, have been identified in wheat (Triticum aestivum L.), and the identity of resistance genes in many cultivars is unknown. Ten winter wheat lines selected from the 1982 International Winter Wheat Mildew and Rust Nurseries were studied to characterize gene number and mode of inheritance of resistance to powdery mildew. Each of the lines were crossed to the susceptible cultivar Chancellor. Seedlings of the parental lines, F-1, F-2, BC1 (Chancellor x F-1), and F-3 populations were inoculated with isolate 127 of B. graminis in the greenhouse and evaluated for powdery mildew reaction. Ad parents were resistant, except for ST1-25, which had an intermediate reaction type. Genetic analyses revealed that resistance in C39 and SI5 is conferred by three dominant genes, and resistance in A55-2, R107, GO4779, OK75R3645, and Bulk PV63-6 is governed by single partially dominant genes. Data from F-2, F-3, and BC1 populations, derived from crosses between 'Armada' and Chancellor, were inconsistent but indicated that Armada has at least one dominant gene for resistance, which likely is Pm4b as previously postulated. Resistance in VPM1 and ST1-25 is governed by one recessive gene in each line. Three to 11 different resistance genes are represented among the 10 parents. [References: 22].

2120 Chung, YS.; Griffey, CA. (1995) **POWDERY MILDEW RESISTANCE IN WINTER WHEAT .2. IDENTITY OF RESISTANCE GENES.** *Crop Science. 35(2):383-388.* English. [VIRGINIA POLYTECH INST & STATE UNIV DEPT CROP & SOIL ENVIRONM SCI BLACKSBURG, VA 24061 USA].

Gene number and mode of inheritance of powdery mildew resistance in 10 wheat (Triticum aestivum L.) lines was determined in a previous report. However, the allelic relationships of these genes to each other and to known genes was not determined. Eight of the 10 powdery mildew resistant wheat lines were crossed with each other and to each of 13 host differential lines that have known genes for resistance to powdery mildew, caused by Blumeria graminis (DC.) E. O. Speer f. sp. tritici Em. Marchal. In each cross, 300 to 800 F-2 seedlings were evaluated for their reaction to isolate 127 of B. graminis f. sp. tritici in the greenhouse to determine the relationship and putative identity of resistance genes in the eight lines. One common gene, Pm4b, was identified in the wheat lines C39, A55-2, R107, 'Armada', and SI5. The three genes in C39 and SI5 were identified as Pm2, Pm4b, and Pm6 based on lack of susceptible progeny from crosses of these lines with the corresponding host differentials. The resistance genes in OK75R3645 and GO4779 differ from each other and from those identified in the other resistant lines. The resistance gene in OK75R3645 most likely is an allele or closely linked to the Pm3 locus. It is probable that the resistance gene in GO4779 is Pm1, as no segregation for susceptible progeny was observed in the cross of GO4779 with the differential line Axminster/8*CC(Pm1). A single recessive gene, pm8, was postulated for ST1-25, whose disease reaction was intermediate to isolate 127. Six different genes governing resistance to powdery mildew were identified among the eight wheat lines, and Pm4b was the most common gene. [References: 14].

2121 Corazza, L.; Balmas, V. (Istituto Sperimentale per la Patologia Vegetale, Rome (Italy)) (1994) **[The fungal diseases of wheat transmitted through the soil]. Le malattie fungine del frumento trasmesse attraverso il terreno.** *Sementi Elette (Italy) v. 40(5) p. 39-43.* Italian. (AGRIS 95-036688).

2122 Danial, DL.; Stubbs, RW.; Parlevliet, JE. (1994) **EVOLUTION OF VIRULENCE PATTERNS IN YELLOW RUST RACES AND ITS IMPLICATIONS FOR BREEDING FOR RESISTANCE IN WHEAT IN KENYA.** *Euphytica. 80(3):165-170.* English. [AGR UNIV WAGENINGEN DEPT PLANT BREEDING POB 386 6700 AJ WAGENINGEN NETHERLANDS].

Virulence patterns of yellow rust isolates collected in Kenya between 1986-1989 were compared with earlier results. The number of virulence factors per race and the range in virulence factors both increased considerably. Before 1976 races carried on average 4.5 to 5.0 virulence factors, whereas the races after 1986 had a mean of 6.5 virulence factors. The range in the number of virulence factors increased from some seven to eight in the first period to 12 in the second out of the 17 evaluated. In the period 1986-1989 another three virulence factors (2, 9 and A) were assessed. All three occurred at a high frequency. Virulence neutralizing the resistance genes Yr2, Yr2+, Yr6, Yr6+, Yr7, Yr7+, Yr8, Yr9, Yr9+ and those in the cultivars Anza (A), Strubes Dickkopf (SD) and Suwon92/Omar (SU) occurred at a high frequency, while virulence for Yr3V, Yr4+, Yr5, CV and SP (resistance in Carstens V and Spaldings Prolific resp.) were not found. The remaining three virulence factors for Yr1, 10 and 3N were rare. In the past ten years the resistance of most released cultivars became ineffective in less than six years. They were shown to carry race-specific major resistance genes such as Yr7+, Yr9+, SD and A. However, in the field, the resistance of the cultivars was not completely neutralized. A residual resistance, ranging from moderate to fairly high, was observed in all cultivars in which the major gene resistances were neutralized by corresponding virulence genes. Other wheat cultivars such as Africa Mayo, Kenya Kudu, Enkoy, Kenya Leopard, Bounty, Frontatch, Bonny and Kenya Plume appeared to keep their resistance over a considerable period of time. They are considered to be durably resistant to the Kenyan yellow rust populations. This form of resistance, together with the residual resistance, can be recommended for use in breeding programmes. [References: 19].

2123 de La Rocque, B. (Ministere de l'Agriculture, Bordeaux (France). Service Regional de la Protection des Vegetaux Aquitaine) (1994) **[Glume blotch is back as the threat of leaf stripe and brown rust increases. Lessons to be learnt from the 1992-93 crop year for 1994]. Septo: le retour. Helmintho et rouille: la pression. Les enseignements pour 1994 de la campagne 1992-93 [Septoria nodorum, Puccinia recondita, Helminthosporium gramineum].** *Phytoma La Defense des Vegetaux (France) (no 457) p. 29-32.* French. (AGRIS 95-025283).

2124 Decoin, M. (1994) **[Diseases transmitted by seeds. A reminder of the risks [Fusarium roseum, Fusarium nivale, Septoria nodorum, Tilletia caries]]. Les maladies transmises par les semences. Des risques a redecouvrir [Fusarium roseum, Fusarium nivale, Septoria nodorum, Tilletia caries].** *Phytoma La Defense des Vegetaux (France) (no 460) p. 35-37.* French. (AGRIS 95-025288).

2125 Dubin, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **South Asia regional wheat pathology/breeding: Review of current activities.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 97-101. CIMMYT. p. 97-101. English. (AGRIS 95-025225).

2126 Dubin, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo, (CIMMYT), Kathmandu (Nepal). Wheat Program); Bimb, H.P. (National Wheat Research Program (NWRP), Bhairahawa (Nepal)) (1994) **Soilborne diseases of wheat in warmer areas of South Asia: An update.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 353-359.* CIMMYT. 7 tables; 13 ref. English. (AGRIS 95-025220).

A brief review and update of the information related to soilborne diseases of wheat in the warmer areas of South Asia are given. Results of experiments on yield losses due to soilborne diseases in lowland Nepal are also presented Little well documented information is available on the importance of soilborne diseases in the commercial warmer areas. Where information is available, the principal pathogens appear to be Sclerotium rolfsii and Bipolaris sorokiniana. Fusarium spp. are also observed in some areas, as are nematodes. The nematodes observed are Meloidogyne spp. and Tylenchorenchus vulgaris. Soil solarization experiments at the National Wheat Research Program (NWRP), Nepal, indicate significant yield losses by soilborne pathogens (12-23). Farmers' field trials in one year indicated a conservative yield loss estimate of 4. Solarization reduced root and sub-crown internode necrosis significantly as well as increased height, total yield, and several yield components. B. Sorokiniana was considered to be the most important pathogen detected various fusaria were isolated, but appeared of secondary importance. Where soilborne diseases are important in the warmer areas integrated control measures are called for, including resistance/tolerance, crop management, biological, and chemical.

2127 Dubin, HJ.; Wolfe, MS. (1994) **COMPARATIVE BEHAVIOR OF 3 WHEAT CULTIVARS AND THEIR MIXTURE IN INDIA, NEPAL AND PAKISTAN.** *Field Crops Research. 39(2-3):71-83.* English. [SWISS FED INST TECHNOL INST PLANT SCI PHYTOPATHOL GRP CH-8092 ZURICH SWITZERLAND].

Little is known about the behavior of wheat cultivar mixtures over a broad range of environments. Therefore, the main objectives of this study were: (1) to compare the stability of yield of a three-component wheat mixture with that of its components over a range of environments, and (2) to compare natural infection, by different diseases, of the mixture versus its components. The results provide strong evidence that the mixture behaved in a usefully predictable manner, at least as well as the means of the components, over a diverse range of environments in South Asia. The mixture was less variable over all environments compared with its components but was not necessarily more stable. The mixture restricted yellow and leaf rusts and foliar blight relative to the means of the components. No single method of stability analysis gave an unequivocal idea of stability. However, stochastic dominance analysis and the Westcott geometric method seemed most useful for indicating the genotypes that were least risky. Considering all environments, UP262 was the least stable genotype. Ska was less variable but had a lower mean yield. The mixture was relatively high yielding with the least variability. NL459 had the highest yield but was variable. Nevertheless, it emerged as stable in some analyses. From the point of view of safety over a large area of cultivation, the mixture would be preferable to NL459. [References: 18].

2128 Duveiller, E. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **The nonspecific foliar pathogens (NSFP).** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 50-61. CIMMYT. 4 maps; 30 ref. p. 50-61. English. (AGRIS 95-025224).

2129 Duveiller, E.; Gilchrist, L. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Production constraints due to Bipolaris sorokiniana in wheat: current situation and future prospects.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 343-352.* CIMMYT. 41 ref. English. (AGRIS 95-025219).

Spot blotch caused by Bipolaris sorokiniana is the major disease constraint limiting wheat production in the warmer areas. Controlling the disease requires an integrated approach to reduce the fungal inoculum. This can be achieved by using seeds with a low level of infection, spraying appropriate fungicides, eliminating secondary hosts and crop residues, and improving agronomical practices and genetic host resistance. However, breeding progress towards the selection of resistant genotypes, the key factor to increase yields or make wheat a commercial crop in several areas, has been slow due principally to the high variability of the pathogen and insufficient knowledge on environmental factors modulating disease expression and host response. Research needs to improve disease control are reviewed.

2130 Dyck, PL. (1994) **GENETICS OF LEAF RUST RESISTANCE IN 13 ACCESSIONS OF THE WATKINS WHEAT COLLECTION.** *Euphytica. 80(1-2):151-155.* English. [AGR & AGRI FOOD CANADA RES STN 195 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

The inheritance of leaf rust resistance was studied in 13 accessions of the A.E. Watkins wheat collection. Eight of the accessions (V409, V624, V628, V712, V731, V734, V745, and V855) were shown to have gene Lr33 and four of these (V409, V624, V628, and V731) also have LrW. Accessions V624 and V338 have LrB, and V377 and V488 have Lr11. V46 has an unidentified gene that gives an intermediate level of resistance. V860 has a partially dominant gene that gives a fleck reaction to avirulent isolates in the seedling stage. This gene is different from LrW and may be previously unidentified. It has been assigned the temporary gene symbol LrW2. In addition to seedling-effective genes, V46, V731, and V745 may have Lr34 and V745 may have Lr13. The adult-plant resistance in V488, V624, and V860 could not be identified. Seedling gene LrW2 and some of the adult-plant resistance should be useful sources of resistance. [References: 10].

2131 El Yamani, M. (Institut National de la Recherche Agronomique, Settat (Maroc)) (1993) **[Studies on barley yellow dwarf virus in West-Central Morocco]. [Etudes sur le virus de la jaunisse nanisante de l'orge dans la region Centre-Ouest du Maroc].** *Cahiers de la Recherche Agronomique (Maroc) (no 41) p. 81-98.* 13 Tableaux 5 ref. English. (AGRIS 95-025243).

2132 Eversmeyer, MG.; Kramer, CL. (1995) **SURVIVAL OF PUCCINIA RECONDITA AND P-GRAMINIS UREDINIOSPORES EXPOSED TO TEMPERATURES FROM SUBFREEZING TO 35 C.** *Phytopathology. 85(2):161-164.* English. [KANSAS STATE UNIV AGR & APPL SCI USDA ARS MANHATTAN, KS 66506 USA].

Viable urediniospores and dormant mycelial infections are the principal inoculum sources that contribute to the establishment and development of destructive wheat rust epidemics in the central Great Plains. Viability of urediniospores of Puccinia recondita and P. graminis was measured by exposure in environmental chambers set at constant temperatures ranging from -6 to 35 C. Exposure of P. recondita and P. graminis urediniospores for up to 120 h to constant temperatures of 5-35 C did not significantly (P less than or equal to 0.05) affect spore viability among isolates. However, P. recondita and P. graminis urediniospore viability as measured by germination observed after exposure to constant temperatures of -6, -4, -2, 0, 5, 10, 20, 25, 30, or 35 C for 24, 48, 72, 96, or 120 h indicated significant differences in viability among temperature treatment means (P less than or

equal to 0.05). Urediniospores remained viable up to 864 h at constant temperatures between 10 and 30 C and up to 504 h at constant temperatures of 5 and 35 C. Viability of urediniospores exposed at temperatures ranging from -2 to 0 C decreased rapidly after the first 4 h of exposure. At below-freezing temperatures, viability of spores declined rapidly after 1-2 h of exposure. Viability of urediniospores exposed to freezing or below-freezing temperatures was not restored by heat shocking at temperatures typically encountered in the field during an epidemic. Infectivity of P. recondita and P. graminis urediniospores exposed at 5-35 C for 120 h was not significantly different from infectivity of unexposed urediniospores; an average of 58% of the viable urediniospores produced appressoria. [References: 17].

2133 Feraugе, A.P. (Universite Catholique de Louvain, Louvain la Neuve (Belgique). Unite de Phytopathologie); Maraite, H. (1994) **[Light and transmission electron microscopical study of the interactions between Xanthomonas campestris pv. translucens and pv. undulosa on wheat, barley and oat]. [Etude microscopique a la lumiere et electronique a transmission des interactions entre Xanthomonas campestris pv. translucens et pv. undulosa chez le ble, l'orge et l'avoine].** Colloques de l'INRA (France); no. 66 p. 813-818. INRA. 5 illus., 11 ref. p. 813-818. English. (AGRIS 95-025241).

2134 Figueroa Lopez, Pedro; Singh P, Ravi (1993) **[Estimating of potential wheat losses due to leaf rust in the South of Sonora State (1st year)]. Estimacion de perdidas potenciales por roya de la hoja del trigo en el sur de Sonora. (1er. ano).** Avances de la investigacion CIANO (Mexico); no. 27 p. 55. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 55. Spanish. (AGRIS 95-025298).

2135 Formanova, M.; Sebesta, J. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyne (Czech Republic)) (1994) **[Adult plant resistance of Czech and Slovak cultivars and advanced lines of winter wheat to powdery mildew]. Rezistence ceskych a slovenskych odrud a novoslechteni psenice ozime k padli travnimu v dospelosti.** *Ochrana Rostlin - UZPI (Czech Republic) v. 30(4) p. 311-322.* 4 tables; 14 ref. Czech. (AGRIS 95-036752).

2136 Fuentes Davila, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Karnal bunt (Tilletia indica) and research efforts at CIMMYT.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 62-74. CIMMYT. 7 maps; 5 tables; 7 ref. p. 62-74. English. (AGRIS 95-025176).

2137 Gaulliard, J.M. (Rhone Poulenc (France). Service Technique); Peron, L. (1993) **[Triticonazole, a new systemic fungicide for cereal crops]. Le triticonazole: fongicide cereales.** *Phytoma La Defense des Vegetaux (France) (no 454) p. 57-59.* French. (AGRIS 95-025233).

2138 Gordon, R.; Camargo, I.; De Gracia, N.; Gonzalez, A.; Perez, D.; Franco, J.; Alvarado, A. (Instituto de Investigacion Agropecuaria de Panama (IDIAP), Azuero (Panama)) (1993) **[Status of stunt on the maize crop in Azuero, Panama, 1992-93]. Situacion del achaparramiento en el cultivo de maiz en Azuero, Panama 1992-93.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 239-246.* Programa Regional de Maiz (PRM). 7 tables; 2 ref. Spanish. (AGRIS 95-025255).

2139 Grausgruber, H.; Lemmens, M.; Burstmayr, H.; Ruckenbauer, P. (1995) **EVALUATION OF INOCULATION METHODS FOR TESTING FUSARIUM HEAD BLIGHT RESISTANCE OF WINTER WHEAT ON SINGLE PLANT BASIS.** *Bodenkultur. 46(1):39-49.* English. [AGR UNIV VIENNA DEPT PLANT BREEDING GREGOR MENDEL STR 33 A-1180 VIENNA AUSTRIA].

Two methods for artificial inoculation of single plants were investigated regarding their reliability in the estimation of Fusarium head blight (FHB) resistance of winter wheat. The inoculation methods used were the injection and the cotton method. Head blight was provoked by two Fusarium graminearum and one Fl culmorum isolate. The test material consisted of nine winter wheat genotypes, which were investigated in their FHB resistance by five European research institutes since 1990. From this international trial a FHB index (% FHB) was evaluated for each genotype. The environmental dimension of this trial was made up of 59 year by isolate by location combinations. Therefore the FHB index represents the best available measure of the resistance level of the nine tested genotypes. The FHB index served as a standard of comparison for the single plant data. The most reliable assessment of the FHB resistance level was reached with the cotton method and an isolate of high virulence. In this case repeatabilities about R=0.7 were obtained. The best parameters for a reliable assessment of the resistance level were visual scoring of bleached spikelets done on the 18th and/or 22nd day after artificial inoculation and the determination of the systemic growth of the fungus in the ear (r(s) = 0.62 - 0.65; R = 0.66 - 0.72). The last mentioned parameter, however, is more labor-intensive to determine.

2140 Huerta Espino, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico)) (1994) **Evolution of virulence combinations in wheat leaf and stem rust in Mexico.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 34-36. CIMMYT. 6 ref. p. 34-36. English. (AGRIS 95-025223).

2141 Ireta, M.J. (Instituto Nacional de Investigaciones Forestales y Agro Pecuarias (INIFAP), Tepatitlan, Jal. (Mexico). Estacion Experimental Altos de Jalisco); Gilchrist, L. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Wheat Program) (1994) **Fusarium head scab of wheat (Fusarium graminearum Schwabe).** *CIMMYT Wheat Special Report (CIMMYT); no. 21b 25 p.* CIMMYT. 11 tables; 1 map; 7 illus., 2 graphs., 63 ref. English. (AGRIS 95-025217).

This brief synopsis not only includes what is known about the scab of wheat in Mexico, but also contains essential information from all over the world. We hope the information presented here will help guide researchers facing the problem and pave the way for wheat scientists to refocus their efforts in trying to control this serious disease.

2142 Ireta, M.J. (Instituto Nacional de Investigaciones Forestales y Agro Pecuarias (INIFAP), Tepatitlan, Jal. (Mexico). Estacion Experimental Altos de Jalisco); Gilchrist, L. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico). Wheat Program) (1994) **[Fusarium head scab of wheat (Fusarium graminearum Schwabe)]. Rona o tizon de la espiga del trigo (Fusarium graminearum schwabe).** *CIMMYT Wheat Special Report (CIMMYT); no. 21a 25 p.* CIMMYT. 11 tables; 1 map; 7 illus., 2 graphs., 63 ref. Spanish. (AGRIS 95-025216).

2143 Jones, DR. (1995) **EVALUATION OF FUNGICIDES FOR CONTROL OF EYESPOT DISEASE AND YIELD LOSS RELATIONSHIPS IN WINTER WHEAT, (VOL 43, PG 831, 1994).** *Plant Pathology. 44(1):206.* English. [AGR DEV & ADVISORY SERV BRIDGETS MARTYR WORTHY WINCHESTER SO21 1AP HANTS ENGLAND].

2144 Jorgensen, HJL.; Smedegaardpetersen, V. (1995) **PATHOGENIC VARIATION OF RHYNCHOSPORIUM SECALIS IN DENMARK AND SOURCES OF RESISTANCE IN BARLEY.** *Plant Disease. 79(3):297-301.* English. [ROYAL VET & AGR UNIV DEPT PLANT BIOL PLANT PATHOL SECT THORVALDSENSVEJ 40 DK-1871 FREDERIKSBERG DENMARK].

Thirty-eight Danish isolates of Rhynchosporium secalis, 36 from barley and two from rye, were inoculated onto 23 cultivars of barley, one cultivar of rye, and nine species of noncereal grasses. The isolates were divided into 28 different races (DK1-DK28) according to their reaction with the barley cultivars. These 28 races represent a very broad virulence spectrum. Race 1 caused susceptible reactions in 19 of the 23 cultivars, whereas race 26 caused susceptible reactions in only six cultivars and race 27 in only one cultivar. All barley cultivars were resistant to race 28, represented by the two isolates from rye. Fifteen cultivars of barley with race-specific resistance were included in the present set of differentials. Of these cultivars, only two, Atlas and Osiris, were resistant to all races tested, whereas the rest was susceptible to two or more races. Of eight commercial cultivars, Corgi, Digger, and Hasso were resistant to 27, eight and, eight races, respectively. Four other cultivars were susceptible to all but two of the races: Race 27, virulent on only cultivar Magda and race 28, comprising isolates from rye. The last cultivar was only resistant to race 28. These results suggest that known sources of race-specific resistance to R. secalis

may not be effective in Denmark if not used in combination with race-nonspecific resistance. One isolate from barley caused minor infections in rye but not in any of the noncereal grasses. The two isolates from rye caused minor infections in some barley cultivars but the noncereal grasses were not infected. This suggests not only that R. secalis is rather strongly specialized to the host species from which it is isolated, but also that it may infect other species as well. [References: 41].

2145 Karki, C.B. (National Agricultural Research Center, Khumaltar (Nepal).Central Plant Pathology Division) (1994) **The virulence spectrum of leaf rust and the status of leaf rust resistance in Nepalese wheats.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 367-372.* CIMMYT. 2 tables; 14 ref. English. (AGRIS 95-025221).

Leaf rust caused by Puccinia recondita f.sp. tritici is a major disease of wheat in the terai region of Nepal. It has reduced grain yield by 14 with a moderate infection. The leaf rust pathogen is known to survive in self-sown wheat plants in the higher hill regions of the country. Fourteen different pathotypes of P. recondita f.sp. tritici have been recorded in Nepal, attacking many of the resistant genes present in the Nepalese cultivars. Twelve leaf rust- resistant genes Lr 1,3, 10,13,14a,16,17,23,26, 27,31, and 34 were postulated from 25 promising and recommended varieties in Nepal. Lr13 and Lr 23 were the genes most frequently found. Among the list of future strategies, emphasis will be on the development of a complete map of virulence and avirulence of pathotypes present in the leaf rust pathogen population and development of wheat varieties with durable and adult plant resistance and having a wide genetic base with slow rusting characteristics.

2146 Kawonga, W.T. (Blantyre Agricultural Development Division, Blantyre (Malawi). Adaptive research team) (1993) **Adaptive research on varieties of Pigeon pea with resistance to fusarium wilt in Blantyre agricultural development division,Malawi.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 254-263.* CIMMYT. 6 tables; 2 graphs., 5 ref. English. (AGRIS 95-025253).

2147 Kiriswa, F.L. (National Plant Breeding Research Center (NPBRC),Njoro Kenya); Jacobs, Th. (Wageningen University, Wageningen (Netherlands). Plant Breeding Department) (1994) **The effect of leaf age on two components of partial resistance to leaf rust in wheat and barley.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 164-170.* CIMMYT. 5 tables; 6 ref. English. (AGRIS 95-025246).

The effect of development stage on latency period (LP) and infection frequency (IF) was examined in 5 wheat and 3 barley genotypes inoculated with wheat leaf rust, Puccinia recondita, and barley leaf rust, P. hordei, respectively. Both in wheat and barley, there was a significant developmental stage effect on LP. Relative LP was more clearly expressed at the adult plant stage than in the seedling stage. There was a good correlation between the flag leaf and the seedling leaves. IF was highly variable, and is unsuitable for use as a selection component. The variation for IF in barley was less than that in wheat.

2148 Kokko, EG.; Conner, RL.; Kozub, GC.; Lee, B. (1995) **EFFECTS OF COMMON ROOT ROT ON DISCOLORATION AND GROWTH OF THE SPRING WHEAT ROOT SYSTEM.** *Phytopathology. 85(2):203-208.* English. [AGR & AGRIFOOD CANADA POB 3000 LETHBRIDGE AB T1J 4B1 CANADA].

Image analysis procedures were used to quantify the effect of common root rot on the growth and discoloration of the subcrown internode (SCI), crown roots, and seminal roots of spring wheat. Severe discoloration of the SCI was associated with diminished growth of the seminal and crown roots. The linkage of discoloration of the SCI to a reduction in root growth was most evident for the crown roots. Reduced growth of either the crown or seminal roots was not compensated for by increased growth of the other root system. The differences in root discoloration among different root rot categories were generally small. On average, the crown and seminal roots were whiter than the SCI in the healthy (nil) category; There was a weak negative relationship between discoloration of the SCI and the crown and seminal root systems. However, it was also observed that root discoloration usually increased with greater root length. Since plants with healthy SCIs usually had longer roots, they were more likely to be exposed to the pathogen and become discolored than were plants with severely diseased SCIs. The image analysis procedures developed in this study can be used to objectively and precisely measure damage caused by root diseases in other host species. This procedure validates the most commonly used field research method of rating plants for common root rot. [References: 39].

2149 Kumar, A. (University Department of Botany, Ranchi (Inde). Phytobacteriology Laboratory); Prasad, M. (1994) **[A new bacterial disease of rice and barley from Ranchi (India) due to Pseudomonas marginalis (Brown) Stevens]. [Nouvelle maladie bacterienne du riz et de l'orge a Ranchi (Inde) due a Pseudomonas marginalis (Brown) Stevens].** Colloques de l'INRA (France); no. 66 p. 103-108. INRA. 13 ref. p. 103-108. English. (AGRIS 95-025264).

2150 Laffranque, J.P. (Cyanamid Agro (France)); Thienpont, E.; Garforth, B. (1994) **[Metconazole, a cereal fungicide]. Le metconazole: fongicide cereales.** *Phytoma La Defense des Vegetaux (France) (no 459) p. 49-51.* French. (AGRIS 95-025286).

2151 Larkin, PJ.; Banks, PM.; Xiao, C. (1995) **REGISTRATION OF SIX GENETIC STOCKS OF WHEAT WITH RUST AND BYDV RESISTANCE - Z1, Z2, Z3, Z4, Z5, AND Z6 DISOMIC ADDITION LINES WITH THINOPYRUM INTERMEDIUM CHROMOSOMES.** *Crop Science. 35(2):604.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

2152 Mccormack, P.; Wildman, HG.; Jeffries, P. (1995) **THE INFLUENCE OF MOISTURE ON THE SUPPRESSION OF PSEUDOMONAS SYRINGAE BY AUREOBASIDIUM PULLULANS ON AN ARTIFICIAL LEAF SURFACE.** *FEMS Microbiology Ecology. 16(2):159-165.* English. [UNIV KENT RES SCH BIOSCI BIOL LAB CANTERBURY CT2 6NJ KENT ENGLAND].

Isolates of Aureobasidium pullulans which produce antibacterial metabolites were compared with non-antibiotic-producing isolates of Tremella foliacea and Trichosporon beigelii for their ability to inhibit growth of Pseudomonas syringae pv phaseolicola. The bacteria and fungi were co-inoculated on an artificial leaf surface under conditions of low and high water availability. Under conditions of excess moisture, antibiotic production gave no advantage to the Aureobasidium isolates, and all the yeasts were equally antagonistic. Under drier conditions the Aureobasidium isolates reduced the population of P. syringae by 96-99%, a result which was significantly different from that which occurred when the bacteria were co-inoculated with the other yeasts under these conditions. An antibacterial compound, similar to that produced in liquid culture by Aureobasidium, was detected in washings from the artificial leaf surface following growth of this species. [References: 26].

2153 Mcelhany, P.; Real, LA.; Power, AG. (1995) **VECTOR PREFERENCE AND DISEASE DYNAMICS - A STUDY OF BARLEY YELLOW DWARF VIRUS.** *Ecology. 76(2):444-457.* English. [INDIANA UNIV DEPT BIOL BLOOMINGTON, IN 47405 USA].

Using simple analytical models of the probability of disease transmission and a spatially explicit computer simulation of the spread of the aphid-transmitted barley yellow dwarf virus, we examined the effect of vector preference for diseased or healthy hosts on the spread of an economically important plant pathogen. Our analytical models indicate that the effect of vector preference for diseased plants on the probability of disease spread depends on the frequency of diseased plants in the population. In a non-spatial environment with a high frequency of diseased plants, disease spread is favored by vectors preferring healthy plants. With a low frequency of diseased plants, disease spread is favored by vectors preferring diseased plants. The effect of vector preference depends on the amount of persistence exhibited by the disease. For persistently transmitted diseases, the vector remains infective for a long period after visiting a diseased host. Persistence increases the rate of spread for a vector preferring healthy hosts more than

it increases the rare of spread for a vector preferring diseased hosts. Using a Markov chain model of disease transmission, we have shown that an increase in the spatial patchiness of the disease can lead to a decrease in the rate of disease spread by a vector capable of moving only limited distances. The effect of spatial disease structure depends on the preference behavior exhibited by the vector. Our spatially explicit computer simulation explored the effect of frequency, persistence, and spatial structure in a dynamic model. All of these factors were shown to be important in describing the impact of vector disease preference on epidemiology, Many of our results contrast with the assumption found in the agricultural literature that a preference for diseased plants leads to an increase in disease spread. These results may have implications for the evolution of pathogen-modified vector behavior and/or host attractiveness, Explicit knowledge of the interaction between spatial dynamics and vector preference will improve our ability to model epidemics and predict the spread of infectious diseases. [References: 33].

2154 Melo Reis, E. (Empresa Brasileira de Pesquisa Agropecuaria (EMBRAPA), Rio Grande do Sul (Brazil). Centro Nacional de Pesquisa de Trigo); Kohli, M.M. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Asuncion (Paraguay). Wheat Program) (1994) **Wheat diseases in South America and strategies for their control.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa: Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 153-163.* CIMMYT. 8 tables; 19 ref. English. (AGRIS 95-025213).

Disease occurrence and intensity vary according to specific environmental conditions in the different countries of the Southern Cone. In Argentina the main diseases are the three rusts, scab, speckled leaf blotch, and yellow spot; in Chile - the three rusts, take-all, and speckled leaf blotch; in Bolivia - leaf rust, powdery mildew, and spot blotch; in Brazil - common root rot, take- all, leaf and stem rust, powdery mildew, yellow spot, spot blotch, septoria leaf blotches, scab, blast, and soil-borne wheat mosaic virus; in Paraguay - leaf and stem rust, spot blotch, yellow spot, common root rot, and scab; and in Uruguay - leaf and stem rust, yellow spot, speckled leaf blotch, and scab. An integrated disease control strategy, combining the following aspects, has been recommended and utilized fully or in part by several countries of the region: (a) use of resistant varieties for rusts, powdery mildew, and soil-borne wheat mosaic virus, and improved genetic resistance to blast, scab, and leaf blotches; (b) crop rotation has successfully controlled common root rot, take-all, and leaf blotches; (c) seed dressing has been used to control powdery mildew in susceptible varieties, and to avoid the transmission of leaf blotch pathogens from seeds to leaves; and (d) fungicides are applied to above-ground plant parts to control rusts and leaf blotches.

2155 Miedaner, T.; Ludwig, WF.; Geiger, HH. (1995) **INHERITANCE OF FOOT ROT RESISTANCE IN WINTER RYE.** *Crop Science. 35(2):388-393.* English. [UNIV HOHENHEIM INST STATE PLANT BREEDING 720 D-70593 STUTTGART GERMANY].

Foot rot in winter rye (Secale cereale L.) caused by Pseudocercosporella herpotrichoides, Fusarium spp., and Microdochium nivale (syn Fusarium nivale) can be controlled best by host resistance. In this study, the inheritance of foot rot resistance was examined using 15 diallel and 11 factorial crosses tested along with their parent inbred lines. Four out of six test environments in southern Germany were artificially inoculated with either P. herpotrichoides, F. culmorum, or M. nivale. In the other two environments, naturally occurring field epidemics were used. At milk ripening, 50 stems per plot were rated individually for foot rot on a 1 to 9 scale. Significant estimates of genotypic variance and high heritabilities (h(2) = 0.82-0.92) were observed in all genetic materials, General combining ability (GCA) was the main source of genetic variation among crosses, while specific combining ability was negligible. Considerable environmental effects and significant genotype x environment interactions were found. Strong phenotypic correlations (r approximate to 0.9) existed between line per se performance and GCA effects. Heterosis was not important. For optimizing disease assessment, h(2) was estimated for varying numbers of stems, environments, and replicates. For inbred lines tested in two environments with two replicates or for single crosses tested in four environments with two replicates, a sample size of 15 plants per plot should result in a h(2) of about 0.7. In conclusion, substantial progress can be expected from selection for foot rot resistance in hybrid rye on the basis of line per se performance by rating unspecific foot rot lesions. [References: 32].

2156 Milus, EA.; Mirlohi, AF. (1995) **SURVIVAL OF XANTHOMONAS CAMPESTRIS PV TRANSLUCENS BETWEEN SUCCESSIVE WHEAT CROPS IN ARKANSAS.** *Plant Disease. 79(3):263-265.* English. [UNIV ARKANSAS DEPT PLANT PATHOL FAYETTEVILLE, AR 72701 USA].

Reducing the level of initial inoculum may be a feasible means of controlling bacterial streak and black chaff of wheat caused by Xanthomonas campestris pv. translucens. The objective of this research was to determine the principal source of inoculum under Arkansas conditions. Using artificially infested seeds, a rifampicin-resistant mutant of the pathogen (strain 88-14(Rif)) was established in field plots of wheat cultivars Florida 302 (susceptible) and Terral 101 (moderately resistant) at two locations and in a plot of Florida 302 at a third location. Bacterial streak caused by strain 88-14(Rif) developed in all plots. Strain 88-14(Rif) was not detected in crop debris, soil, or possible alternative host plants in the field 3 mo after harvest at any location. No bacterial streak symptoms were observed at any location on Florida 302 planted with disinfested seed 4 mo after harvest. However, strain 88-14(Rif) was isolated from one of 480 Florida 302 leaves assayed from one location at one sampling time. The percentage of harvested seed infested with strain 88-14(Rif) 2 mo after harvest ranged from 9.8 to 37.7% for Florida 302 and from 0.3 to 5.3% for Terral 101. Under growth chamber conditions, transmission of seedborne strain 88-14(Rif) to seedlings ranged from 4.0 to 24.5% for Florida 302 and from 0.0 to 0.2% for Terral 101. Under field conditions, however, strain 88-14(Rif) was isolated only from one seedling of one Florida 302 seed lot. Based on the poor survival of the pathogen in the field and the relatively high percentage of infested seed and transmission to seedlings under growth chamber conditions for the susceptible cultivar, infested seed is suspected to be the principal source of inoculum. [References: 15].

2157 Minarcic, P.; Janitor, A. (1995) **HALO FORMATION IN THE EPIDERMAL CELL OF BARLEY AFTER POWDERY MILDEW (ERYSIPHE-GRAMINIS DC) INFECTION.** *Biologia. 50(1):73-78.* English. [SLOVAK ACAD SCI INST EXPTL PHYTOPATHOL & ENTOMOL CS-90028 IVANKA CZECHOSLOVAKIA].

Formation of haloes, their location and structure in the epidermal cell wall in barley cvs. of different susceptibility to powdery mildew, were studied by SEM, freeze etching and cytological methods. The results confirmed that differentiation of a halo occurs when the tip of the infection peg has enzymatically breached the cuticular layer of the epidermis. Haloes were formed in compatible cv. earlier (4-6 h after inoculation). The tip of the penetrating infection peg breaches the colored complex in the middle part of halo and so enables gradual formation of a halo, with a ring-shaped circle at its periphery. On the basis of our results, predictions have been made about host-parasite relations at the epidermal cell level.

2158 Mirocha, CJ.; Xie, WP.; Xu, YC.; Wilcoxson, RD.; Woodward, RP.; Etebarian, RH.; Behele, G. (1994) **PRODUCTION OF TRICHOTHECENE MYCOTOXINS BY FUSARIUM GRAMINEARUM AND FUSARIUM CULMORUM ON BARLEY AND WHEAT.** *Mycopathologia. 128(1):19-23.* English. [UNIV MINNESOTA DEPT PLANT PATHOL ST PAUL, MN USA].

Wheat cultivars (Stoa, MN87150, SuMai-3, YMI-6, Wheaten) and barley cultivars (Robust, Excel, Chevron, M69) were inoculated in the field with isolates of Fusarium graminearum and F. culmorum. The diseased (Fusarium head blight) kernels were analyzed for deoxynivalenol (DON), 15-acetyldeoxynivalenol (15-ADON) and nivalenol (NIV). F. culmorum produced all three trichothecenes on all cultivars tested whereas F. graminearum only produced DON and 15-ADON. There was no well defined correlation between DON production in the host and resistance although the data tended to favor SuMai-3 as having definitive resistance to both F. graminearum and F. culmorum. [References: 12].

2159 Mundt, CC.; Brophy, LS.; Schmitt, MS. (1995) **DISEASE SEVERITY AND YIELD OF PURE-LINE WHEAT CULTIVARS AND MIXTURES IN THE PRESENCE OF EYESPOT, YELLOW RUST, AND THEIR COMBINATION.** *Plant Pathology. 44(1):173-182.* English. [OREGON STATE UNIV DEPT BOT & PLANT PATHOL 2082 CORDLEY HALL CORVALLIS, OR 97331 USA].

Five winter wheat cultivars, six two-component cultivar mixtures, and one four-way mixture were grown in the presence of yellow rust, eyespot,

both diseases, and neither disease for three seasons. On average, mixtures reduced the severity of yellow rust relative to their component pure stands by 53%. The four-component mixture provided better yellow rust control than did the two-way mixtures. Eyespot severity was reduced through mixing only in the absence of yellow rust and by only three of the seven mixtures (mean reduction = 13%). Yellow rust was 13% less severe in the presence of eyespot, and eyespot was 10% more severe in the presence of yellow rust. Averaged over all years, the mixtures increased yield relative to the pure stands by 6.2, 1.7, 7.1, and 1.3% in the presence of yellow rust, eyespot, both diseases, and neither disease, respectively. Two mixtures provided significant yield increases over the means of their component pure stands (7% and 9%) in the presence of eyespot even though one of them did not significantly reduce eyespot severity. Accounting for all disease treatments and years, four mixtures provided distinctly higher yield increases than the other three. In mixtures containing a resistant cultivar and a cultivar susceptible to eyespot, yield loss by the susceptible cultivar was not compensated for by increased yield of the resistant cultivar. The mixtures showed improved yield stability relative to the pure stands, with the four-component mixture being particularly stable. [References: 31].

2160 Novikova, II.; Ivaschenko, VI.; Kalko, GV.; Boykova, IV.; Nazarovskya, LA.; Litvinenko, AI. (1994) **TESTING OF NEW BIOPREPARATIONS IN THE WHEAT FUSARIOSIS CONTROL.** *Mikologiya i Fitopatologiya. 28(1):70-75.* Russian. [ALL RUSSIAN PLANT PROTECT INST ST PETERSBURG RUSSIA].

2161 Paul, Y.S.; Bekele Hunde; Mesele Alemu; Melkamu Ayalew (Institute of Agricultural Research (IAR), Addis Ababa (Ethiopia). Adet Research Center) (1994) **Studies on seed-borne mycoflora of wheat in Ethiopia.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 305-306.* CIMMYT. 1 table. English. (AGRIS 95-025215).

Seed-borne mycoflora comprise various storage and field fungi, including plant pathogens. Knowledge of the various fungi associated with seed helps to understand seed quality as well as the possibility of plant diseases being transmitted through seed Twenty-one wheat seed samples were collected from 7 locations in Northwestern Ethiopia, and were subjected to a modified standard blotter test, and germination and accelerated aging vigor tests. Out of a total of 32 fungi recorded, Alternaria tenuis, Cladosporium herbarum, Fusarium moniliforme, Fusarium sp., Penicillium sp. and Rhizopus stolonifer were present in almost all the seed samples in varying proportions. Various wheat pathogens recorded on seed were Drechslera sativus, Fusarium graminearum, Mycosphaerella graminicola, Septoria nodorum, Tilletia foetida, T. caries, and Puccinia striiformis. Seeds associated with D. sativus either failed to germinate or produced abnormal seedlings. Fusarium and Penicillium species were positively correlated with ungerminated seed and abnormal seedlings, and were negatively correlated with germination percentage. Except Aspergillus species and Fusarium moniliforme, all fungi reduced root and shoot length. Curvularia lunata, Fusarium graminearum, F. roseum and Penicillium species were found to be positively correlated with thousand grain weight and thousand grain volume.

2162 Paul, Y.S.; Melkamu Ayalew; Mesele Alemu; Bekele Hunde (Institute of Agricultural Research (IAR), Addis Ababa (Ethiopia). Adet Research Center) (1994) **Aerobiology of wheat with special reference to stripe rust.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 298-300.* CIMMYT. 1 table. English. (AGRIS 95-025214).

Aerobiology of two wheat fields at the Adet Research Center. was studied using slide traps from the end of August to mid October, 1992. A total of 10 fungal species namely Puccinia striiformis, P. graminis, P. recondita, P. hordei, Drechslera spp., Alternaria spp., Epicoccum purpurascens, Ascochyta sp., Oidium sp. and Ustilago spp. were trapped P. striiformis urediospores were observed to be dominant throughout the period studied. Two peaks of P. striiformis urediospores were recorded: the end of August, and after the first week of October. This indicated an influx of spores during August, the establishment of yellow rust by September, and spore release after October. Easterly followed by westerly wind directions contributed the maximum influx of spores; after disease establishment, maximum spore densities were trapped from the north and east directions. Yellow rust was first observed on the highly susceptible variety Morocco at the end of August, and attained 95 per cent severity by the last week of October. The wheat variety ET13 was immune throughout the study period, while surrounding farmers' fields with the variety Dashen were highly infected.

2163 Penrose, LDJ. (1995) **2 WHEAT GENOTYPES DIFFER IN ROOT DISEASE DUE TO GAEUMANNOMYCES-GRAMINIS WITHOUT INTERACTION WITH SITE.** *Soil Biology & Biochemistry. 27(2):133-138.* English. [AGR RES INST PINE GULLY RD WAGGA WAGGA NSW 2650 AUSTRALIA].

Data were extracted from five trials where wheat had been naturally infected with the root-infecting pathogen Gaeumannomyces graminis var. tritici in three separate years. Three trials were of local and introduced cultivars, and two were of segregate families from crosses, employing a total of three sets of wheat. Of genotypes considered to differ in resistance to G. graminis, only Temu89-72 and cv. Bayonet were grown at each of the five sites. Measurement at four of the sites of the number of diseased seminal and coronal roots at tillering and anthesis showed differences in root disease between Temu89-72 and cv. Bayonet varied with root system and sampling time. Temu89-72 differed from cv. Bayonet only in having less disease of coronal roots at anthesis, and differences were then independent of site. This finding is not consistent with the predominant view that differences in susceptibility to G. graminis in wheat are very small or non-existent, and environmentally labile. To distinguish between the possibilities that either a level of resistance or differences in rooting pattern were responsible for findings, the relationship between the number of coronal roots and the proportion of infected roots at anthesis was considered. Coronal root number was not correlated with the incidence of root disease in the three sets of wheat, or associated with differences in disease between Temu89-72 and cv. Bayonet. This suggested that in this study, differences in rooting pattern were less significant than resistance in influencing the incidence of root disease. [References: 24].

2164 Robbertse, B.; Campbell, GF.; Crous, PW. (1995) **REVISION OF PSEUDOCERCOSPORELLA-LIKE SPECIES CAUSING EYESPOT DISEASE OF WHEAT.** *South African Journal of Botany-Suid-Afrikaanse Tydskrif vir Plantkunde. 61(1):43-48.* English. [UNIV STELLENBOSCH DEPT PLANT PATHOL STELLENBOSCH 7600 SOUTH AFRICA].

Three species and two varieties of Pseudocercosporella Deighton are known to be associated with the eyespot disease complex of graminicolous hosts. Based on the production of lateral conidial branches, and conidiogenous cells with flat to protuberant, unthickened scars, three species had been disposed to Ramulispora Miura. The description of the teleomorph in Tapesia (Pers.) Fuckel supported this view. Although these species are regarded as varieties of Ramulispora herpotrichoides (Fron) Arx by some workers, a clear distinction could be made between them in the present study based upon morphology and DNA banding patterns. Tapesia yallundae Wallwork & Spooner (anam. Ramulispora herpotrichoides) is distinguished from R. herpotrichoides var. acuformis Nirenberg. Furthermore, the latter variety is erected to species level as Tapesia acuformis (Boerema, Pieters & Hamers) Crous stat. nov. [anam. R. acuformis (Nirenberg) Crous comb. nov. Furthermore, P. aestiva does not represent a species of either Pseudocercosporella or Ramulispora, and its generic status remains uncertain.

2165 Saadaoui, M.; Zine El Abidine, F. (Institut National de la Recherche Agronomique, Kenitra (Maroc). Dept. de Phytiatrie) (1993) **[The principal researches on cereal diseases in Morocco]. apercu sur les principaux travaux de recherche effectues au Maroc sur les maladies des cerales.** *Cahiers de la Recherche Agronomique (Maroc) (no 41) p. 17-64.* Ill. Bibliogr. p. 60-64. French. (AGRIS 95-025242).

2166 Salazar Huerta, Francisco Javier (1993) **[Comparison of different times of inoculation for the infection of wheat with Tilletia indica Mitra, the causal agent of Karnal bunt: Yaqui valley, Sonora]. Comparacion de la efectividad de Tilletia indica Mitra, causante del carbon parcial, bajo diferentes tiempos de inoculacion en trigo, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 52. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 52. Spanish. (AGRIS 95-025293).

2167 Salazar Huerta, Francisco Javier; Figueroa Lopez, Pedro (1993) **[Evaluation of the fungicide Folicur for the control of Karnal bunt (Tilletia indica Mitra) on wheat: Yaqui valley, Sonora]. Evaluacion del fungicida Folicur para el combate del carbon parcial (Tilletia indica Mitra) en trigo, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 50-51. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 50-51. Spanish. (AGRIS 95-025292).

2168 Salazar Huerta, Francisco Javier; Figueroa Lopez, Pedro (1993) **[Survey of the incidence of Karnal bunt (Tilletia indica Mitra) on wheat: Yaqui valley, Sonora]. Reconocimiento de la incidencia del carbon parcial Tilletia indica Mitra del trigo, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 52-53. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 52-53. Spanish. (AGRIS 95-025294).

2169 Salazar Huerta, Francisco Javier; Figueroa Lopez, Pedro; Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Effect of sowing density and sowing method on the incidence of Karnal bunt, Tilletia indica Mitra, in 4 varieties of wheat: Yaqui valley, Sonora]. Efecto de la densidad y metodo de siembra en 4 variedades de trigo sobre la incidencia del carbon parcial Tilletia indica Mitra, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 54. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 54. Spanish. (AGRIS 95-025297).

2170 Salazar Huerta, Francisco Javier; Figueroa Lopez, Pedro; Camacho Casas, Miguel Alfonso; Felix Valencia, Pedro (1993) **[Observations on the incidence of Karnal bunt in 35 wheat varieties with 5 sowing dates (ENET): Yaqui valley, Sonora]. Observacion de la incidencia del carbon parcial en 5 fechas de siembra y 35 variedades de trigo (ENET), en el Valle del Yaqui,Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 54. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 54. Spanish. (AGRIS 95-025296).

2171 Salazar Huerta, Francisco Javier; Figueroa Lopez, Pedro; Ortiz Enriquez, Jose Eliseo (1993) **[Effect of different irrigation schedules and sowing methods on the natural infection of 2 varieties of wheat with Karnal bunt, Tilletia indica Mitra: Yaqui valley, Sonora]. Efecto de calendarios de riego y metodo de siembra en 2 variedades de trigo a la infeccion natural del carbon parcial Tilletia indica Mitra, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 53. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 53. Spanish. (AGRIS 95-025295).

2172 Schilder, AMC.; Bergstrom, GC. (1995) **SEED TRANSMISSION OF PYRENOPHORA TRITICI-REPENTIS, CAUSAL FUNGUS OF TAN SPOT OF WHEAT.** *European Journal of Plant Pathology. 101(1):81-91.* English. [CORNELL UNIV DEPT PLANT PATHOL ITHACA, NY 14853 USA].

Seed transmission of Pyrenophora tritici-repentis, a common foliar pathogen of wheat, was investigated in soft white winter wheat cv. Frankenmuth and found to be non-systemic; the emerging coleoptile was infected externally by hyphal growth from the infected pericarp. Hyphae from the infected coleoptile then infected the first and second seedling leaves as they emerged. Coleoptile symptoms ranged from tiny brown streaks or spots to large, brown necrotic areas accompanied by cracking and distortion of the coleoptile. Small brown spots sometimes occurred on the first and rarely on the second seedling leaves, often accompanied by leaf distortion. Pseudothecial initials of the fungus were present within or on the seed remnants. Seed transmission efficiency was as high as 92% in vitro and 60% in potting soil outdoors. Seed infection did not affect germination in vitro, but slightly reduced emergence in potting soil. Seedling weight and height were reduced significantly. In potting soil, seed infection also resulted in delayed plant growth and increased tan spot severity at later stages of plant development. Under controlled conditions, seed transmission efficiency and incidence of pseudothecia on seed were negatively correlated with seed germination temperature in the range of 9 to 21 degrees C, whereas frequency of recovery of the fungus from symptomatic coleoptiles and leaves was positively correlated with seed germination temperature. These results suggest that infected seed may serve as a source of inoculum for tan spot epidemics and for dispersal of strains of the fungus to new areas. [References: 27].

2173 Singh, G.; Rajaram, S.; Montoya, J.; Fuentesdavila, G. (1995) **GENETIC ANALYSIS OF RESISTANCE TO KARNAL BUNT (TILLETIA INDICA, MITRA) IN BREAD WHEAT.** *Euphytica. 81(2):117-120.* English. [INT MAIZE & WHEAT IMPROVEMENT CTR LISBOA 27 APDO POSTAL 6-64 MEXICO CITY 06600 DF MEXICO].

Karnal bunt caused by Tilletia indica in wheat seriously affects the quality of the grains. It is important to generate information on the genetics of resistance to this pathogen so as to aid resistance breeding. For this purpose, four Karnal bunt-resistant lines from China, Brazil and CIMMYT (International Maize and Wheat Improvement Center) and a susceptible Indian cultivar, WL711, were used. The parents, F1 and F3 progenies of five parental diallel crosses revealed that independently segregating loci with three partial dominant resistance alleles were involved in the resistance of Karnal bunt. Lines RC7201/2*BR2 and Roek/Maya/NAC carried one locus for resistance while Shanghai#7 and Aldan/IAS58 have two and three loci, respectively. One common locus was present in all four resistant parents, which imparted a high level of resistance. [References: 6].

2174 Singh, R.P.; Hong Ma; Huerta Espino, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Wheat Program) (1994) **Rust disease of wheat.** CIMMYT Wheat Special Report (CIMMYT); no. 24 p. 19-33. CIMMYT. 4 maps; 4 tables; 4 graphs., 15 ref. p. 19-33. English. (AGRIS 95-025222).

2175 Singh, RP.; Ma, H.; Rajaram, S. (1995) **GENETIC ANALYSIS OF RESISTANCE TO SCAB IN SPRING WHEAT CULTIVAR FRONTANA.** *Plant Disease. 79(3):238-240.* English. [CIMMYT CTR INT MAIZE & WHEAT IMPROVEMENT LISBOA 27 APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

The Brazilian spring wheat (Triticum aestivum) cv. Frontana is resistant to scab (caused by Fusarium graminearum) in Mexico and various other countries. The number of genes involved in resistance to this disease was estimated. This was done by evaluating random inbred F-6 lines and their parents for scab resistance. The lines were derived from crosses of Frontana with susceptible, or moderately susceptible, cvs. Inia 66, Opata 85, and Pavon 76. These evaluations took place in the field with a mixture of Mexican isolates of F. graminearum. Spikes were inoculated by placing a tiny tuft of cotton soaked with the inoculum in the middle spikelet close to the anthers just prior to anthesis. Glassine bags were placed over the inoculated spikes. These spikes were harvested 45 days after inoculation. Scab severity was determined by recording the number of infected and healthy spikelets. Analyses of variance showed significant differences in scab severities of the F-6 lines. The distribution of F-6 lines was continuous in each cross. The narrow-sense heritability estimates for the crosses evaluated during 1991 and 1993 were 0.66 and 0.93, respectively. Both quantitative and qualitative models were applied to estimate the number of segregating genes. The resistance of Frontana is controlled by the additive interaction of a minimum of three minor genes. Transgressive segregants were identified in each cross, indicating that the susceptible (or moderately susceptible) parents also carry one (or two) minor genes. The combinations of these genes with the genes in Frontana have given F-6 lines with significantly better scab resistance than that of Frontana. [References: 15].

2176 So, I.Y. (Chonpuk National University, Chonju (Korea Republic). Department of Agricultural Biology) (1993) **Transmission of barley yellow mosaic virus by the fungal vector, Polymyxa graminis ledingham.** *Korean Journal of Plant Pathology (Korea Republic) v. 9(2) p. 128-135.* 16 illus.; 2 tables; 30 ref. Korean. (AGRIS 95-025244).

2177 Szecsi, A. (Magyar Tud. Akad. (Hungary). Novenyved. Kut. Int.) (1994) **[Identification of isolates of Fusarium graminearum by a new method]. Fusarium graminearum izolatumanak azonositasa egy uj modszerrel.** *Novenyvedelem (Hungary) v. 30(1) p. 1-6.* 1 table; 2 ill. 18 ref. Hungarian. (AGRIS 95-025211).

A selective media (Bohm-Schraml et al. 1993) has been used for identification of Fusarium graminearum isolates. In experiments 40 stock cultures of Fusarium were set on an 0,2 o/o mannitolagar and incubated at 30 degrees C for 4 days. An intensive cherry-red pigmentation could be obtained only by F. graminearum. On the basis of our investigations this

media is suitable for isolation and identification of. F. graminearum from wheat grains.

2178 Sztor, E. (Ciba Agriculture, Rueil (France). Departement Recherche et Developpement); Schutz, D.; Frasnay, G. (1994) **[Fludioxonil, a fungicide for seed treatment on cereals [CGA 173506, Celest, phenylpyrrole]]. Le fludioxonil, fongicide pour le traitement des semences des cereales a paille [phenylpyrrole, CGA 173506].** *Phytoma La Defense des Vegetaux (France) (no 460) p. 51-54.* 10 ref., 5 graph. French. (AGRIS 95-025289).

2179 Tamas, L.; Fric, F. (1995) **ACTIVITY OF HYDROLYTIC ENZYMES IN BARLEY LEAVES INFECTED WITH POWDERY MILDEW.** *Biologia. 50(1):85-92.* English. [SLOVAK ACAD SCI INST BOT DUBRAVSKA CESTA 14 CS-84223 BRATISLAVA SLOVAKIA].

The behavior of hydrolytic enzymes (acid phosphatase, non specific esterase, exoprotease, beta-glucosidase) were investigated in the epidermal and in whole leaf extracts as well as in intercellular spaces of barley plants infected with powdery mildew. Compatible and incompatible barley - powdery mildew genotype combinations were used for this analysis. The course of the studied hydrolase activity changes post inoculation of barley leaves was significantly influenced by the degree of compatibility or incompatibility. Generally in the epidermal cells that were directly attacked by the fungus, the activity of hydrolases was higher in the compatible combination than in the incompatible one. The epidermal exoprotease activity showed the highest differences between compatibility and incompatibility and a positive correlation between the enzyme activity and the host-parasite genotype compatibility. Our results indicate that the investigated hydrolases do not play a key role in the host resistance.

2180 Tamas, L.; Fric, F. (1995) **PATHOGENESIS-RELATED PROTEINS IN BARLEY INDUCED BY POWDERY MILDEW INFECTION.** *Biologia. 50(1):79-83.* English. [SLOVAK ACAD SCI INST BOT DUBRAVSKA CESTA 14 CS-84223 BRATISLAVA SLOVAKIA].

Proteins in intercellular washing fluid (IWF) from noninoculated and powdery mildew inoculated barley leaves were separated by polyacrylamid gel electrophoresis. Induction of pathogenesis-related (PR) proteins was ascertained as early as in the preparasitic stage of host-parasite interaction, i.e. up to 24h after the inoculation. One multiple form of IWF-peroxidase was especially strongly activated after inoculation. The quantity of PR proteins was increasing up to 72h. The accumulation of PR proteins at host-parasite incompatibility was more expressive than at compatibility.

2181 Tooley, PW.; Carras, MM.; Beck, R.; Peterson, G.; Bonde, MR. (1995) **SEPARATION OF TILLETIA INDICA CHROMOSOMES USING CHEF GEL ELECTROPHORESIS.** *Mycologia. 87(1):61-67.* English. [USDA ARS FOREIGN DIS WEED SCI RES UNIT BLDG 1301 FREDERICK, MD 21702 USA].

Electrophoretic karyotypes were determined for single teliospore isolates and monosporidial lines of Tilletia indica, causal agent of Karnal bunt disease of wheat. Good separation of chromosomes of T. indica was achieved using 0.7% chromosomal grade agarose and a 3-15 minute ramped switching interval for 168 hours at 60 volts. At least 11 chromosomes were observed in T. indica, ranging in size from ca 1 to over 3.3 megabases. Many isolates contained unique karyotypes. Substantial variation in banding intensity was observed within many isolates, indicating the possible presence of multiple chromosomes within single bands. Electrophoretic karyotypes of single teliospore isolates from infected wheat seeds were compared with those of monosporidial isolates derived therefrom. Some differences were observed in karyotypes of teliospore and monosporidial lines, indicating that alterations in karyotype may occur through meiosis in T. indica. Southern blot hybridization revealed that the large subunit ribosomal DNA gene is located on the largest chromosome in T. indica. [References: 13].

2182 Tvaruzek, L.; Klem, K. (Zemedelsky Vyzkumny Ustav, Kromeriz (Czech Republic)) (1994) **Assessment of Stagonospora nodorum disease severity in winter wheat after inoculation.** *Ochrana Rostlin - UZPI (Czech Republic) v. 30(4) p. 245-250.* 1 graph, 2 tables; 12 ref. English. (AGRIS 95-036750).

There were assessed different parameters of the reaction of winter wheat to Stagonospora nodorum after artificial inoculation in the field. Previous findings that symptoms on the flag leaf are more closely correlated with yield reduction than those on the ear were confirmed. Visual symptoms of infection were influenced by the mean daily temperature and distribution of precipitation during May-June, i.e. the heading period. High temperatures at inoculation, followed by a steady decrease, caused a lower infection level. Only yield reduction showed no significant differences in the parameters tested. Possibilities of breeding for tolerance to Stagonospora nodorum are discussed.

2183 Vaneeuwijk, EA.; Mesterhazy, A.; Kling, CI.; Ruckenbauer, P.; Saur, L.; Burstmayr, H.; Lemmens, M.; Keizer, LCP.; Maurin, N.; Snijders, CHA. (1995) **ASSESSING NON-SPECIFICITY OF RESISTANCE IN WHEAT TO HEAD BLIGHT CAUSED BY INOCULATION WITH EUROPEAN STRAINS OF FUSARIUM CULMORUM, F-GRAMINEARUM AND F-NIVALE USING A MULTIPLICATIVE MODEL FOR INTERACTION.** *Theoretical & Applied Genetics. 90(2):221-228.* English. [DLO CTR PLANT BREEDING & REPROD RES POB 16 6700 AA WAGENINGEN NETHERLANDS].

To determine whether resistance to Fusarium head blight in winter wheat is horizontal and non-species specific, 25 genotypes from five European countries were tested at six locations across Europe in the years 1990, 1991, and 1992. The five genotypes from each country had to cover the range from resistant to susceptible. The locations involved were Wageningen, Vienna, Rennes, Hohenheim, Oberer Lindenhof, and Szeged. In total, 17 local strains of Fusarium culmorum, F. graminearum, and F. nivale were used for experimental inoculation. One strain, F. *culmorum IPO* 39-01, was used at all locations. Best linear unbiased predictions (BLUPs) for the head blight ratings of the genotypes were formed within each particular location for each combination of year and strain. The BLUPs over all locations were collected in a genotype-by-environment table in which the genotypic dimension consisted of the 25 genotypes, while the environmental dimension was made up of 59 year-by-strain-by-location combinations. A multiplicative model was fitted to the genotype-by-environment interaction in this table. The inverses of the variances of the genotype-by-environment BLUPs were used as weights. Interactions between genotypes and environments were written as sums of products between genotypic scores and environmental scores. After correction for year-by-location influence very little variation in environmental scores could be ascribed to differences between strains. This provided the basis for the conclusion that the resistance to Fusarium head blight in winter wheat was of the horizontal and non-species specific type. There was no indication for any geographical pattern in virulence genes. Any reasonable aggressive strain, a F. culmorum strain for the cool climates and a F. graminearum strain for the warmer humid areas, should be satisfactory for screening purposes. [References: 33].

2184 Vechet, L. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyne (Czech Republic); Odbor Aplikovane Genetiky) (1994) **Development of yellow rust epidemic in a susceptible winter wheat variety.** *Ochrana Rostlin - UZPI (Czech Republic) v. 30(4) p. 251-260.* 4 tables; 12 ref. English. (AGRIS 95-036751).

Winter wheat, cultivar Danubia was attacked by yellow rust (race Clement) in a different way in each year of a six-year trial. The flag leaves were the most affected leaves of the plant, with flag and F-1 leaves each having more than 30 % of the total infection of the plant. The share of other leaves was 4 to 14 %. More than 50 % of all ears were affected. A highly, positive correlation was found between the attack of whole plants, F-2 leaves and that of the flag leaves. The number of attacked ears was strongly influenced by the attack of the flag leaves and somewhat less by the attack of F-2 leaves and of whole plants. The rate of disease development in different leaf floors was on average highest in the F-1 and flag leaves; it was dependent strongly on the daily mean temperature in the period of visible attack of leaves.

2185 Wall, P.C. (International Maize and Wheat Improvement Center, Santa Cruz (Bolivia)); Neate, S.M.; Graham, R.D.; Reuter, D.J.; Rovira, A.D. (1994) **The effect of rhizoctonia root disease and applied nitrogen on growth, nitrogen uptake and nutrient concentrations in spring wheat.** *Plant and Soil (Netherlands) v. 163(1) p. 111-120.* 26 ref. English. (AGRIS 95-025500).

2186 Whitehead, AG. (1995) **DECLINE OF POTATO CYST NEMATODES, GLOBODERA ROSTOCHIENSIS AND G-PALLIDA, IN SPRING BARLEY MICROPLOTS.** *Plant Pathology. 44(1):191-195.* English. [ROTHAMSTED EXPTL STN AFRC INST ARABLE CROPS RES DEPT ENTOMOL & NEMATOL HARPENDEN AL5 2JQ HERTS ENGLAND].

In microplots of nine soils freed from volunteer potatoes and sown for four consecutive years with spring barley, the eggs of five populations of Globodera pallida and four populations of G. rostochiensis declined at annual rates of 12.8–40.5%. One population of G. rostochiensis declined faster than other populations of either species, although average rates of decline did not differ significantly between the two species of Globodera. These results are compared with earlier research and their relevance to control of the nematodes by crop rotation is discussed. [References: 15].

2187 Wong, LSL.; Abramson, D.; Tekauz, A.; Leisle, D.; Mckenzie, RIH. (1995) **PATHOGENICITY AND MYCOTOXIN PRODUCTION OF FUSARIUM SPECIES CAUSING HEAD BLIGHT IN WHEAT CULTIVARS VARYING IN RESISTANCE.** *Canadian Journal of Plant Science. 75(1.):261-267.* English. [AGR & AGRI FOOD CANADA WINNIPEG RES CTR 195 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

Fusarium head blight (FHB) of wheat has recently become more prevalent in Manitoba, Canada. The objectives of this study were to assess the pathogenicity of Fusarium species isolated from infected wheat spikes, determine their potential to produce trichothecene mycotoxins and evaluate wheat cultivars for resistance to these Fusarium species. This information is a prerequisite to the development of cultivars with effective resistance to FHB in Manitoba. Eight Chinese and three Canadian wheat cultivars were evaluated against individual strains of seven Fusarium species singly in the field. Severity of FHB was measured as percentage of discolored peduncles and percentage of tombstone kernels. On this basis, Fusarium culmorum and F. graminearum were highly pathogenic, F. sporotrichioides had intermediate pathogenicity, and the other species were weakly pathogenic. For F. culmorum and F. graminearum, FHB severity correlated positively with kernel weight reduction and recovery of Fusarium species from the seed and correlated negatively with seed germination. Fusarium species varied in their ability to produce trichothecenes in infected wheat spikes. Wheat inoculated with F. poae contained both type A and B trichothecenes, while that inoculated with F. culmorum and F. graminearum produced type B only. Wheat inoculated with F. sporotrichioides contained type A trichothecenes, while that inoculated with F. avenaceum contained no detectable trichothecenes. Concentration of DON correlated positively with percentage of tombstone kernels in F. culmorum and F. graminearum, and that of HT-2 toxin correlated positively with percentage tombstone kernels in F. sporotrichioides. Biggar, Katepwa and Sceptre wheats were susceptible to F. culmorum and F. graminearum. High levels of resistance, expressed as low FHB severity combined with low trichothecene production, were found in several Chinese cultivars. These traits could be incorporated in adapted cultivars and be monitored by use of artificial inoculation. [References: 25].

H50 MISCELLANEOUS PLANT DISORDERS

2188 Adam, H.S. (University of Gezira, Wad Medani (Sudan)); Ageeb, O.A.A. (Agricultural Research Corporation (ARC), Wad Medani (Sudan)) (1994) **Temperature analysis and wheat yields in the Gezira Scheme.** Wheat in Hot, Dry, Irrigated Environments; Wad Medani (Sudan); 1-4 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 143-145.* CIMMYT. 1 table; 1 graph. English. (AGRIS 95-025607).

Temperature is the single most important climatic element affecting the growth, development, and yield of wheat in the Gezira. The normal mean temperatures for December, January, and February are 24.1, 23.6, and 25.4 deg C, respectively (1951-80). This paper analyzes the temperature regime during the last 10 years (1981-82 through 1991-92) and relates the analysis to the yield of wheat in the Gezira Scheme. Results show that it is important to consider 10-day averages of mean temperature in addition to the monthly averages. Also, good management may offset the harmful effects of high temperature and yield relates well with the mean temperature over the whole season.

2189 Ben Naceur, M. (1994) **[Contribution to assessment of resistance degree to water stress (drought and water flooding) at barley (Hordeum vulgare L.) and tall fescue (Festuca arundinacea Schreb.)]. Contribution a l'evaluation du degre de resistance aux contraintes hydriques (secheresse et exces d'eau) chez l'orge (Hordeum vulgare L.) et la fetuque (Festuca arundinacea Schreb.).** Faculte des Sciences Agronomiques de Gembloux (Belgium). Unite de Biologie Vegetale. 26 ill.; 5 tables; Bibliography p. 105-118x. 118 p. French. (AGRIS 95-025609).

The ability of barley and tall fescue to resist water stress (drought and flooding) was assessed by a study of plant water relations, cell membrane integrity, activity of phosphatasic enzymes and adaptation of root systems. Under drought stress, barley maintained an adequate leaf water potential, a high relative water content and maintained a low but continuous rate of transpiration. As a result, growth of barley was less affected by drought stress. Tall fescue was more sensitive to droughting, and grew poorly under these conditions. The integrity of barley cell membranes was less affected by drought or polyethylene glycol (PEG), induced osmotic shock than was the case for tall fescue. When tall fescue was subject to flooding, aerenchyma formed in the root cortex, enabling oxygen to diffuse into the rooting zone, thus reducing the incidence of anaerobic conditions. Changes in water supply regimes were found to induce characteristic changes in plant acid phosphatases. Those species or varieties,with greater sensitivity to water stress showed increases in activity under stress conditions. The relationships between the above parameters and water stress were used to rank Tunisian barley cultivars with respect to drought resistance.

2190 Cheng, C. (Chiang Mai Univ. (Thailand). Faculty of Agriculture, Agricultural Systems Programme); Rerkasem, B. (1993) **Effects of boron on pollen viability in wheat.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 313-315.* 9 ref. English. (AGRIS 95-025606).

2191 Elliott, D.E. (South Australian Research and Development Inst.,Adelaide, SA (Australia)); Pelham, S.D.; Reuter, D.J. (1993) **Synchronising diagnosis and correction of nitrogen deficiency in barley grown in semi-arid environments.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 363-366.* 4 ref. English. (AGRIS 95-025611).

2192 Garnett, T.P. (Adelaide Univ., Glen Osmond, SA (Australia). Dept. of Botany); Tester, M.A.; Nable, R.O. (1993) **The control of boron accumulation by two genotypes of wheat.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 305-308.* 12 ref. English. (AGRIS 95-025625).

2193 Kanazawa, K. (Tache Univ., Bunkyo ku (Japan). Lab. of Plant Nutrition and Fertilisers); Mihashi, S.; Nishizawa, N.K.; Chino, M.; Mori, S. (1993) **Biosynthetic pathway of phytosiderophores in iron-deficient graminaceous plants: a new assay system for the detection of nicotianamine aminotransferase activity.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 103-105.* 4 ref. English. (AGRIS 95-025610).

2194 Longnecker, N. (Western Australian Univ., Nedlands, W.A. (Australia). Dept. of Soil Science and Plant Nutrition); Slater, J.; Robson, A. (1993) **Copper supply and the leaf emergence rate of spring wheat.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 457-459.* 10 ref. English. (AGRIS 95-025626).

2195 Pineros, M. (Adelaide Univ., Adelaide, SA (Australia). Dept. of Botany); Tester, M. (1993) **Plasma membrane Ca(2+) channels in roots of higher plants and their role in aluminium toxicity.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 119-122.* 18 ref. English. (AGRIS 95-025604).

2196 Rerkasem, B. (Chiang Mai University, Chiang Mai (Thailand). Faculty of Agriculture, Agronomy Department) (1994) **Grain set failure in warm, nontraditional wheat growing areas of Asia: The boron response.** Wheat in Warm Area, Rice Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 290-296.* CIMMYT. 3 tables; 1 graph., 15 ref. English. (AGRIS 95-025608).

Grain set failure is common and widespread in the warm, nontraditional, wheat growing areas of Asia. The problem is distinguishable from the depression of grain number and yield by two other causes: frost damage and limited grain- filling capacity. Responses to boron (B) determined by the Boron Probe Nurseries throughout the region in 1990-91 confirmed earlier findings by researchers from National Agricultural Research Systems in China, India, Nepal, and Thailand, and helped to establish B deficiency as a major cause. Management of the problem is complicated by extreme variability of the B responses in wheat. In one study, the grain set index of SW41, a Thai selection, on a low B soil at Chiang Mai without B application, ranged from 27 to 69 and always >90 with B. Large differences in sensitivity to B deficiency found among wheat genotypes suggest that selection for tolerance may be one way to overcome the problem. A simple screening method for tolerance to B deficiency in a sand culture is presented.

2197 Rerkasem, B. (Chiang Mai Univ. (Thailand). Faculty of Agriculture, Agricultural Systems Programme); Netsangtip, R.; Lordkaew, S.; Cheng, C. (1993) **Grain set failure in boron deficient wheat.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 309-312.* 16 ref. English. (AGRIS 95-025605).

2198 Ring, S.M. (Agricultural Research Inst., Wagga Wagga, NSW (Australia)); Fisher, R.P.; Poile, G.J.; Helyar, K.R.; Conyers,M.K.; Morris, S.G. (1993) **Screening species and cultivars for their tolerance to acidic soil conditions.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 521-524.* 7 ref. English. (AGRIS 95-025676).

2199 Schnyder, H. (Universitaet Bonn (Allemagne). Institut fuer Pflanzenbau); Weiss, J. (1993) **[Growth of the grain of wheat (Triticum aestivum L.). The significance and timing of greening]. [Formation du grain de ble (Triticum aestivum L.). Importance et epoque du verdissement].** *European Journal of Agronomy (France) v. 2(2) p. 93-98.* 17 ref. English. (AGRIS 95-025623).

2200 Schreiner, K.A. (Alberta Univ., Edmonton, Alta. (Canada). Dept. of Botany); Hoddinott, J.; Taylor, G.J. (1994) **Aluminum-induced deposition of (1,3)-beta-glucans (callose) in Triticum aestivum L.** *Plant and Soil (Netherlands) v. 162(2) p. 273-280.* 22 ref. English. (AGRIS 95-025624).

2201 Steveninck, R.F.M. van (Trobe Univ., Bundoora (Australia). School of Agriculture); Babare, A.; Fernando, D.R.; Steveninck,M.E. van (1993) **The binding of zinc in root cells of crop plants by phytic acid.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 525-528.* 13 ref. English. (AGRIS 95-025639).

2202 Vol'nova, T.L.; Koreneva, V.M.; Astakhova, N.V.; Muromtsev, G.S. (1993) **[Frost hardiness of winter wheat under the effect of biosynthetic growth regulator fusicoccin]. Morozoustojchivost' ozimoj pshenitsy pod vliyaniem biosinteticheskogo regulyatora rosta fuzikoktsina.** *Sel'skokhozyajstvennaya biologiya. Seriya Biologiya rastenij (Russian Federation) (no.5) p. 108-114.* 12 ref. Russian. (AGRIS 95-037078).

In a vegetational experiment the effect of fusicoccin (the biosynthetic plant growth regulator of terpenoid nature) on the frost hardiness of winter wheat seedlings and tillered plants has been studied. It has been shown that in 5x10-7, 10-6 and 10-5 M concentration fusicoccin practically had no effect on the frost hardiness of seedling. At the same time, during the tillering and the beginning of the rooting the frost hardiness of plants treated with fusicoccin (in 5x10-7 concentration especially) significantly increased as compared to the control.

2203 Wheeler, D.M. (New Zealand Pastoral Agriculture Research Inst. Ltd., Hamilton (New Zealand)); Power, I.L.; Edmeades, D.C. (1993) **Effect of various metal ions on growth of two wheat lines known to differ in aluminium tolerance.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 489-492.* 8 ref. English. (AGRIS 95-025628).

2204 Zakharin, A.A. (1994) **[Rapid kinetics of plant growth under salt stress [growth of roots]]. Bystraya kinetika rosta rastenij pri solevom stresse.** *Fiziologiya rastenij (Russian Federation) v. 41(1) p. 101-106.* 15 ref. Russian. (AGRIS 95-037064).

H60 WEEDS

2205 Babalola, A.; Froud Williams, R.J.; Drennan, D.S.H. (Department of Agricultural Botany, School of Plant Sciences, University of Reading, 2 Earley Gate, Reading RG6 2AU (United Kingdom)) (1993) **Varietal competitiveness of autumn and spring-sown field beans (Vicia faba L.) with volunteer barley.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 635-636.* British Crop Protection Council (BCPC). 1 ref. English. (AGRIS 95-037294).

2206 Chaisattapagon, C.; Zhang, N. (1992) **Identifying effective criteria for weed detection using machine vision.** *Paper - American Society of Agricultural Engineers (USA); no. 92-3576 19 p.* references. Paper presented at the "1992 International Winter Meeting sponsored by the American Society of Agricultural Engineers," December 15-18, 1992, Nashville, Tennessee. English. (AGRIS 95-037279).

2207 Contreras de la Cruz, Enrique (1993) **[Eight herbicides used for weed control and their phytotoxic effects in 17 different wheats: Yaqui valley, Sonora]. Efecto de la fitotoxicidad de 8 herbicidas para el control de maleza sobre 17 materiales de trigo, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 55-56. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 55-56. Spanish. (AGRIS 95-025787).

2208 Contreras de la Cruz, Enrique (1993) **[Evaluation of 6 herbicides and weeding methods for the control of adventitious grasses in row-planted wheat: Yaqui valley, Sonora]. Evaluacion de 6 herbicidas y escardas para el control de maleza graminea en trigo sembrado en surcos, en el Valle del Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 57-58. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 57-58. Spanish. (AGRIS 95-025790).

2209 Contreras de la Cruz, Enrique (1993) **[Evaluation of the herbicides Grasp (Tralkoxidim), PUMA (Fenoxaprop-Etil) and AC-222-293 for the control of canary grass in wheat: Yaqui valley, Sonora]. Evaluacion de los herbicidas Grasp (Tralkoxidim), PUMA (Fenoxaprop-Etil) y AC-222-293 para el control de alpiste silvestre en trigo, en el Valle de Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 57. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 57. Spanish. (AGRIS 95-025789).

2210 Contreras de la Cruz, Enrique (1993) **[Evaluation of the herbicides Grasp (Tralkoxidium), PUMA (Fenoxaprop-Etil) and AC-222-293 for the control of wild oat in wheat: Yaqui valley, Sonora]. Evaluacion de los herbicidas Grasp (Tralkoxidim), PUMA (Fenoxaprop-Etil) y AC-222-293 para el control de avena silvestre en trigo, en el Valle de Yaqui, Son.** Avances de la investigacion CIANO (Mexico); no. 27 p. 56. Centro de Investigaciones Agricolas del Noroeste. Solo sumario. p. 56. Spanish. (AGRIS 95-025788).

2211 Covarelli, G. (Perugia Univ. (Italy). Istituto di Agronomia e Coltivazioni Erbacee) (1994) **[Spontaneous plant evolution and cultural techniques [wheat, maize, sugar beet]]. Evoluzione della flora spontanea e tecniche colturali [frumento, mais, barbabietola da zucchero].** [Management and integrated control of weeds]; Bologna (Italy); [nd]. *Terra e Vita (Italy) v. 35(suppl.7) p. 18-21.* Italian. (AGRIS 95-025771).

2212 Dossantos, HP.; Reis, EM. (1994) **EFFECTS OF RYEGRASS AND FORAGE BLACK OATS CULTIVATION ON ROOT DISEASES AND YIELD OF WHEAT.** *Pesquisa Agropecuaria Brasileira. 29(10):1571-1576.* Portuguese. [EMBRAPA CNPT CAIXO POSTAL 569 BR-99001970 PASSO FUNDO RS BRAZIL].

During five seasons (1985 to 1989), the effects of several cultivation systems with ryegrass (Lolium multiflorum) and with black oats (Avena strigosa) for forage were evaluated in the National Center for Research on Wheat (EMBRAPA), Passe Fundo, RS, for root disease intensity and grain yield of wheat (Triticum aestivum). The treatments consisted of the

following cultivation systems for wheat: 1) monoculture of wheat; 2) rotation of a winter crop with wheat and two with ryegrass; 3) rotation of a winter cereal with wheat and two with black oats; 4) rotation of a winter crop with wheat and three with black oats. The wheat with two consecutive winter crops with ryegrass showed, in absolute values, a higher percentage of root disease intensity and less grain yield. For the parameters studied, this treatment had a worse performance than wheat in monoculture.

2213 Franetovich, L.M.; Peeper, T.F. (1995) **QUINCLORAC FOR CHEAT (BROMUS-SECALINUS) CONTROL IN WINTER WHEAT (TRITICUM-AESTIVUM).** *Weed Technology. 9(1):131-140.* English. [OKLAHOMA STATE UNIV DEPT AGRON STILLWATER, OK 74078 USA].

Thirteen field experiments were conducted to evaluate quinclorac for cheat control in hard red winter wheat. Cheat control with quinclorac was variable. Quinclorac at 560 and 1120 g a.i./ha applied to tillered wheat controlled cheat 93 to 100% at four sites. In contrast, pooled over four other experiments and four application times, quinclorac at 420 g/ha and 560 g/ha controlled cheat only 20 and 31%, respectively. Quinclorac at 420 g/ha plus chlorsulfuron:metsulfuron (5:1) at 35 g a.i./ha applied PRE increased wheat yield 28% at one of three sites. At two of these sites, averaged over chlorsulfuron:metsulfuron rates of 0, 18, and 35 g a.i./ha, quinclorac at 280 and 420 g/ha applied POST, increased wheat yield 32 to 112%. In two cultivar tolerance experiments, quinclorac treatments did not damage any cultivar. Pooled over cultivars, yields were increased 7 and 10% when quinclorac at 280 and 560 kg/ha was applied, respectively. In a greenhouse experiment, quinclorac plus dicamba or esfenvalerate consistently reduced the leaf area of cheat in a manner suggesting synergistic effects. Of eight adjuvants evaluated in a laboratory experiment, only quinclorac plus the adjuvant BCH 864015 reduced cheat leaf area more than quinclorac alone.

2214 Hailu Beyene (Institute of Agricultural Research, Addis Ababa (Ethiopia). Holetta Research Center) (1994) **Herbicide use for sustainable bread wheat production in the Central Highlands of Ethiopia.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 186-191.* CIMMYT. 5 tables; 13 ref. English. (AGRIS 95-025794).

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

2215 Ingham, R.M.; Horne, C.J.; Hewson, R.T. (Agriculture Business Unit, Hoechst UK Limited, East Winch Hall, East Winch, King's Lynn, Norfolk PE32 1HN (United Kingdom)) (1993) **A novel mixture of fluoroglycofen-ethyl with isoproturon for the control of Galium aparine and other important weeds in winter cereals.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 591-596.* British Crop Protection Council (BCPC). 7 ref. English. (AGRIS 95-037307).

2216 Kirkland, K.J. (1995) **FREQUENCY OF POST-EMERGENCE HARROWING EFFECTS WILD OAT CONTROL AND SPRING WHEAT YIELD.** *Canadian Journal of Plant Science. 75(1):163-165.* English. [AGR CANADA EXPTL FARM SCOTT SK S0K 4A0 CANADA].

Crops grown by organic producers or others choosing not to use herbicides require alternative weed control methods. In a 3-yr study at Scott, Saskatchewan, several harrowing frequencies were applied to emerged wild oats infesting spring wheat. Two passes with diamond tooth harrows at the one- to two-leaf stage of wild oats reduced panicle density and fresh weight in 2 of 3 yr. Multiple harrowings reduced wheat culms, fresh weight, and yield in 2 of the 3 yr. In 1992, four harrowings reduced wheat culms and yield, but had no effect on wild oat. In 1993, two harrowings reduced wild oat panicles and fresh weight, but had no effect o wheat culms and fresh weight, suggesting that moisture conditions at and immediately following harrowing have a differential effect on the ability of the two species to recover. [References: 6].

2217 Kolo, M.G.M.; Froud Williams, R.J. (Department of Agricultural Botany, University of Reading, 2 Earley Gate, Reading RG6 2AU (United Kingdom)) (1993) **Competition between Cirsium arvense (L.) Scop. and spring barley.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 637-638.* British Crop Protection Council (BCPC). 1 ref. English. (AGRIS 95-037328)

2218 Legere, A.; Samson, N.; Rioux, R. (MacDonald Campus, Department of Plant Sciences, McGill University, 21 111 Lakeshore Road, Ste Anne de Bellevue, Que. H9X 1C0 (Canada)) (1993) **Perennial weeds in conservation tillage systems: more of an issue than in conventional tillage systems.. vol 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 747-752.* British Crop Protection Council (BCPC). 11 ref. English. (AGRIS 95-037310).

2219 Mallory Smith, C.A.; Thill, D.C.; Stallings, G.P. (Department of Plant, Soil and Entomolgical Sciences, College of Agriculture, University of Idaho, Moscow, ID 83843 (USA)) (1993) **Survey and gene flow in acetolactate synthase resistant kochia and Russian thistle.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 555-558.* British Crop Protection Council (BCPC). 8 ref. English. (AGRIS 95-037256).

2220 Manning, T.H.; Palmer, J.J.; Hewson, R.T. (Agriculture Business Unit, Hoechst UK Limited, East Winch Hall, East Winch,King's Lynn, Norfolk PE32 1HN (United Kingdom)) (1993) **Weed control in wheat with HOE 1028 - a combination of fenoxaprop-P-ethyl and isoproturon.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 597-600.* British Crop Protection Council (BCPC). 9 ref. English. (AGRIS 95-037309).

2221 Marocchi, G. (Regione Emilia Romagna, Bologna (Italy). Osservatorio per le Malattie delle Piante) (1994) **[A balanced weed control [cereals, sugar beet, grapevine, fruit crops]]. Un diserbo equilibrato [cereali, bietola da zucchero, vite, colture da frutto].** *Terra e Vita (Italy) v. 35(13) p. 51-53.* 2 graphs. Italian. (AGRIS 95-025772).

2222 Marocchi, G. (Regione Emilia Romagna, Bologna (Italy). Osservatorio per le Malattie delle Piante) (1994) **[Weed control in wheat - comparison of different strategies]. Diserbo del frumento - strategie a confronto.** *Terra e Vita (Italy) v. 35(37) p. 56-59.* 1 table. Italian. (AGRIS 95-025744).

2223 Marocchi, G. (Regione Emilia Romagna, Bologna (Italy). Osservatorio per le Malattie delle Piante) (1994) **[Wheat - growing interest for the post-emergence [weed control,Italy]]. Frumento - cresce l'interesse per il [diserbo] post-emergenza [Italia].** *Terra e Vita (Italy) v. 35(2) p. 58-62.* 4 tables; 1 graph. Italian. (AGRIS 95-025743).

2224 Mathiassen, S.K.; Jensen, P.K.; Kudsk, P.; Larsen, T.K. (Department of Weed Control and Pesticide Ecology, Danish Institute of Plant and Soil Science, Flakkebjerg, 4200 Slagelse (Denmark)) (1993) **Possibilities for improving the foliar activity of isoproturon.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 585-590.* British Crop Protection Council (BCPC). 5 ref. English. (AGRIS 95-037330).

2225 Mirkamali, H. (Weed Research Division, Plant Pests and Diseases Research Institute, Tehran (Iran Islamic Republic)) (1993) **Chemical control of grasses in wheat.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 579-584.* British Crop Protection Council (BCPC). 7 ref. English. (AGRIS 95-037376).

2226 Pannell, D.J. (1994) **THE VALUE OF INFORMATION IN HERBICIDE DECISION MAKING FOR WEED CONTROL IN AUSTRALIAN WHEAT CROPS.** *Journal of Agricultural & Resource Economics. 19(2):366-381.* English.

[UNIV WESTERN AUSTRALIA DEPT AGR & RESOURCE ECON NEDLANDS WA 6009 AUSTRALIA].

Most weed control decisions are made with the benefit of some information about wheather conditions and actual weed densities. This study is an investigation of the value of adjusting weed control decisions in response to these types of information. For a specific example, it is found that the expected value of information can reach 15% of expected gross margin. The value of information about yield prospects is higher than that for weed density. The value of information is markedly affected by the degree of risk aversion and the type of decision rule adopted. Use of information reduces the expected level of herbicide usage. [References: 33].

2227 Panwar, RS.; Malik, RK.; Balyan, RS.; Singh, DP. (1995) **EFFECT OF ISOPROTURON, SOWING METHOD AND SEED RATE ON WEEDS AND YIELD OF WHEAT (TRITICUM AESTIVUM).** *Indian Journal of Agricultural Sciences. 65(2):109-111.* English. [CHAUDHARY CHARAN SINGH HARYANA AGR UNIV DEPT AGRON HISAR 125004 HARYANA INDIA].

A field experiment was conducted during winter season of 1989-90 and 1990-91 to study the effect of isoproturon, sowing method and seed rate on weed management in 'WH 423' wheat (Triticum aestivum L. emend Fiori & Paol.). Cross-row sowing significantly reduced the dry weight of weeds both in the weedy control and plots treated with isoproturon 0.75 kg/ha. In the weedy control the dry weight of weeds at 90 days after sowing decreased from 134.9 g/m(2) at 100 kg seed/ha to 96.1 g/m(2) at 175 kg seed/ha. Based on the average of seed rate and weed-control treatments, cross-row sowing increased the average wheat yield by 0.44 tonne/ha compared with line sowing. Seed 100 and 175 kg/ha gave an average wheat yield of 4.57 and 5.44 tonnes/ha respectively. Isoproturon 0.75 kg/ha applied 20 days after sowing gave 52% more average grain yield of wheat than the weedy control.

2228 Parrish, S.K. (Agricultural Group, Monsanto, Louvain la Neuve (Belgium)) (1993) **Dithiopyr; potential use in European cereals.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 573-578.* British crop protection council (BCPC). 3 ref. English. (AGRIS 95-037306).

2229 Prasad, K.; Singh, RS. (1995) **INFLUENCE OF WEED AND NITROGEN MANAGEMENT ON WEED GROWTH, NUTRIENT UPTAKE AND YIELD OF WHEAT (TRITICUM AESTIVUM).** *Indian Journal of Agricultural Sciences. 65(2):117-122.* English. [BIRSA AGR UNIV DEPT AGRON RANCHI 834006 BIHAR INDIA].

An experiment was conducted during winter season of 1991-92 and 1992-93 at Ranchi on weed management in wheat (Triticum aestivum L. emend. Fiori & Paol.) under different nitrogen levels. An increase in N level increased the weed density, its dry-matter accumulation and the NPK depletion. Post-emergence application of isoproturon 0.75 kg/ha + 2,4-D Na salt 0.75 kg/ha gave better control of weeds than their separate application at higher rate of 1.0 kg/ha each in both the seasons. It was comparable with that of weeding by dutch hoe (at 15, 30 and 45 days after sowing) in minimizing the weed density, its dry weight and nutrient depletion by weeds as well as in improving the nutrient uptake and grain yield of wheat. There was no sufficient difference in the grain yields of wheat at 80 and 120 kg Nma (2 826 and 2 904 kg/ha). Interaction effects of N Levels and weed-control methods indicated that sustainable yield of wheat (3 625 kg/ha) could be obtained at 80 kg N/ha with post-emergence application of isoproturon 0.75 kg/ha + 2,4-D Na salt 0.75 kg/ha.

2230 Rooney, J.M.; Brain, P.; Caseley, J.C.; Butler, D.R. (Department of Agricultural Sciences, University of Bristol, AFRC Institute of Arable Crops Research, Long Ashton Research Station, Bristol BS18 9AF (United Kingdom)) (1993) **Early competition of Avena fatua or Galium aparine and Triticum aestivum with differing soil types and sowing times.. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 619-624.* British Crop Protection Council (BCPC). 17 ref. English. (AGRIS 95-037375).

2231 Saffour, K. (1992) **[Competition between hard wheat and weeds in the Sais regions [Morocco]]. Concurence entre le ble dur et les mauvaises herbes dans le Sais [Maroc].** Ministere de l'Agriculture et de la Reforme Agraire, Rabat (Maroc). Institut Agronomique et Veterinaire Hassan 2. 155 ref. 145 p. French. (AGRIS 95-025786).

2232 Singh, S.; Malik, RK. (1994) **EFFECT OF 2,4-D AND TRIBENURON ON THE CONTROL OF BROAD-LEAF WEEDS IN WHEAT (TRITICUM-AESTIVUM).** *Indian Journal of Agronomy. 39(3):410-414.* English. [CHAUDHARY CHARAN SINGH HARYANA AGR UNIV DEPT AGRON HISAR 125004 INDIA].

A field experiment was conducted during 1990-91 and 1991-92 to study the effect of 2, 4-D and tribenuron on broad-leaf weeds in wheat (Triticum aestivum L. emend. Fiori & Paol). In the presence of lamb's quarters (Chenopodium album L.), 0.25 kg ai/ha ester or 0.75 kg ai/ha sodium salt was found effective, but in the presence of yellow vetchling (Lathyrus aphaca L.) higher doses of 2,4-D were effective. Tribenuron 10 g ai/ha provided satisfactory control of the former but was not effective against the latter even at higher dose. Tank mixture of 2, 4-D ester 0.25 kg ai/ha and isoproturon 0.75 kg ai/ha was more effective, recording an average yield of 5,039 kg/ha and 3,808 kg/ha compared with 4,056 kg/ha and 1,892 kg/ha in weedy check plots during 1990-91 and 1991-92 respectively.

2233 Tanji, A. (Institut National de la Recherche Agronomique, Settat (Maroc). Centre Aridoculture) (1993) **[Forage analysis of 26 weeds of non irrigated wheat in Chaouia regions [Morocco]]. Analyse fourragere de 26 adventices du ble non irrigue en chaouia [Maroc].** *Awamia (Maroc); Revue Marocaine de la Recherche Agronomique (no 83) p. 59-75.* 4 Tableaux 39 ref. French. (AGRIS 95-025725).

2234 Tanji, A.; El Brahli, A. (Institut National de la Recherche Agrnomique, Settat (Maroc). Centre Regional de la Recherche Agronomique); Jlibene, M. (1993) **[The competitive ability of 20 cereals varieties to weeds]. Capacite competitive de vingt varietes de cereales a l'egard des mauvaises herbes.** *Awamia (Maroc); Revue Marocaine de la Recherche Agronomique (no 83) p. 77-93.* 4 Tableaux 24 ref. French. (AGRIS 95-025766).

2235 Vanova, M.; Spitzer, T.; Klem, K. (1995) **CONTROL OF DICOTYLEDONOUS WEED OCCURRENCE IN SPRING BARLEY.** *Rostlinná Vyroba. 41(2):83-89.* Polish. [AGR RES INST KROMERIZ CZECH REPUBLIC].

Our trials showed that spring barley could suppress dicotyledons effectively even in the field with a higher weed seed bank in the soil; in a lot of cases, an application of herbicides was not effective because no significant influence on the yield was found. Spring barley can suppress weeds and keep the field free of weeds till the harvest under certain conditions. The crop density plays an important role. It can be reached by an increased seeding rate or higher tillering. Conditions for powerful tillering based on cold weather and rainfall can be hardly foreseen. In the past, tillering was also supported by nitrogen top dressing applied at the 3rd-leaf growth stage of barley. Now, this application is strongly limited or completely eliminated. With regard to the fact that possibilities for the optimum density at low seeding rates are not sure it is necessary to reach the density required using a well considered seedling rate in relation to a variety. At adequate crop densities (750 to 850 ears.m-2), weeds are supposed to wither away in the shade and other ones will not emerge. The trials also show that it is not always easy to select out a suitable herbicide or a combination of them to control weeds in spring barley. Even in trials where a number of weeds at the beginning of the growing season was quite high and exceeded threshold values, only a low or no yield increase was observed after herbicide application. That can be caused either by the phytotoxicity of herbicides or the fact that the weed spectrum did not reduce the yield in those stands. Spring barley sensitivity to herbicides differs from that of winter wheat and some products can be detrimental. Mostly, herbicide rates applied to spring barley can be much lower than those applied to winter wheat. To recommend the weed control it is necessary to take into account that thresholds for weeds in spring barley are higher as compared to those in winter wheat. Weeds in winter wheat grow faster (during autumn and winter) than the crop while in spring, dicotyledons in spring barley grow slowlier than the crop in the field well prepared, and a strong competition of spring barley does not allow emerged weeds to develop. For good competitive ability the soil has to be well prepared in both the autumn and spring seasons. Not only the soil surface of the field should be treated because the compacted soil delays the initial crop growth and development. A sufficient amount of air in the soil is very important for a weak root system of spring barley and together with early sowing will secure rapid germination and growth. Agronomic and cropping practices for spring barley play a considerable role in consequent decision of

using herbicides and their rates applied against dicotyledons in spring barley.

2236 Villarroya, M.; Chueca, M.C.; Garcia Baudin, J.M. (Departamento de Proteccion Vegetal, CIT INIA, Apto. 8111, 28080 Madrid (Spain)) (1993) **Variation in metribuzin response between wheat cultivars and Bromus diandrus (great brome).. vol. 2.** *Brighton crop protection conference, weeds. Proceedings of an international conference, Brighton, UK, 22-25 November 1993. p. 607-612.* British Crop Protection Council (BCPC). 22 ref. English. (AGRIS 95-037263).

J11 HANDLING, TRANSPORT, STORAGE AND PROTECTION OF PLANT PRODUCT

2237 Bakhella, M. (Institut Agronomique et Veterinaire Hassan 2, Rabat (Maroc)); Kaanana, A.; Baba, M. (1993) **[Effect of underground storage on some chemical and rheological properties of wheat]. [Effet du stockage souterrain sur quelques proprietes chimiques et rheologique du ble].** *Awamia (Maroc); Revue Marocaine de la Recherche Agronomique (no 83) p. 5-28.* 5 Tableaux 24 ref. English. (AGRIS 95-025867).

2238 Ergudenler, A.; Ghaly, AE. (1994) **A COMPARATIVE STUDY ON THE THERMAL DECOMPOSITION OF FOUR CEREAL STRAWS IN AN OXIDIZING ATMOSPHERE.** *Bioresource Technology. 50(3):201-208.* English. [TECH UNIV NOVA SCOTIA DEPT AGR ENGN POB 1000 HALIFAX NS B3J 2X4 CANADA].

The thermal decomposition characteristics of four types (wheat barley, oats and rye) of cereal straws were studied. Two varieties from each type of straw were used The thermal degradation behaviours and kinetic parameters (order of reaction, activation energy and pre-exponential factor) of the straws were compared. Two distinct reaction zones were observed for all types and varieties of straws. Thermal degradation rates in the first reaction zone were significantly higher than those in the second reaction zone. The activation energy was in the ranges of 80-102 kJ/mol and 34-75 kJ/mol, whereas the order of reaction was in the ranges of 1.3-2.3 and 0.1-0.7 for the first and second reaction zones, respectively. The Shaw variety of oats straw had the highest activation energies (102 and 75 kJ/mol) and reaction orders (2.3 and 0.7) in both the first and second reaction zones, respectively. The lowest activation energy (80 kJ/mol) and order of reaction (1.3), in the first reaction zone, corresponded to Absolvant and Monopol wheat straws. The activation energies and reaction orders of barley and rye straws were in the ranges of 85-94 kJ/mol and 1.9-2.3, respectively. There was not any significant difference between the rate constants of the straw varieties, in the first reaction zone. However, oats straws had significantly higher rate constants in the second reaction zone as compared to the rate constants of wheat, barley and rye straws. [References: 29].

2239 Frontczak, J. (Agricultural University, Wroclaw (Poland). Inst. of Mechanization of Agriculture) (1993) **Kinetic friction of triticale grains.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 63-68. Instytut Agrofizyki. 7 fig.; 13 ref.. Distributed 1994. p. 63-68. English. (AGRIS 95-037468).

Tests have been carried out for triticale grains of "Lasko" variety, at 15 rpm rotary speed of the rubbing element. There have been tested triticale grain - on - construction material friction combinations with use of following five construction material kinds: steel, wood, rubber, teflon and "textolite" (kind of laminated material). Triticale grain have been moistened by 1 percent moisture content within limits: 9 to 22 percent. Test results have been submitted to statistical analysis and have been graphically shown as kinetic friction coefficient influenced by moisture content in triticale grains.

2240 Gowin, J. (Agricultural University, Lublin (Poland). Inst. of Agriculture Engineering) (1993) **Some tensile and bending characteristics of wheat stalks.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 87-89. Instytut Agrofizyki. 2 fig.; 4 ref.. Distributed 1994. p. 87-89. English. (AGRIS 95-037475).

The paper presents the results of the study on the mechanical properties of wheat stalks during tension and bending including the effect of fertilization and stage of plant vegetation. The tensile strength and modulus of elasticity are higher, the stalk cross-sectional area is smaller.

2241 Grundas, S.; Geodecki, M.; Niewczas, J. (Polish Academy of Sciences, Lublin (Poland). Inst. of Agrophysics); Velikanov, L. (Russian Academy of Agricultural Sciences, Petersburg (Russian Federation). Inst. of Agrophysics) (1993) **Static loading of wheat grain mass of differentiated moisture content, and its physical effects. Pt. 1.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 103-109. Instytut Agrofizyki. 5 fig., 6 tables; 4 ref.. Distributed 1994. p. 103-109. English. (AGRIS 95-037471).

The authors have undertaken an attepmt at examining the physical outcome of the effect of static loading applied to grain mass of differentiated moisture content, at constant levels of grain column deformation. To assess the results of the destructive action of static loading, manifested in the form of external mechanical damage to grain, the colorimetry was applied, and the x-ray method was used to assess the internal damage grain.

2242 Janzen, RA.; Dormaar, JF.; Mcgill, WB. (1995) **A COMMUNITY-LEVEL CONCEPT OF CONTROLS ON DECOMPOSITION PROCESSES - DECOMPOSITION OF BARLEY STRAW BY PHANEROCHAETE-CHRYSOSPORIUM OR PHLEBIA-RADIATA IN PURE OR MIXED CULTURE.** *Soil Biology & Biochemistry. 27(2):173-179.* English. [UNIV ALBERTA DEPT RENEWABLE RESOURCES EDMONTON AB T6G 2E3 CANADA].

We tested the hypothesis that interactions among populations in communities of decomposer microbes integrate physicochemical and population-level factors to control decomposition. To this end, we measured the relationship between inoculation with Phanerochaete chrysosporium and Phlebia radiata and the evolution of CO2 from barley straw by decomposer communities. At 45-degrees-C, 80% as much CO2 was evolved from straw inoculated with P. chrysosporium in pure culture as from mixed cultures containing P. chrysosporium or P. radiata with indigenous barley straw and compost microflora. P. radiata in pure culture evolved less CO2 than all other tested inocula. At 20-degrees-C, P. radiata evolved 3-fold more CO2 in pure culture on barley straw over 42 days than did other tested inocula. Adding P. radiata to straw in co-culture with Trichoderma harzianum or indigenous barley straw microflora did not increase CO2 evolution, and by inference decomposition rate, compared to microcosms without added P. radiata. We conclude that community-level controls on decomposition dynamics integrate physicochemical and population-level controls, and therefore might facilitate extension to the environment. [References: 22].

2243 Mouhouche, F. (Institut National Agronomique, El Harrach (Algeria). Dept. de Zoologie Agricole et Forestiere. Lab. de Phytopharmacie) (1992) **[Effects of three insecticides on some biological parameters of stored grain insect Trogoderma granarium Everts (Coleoptera,Dermestidae)]. Effet de trois insecticides sur quelques parametres biologiques d'un insecte des grains stockes Trogoderma granarium Everts (Coleoptera, Dermestidae).** Memoires de la Societe Royale Belge d'Entomologie (Belgium); Memoires van de Koninklijk Belgische Vereniging voor Entomologie; v. 35(2) p. 433-437. Societe Royale Belge d'Entomologie. 4 tables; 7 ref. p. 433-437. French. (AGRIS 95-025861).

2244 Petersson, S.; Schnurer, J. (1995) **BIOCONTROL OF MOLD GROWTH IN HIGH-MOISTURE WHEAT STORED UNDER AIRTIGHT CONDITIONS BY PICHIA ANOMALA, PICHIA GUILLIERMONDII, AND SACCHAROMYCES CEREVISIAE (VOL 61, PG 1029, 1995).** *Applied & Environmental Microbiology. 61(4):1677.* English. [SWEDISH UNIV AGR SCI DEPT MICROBIOL BOX 7025 S-75007 UPPSALA SWEDEN].

2245 Petersson, S.; Schnurer, J. (1995) **BIOCONTROL OF MOLD GROWTH IN HIGH-MOISTURE WHEAT STORED UNDER AIRTIGHT CONDITIONS BY PICHIA ANOMALA, PICHIA GUILLIERMONDII, AND SACCHAROMYCES CEREVISIAE.** *Applied & Environmental Microbiology. 61(3):1027-1032.* English. [SWEDISH UNIV AGR SCI DEPT MICROBIOL BOX 7025 S-75007 UPPSALA SWEDEN].

Pichia anomala inhibits the growth of Penicillium roqueforti and Aspergillus candidus on agar. In this investigation, antagonistic activity on agar against 17 mold species was determined. The abilities of Pichia anomala, Pichia guilliermondii, and Saccharomyces cerevisiae to inhibit the growth of the mold Penicillium roqueforti in nonsterile high-moisture wheat were compared by adding 10(3) Penicillium roqueforti spores and different amounts of yeast cells per gram of wheat. Inoculated grain was

packed in glass tubes, incubated at 25 degrees C with a restricted air supply, and the numbers of yeast and mold CFU were determined on selective media after 7 and 14 days. Pichia anomala reduced growth on agar plates for all of the mold species tested in a dose-dependent manner. Aspergillus fumigatus and Eurotium amstelodami were the most sensitive, while Penicillium italicum and Penicillium digitatum were the most resistant. Pichia anomala had the strongest antagonistic activity in wheat, with 10(5) and 10(6) CFU/g completely inhibiting the growth of Penicillium roqueforti. Inhibition was least pronounced at the optimum temperature (21 degrees C) and water activity (0.95) for the growth of Penicillium roqueforti. Pichia guilliermondii slightly reduced the growth of Penicillium roqueforti in wheat inoculated with 10(5) and 10(6) yeast CFU/g, S. cerevisiae inhibited mold growth only weakly at the highest inoculum level. Pichia anomala grew from 10(3) to 10(7) CFU/g of wheat in 1 week To reach the same level, Pichia guilliermondii had to be inoculated at 10(4) CFU while S. cerevisiae required an inoculum of 10(5) CFU to reach 10(7) CFU/g of wheat. [References: 20].

2246 Reed, C.; Worman, F. (1993) **Quality maintenance and marketing of wheat stored on farms and in elevators in Kansas: description, techniques, and innovations.** *Bulletin (USA); no. 660 55 p.* references. English. (AGRIS 95-025869).

2247 Suk, H.M.; Hong, H.D.; Kim, S.S.; Kim, K.T. (Korea Food Research Institute, Sungnam (Korea Republic)); Kim, J.S. (Inju University, Pusan (Korea Republic). Department of Food Science and Nutrition) (1993) **Effect of parboiling on the physicochemical properties of immature barley kernels.** *Journal of the Korean Agricultural Chemical Society (Korea Republic) v. 36(6) p. 456-462.* 1 illus.; 8 tables; 15 ref. Korean. (AGRIS 95-025862).

2248 Szot, B.; Stepniewski, A.; Rybczynski, R. (Polish Academy of Sciences, Lublin, (Poland). Inst. of Agrophysics) (1993) **Variability of winter wheat grains resistance to static loads.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 255-259. Instytut Agrofizyki. 5 fig.; 6 ref.. Distributed 1994. p. 255-259. English. (AGRIS 95-037472).

Five winter wheat: Alcedo, Beta, Grana, Liwilla and Salwa in four levels of moisture: 5, 9, 16, and 21 percent were examined. Static compression test of a single grain was performed between two parallel plates. Maximal compression force and deformation within limits of elasticity were read from the curves in force - deformation coordinate system. Point where curve bent was regarded as a limit of elasticity.

2249 Tembo, E.; Murfitt, RFA. (1995) **EFFECT OF COMBINING VEGETABLE OIL WITH PIRIMIIPHOS-METHYL FOR PROTECTION OF STORED WHEAT AGAINST SITOPHILUS-GRANARIUS (L).** *Journal of Stored Products Research. 31(1):77-81.* English. [AGRITEX BOX 8117 CAUSEWAY HARARE ZIMBABWE].

Vegetable oils (groundnut, rape seed and sunflower) at 10 ml/kg were tested alone and in combination with pirimiphos-methyl at 1/2, 1/3 or 1/4 recommended dosage against Sitophilus granarius (L.) in wheat grain. All bioassays were conducted at 20 and 30-degrees-C. All treatments caused significant mortality compared to controls (untreated grain). Treatments with vegetable oils combined with pirimiphos-methyl at half the recommended dose were as effective as pirimiphosmethyl at the recommended dose, both achieving complete control within 24 h of exposure to freshly treated grain. The same treatments remained effective after 90 days of storage. The vegetable oils alone achieved considerable mortality (60-80%) within 14 days and there was little difference between the three oils in their effect. Pirimiphos-methyl activity was dose dependent. When applied alone, the vegetable oils and pirimiphos-methyl at reduced rates were less effective than combined treatments. The toxicity and persistence of treatments did not vary significantly between 20 and 30-degrees-C. Viability and water absorption were reduced by the oil treatments, but particle size distribution after milling was unaffected. Treatment of grain with pesticide/vegetable oil mixtures could have important practical implications for parts of the world where pesticides are expensive or in short supply. [References: 17].

2250 Tryka, S. (Agricultural University, Zamosc (Poland). College of Agriculture); Koper, R. (Agricultural University, Lublin (Poland). Inst. of Agricultural Engineering) (1993) **Ultraweak luminiscence of wheat grain of differentiated moisture content at the primary period of swelling.** Zeszyty Problemowe Postepow Nauk Rolniczych (Poland); no. 399 p. 261-265. Instytut Agrofizyki. 3 fig., 1 table; 13 ref.. Distributed 1994. p. 261-265. English. (AGRIS 95-037473).

The moisture content (w) of grain was in the range of 8.3 to 22.7 percent. The measurements were performed using a high sensivity quantum-metric apparatus working in the single photon counting arrangement. Higher values of intensity I sub (m) were obtained for the lowest moisture content of grain and for the grain mechanically damaged. In both cases the dependences of I sub (m) on w may be described as an expotential function.

L01 ANIMAL HUSBANDRY

2251 Anon. (1992) **Performance of finishing swine fed wheat and barley based rations.** *Proceedings of the... Montana Livestock Nutrition Conference (USA) (no. 45) p. 4.1-4.4.* Meeting held January 30-31, 1992, Bozeman, Montana. English. (AGRIS 95-038064).

2252 Hatfield, P.G.; Snowder, G.D. (1992) **Barley feedlot and range supplementation studies at USDA sheep research station. I. Zinc supplementation of a barley diet for feedlot lambs.** *Proceedings of the... Montana Livestock Nutrition Conference (USA) (no. 45) p. 14.1-14.15.* references. Meeting held January 30-31, 1992, Bozeman, Montana. English. (AGRIS 95-038042).

2253 Husby, F.M.; Danielson, A.D.; Newman, C.W.; Danielson, D.M.; Beames, R.M.; England, D.C. (1992) **Performance of weanling swine fed different protein and energy sources.** *Proceedings of the... Montana Livestock Nutrition Conference (USA) (no. 45) p. 2.1-2.9.* references. Meeting held January 30-31, 1992, Bozeman, Montana. English. (AGRIS 95-038063).

2254 Nichols, M.E.; Dolezal, H.G.; Fitch, G.Q.; Phillips, W.A. (1993) **Feedlot performance and carcass characteristics for small, medium and large framed wethers backgrounded on wheat pasture.** *Sheep research journal (USA) v. 9(2) p. 82-85.* references. English. (AGRIS 95-038047).

L02 ANIMAL FEEDING

2255 Castro, FB.; Hotten, PM.; Orskov, ER.; Rebeller, M. (1994) **INHIBITION OF RUMEN MICROBES BY COMPOUNDS FORMED IN THE STEAM TREATMENT OF WHEAT STRAW.** *Bioresource Technology. 50(1):25-30.* English. [ROWETT RES INST GREENBURN RD BUCKSBURN AB2 9SB ABERDEEN SCOTLAND].

The aim of this study was to quantify the toxic compounds present in steam-treated wheat straw and measure their effects on rumen microbial activity. Wheat straw was impregnated with 1.8% H2SO4 and subjected to steam treatment at either low temperature (134-degrees-C) for 100, 200 and 300 min or high temperature (210-degrees-C) for 1.5, 3, 4.5 and 6 min. Samples were analyzed for carbohydrate composition, total and extractable phenolics, tannin, furfural and hydroxy-methylfurfural (HMF). Utilization of steam-treated samples by rumen microbes were assessed by gas production. At both treatment temperatures significant hemicellulose hydrolysis (80.1 and 96.7%), formation of furfural (0.31 and 1.24%) and deploymerization of lignin, measured as extractable phenolics (5.1 and 9.0%), occurred. There was no evidence that furfural was toxic to rumen microbes. However, the presence of extractable phenolics lowered total gas production. [References: 27].

2256 Choct, M.; Hughes, RJ.; Trimble, RP.; Angkanaporn, K.; Annison, G. (1995) **NON-STARCH POLYSACCHARIDE-DEGRADING ENZYMES INCREASE THE PERFORMANCE OF BROILER CHICKENS FED WHEAT OF LOW APPARENT METABOLIZABLE ENERGY.** *Journal of Nutrition. 125(3):485-492.* English. [CSIRO DIV HUMAN NUTR GLENTHORNE LAB OHALLORAN HILL SA 5158 AUSTRALIA].

The effect of a commercial glycanase product (Avizyme TX) on the performance of 4-wk-old broiler chickens fed wheats with low and normal apparent metabolizable energy values was studied. Controls were fed a corn-based diet. Supplementation with the enzyme product significantly ($P < 0.01$) increased the apparent metabolizable energy of the low metabolizable energy wheat from 12.02 to 14.94 MJ/kg dry matter. The apparent metabolizable energy value of the normal wheat was increased from 14.52 to 14.83 MJ/kg dry matter; this was, however, not significant. Birds fed the Low metabolizable energy wheat diet had significantly ($P < 0.01$) higher digesta viscosity and lower small intestinal starch and protein

digestibilities than birds fed the normal wheat diet. Chickens fed the low metabolizable energy wheat tended to grow less than those fed the normal wheat diet. When the low metabolizable energy wheat + enzyme diet was fed, digesta viscosity was significantly (P < 0.01) lower (20.28 vs. 10.36 mPa . s), and small intestinal digestibility coefficient of starch was significantly (P < 0.01) greater (0.584 vs. 0.861) relative to values in birds fed the low metabolizable energy wheat diet alone. Although the protein digestibility coefficient also increased from 0.689 to 0.745, the difference was not significant. Weight gain and feed efficiency of birds fed the low metabolizable energy wheat + enzyme equaled those of controls. The enzyme product significantly (P < 0.01) increased the solubilization of non-starch polysaccharides within the gastrointestinal tract of birds fed both types of wheat diets. This experiment demonstrated that non-starch polysaccharide-degrading enzymes markedly increase the nutritive value of low metabolizable energy wheat broiler chicken diets, suggesting that increased level of viscous non-starch polysaccharides may cause the low apparent metabolizable energy contents of some wheats. [References: 31].

2257 Fox, JM.; Lichan, E.; Lawrence, AL. (1995) **CARBODIIMIDE-MEDIATED COVALENT ATTACHMENT OF LYSINE TO WHEAT GLUTEN AND ITS APPARENT DIGESTIBILITY BY PENAEID SHRIMP.** *Journal of Agricultural & Food Chemistry. 43(3):733-737.* English. [TEXAS A&M UNIV SHRIMP MARICULTURE RES POB Q PORT ARANSAS, TX 78373 USA].

Carbodiimide-mediated covalent attachment of lysine to wheat gluten was evaluated with respect to its availability to penaeid shrimp. Normality of acid hydrolysis and carbodiimide reaction criteria (levels of carbodiimide and L-lysine hydrochloride) were optimized, and the resultant lysine-enriched samples were evaluated for extent of isopeptide bonding. In vivo apparent digestibilities of both enriched and unenriched glutens to shrimp were compared. Large-scale lysine enrichment of wheat gluten yielded a 590% increase in lysine content of wheat gluten. Only an additional 6% of the lysine present was attached by isopeptide bonding. In vivo apparent dry matter digestibility, protein digestibility, and lysine availability of both the enriched and unreacted glutens were similar, confirming suitability of reaction criteria. The ability of shrimp to hydrolyze isopeptide-bound lysine was indicated by similarities in apparent digestibility of lysine in enriched and unenriched glutens. [References: 22].

2258 HADDAD. (1995) **DIGESTIBILITY OF ALKALI-TREATED WHEAT STRAW MEASURED IN VITRO OR IN VIVO USING HOLSTEIN HEIFERS (VOL 72, PG 3258, 1994).** *Journal of Animal Science. 73(2):632.* English.

2259 Kyriazakis, I.; Emmans, GC. (1995) **THE VOLUNTARY FEED INTAKE OF PIGS GIVEN FEEDS BASED ON WHEAT BRAN, DRIED CITRUS PULP AND GRASS MEAL, IN RELATION TO MEASUREMENTS OF FEED BULK.** *British Journal of Nutrition. 73(2):191-207.* English. [SCOTTISH AGR COLL EDINBURGH DEPT GENET & BEHAV SCI W MAINS RD EDINBURGH EH9 3JG MIDLOTHIAN SCOTLAND].

Two experiments were carried out to investigate the capacities of pigs for bulky feeds. In Expt 1 fifteen pigs were offered, from 12 to 25 kg live weight, ad lib. access to one of five feeds which were made by progressively diluting a high-quality feed with wheat bran. Intake initially increased, and then declined, as the proportion of wheat bran was increased. The pigs became better able to accommodate to the more bulky feeds over time. In Expt 2 thirty-six pigs, initially of 12 kg live weight, were used. The feeds were the same high-quality basal feed as in Expt 1 and three others made almost entirely of either wheat bran, dried grass or dried citrus pulp, respectively. The equal-parts mixtures of each of these three bulky feeds with the basal feed were also made to give three series of feeds each comprising the basal, the mixture and the bulky feed. The three feeds in each series were given ad lib. to twelve pigs in a design of two replicated Latin squares with three time-periods. Within each series, and across periods, the intakes of the feeds that were limiting intake were directly proportional to Live weight and so a scaled intake, expressed as g/kg live weight per d, was calculated. Across the six limiting feeds, scaled intakes in the final 5 d of each period, when the pigs were in equilibrium with their feeds,were directly proportional to the reciprocal of the water-holding capacities (WHC) of the feeds, as measured by a centrifugation method. There were large effects of feed changes on intake, in the short term, with previous experience of a bulky feed leading to higher intakes of another bulky feed. The intake of the basal feed was not affected by the feed given previously. It was concluded that: (a) the time of adaptation to bulky feeds needs to be considered when attempting to measure, or predict, the rates of intake on different bulky feeds and, (b) the WHC of the feeds could be an appropriate measurement of 'bulk' responsible for limiting their intake, and could be used to predict the maximum feed intake capacity of pigs on different bulky feeds. [References: 21].

2260 Leeson, S.; Caston, L.J. (1993) **Production and carcass yield of broilers using free-choice cereal feeding.** *The Journal of applied poultry research (USA) v. 2(3) p. 253-258.* references. English. (AGRIS 95-038401).

2261 Nathierdufour, N.; Angue, Y.; Devaux, MF.; Bertrand, D.; Ledeschaultdemonredon, F. (1995) **INFLUENCE OF WHEAT MEAL VARIABILITY UPON COMPACTING BEHAVIOUR DURING PELLETING.** *Animal Feed Science & Technology. 51(3-4):255-268.* English. [TECALIMAN RUE GERAUDIERE F-44026 NANTES FRANCE].

The influence of wheat meal variability on its compacting behaviour has been studied. Seventeen, samples of wheat, identified according to their origin and their supplier, were ground in the same conditions and characterised both by near-IR reflectance spectroscopy (NIRS) and a compression test. The NIRS technique was used to determine the chemical and particle size variability. A laboratory press was used to characterise the compacting behaviour of the meal. The study of the relationships between the variability and the compacting behaviour of the wheat meals has been performed by using a multivariate statistical treatment called canonical correlation analysis (CCA). The only chemical information that was highlighted by CCA was the water content. The water improved the meal compression by decreasing the force corresponding to the yield point of plasticity. The water influence has been observed from a low variation range of the moisture content (from 11 to 12.8%). Difference in particle size had no significant effect on the compacting behaviour. [References: 16].

2262 Phillips, W.A. (1993) **Feedlot performance of feeder lambs fed diets containing different proportions of wheat, corn and sorghum.** *Sheep research journal (USA) v. 9(2) p. 71-75.* references. English. (AGRIS 95-038293).

2263 Phillips, WA.; Hart, SP.; Glimp, HA.; Vontungeln, DL. (1995) **SUPPLEMENTATION TO COMPENSATE FOR DIFFERING STOCKING RATES FOR STEERS GRAZING WHEAT PASTURE.** *Journal of Production Agriculture. 8(1):84-88.* English. [USDA ARS GRAZINGLANDS RES LAB POB 1199 EL RENO, OK 73036 USA].

Throughout the southern Great Plains, the inability to predict optimum stocking rates for wheat (Triticum aestivum L.) pastures limits efficient use of wheat forage by stocker cattle. This is particularly true during the spring graze-out period when forage production can vary greatly due to environmental conditions. The objectives of this study were to evaluate animal performance and economic returns for systems in which increased stocking rates on spring wheat pastures were accompanied by increasing supplementation levels. Steers averaging 671 lb grazed wheat pastures from March through May in the spring of 1987 and 1992. As stocking rate increased, the amount of 11.6% crude protein (CP) supplement consumed increased from 0 to 1% of body weight (BW). Individual steer performance was similar across stocking rates, but beef production per acre increased (P < 0.05) with increasing stocking rate. As wheat matured, forage quality decreased (P < 0.05) and forage available for grazing became primarily stem (P < 0.05). As stocking rate increased, pasture cost per head decreased. At the highest stocking rate, return ($/acre) was $16.89 greater than at the lowest stocking rate. Grain-based supplements can be fed at levels up to 1% BW daily to steers grazing spring wheat pastures to allow stocking rates to be increased to ensure maximum forage use.

2264 Pullar, D. (1995) **MAIZE GLUTEN AND RAPESEED MEAL AS PROTEIN SUPPLEMENTS TO BARLEY OR WHEAT FOR INTENSIVELY FINISHED CHAROLAIS-CROSS BULLS.** *Animal Production. 60(Part 1):49-54.* English. [AGR DEV & ADVISORY SERV HIGH MOWTHORPE MALTON YO17 8BP N YORKSHIRE ENGLAND].

Four diets, barley/proprietary protein concentrate (B/PC), barley/maize gluten (B/MG), barley/rapeseed meal (B/RSM) and wheat/rapeseed meal (W/RSM) were formulated to contain 165 g crude protein and 13.0 MJ metabolizable energy per kg dry matter. In experiment 1, all four diets were offered ad libitum to Charolais X Friesian bulls from 187 kg live weight to

slaughter at about 488 kg live weight. In experiment 2, the B/PC and B/RSM were offered ad libitum to Charolais X (Hereford X Friesian) bulls from 222 kg live weight to slaughter at about 491 kg live weight. There were no significant differences between treatments in daily live-weight gain, percentage fat and lean in the live animal, slaughter weight or days on experiment in either experiment. In experiment 1, the carcasses from bulls given B/PC were 14 kg heavier than carcasses from bulls given W/RSM ($P < 0.05$), but only 10 and 7 kg heavier than from bulls given B/MG and B/RSM respectively ($P > 0.05$). The killing-out proportion of bulls given B/PC was significantly greater ($P < 0.05$) than bulls given B/RSM. In experiment 2. cal cass weights were similar but the killing-out proportion of bulls given B/PC were again greater ($P < 0.001$). It is concluded that B/MG and B/RSM were as effective as B/PC as finishing diets and that wheat can be successfully substituted for barley, wizen offered with rapeseed meal. [References: 16].

2265 Rose, SP.; Fielden, M.; Foote, WR.; Gardin, P. (1995) **SEQUENTIAL FEEDING OF WHOLE WHEAT TO GROWING BROILER CHICKENS.** *British Poultry Science. 36(1):97-111.* English. [HARPER ADAMS AGR COLL NATL INST POULTRY HUSB NEWPORT TF10 8NB SHROPS ENGLAND].

1. Four broiler feeding trials were performed to examine the suitability of a whole wheat sequential feeding regimen for commercial broiler production. The sequential feeding programme gave a continuous cycle of ad libitum access to only whole wheat followed by the same time of access to only a pelleted diet. The pelleted diet provided a concentration of nutrients to balance that provided by the whole wheat. This was called a balancer diet. 2. The first trial used 144 cage-reared broilers from 28 to 49 d of age. Four different times of access (4, 8, 12 and 24 h) to the two alternate foods were compared. A whole wheat choice-feeding treatment and a complete single diet treatment were also compared. Whole wheat accounted for over 40% of the broilers' total food intakes when they were given the sequential feeding treatments of 8 h or greater. The whole wheat intakes of the birds given the 4 h sequential feeding and the choice-feeding were only 20 and 5% respectively. There was a non linear relationship between the weight gains of the broilers and the length of the sequential feeding period ($P < 0.01$). The growth rates of the broilers given sequential feeding were lowest ($P < 0.05$) in the 4-h feeding periods but highest ($P < 0.05$) in the 8-h periods. Weight gains decreased ($P < 0.01$) linearly as the sequential feeding periods were increased above 8 h. 3. A second trial, using 144 cage-reared broilers, examined the effect of different balancer compositions or different wheat varieties in 8-h sequential feeding. The broilers selected more whole wheat in their diet when they were given balancers with increased cereal contents. However, these broilers did not eat enough whole wheat to compensate for the reduced cereal content of the balancers and their overall diets had lower energy:protein ratios. The two different wheat samples did not result in any differences ($P > 0.05$) in the proportion of whole wheat selected by the broilers. 4. A third trial compared the diet selections, weight gains, food intakes and water excretions of 72 cage-reared broilers given whole wheat feeding regimens. The growth rates of the broilers given loose mix of whole wheat and a pelleted balancer diet were similar ($P > 0.05$) to broilers given a complete single diet. The growth rates of these two groups were 7% greater ($P < 0.05$) than broilers given choice-feeding or 8-h sequential feeding. There were no differences ($P > 0.05$) in the total amounts of water excreted among the 4 treatments. 5. The fourth trial used 828 broilers distributed in 6 floor pens. They were given either a complete diet or an 8-h whole wheat sequential feeding regimen from 25 to 46 d of age. The food intakes and the growth rates of the broilers were reduced ($P < 0.05$) in the sequential feeding treatment by 9% and 5% respectively. There was no difference ($P > 0.05$) in litter moisture between the 2 treatments. [References: 22].

2266 Swaerd, C. (1994) **[Feeding wheats and triticale to cattle]. Moejligheter att anvaenda vete och raagvete till noetkreatur.** *Examensarbete - Sveriges Lantbruksuniversitet, Institutionen foer Husdjurens Utfodring och Vaard (Sweden); no. 62 21 p.* 44 ref. Swedish. (AGRIS 95-026571).

2267 Valaja, J.; Alaviuhkola, T.; Siljanderrasi, H. (1995) **WET BARLEY DISTILLERS SOLIDS AS A PROTEIN SOURCE FOR GROWING PIGS.** *Animal Feed Science & Technology. 51(3-4):193-202.* English. [UNIV HELSINKI DEPT ANIM SCI POB 28 SF-00014 HELSINKI FINLAND].

The study was conducted to evaluate the chemical composition and nutritive value of wet barley distillers solids (DS) for growing pigs. The variability in the chemical composition was assayed from ten samples of DS. The variation in chemical composition was high, dry matter (DM) ranging from 140 to 236 g kg-1, crude protein ranging from 432 to 599 g kg-1 DM and lysine ranging from 37 to 51 g (160 g N)-1. In vitro digestibility of dry matter and nitrogen was determined from DS and soyabean meal (SBM) and was found to be lower in DS than in SBM (dry matter: 0.560 vs. 0.708; nitrogen: 0.662 vs. 0.922). A growth experiment was conducted with 160 growing pigs (40 pigs in each treatment) from 25 to 105 kg live weight range. Four pigs were kept in each pen (two female and two castrated males). In four isonitrogenous and isolysineous diets, 0, 0.33, 0.66 or all SBM was replaced by DS and synthetic lysine. The daily feeding allowance was restricted to provide uniform crude protein intakes. The daily weight gain and feed conversion ratio of the pigs remained about the same when one-third of SBM was replaced by DS, but they both decreased linearly ($P < 0.001$) when higher amounts of DS were added to the diets. Dietary DS also linearly decreased the content of lean in valuable cuts and in carcass ($P < 0.001$). In organoleptic evaluation of meat samples no differences were found between the treatments. In conclusion, the lower performance of the pigs on DS diets was mainly a result of the high variation in chemical composition of DS, which affected the protein and amino acid supply of the pigs. The results also indicated that the quality of protein is impaired during the processing of DS. [References: 29].

L10 ANIMAL GENETICS AND BREEDING

2268 Moran, E.T. Jr.; Chen, X.; Blake, J.P. (1993) **Comparison of broiler strain crosses developed in the US and UK using corn and wheat based feeds: live performance and processing of males for nine piece cuts.** *The Journal of applied poultry research (USA) v. 2(1) p. 26-32.* references. English. (AGRIS 95-026862).

L51 ANIMAL PHYSIOLOGY-NUTRITION

2269 Mariscal Landin, Gerardo; LeBreton, Y; Seve, B. (1993) **[Ideal nitrogen and amino acids of wheat subproducts digestibililty used in pig alimentation]. Digestibilidad ideal del nitrogeno y aminoacidos de subproductos del trigo usados en la alimentacion porcina.** Reunion Nacional de Investigacion Pecuaria. Jalisco 1993; Guadalajara, Jal. (Mexico); 27-30 Sep 1993. *National Reunion on Animal Research. Jalisco 1993 (Summaries). Reunion Nacional de Investigacion Pecuaria. Jalisco 1993 (Resumenes) p. 102.* CENID Microbiologia. Solo sumario. Spanish. (AGRIS 95-027182).

N20 AGRICULTURAL MACHINERY AND EQUIPMENT

2270 Bahri, A.; Bansal, R.K. (Institut National de la Recherche Agronomique, Settat (Maroc). Centre Regional de la Recherche Agronomique); Von Bargen, K. (Univ. of Nebraska, Lincoln (Etats Unis)) (1993) **[Furrow openers and presswheels evaluation for no-till wheat sowing]. [Evaluation des ouvreurs de sillon et des roues de pression pour le semis du ble sans labour prealable].** *Auamia (Maroc); Revue Marocaine de la Recherche Agronomique (no 83) p. 179-198.* 8 Tableaux Ill. 6 figs. 6 ref. French. (AGRIS 95-028604).

2271 Biondi, P. (Universita della Tuscia, Viterbo (Italy). Istituto di Genio Rurale) (1994) **[How I choose a combine harvester]. Come scelgo la mietitrebbia.** *Terra e Vita (Italy) v. 35(27) p. 34-39.* 1 table; 8 graphs. Italian. (AGRIS 95-028637).

P06 RENEWABLE ENERGY RESOURCES

2272 Pokorny, Z. (Vyzkumny Ustav Zemedelske Techniky, Prague (Czech Republic)); Kozak, J. (1994) **[Biofuels and new agrarian policy of the European Union]. Biopaliva a nova agrarni politika Evropske Unie.** *Mechanizace Zemedelstvi (Czech Republic) v. 44(3) p. 30-34.* 7 tables. Czech. (AGRIS 95-042448).

P10 WATER RESOURCES AND MANAGEMENT

2273 Narang, R.S.; Gill, M.S. (Punjab Agricultural University, Ludhiana, Punjab (India). Department of Agronomy) (1994) **Water management constraints in rice-wheat rotations in India.** Wheat in Warm Area, Rice-Wheat Farming Systems; Dinajpur (Bangladesh); 13-15 Feb 1993. *Wheat in heat stressed environments: Irrigated, dry areas and rice-wheat farming systems. Saunders, D.A. (Interag, Pty., Victor Harbor, SA (Australia)); Hettel, G.P. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico,DF (Mexico)) p. 328-338.* CIMMYT. 5 tables; 31 ref. English. (AGRIS 95-028980).

It is estimated that the ground water table in the rice-wheat areas of Punjab is receding by 20 cm per annum and this phenomenon is reflected in other rice-wheat areas of India to varying extents. The efficiency of water use of this cropping system could be increased through the transplanting of rice in periods of lower evaporative demand and by the adoption of revised irrigation practices in both rice and wheat. There is also a need to make the cost of irrigation water more realistic to induce farmers to adopt the management recommendations which would conserve the water resources.

P33 SOIL CHEMISTRY AND PHYSICS

2274 Andersson, J. (1994) **[Soil moisture measurements with TDR (time domain reflectrometry) and neutron probe in a field experiment with early sowing of barley]. Vattenhaltsmaetningar med TDR och neutronsond i foersoek med tidig saadd av korn.** *Meddelanden fraan Jordbearbetningsavdelningen, Sveriges Lantbruksuniversitet, Institutionen foer Markvetenskap (Sweden); no. 11 36 p.* 27 ref. SLU-JB-M--11-SE. Swedish. (AGRIS 95-029160).

2275 Causarano, H. (DIA IAN, Caacupe (Paraguay)); Romero, A. (DIA CRIA, Capitan Miranda (Paraguay)); Wall, P.C. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Asuncion (Paraguay). Wheat Program) (1994) **A comparison of four methods of measuring soil aggregate stability.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 312-315.* CIMMYT. 1 table; 1 graph., 6 ref. English. (AGRIS 95-029139).

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

2276 Li, X. (Alberta Environmental Centre, Vegreville, Alta. (Canada). Soils Branch); Feng, Y.; 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 and Soil (Netherlands) v. 164(1) p. 43-50.* 34 ref. English. (AGRIS 95-029111).

2277 Romero, A. (DIA CRIA, Capitan Miranda (Paraguay)); Causarano, H. (DIA IAN, Caacupe (Paraguay)); Wall, P.C. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Asuncion (Paraguay). Wheat Program) (1994) **Tillage and rotation effects on aggregate stability in Southeastern Paraguay.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 316-318.* CIMMYT. 1 table; 2 graphs., 2 ref. English. (AGRIS 95-029140).

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

P34 SOIL BIOLOGY

2278 Baon, J.B. (Adelaide Univ., Glen Osmond, SA (Australia). Dept. of Soil Science); Smith, S.E.; Alston, A.M. (1993) **Phosphorus allocation in P-efficient and inefficient barley cultivars as affected by mycorrhizal infection.** Proceedings of the 12. International Plant Nutrition Colloquium; Perth, WA (Australia); 21-26 Sep 1993. *Plant and Soil (Netherlands) v. 155/156 p. 277-280.* 14 ref. English. (AGRIS 95-029213).

2279 Christensen, H. (Copenhagen Univ. (Denmark). Dept. of Population Biology); Christensen, S. (1994) **(3)Hthymidine incorporation of rhizosphere bacteria influenced by plant N-status.** *Plant and Soil (Netherlands) v. 162(1) p. 113-116.* 15 ref. English. (AGRIS 95-029208).

2280 Liljeroth, E. (Instituut voor Agrobiologisch en Vruchtbaarheidsonderzoek DLO, Wageningen (Netherlands)); Kuikman, P.; Veen, J.A. van (1994) **Carbon translocation to the rhizosphere of maize and wheat and influence on the turnover of native soil organic matter at different soil nitrogen levels.** *Plant and Soil (Netherlands) v. 161(2) p. 233-240.* 28 ref. English. (AGRIS 95-029215).

2281 Lukin, S.A.; Prozorov, A.A. (1994) **[Conjugal transfer of RP4 plasmid on the different stages of microbial succession in soil and in the rhizosphere of barley]. Kon"yugatsiya mezhdu azospirillami v rizosfere yachmenya i v pochve.** *Mikrobiologiya (Russian Federation) v. 63(2) p. 254-258.* 11 ref. Russian. (AGRIS 95-042996).

Transfer of plasmid RP4 between introduced strains of Azospirillum brasiliense was studied in nonsterile soil and rhizosphere of plants. It was shown that plant roots stimulated the process of genetic transfer. Both the frequency of bacterial conjugation and survival of transconjugants were essentially higher in the rhizosphere as compared with soil. The efficiency of conjugal plasmid transfer in plants-free soil depended upon the succession stage of soil microbial complex on which the parental strains were introduced into soil. Maximum frequency of plasmid transfer was observed on the initial stage of succession.

2282 Papastylianou, I. (Agricultural Research Institute, Nicosia (Chypre)) (1993) **[Estimating total N2 fixation by legumes in long-term rotation studies]. [Estimation de la fixation totale de N2 par les legumineuses dans des etudes de rotation a long terme].** *European Journal of Agronomy (France) v. 2(1) p. 1-10.* 34 ref., 7 tableaux. English. (AGRIS 95-029270).

2283 Polyanskaya, L.M.; Orazova, M.Kh.; Sveshnikova, A.A.; Zvyagintsev, D.G. (1994) **[The influence of nitrogen on colonization by microorganisms of barley root region]. Vliyanie azota na kolonizatsiyu mikroorganizmami kornevoj zony yachmenya.** *Mikrobiologiya (Russian Federation) v. 63(2) p. 308-313.* 11 ref. Russian. (AGRIS 95-042997).

The dynamic of various groups of microorganisms in the rhizosphere and rhizoplane of barley with addition and without addition of nitrogen was studied. It was shown that the dynamics of bacteria, actinomycetes and fungi in the rhizophere treatment plant (with nitrogen) is the same as the dynamic of their microorganisms in the rhizosphere control plant (without nitrogen). Increase of numerous microorganisms in the rhizoplane

treatment plant at the beginning of experiment reflects that nitrogen is extremely deficient resource because of the competition between plant and microorganisms in the rhizoplane. At the beginning vegetation treated plants grow more slowly then control ones; it may be explained by intensive colonization of root by microorganisms. But by the end of the experiment the plants grow better then in the control. The fact of increase in microorganisms amount in rhizoplane of barley in the presence of additional nitrogen helps in the problem of menagement both beneficial and harmful populations of microorganisms including phytopathogens.

2284 Stoumann Jensen, L. (Royal Veterinary and Agricultural Univ., Frederiksberg (Denmark). Dept. of Ecoloy and Molecular Biology); Soerensen, J. (1994) **Microscale fumigation-extraction and substrate-induced respiration methods for measuring microbial biomass in barley rhizosphere.** *Plant and Soil (Netherlands) v. 162(2) p. 151-161.* Bibliography (61 ref.). English. (AGRIS 95-029211).

P35 SOIL FERTILITY

2285 Delcourt, H. (Leuven Katholieke Univ. (Belgium). Dept. of Agricultural Engineering); Baerdemaeker, J. De (1994) **Soil nutrient mapping implications using GPS [global positioning system].** *Computers and Electronics in Agriculture (Netherlands) v. 11(1) p. 37-51.* 16 ref. English. (AGRIS 95-029331).

2286 Soerensen, P. (Risoe National Lab., Roskilde (Denmark). Dept. of Environmental Science and Technology); Jensen, E.S.; Nielsen, N.E. (1994) **The fate of (15)N-labelled organic nitrogen in sheep manure applied to soils of different texture under field conditions.** *Plant and Soil (Netherlands) v. 162(1) p. 39-47.* 28 ref. English. (AGRIS 95-029324).

2287 Tsadilas, C.D. (Athens Agricultural Univ. (Greece). Lab. of Soils and Agricultural Chemistry); Yassoglou, N.; Kosmas, C.S.; Kallianou, C. (1994) **The availability of soil boron fractions to olive trees and barley and their relationships to soil properties.** *Plant and Soil (Netherlands) v. 162(2) p. 211-217.* 30 ref. English. (AGRIS 95-029332).

2288 Wu, X. (Agricultural Univ. of Norway, Aas (Norway). Dept. of Soil and Water Sciences); Aasen, I. (1994) **Models for predicting soil zinc availability for barley.** *Plant and Soil (Netherlands) v. 163(2) p. 279-285.* 24 ref. English. (AGRIS 95-029325).

2289 Zhao, F. (Rothamsted Experimental Station, Harpenden, Herts. (United Kingdom). Inst. of Arable Crops Research); McGrath, S.P. (1994) **Extractable sulphate and organic sulphur in soils and their availability to plants.** *Plant and Soil (Netherlands) v. 164(2) p. 243-250.* 33 ref. English. (AGRIS 95-029323).

P36 SOIL EROSION, CONSERVATION AND RECLAMATION

2290 Barasebwa, L.; Rutunga, V.; Kayonga, J.B.; Nkusi, J.B. (Institut des Sciences Agronomiques du Rwuanda (ISAR), Butare (Rwanda)) (1994) **The effects of soil amendment on wheat yield in the Zaire-Nile Crest Highlands.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 247-253.* CIMMYT. 5 tables; 6 ref. English. (AGRIS 95-029358).

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

2291 Wall, P.C. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Asuncion (Paraguay). Wheat Program); Causarano,H. (DIA IAN, Caacupe (Paraguay)) (1994) **The reversal of soil degradation in the wheat-soybean cropping system of the Southern Cone of South America.** 8, Regional Wheat Workshop for Eastern, Central and Southern Africa; Kampala (Uganda); 7-10 Jun 1993. *Developing sustainable wheat production systems. Tanner, D.G. (ed.) (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Addis Ababa (Ethiopia). Regional Program) p. 208-220.* CIMMYT. 1 table; 7 graphs., 17 ref. English. (AGRIS 95-029375).

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

P40 METEOROLOGY AND CLIMATOLOGY

2292 Bindi, M. (Academia dei Georgofili Logge Uffizi Corti, Florence (Italie)); Castellani, M.; Maracchi, G.; Miglietta, F. (1993) **[The ontogenesis of wheat under scenarios of increased air temperature in Italy: a simulation study]. [L'ontogenese du ble dans des scenarios avec une augmentation de la temperature de l'air en Italie: une etude par simulation].** *European Journal of Agronomy (France) v. 2(4) p. 261-280.* 33 ref., 11 graph. English. (AGRIS 95-029430).

2293 Kenny, G.J. (University of Waikato, Hamilton (Nouvelle Zelande). Centre for Environmental and Resource Studies); Harrison, P.A.; Olesen, J.E.; Parry, M.L. (1993) **[The effects of climate change on land suitability of grain maize, winter wheat and cauliflower in Europe]. [Effet du changement du climat sur l'aptitude des terres pour la culture de mais, ble d'hiver et chou fleur en Europe].** *European Journal of Agronomy (France) v. 2(4) p. 325-338.* 32 ref., 8 graph. English. (AGRIS 95-029427).

2294 Semenov, M.A. (University of Bristol (Royaume Uni). Department of Agricultural Sciences); Porter, J.R.; Delecolle, R. (1993) **[Climatic change and the growth and development of wheat in the UK and France]. [Changement du climat et croissance et developpement du ble au Royaume Uni et en France].** *European Journal of Agronomy (France) v. 2(4) p. 293-304.* 41 ref., 8 graph. English. (AGRIS 95-029428).

2295 Wolf, J. (Wageningen Agricultural University (Pays Bas). Department of Theoretical Production Ecology) (1993) **[Effects of climate change on wheat production potential in the European Community]. [Effet du changement du climat sur le potentiel de production de ble dans la Communaute Europeenne].** *European Journal of Agronomy (France) v. 2(4) p. 281-292.* 12 illus., 31 ref., 5 tableaux. English. (AGRIS 95-029401).

Q01 FOOD SCIENCE AND TECHNOLOGY

2296 **REPORT ON THE 16TH DURUM WHEAT AND DOUGH PRODUCTS CONFERENCE - DETMOLD, MAY 4-6, 1994 - ABSTRACTS** (1995) *Deutsche Lebensmittel-Rundschau. 91(1):17-19.* German.

2297 Back, W.; Narziss, L.; Sacher, B.; Ketterer, M.; Stich, S.; Brand, O. (1995) **TESTS ON WINTER BARLEY FROM THE 1992 HARVEST.** *Monatsschrift fur Brauwissenschaft. 48(1-2):12-20.* German. [LEHRSTUHL TECHNOL BRAUEREI 1 D-85350 FREISING GERMANY].

Although winter barley is traded as brewing product in the west European countries outside the Federal Republic in Germany itself, the demand for this crop by the malt houses is only sporadic in those years summer barley is short or of poorer quality. On the other hand, by systematic crossing and selection in recent years winter barley varieties have been produced which are interesting from the malting point of view.

Testing such new strains as to the quality of the malt and beer is the purpose of the series of tests carried out in cooperation with the Eichenau Brewing Barley Association as a regular annual project. The findings by the Lehrstuhl fur Technologie der Brauerei I (Professorial Chair for Technology - Brewery I) in Weihenstephan, Germany, for the 1992 winter barley harvest are the subject of this publication.

2298 Berland, S.; Launay, B. (1995) **RHEOLOGICAL PROPERTIES OF WHEAT FLOUR DOUGHS IN STEADY AND DYNAMIC SHEAR - EFFECT OF WATER CONTENT AND SOME ADDITIVES.** *Cereal Chemistry. 72(1):48-52.* English. [ECOLE NATL SUPER IND ALIMENTARIES DEPT SCI ALIMENT BIOPHYS LAB 1 AVE OLYMPIADES F-91305 MASSY FRANCE].

Dynamic tests and steady flow measurements were made with a controlled stress rheometer to study rheological properties of wheat flour doughs and to examine how theological properties are related to dough composition (water content, oxidizing and reducing agents, emulsifiers, etc.). Water added to doughs has mainly strong plasticizing effects, but it probably does not change dough structure. The phase angle tgs, the shift parameter a, related to the extended Cox-Merz rule, and the power law exponent n are practically independent of water content, and these parameters may reflect the structure level of the protein network. Ascorbic acid has strengthening effects, and lecithins have softening effects, but dough structure is little modified by the presence of these components. Beyond 50 ppm, glutathione has strong softening effects, but it simultaneously affects dough structure. In all cases, when dough composition varies, either tgo, a, or n remain constant, or they vary simultaneously. Results obtained with glutathione lead us to assume that these parameters are closely interrelated. [References: 24].

2299 Berot, S.; Gautier, S.; Nicolas, M.; Godon, B.; Popineau, Y. (1994) **PILOT SCALE PREPARATION OF WHEAT GLUTEN PROTEIN FRACTIONS I-INFLUENCE OF PROCESS PARAMETERS ON THEIR PROTEIN COMPOSITION.** *International Journal of Food Science & Technology. 29(5):489-502.* English. [INRA BIOCHIM & TECHNOL PROT LAB RUE GERAUDIERE F-44026 NANTES 03 FRANCE].

Commercial wheat gluten was fractionated on a pilot plant scale to produce gliadin- and glutenin-rich fractions. Acetic acid solutions (0.01-0.05 M) were blended with dry gluten (16, 10 or 7 volumes unit(-1) of dry gluten ratio) and the slurry was separated by continuous centrifugation to yield a gliadin-rich supernatant, which was then concentrated by ultrafiltration and spray-dried. The pellet obtained was optionally rinsed by water or acetic acid and separated in a second stage. The second supernatant was treated as the first one, and the final residue, insoluble and glutenin-rich, was then dispersed in ammonia and spray-dried. The protein distributions in supernatants and residues depended on pH and ranged from 20/80 to 40/60 for the first stage, and from 40/60 to 80/20 for the sum of the two stages. The compositions of the fractions were measured by solubility tests and size exclusion high performance liquid chromatography (SE-HPLC) profiles. A [-1, +1] selectivity scale was created: each fraction was compared to pure gliadins (-1), gluten (0) and pure glutenins (+1). The best combination between yields of soluble and insoluble fractions (40/60 distribution) and selectivities for gliadins and glutenins (-0.32 and +0.26 respectively) was obtained at ratio 16 and a 0.01 M molarity. Though the selectivities were limited because gliadins and medium-size glutenin polymers have similar solubilities in acid solutions, this process permits preparation of fractions which differ widely from gluten in contents of high molecular weight glutenin polymers. [References: 18].

2300 Black, J.; Durig, L. (1995) **SEQUENTIAL METHOD FOR THE ELECTROPHORETIC ANALYSIS OF BARLEY VARIETIES, INCLUDING COMPUTER STORAGE AND MATCHING OF BANDING PATTERNS.** *Journal of the American Society of Brewing Chemists. 53(1):19-23.* English. [ISOLAB INC DRAWER 4350 AKRON, OH USA].

A new approach to identify barley varieties by isoelectric focusing of three separate protein fractions is presented. Thin-layer agarose isoelectric focusing gels are used to separate hordeins, albumins/globulins, and peroxidase isoenzymes. The technique is suitable for fingerprinting or purity testing. A digital image of the gel is captured by a flatbed scanner. A computer program stores the barley banding patterns in a library, defined by isoelectric point values determined from reference tracks. The library function allows three databases to be constructed for each variety. Each unknown pattern may be sequentially compared to the stored patterns from all three methods to enable a match. Twenty-one varieties were examined and could be uniquely identified with the sequential analysis approach. [References: 11].

2301 Blumenthal, C.; Gras, PW.; Bekes, F.; Barlow, EWR.; Wrigley, CW. (1995) **POSSIBLE ROLE FOR THE GLU-DL LOCUS WITH RESPECT TO TOLERANCE TO DOUGH-QUALITY CHANGE AFTER HEAT STRESS.** *Cereal Chemistry. 72(1):135-136.* English. [CSIRO DIV PLANT IND N RYDE NSW 2113 AUSTRALIA].

2302 Burnett, CJ.; Lorenz, KJ.; Carver, BF. (1995) **EFFECT OF 1B/1R TRANSLOCATION IN WHEAT ON PHYSICAL AND CHEMICAL PROPERTIES OF STARCH.** *Starch-Starke. 47(2):51-55.* English. [COLORADO STATE UNIV DEPT FOOD SCI & HUMAN NUTR FT COLLINS, CO 80523 USA].

Starches were isolated from near-isoline pairs of 1B/1R translocation wheats and their parents for determination of water binding capacity, swelling power, solubility, Amylograph viscosity, scanning electron microscopy, differential scanning calorimetry and bread baking characteristics. Translocation wheats had a statistically lower starch yield. The starches of these wheats had a lower swelling power at 60 degrees and 80 degrees and a reduction in Brabender viscosity after a 15 min holding period when compared with control starches. Texture scores of breads baked with starches from translocation wheats were better than those of control breads. [References: 29].

2303 Cairns, P.; Sun, L.; Morris, VJ.; Ring, SG. (1995) **PHYSICOCHEMICAL STUDIES USING AMYLOSE AS AN IN VITRO MODEL FOR RESISTANT STARCH.** *Journal of Cereal Science. 21(1):37-47.* English. [AFRC INST FOOD RES NORWICH LAB BBSRC NORWICH RES PK NORWICH NR4 7UA NORFOLK ENGLAND].

The effects of hydrolysing amylose gels and films with porcine pancreatic alpha-amylase were studied in order to construct an in vitro model of resistant starch. Both gels and films proved to be partially resistant to hydrolysis, their susceptibility decreasing with increasing substrate concentration. Storage of gels for 1 day resulted in levels of crystallinity from 6 to 12%. Hydrolysis of these gels produced significant increases (from 272 to 557%) in crystallinity in all cases. The amount of resistant material remaining after hydrolysis increased (from 33% to 50%)with increasing gel concentration. Storage of amylose gels for 7 days resulted in levels of crystallinity of 28 to 35%. Hydrolysis of these gels led to increases in crystallinity, but to a lesser extent (from 148 to 175%) than before. The amount of resistant material remaining after hydrolysis increased (from 41 to 50%) with increasing gel concentration. Size-exclusion chromatography of resistant material from hydrolysed films indicated the presence of a high molecular weight component corresponding to undigested amylose, in addition to a low molecular weight component corresponding to partially digested amylose. Chromatograms of resistant material from both gels stored for 1 day and those stored for 7 days were almost identical and contained only a low molecular weight component with no sign of undigested amylose. X-ray line-broadening analysis showed the average sizes of the crystallites in the resistant material produced by hydrolysis of gels stored for both 1 day and 7 days to be approximately equal. The ability of the enzyme to diffuse into its substrate played a major part in the resistance to hydrolysis of amylose films, but had a much less important role in the resistance of gels. Not only crystalline, but also amorphous portions of amylose gels, were found to be resistant to enzymic hydrolysis. The resistant portion of amylose gels was modelled in vitro with a view to explaining the structure of resistant starch in vivo. [References: 51].

2304 Cherian, G.; Gennadios, A.; Weller, C.; Chinachoti, P. (1995) **THERMOMECHANICAL BEHAVIOR OF WHEAT GLUTEN FILMS - EFFECT OF SUCROSE, GLYCERIN, AND SORBITOL.** *Cereal Chemistry. 72(1):1-6.* English. [UNIV MASSACHUSETTS DEPT FOOD SCI AMHERST, MA 01003 USA].

Glass transition temperature (T-g) and mechanical and water vapor barrier properties of wheat gluten films containing glycerin, sucrose, glycerin-sucrose, and glycerin-sorbitol were studied. Glycerin and sucrose were immiscible; the wheat gluten film containing both solutes showed two separate thermal transitions (-58 degrees C and -5 degrees C, respectively). The low temperature (low-T) transition (-58 degrees C) was due to a glycerin-rich region. The low-T tan delta peak height influenced the tensile strength and elongation linearly and the water vapor permeability (WVP)

curvilinearly. However, the T-g failed to change with solute composition and exhibited low correlation with barrier and mechanical properties. Initial addition of glycerin increased the WVP dramatically. Sucrose decreased the WVP (only slightly), but resulted in a rigid and fragile film. The gluten-glycerinsorbitol film at a ratio of 15:3:3 (w/w), 16.7% moisture (wb), showed a single effective T-g(-42 degrees C) and intermediate values for tensile strength, percent elongation, and WVP, which were between those of the 15:6:0 and 15:4:2 gluten-glycerin-sucrose films. [References: 38].

2305 Czuchajowska, Z.; Kawka, A.; Paszczynska, B.; Pomeranz, Y. (1995) **WHEAT FLOUR PROTEIN CONCENTRATE CHARACTERIZATION BY BIOCHEMICAL, PHYSICOCHEMICAL AND BAKING TESTS.** *Journal of Food Science. 60(1):169-175.* English. [WASHINGTON STATE UNIV DEPT FOOD SCI & HUMAN NUTR PULLMAN, WA 99164 USA].

Protein concentrates before and after defatting from hard and soft wheat flours by water and 1% NaCl solution were characterized by lipid, sodium dodecyl sulphate (SDS) sedimentation, solubility, and breadmaking. Sedimentation values were higher for hard wheat flours than for soft, and in both about three times higher than in separated glutens. Solubility of proteins in SDS was reduced from approximate to 23 to 31% in flours to approximate to 3 to 19% in gluten concentrates. Defatting did not affect electrophoretic patterns but indicated lowered protein extractability. Gliadins and HMW glutenins were lower in extracts of separated glutens than in the extracts of doughs. Protein concentrates from fractionation with 1% salt solution, differed widely from those separated with water. This especially affected water absorption, dough development, and baking performance. [References: 34].

2306 Debbouz, A.; Pitz, WJ.; Moore, WR.; Dappolonia, BL. (1995) **EFFECT OF BLEACHING ON DURUM WHEAT AND SPAGHETTI QUALITY.** *Cereal Chemistry. 72(1):128-131.* English. [N DAKOTA STATE UNIV DEPT CEREAL SCI FARGO, ND 58105 USA].

Durum wheat samples bleached by adverse weather conditions during the 1992 harvest were evaluated for their physicochemical characteristics and their pasta quality. Two sets of wheat samples were tested. The first set, which consisted of 173 samples, was divided into four groups (sound, sound but nonvitreous, bleached, and severely weather-damaged). Because of their small size, these samples were composited for milling and pasta processing. The second set included five large wheat samples, also from the 1992 crop year. These samples were approximately half bleached and half sound, and each sample was manually sorted into sound and bleached fractions. The bleached wheat from both sample sets showed lower test weight and 1,000-kernel weight than the sound wheat. The falling number decreased slightly, but not significantly; while the vitreousness, protein, ash, and hardness values were nearly the same as those obtained for the sound wheat. The physicochemical characteristics of the severely weather-damaged wheat were adversely affected, except for gluten strength. The nonvitreous and the severely weather-damaged wheat showed a decrease in semolina extraction, semolina protein, and wet gluten. Minor bleaching, involving only the discoloration of the kernel seed coat, did not affect the semolina properties or the spaghetti color and cooking quality. [References: 35].

2307 Delwiche, SR. (1995) **SINGLE WHEAT KERNEL ANALYSIS BY NEAR-INFRARED TRANSMITTANCE - PROTEIN CONTENT.** *Cereal Chemistry. 72(1):11-16.* English. [USDA ARS INSTRUMENTAT SENSING LAB BELTSVILLE, MD USA].

Regulatory agencies within the USDA have expressed an interest in single kernel analysis of grain for determination of basic intrinsic properties such as protein content. A study was undertaken to determine the feasibility of measuring protein content of intact wheat kernels using near-infrared transmittance spectrophotometry. Six wheat classes were examined: hard red winter, hard red spring, hard white, soft red winter, soft white, and durum. Five samples per class were used, with each sample represented by 96 randomly drawn kernels. Within each class, single kernel spectra (850-1,050 nm) were calibrated to single kernel protein content using four samples; the remaining sample was set aside for model validation. The chemometric method of partial least squares (PLS) analysis was used. For reference values, the protein content (N X 5.7) of each kernel was measured by combustion. Typical model accuracies of r(2) in the range of 0.85-0.93 and standard errors of prediction of 0.4-0.9% protein were determined on the validation sets. The number of PLS factors required for optimal model performance ranged from 6 to 14, dependent on wheat class and the type of mathematical transformation on the spectra before modeling. Repeatability measurements on kernels that were reloaded into the kernel clamp indicated that the variance of model-determined protein content caused by kernel positioning was largest for the smaller wheat kernels. Improvement in model performance could probably be attained by the averaging of transmittances taken from several positions on each kernel. [References: 16].

2308 Duce, SL.; Ablett, S.; Darke, AH.; Pickles, J.; Hart, C. (1995) **NUCLEAR MAGNETIC RESONANCE IMAGING AND SPECTROSCOPIC STUDIES OF WHEAT FLAKE BISCUITS DURING BAKING.** *Cereal Chemistry. 72(1):105-108.* English. [UNIV CAMBRIDGE SCH CLIN MED HERCHEL SMITH LAB MED CHEM UNIV FORVIE SITE ROBINSON WAY CAMBRIDGE CB2 2PZ ENGLAND].

Wheat flake biscuits of known moisture and lipid contents were studied by nuclear magnetic resonance (NMR) imagining (MRI) to determine whether the moisture content of these low moisture samples could be measured by this technique. The water and lipid components of the observed NMR image signal were assigned from a H-1 relaxation study. A serial imaging study of the baking of a wheat flake biscuit mapped the spatial and temporal changes in moisture content across the biscuit during baking and resting. [References: 19].

2309 Erdogdu, N.; Czuchajowska, Z.; Pomeranz, Y. (1995) **WHEAT FLOUR AND DEFATTED MILK FRACTIONS CHARACTERIZED BY DIFFERENTIAL SCANNING CALORIMETRY .1. DSC OF FLOUR AND MILK FRACTIONS.** *Cereal Chemistry. 72(1):70-75.* English. [WASHINGTON STATE UNIV DEPT FOOD SCI & HUMAN NUTR PULLMAN, WA 99164 USA].

Differential scanning calorimetry (DSC) thermograms were determined for wheat flour and milk fractions. Compositional and structural differences between prime and tailings starch apparently affected their DSC thermograms and interaction patterns. Tailings starch had a lower gelatinization enthalpy and a higher amylose-lipid complex transition enthalpy than did prime starch. These observations were attributed to the faster rate of heat transfer and higher accessibility to water, presumably related to the smaller granule size of tailings starch. Gluten lowered the temperatures of the amylose-lipid complex endotherm of both prime and tailings starches. Water solubles increased the gelatinization temperatures of the starches due to the competition for available water. Laboratory-prepared acid whey showed higher denaturation temperatures than sweet whey, which is explained by the acid-resistant character of the major whey protein beta-lg. A commercial whey protein concentrate showed endotherm temperatures that were considerably higher (>40 degrees C) than those of whey powders. Ultrafiltration in commercial processing could be responsible for this temperature shift. The degree to which protein is concentrated by ultrafiltration or dialysis affects the relative concentration of water solubles and influences the functional properties and interactions of whey protein concentrates with wheat flour components. [References: 49].

2310 Erdogdu, N.; Czuchajowska, Z.; Pomeranz, Y. (1995) **WHEAT FLOUR AND DEFATTED MILK FRACTIONS CHARACTERIZED BY DIFFERENTIAL SCANNING CALORIMETRY .2. DSC OF INTERACTION PRODUCTS.** *Cereal Chemistry. 72(1):76-79.* English. [WASHINGTON STATE UNIV DEPT FOOD SCI & HUMAN NUTR PULLMAN, WA 99164 USA].

Wheat flour prime starch, tailings starch, and gluten were blended (each) in a 1:1 ratio with lactose, commercial and laboratory acid and sweet whey, and acid and sweet casein. Their interactions were measured by differential scanning calorimetry (DSC). Lactose interacted with starches and gluten. It increased the endotherm temperatures of gelatinization and enthalpy (Delta H) of the prime and tailings starches. Gluten reduced the melting temperatures and Delta H of lactose. Caseins did not interact with starches. The enthalpy peak of the amylose-lipid complex of prime starch was eliminated or reduced by most the dairy ingredients. In tailings starch, the complex had a significantly reduced onset temperature. In contrast to commercial or simulated (dialyzed) whey protein concentrates, laboratory nondialyzed whey powders interacted with wheat flour components. Thus, both the isolation and the processing conditions affected the mode of interaction of wheys with wheat flour components. [References: 4].

2311 Evers, AD.; Flintham, J.; Kotecha, K. (1995) **ALPHA-AMYLASE AND GRAIN SIZE IN WHEAT.** *Journal of Cereal Science. 21(1):1-3.* English.

[CAMPDEN & CHORLEYWOOD FOOD RES ASSOC CHORLEYWOOD WD3 5SH HERTS ENGLAND].

2312 Fulcher, RG.; Faubion, JM.; Ruan, R.; Miller, SS. (1994) **QUANTITATIVE MICROSCOPY IN CARBOHYDRATE ANALYSIS.** *Carbohydrate Polymers. 25(4):285-293.* English. [UNIV MINNESOTA DEPT FOOD SCI & NUTR 1334 ECKLES AVE ST PAUL, MN 55108 USA].

2313 Furlong, EB.; Soares, LMV. (1995) **GAS CHROMATOGRAPHIC METHOD FOR QUANTITATION AND CONFIRMATION OF TRICHOTHECENES IN WHEAT.** *Journal of AOAC International. 78(2):386-390.* English. [UNIV ESTADUAL CAMPINAS FAC ENGN ALIMENTOS CP 6121 BR-13081970 CAMPINAS SP BRAZIL].

A capillary gas chromatographic method with flame ionization detection was evaluated for quantitation and confirmation of 7 trichothecenes known to occur in grain crops. The method was applied to spiked and naturally contaminated wheat samples. Samples were extracted with methanol-aqueous KCl. After clarification with ammonium sulfate and partition to chloroform, a charcoal-alumina-Celite column cleanup was used. Heptafluorobutyryl derivatives of trichothecenes were quantitated with a methyl eicosanoate internal standard. Confirmation of identity was achieved by comparing the chromatographic behavior of suspected samples with those of standards after acetylation and hydrolysis for group A trichothecenes, and acetylation and reduction for group B trichothecenes. Limits of detection ranged from 0.1 to 0.5 mu g/g. Average recoveries for diacetoxyscirpenol (DAS) and nivalenol (NIV) determined at 7 levels of contamination were 88 and 93%, respectively. Average recoveries for deoxynivalenol, NIV, DAS, T2 tetraol, and T2 triol at a single level of contamination were 85, 87, 83, 87, and 91%, respectively. Relative standard deviations for determinations of naturally contaminated samples ranged from 2.8 to 12.9%. For spiked wheat samples, the relative standard deviations ranged from 4.6 to 11.9%. [References: 14].

2314 Ito, S.; Sato, A.; Hoshino, T. (1995) **STUDIES ON GRAIN AND FLOUR QUALITY OF WHEAT IN TOHOKU DISTRICT .3. MILLING CHARACTERISTICS OF DOMESTIC AND FOREIGN WHEAT CULTIVARS AND CLASSIFICATION FOR THE HARD AND SOFT WHEATS [Japanese].** *Japanese Journal of Crop Science. 64(1):27-32.* Japanese. [TOHOKU NATL AGR EXPTL STN MORIOKA IWATE 02001 JAPAN].

Thirty Tohoku and 30 foreign wheat cultivars were grown under the same cultivation condition and were analyzed about milling quality. Wheat cultivars were classified into the small group and the large group based on the specific surface area (SSA). The small group was big particle size of A flour and high milling rate, and the other group was small and low. Namely, the small group is considered to be hard wheat and the large group is considered to be soft wheat. The classification of cultivars based on the A flour rate coincides with the classification based on SSA. In the hard wheats, the higher regression coefficient of flour yield rate to SSA was higher than in the soft wheats. It is shown that the effect of selection by SSA in milling characteristics was higher in the softwheats than that in the hard wheats. The hard wheats differed with the soft wheats in the milling characteristics. It is necessary that the examination of milling characteristics of wheat cultivar has to be conducted in the same hardness group.

2315 Kovacs, MIP.; Howes, NK.; Leisle, D.; Zawistowski, J. (1995) **EFFECT OF TWO DIFFERENT LOW MOLECULAR WEIGHT GLUTENIN SUBUNITS ON DURUM WHEAT PASTA QUALITY PARAMETERS.** *Cereal Chemistry. 72(1):85-87.* English. [AGR & AGRIFOOD CANADA WINNIPEG RES CTR WINNIPEG MB CANADA].

FS-derived F-4 and FS durum wheat families from the cross DT471/DT624, homozygous for either of two low molecular weight glutenin subunits (LMWGS 2 and LMWGS 2(-)) were used in a study to determine the effect of these subunits on protein content (PROT), cooked pasta disk viscoelasticity (PDV), cooked gluten viscoelasticity (CGV), sodium dodecyl sulfate sedimentation volume (SV), mixograph mixing development time (MDT), mixograph peak height (MPH), and mixograph total energy(MTE). These subunits were identified using a monoclonal antibody (MAb45/8) specific for the LMWGS 2 allele. Both parents and progeny were homozygous for HMWGS 6+8 and gliadin band 45. Families homozygous for LMWGS 2 had higher PDV ($t = 2.4$, $P < 0.01$) and SV values ($t = 4.9$, $P = 0.001$) than families homozygous for LMWGS 2(-); CGV differed in one year, and MDT and PROT were similar for the two alleles. PDV and SV values were positively correlated with each other ($r = 0.52$, $P < 0.001$) as well as with PROT values ($r = 0.59$, $P < 0.001$, $r = 0.46$, $P < 0.001$, respectively). Neither PDV or SV were correlated with MDT, while PDV showed only a low correlation with CGV ($r = 0.30$, $P < 0.05$). CGV was not correlated with MDT nor consistently with SV. The major effect of LMWGS 2 type was on PDV and SV rather than on measures of gluten strength (MDT, CGV). PDV and SV values were not greatly influenced by either MDT or CGV values, indicating that the former two are being influenced by additional quality components other than gluten strength. This study showed that LMWGS 2 allele is beneficial to improve pasta cooking quality of future cultivars and that selection can be readily accomplished using monoclonal antibody MAb45/8. [References: 21].

2316 Kruger, JE.; Hatcher, DW. (1995) **FY SEDIMENTATION TEST FOR EVALUATION OF FLOUR QUALITY OF CANADIAN WHEATS.** *Cereal Chemistry. 72(1):33-37.* English.

The FY sedimentation test is commonly used by manufacturers of steamed and fried noodles as one of their flour quality specifications. The FY sedimentation values of Canadian wheat flours were determined, and some of the factors influencing the test results were examined. FY readings within the first hour for different wheat classes were as predicted on the basis of their relative protein content and strength. In subsequent 2- and 3-hr sedimentation gel volumes, variations in trends existed between the different classes. Canadian Western Red Spring and Red Winter wheat classes increased in sedimentation gel volumes, while the Canadian Prairie Spring and Western Soft White wheat classes decreased. Examination of flours increasing in protein content and dough strength suggested that the latter was associated with the resultant changes in sedimentation volumes with time. Flour extraction rate was also found to have an influence on FY sedimentation values,as the 30% extraction flours' initial readings were all significantly different from those at or above 50 or 60% flour extraction. Effects due to sprout damage were minimal. A minimum two-week aging period after milling was necessary to ensure reproducible discrimination of the sediment interface. [References: 10].

2317 Lawther, JM.; Sun, RC.; Banks, WB. (1995) **EXTRACTION, FRACTIONATION, AND CHARACTERIZATION OF STRUCTURAL POLYSACCHARIDES FROM WHEAT STRAW.** *Journal of Agricultural & Food Chemistry. 43(3):667-675.* English. [UNIV WALES CTR BIOCOMPOSITES BANGOR LL57 2UW GWYNEDD WALES].

Wheat straw polysaccharides were fractionated into water soluble, pectic, 80% ethanol soluble, sodium chlorite soluble, hemucellulosic, and cellulose fractions using essentially gravimetric methods. The hemucellulosic material was further separated into a dimethyl sulfoxide soluble fraction and hemicellulose types A-C. The sugar and uronic acid compositions of each fraction were determined by gas chromatography after hydrolysis and conversion to trimethylsilyl ether derivatives and by a spectrophotometric method. The average molecular weights (M(w)) of hemicellulosic fractions were estimated using gel permeation chromatography. The major polysaccharides in wheat straw were found to be cellulose (37.19-38.55%), followed by hemicellulosic fractions (30.28-35.01%) and small amounts of water soluble, pectic, 80% ethanol soluble, and sodium chlorite soluble materials. Xylose was found to be the major sugar in all of the hemicellulosic fractions with arabinose, glucose, and galactose as minor constituents. From hemicellulosic fractions A to C, the relative amount of xylose decreased, while the contents of arabinose, glucose, and galactose increased. The contents of phenolic acids and aldehydes remaining in wheat straw hemicellulosic fractions A and B and in cellulose were 0.72, 0.85, and 0.19%, respectively. [References: 51].

2318 Lee, YW.; Kim, JC.; Lee, DH.; Kang, HJ.; Yoshizawa, T. (1995) **NATURAL OCCURRENCE OF TRICHOTHECENES AND ZEARALENONE IN THE 1993 BARLEY CROP IN KOREA.** *Journal of the Food Hygienic Society of Japan. 36(1):85-88.* English. [SEOUL NATL UNIV DEPT AGR BIOL SUWON 441744 SOUTH KOREA].

Trichothecenes and zearalenone (ZEA) in barley samples were surveyed to compare the natural occurrence of the toxins between the southern region and Kangwon province in Korea. Four 8-ketotrichothecenes, namely deoxynivalenol (DON), 3-acetyldeoxynivalenol (3-ADON), nivalenol(NIV), and 4-acetylnivalenol (4-ANIV) and ZEA, were detected in barley samples from the southern provinces, and DON, 15-acetyldeoxynivalenol (15-ADON), NIV, 4-ANIV, and ZEA were found in barley samples from Kangwon province. The major toxins in barley samples from both areas were DON and NIV, but there was a regional difference in the natural

occurrence of monoacetyl-DON; 3-ADON and 15-ADON were detected in barley from the southern region and Kangwon province, respectively. This is the first report of the natural occurrence of 15-ADON in Korean barley.

2319 Lookhart, G.; Bean, S. (1995) **A FAST METHOD FOR WHEAT CULTIVAR DIFFERENTIATION USING CAPILLARY ZONE ELECTROPHORESIS.** *Cereal Chemistry. 72(1):42-47.* English. [USDA ARS N CENT REG US GRAIN MKT RES LAB MANHATTAN, KS 66502 USA].

Capillary zone electrophoresis (CZE) parameters, including capillary length, inside diameter, buffer, temperature, voltage, and extraction conditions, were studied to reduce analysis time and increase resolution of wheat proteins. Conditions for the shortest analysis time include: capillary inside diameter, 20 mu m; shortest possible capillary length, 27 cm (20 cm to detector); temperature, 45 degrees C; voltage, 22 kV; and pressure injection for 4 sec (0.25 nL). Three alcohol-water based solvent systems were studied to improve extraction and analysis of gliadins; 30% ethanol-water was optimum. Gliadins were extracted from cultivars representative of hard red winter, hard red spring, and soft wheat classes and separated by CZE. Three separate sets of cultivars that were not differentiable by polyacrylamide gel electrophoresis at pH 3.1 were differentiated in less than 10 min each by CZE. Cultivars that were closely related (sister lines or intercrossings) were readily differentiated, and cultivars that were not genetically close exhibited quite different CZE patterns. [References: 16].

2320 Magee, TRA.; Bransburg, T. (1995) **MEASUREMENT OF THERMAL DIFFUSIVITY OF POTATO, MALT BREAD AND WHEAT FLOUR.** *Journal of Food Engineering. 25(2):223-232.* English. [QUEENS UNIV BELFAST DEPT CHEM ENGN STRANMILLIS RD BELFAST BT7 1NN ANTRIM NORTHERN IRELAND].

The thermal diffusivity of three food products, Pentland Dell potato, malt bread and wheat flour, was determined using a thermal diffusivity tube under transient heat transfer conditions by two different methods, the log method and the slope method, both based on the solutions of the Fourier equation. Both methods gave similar results for potato, 1.30 x 10(-7) and 1.44 x 10(-7) m2 s-1, flour, 1.00 x 10(-7) and 1.04 x 10(-7) m2 s-1, but different results for bread, 1.17 x 10(-7) and 2.56 x 10(-7) m2 s-1. The values were compared with a prediction model and with previously documented values. The measured values for potato and flour were found to be close to those calculated by the prediction model. The value for bread, calculated by the log method, was also close to the predicted value, but its thermal diffusivity calculated by the slope method was close to literature values. [References: 11].

2321 Marcone, MF.; Yada, RY. (1995) **A PROPOSED MECHANISM FOR THE CRYOAGGREGATION OF THE SEED STORAGE GLOBULIN AND ITS POLYMERIZED FORM FROM TRITICUM AESTIVUM.** *Journal of Food Biochemistry. 18(3):147-163.* English. [UNIV GUELPH ONTARIO AGR COLL DEPT FOOD SCI GUELPH ON N1G 2W1 CANADA].

The purified salt-soluble globulin and its polymerized (i.e., polymerized via interchain disulfide bonds between various subunits of differing molecular weights, excluding any interchain disulfide bonds between the 35,000 and 49,000 Da subunits) counterpart from wheat (Triticum aestivum) seed were studied at a variety of temperatures and holding times (i.e., 25, 15, 10C for holding times between 0 and 600 min). A mechanism responsible for cryoaggregation is proposed. The polymerized form of the globulin was found to be much more cryoaggregatable than the nonpolymerized form. Ultraviolet (UV) and circular dichroism (near- and far-UV) spectral analyses revealed that the polymerized globulin was more susceptible to conformational changes than its nonpolymerized form with decrease in temperature. It is suggested that the higher flexibility of the polymerized globulin would allow for subtle changes in protein conformation, and therefore, permit the surface aromatic amino acids to interact with other hydrophobic groups on neighboring protein molecules in a cooperative manner. The latter situation may result in aggregation and precipitation. [References: 23].

2322 Marcone, MF.; Yada, RY. (1995) **ISOLATION, PURIFICATION AND CHARACTERIZATION OF THE SEED STORAGE GLOBULIN AND ITS POLYMERIZED FORM FROM TRITICUM AESTIVUM.** *Journal of Food Biochemistry. 18(3):123-145.* English. [UNIV GUELPH ONTARIO AGR COLL DEPT FOOD SCI GUELPH ON N1G 2W1 CANADA].

The salt-soluble globulin and its polymerized counterpart from wheat (Triticum aestivum) seed were isolated and purified to homogeneity employing both gel filtration and anion exchange chromatography. The two globulins were purified free of any purothionin (an oxidation-reduction protein) contamination. Some of the physico-chemical properties of purothionin are also reported. Both globulins were found to be oligomers composed of two polypeptide chains, i.e., 35,000 and 49,000 Da, with no apparent evidence of any covalent inter-chain disulfide linkages between these major subunits. The molecular weights for the globulin and its polymerized (i.e., polymerized via interchain disulfide bonds between various subunits of differing molecular weights, excluding any interchain disulfide bonds between the 35,000 and 49,000 Da subunits) counterpart were determined to be 474,000 and 567,000 Da, respectively, by gel chromatography. Surface charge profiles of fractions 2 and 3 were determined using electrophoretic isoelectric focusing, electrophoretic titration and zeta potential analysis and indicated pIs of 6.90 and 6.55, respectively. The nonpolymerized globulin was found to be more positively charged below its isoelectric point and less negatively charged above it than its polymerized counterpart. Microcalorimetric studies indicated that the two globulins had similar T-m values. [References: 30].

2323 Masci, S.; Lew, EJL.; Lafiandra, D.; Porceddu, E.; Kasarda, DD. (1995) **CHARACTERIZATION OF LOW MOLECULAR WEIGHT GLUTENIN SUBUNITS IN DURUM WHEAT BY REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY AND N-TERMINAL SEQUENCING.** *Cereal Chemistry. 72(1):100-104.* English. [UNIV TUSCIA DIPARTIMENTO AGROBIOL & AGROCHIM VIA S CAMILLO LELLIS I-01100 VITERBO ITALY].

Low molecular weight glutenin subunits (LMW-GS) from a residue preparation were fractionated by reversed-phase high-performance liquid chromatography (RP-HPLC) of reduced subunits from two biotypes of the Italian durum wheat cultivar Lira that differ at the Gli-B1/Glu*-B3 loci, such that Lira 42 has the LMW-1 pattern (associated with poor quality) and Lira 45 has the LMW-2 pattern (associated with good quality) of LMW-GS. N-terminal amino acid sequencing was conducted on the major protein fractions (peaks) that differed chromatographically between the two types. The fractions included four types of LMW-GS on the basis of their N-terminal sequences, which differed in their proportions among the various fractions. These N-terminal sequences corresponded to the Ser-His-Ile-(LMW-s) type, the Met-Glu-Thr-(LMW-m) type, the alpha-(gliadin) type, and the gamma-(gliadin) type. The LMW-s type was strongly predominant in the Lira 45 preparation and predominant in the Lira 42 preparation. The LMW-m type was next most important in the Lira 45 preparations, but in the Lira 42 preparations, the percentage of alpha-type sequence was higher than the LMW-m type. Both alpha-type and gamma-type sequences were stronger in Lira 42 than they were in Lira 45. Results indicated that differences in quality between the Lira biotypes may derive from: 1) the relative predominance in Lira 45 glutenins of the LMW-s type and the LMW-m type subunits, probably acting as glutenin polymer chain extenders; 2) the high proportion of the alpha-type and gamma-type glutenin subunits in the Lira 42 glutenins, probably included in the glutenin polymers because they have an odd number of cysteines and act as glutenin polymer chain terminators; 3) the absolute amount of LMW glutenins, which is greater for LMW-2; or 4) some combination of these factors. [References: 20].

2324 Mcelroy, D.; Jacobsen, J. (1995) **WHATS BREWING IN BARLEY BIOTECHNOLOGY [Review].** *Bio-Technology. 13(3):245-249.* English. [UNIV CALIF BERKELEY USDA ARS CTR PLANT GENE EXPRESS 800 BUCHANAN ST ALBANY, CA 94710 USA].

The primary aim of barley (Hordeum vulgare) improvement for use in malting and brewing is to expand the germplasm available to breeders. The development of a transformation system for barley, along with an improved understanding of the biology underlying malting quality, has made it possible to consider improving barley by making planned genetic changes. In this review, we discuss the opportunities for biotechnology as they apply to the use of barley in malting and brewing. [References: 50].

2325 Mcwatters, KH.; Resurreccion, AVA.; Beuchat, LR.; Phillips, RD. (1995) **USE OF PEANUT AND COWPEA IN WHEAT-BASED PRODUCTS CONTAINING COMPOSITE FLOURS.** *Plant Foods for Human Nutrition. 47(1):71-87.* English. [UNIV GEORGIA DEPT FOOD SCI & TECHNOL AGR EXPT STN GRIFFIN, GA 30223 USA].

Cowpeas and peanuts are legumes of major dietary and economic importance. They are favored worldwide because of their palatability,

contribution to nutritional status, and low cost as a protein source compared to animal protein. Flours processed from cowpeas and peanuts have unique physico-chemical and sensory properties when used in composite flour mixtures. Appropriate blends of cowpea and peanut flours to replace wheat flour in Chinese-type noodles, muffins, and tortillas were determined using modelling and optimization procedures. For noodles, 15% peanut flour and 8% cowpea flour supplementation produced an acceptable product with high protein content (21%). For wheat flour replacement in muffins, up to 43% cowpea and up to 44% peanut flours may be used. However, when wheat flour replacement is 50% or greater, cassava flour should comprise 56 to 72% of the blend with a few exceptions. In tortillas, 24% cowpea and 46% peanut flours produced products similar in quality characteristics to those made from 100% wheat flour. The systematic approach used in these studies is more efficient than the traditional substitution method to optimize sensory qualities of wheat-based products containing composite flours.

2326 Murata, S.; Sorour, H.; Imada, D.; Amaratunga, KSP. (1994) **VACUUM EFFECT ON MILLING WHEAT.** *Journal of the Faculty of Agriculture Kyushu University. 39(1-2):59-66.* English. [KYUSHU UNIV FAC AGR AGR PROC ENGN LAB FUKUOKA 812 JAPAN].

Vacuum milling of wheat was used to prevent temperature rise of flour. We have used four vacuum pressure levels and one control pressure level (normal atmospheric pressure "1023.3 hPa"). Many factors of milling machine were measured. The consumption of power and the capacity of milling machine at different wheat moisture contents were determined. The milled flour moisture content was measured as well. We concluded that the flour temperature after milling could be kept stable at a low level under vacuum pressure compared with the control. Milling power and moisture content of flour showed the same trend. Different levels of moisture contents seem to affect the milling machine capacity. [References: 5].

2327 Pena, RJ.; Zarcohernandez, J.; Mujeebkazi, A. (1995) **GLUTENIN SUBUNIT COMPOSITIONS AND BREAD-MAKING QUALITY CHARACTERISTICS OF SYNTHETIC HEXAPLOID WHEATS DERIVED FROM TRITICUM TURGIDUM X TRITICUM TAUSCHII (COSS) SCHMAL CROSSES.** *Journal of Cereal Science. 21(1):15-23.* English. [CIMMYT INT MAIZE & WHEAT IMPROVEMENT CTR LISBOA 27 APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

The Glu-B1, Glu-D1 and Glu-B3 encoded glutenin subunit compositions of a population of synthetic hexaploid wheats (AABBDD, 2n=6x=42), which was random for flour protein (FP), SDS-sedimentation (SDSS), Alveograph strength (W), the tenacity/extensibility (P/G) ratio and bread loaf volume (LV) were examined in this study. The synthetics were produced from various crosses involving several Triticum turgidum cultivars and Triticum tauschii (coss.) Schmal accessions. The Glu-A1 null allele as well as three Glu-B1 (subunits 7+8, 6+8 and 20), 13 Glu-D1 and two Glu-B3 (LMW-1 and LMW-2) allelic variants were present in the synthetic population. Thirty-six different glutenin subunit combinations, including the Glu-B1, Glu-D1 and Glu-B3 encoded alleles, were observed. The synthetic hexaploids showed large variations for all quality parameters evaluated. AU quality characteristics except one (P/G ratio, which showed no association with allelic variations at Glu-B3) were influenced by allelic variations at the Glu-B1 and Glu-B3 loci; subunits 6+8 and 7+8 showed significantly better quality effects than subunit 20. Low M(r) glutenin subunits LMW-1 and LMW-2 showed both negative and positive quality effects. The Glu-D1 locus of I: tauschii contributed various alleles not found in bread wheat. The influence of new Glu-D1 alleles on the bread-making quality characteristics of the synthetic wheats could not be established, partly because there was a limited frequency of some of the alleles in the population, and partly because some synthetics, having a common Glu-DI allele, showed quality differences associated with allelic variation at Glu-B1 and/or Glu-B3. Differential quality effects could be observed, however, among some Glu-DI alleles. Synthetics derived from a common durum wheat source showed better overall quality characteristics and bread loaf volume when they possessed subunits 5+12 or 1.5+10 than when they had any other Glu-D1 encoded glutenin subunit. [References: 32].

2328 Petrofsky, KE.; Hoseney, RC. (1995) **RHEOLOGICAL PROPERTIES OF DOUGH MADE WITH STARCH AND GLUTEN FROM SEVERAL CEREAL SOURCES.** *Cereal Chemistry. 72(1):53-58.* English. [KANSAS STATE UNIV AGR & APPL SCI DEPT GRAIN SCI & IND MANHATTAN, KS 66506 USA].

The range in moduli for isolated starch and vital gluten doughs showed the existence of starch-gluten or starch-gluten-water interactions in dough. Starches isolated from different wheat cultivars and mixed into dough with a constant gluten, both amount and source, gave large theological differences. This shows that starch had an active role in determining dough theological characteristics. Soft wheat and nonwheat starch doughs had higher moduli compared to the hard wheat starch and the control (commercial gluten and starch) doughs, possibly because of greater interaction of the starch with the gluten. The source of gluten also had a significant effect on dough theology, as indicated by the range of elastic (G') and loss (G") moduli for isolated wheat gluten and commercial starch doughs. Hard wheat gluten doughs had low G' and G" values, indicating a greater extensibility and possibly less starch-gluten interaction. Soft wheat gluten doughs had higher G' and G" values, possibly because of increased starch-gluten interaction. [References: 30].

2329 Prokopowich, DJ.; Biliaderis, CG. (1995) **A COMPARATIVE STUDY OF THE EFFECT OF SUGARS ON THE THERMAL AND MECHANICAL PROPERTIES OF CONCENTRATED WAXY MAIZE, WHEAT, POTATO AND PEA STARCH GELS.** *Food Chemistry. 52(3):255-262.* English. [UNIV MANITOBA DEPT FOOD SCI WINNIPEG MB R3T 2N2 CANADA].

A comparative study was undertaken to examine the effect of sugars on the thermal and mechanical properties of ageing waxy maize, wheat, potato and pea starch gels. The addition of sugars, at a ratio of 1:0.5:1.5 (w/w) for starch-sugar-water mixtures, inhibited chain reorganization in starch gels, as followed by differential scanning calorimetry and dynamic rheometry in the order, ribose > sucrose > maltotriose > water alone, glucose > fructose. Kinetic experiments on the evolution of storage modulus (G') at 8 degrees C indicated a progressive transition from a sigmoid curve (waxy maize) to a hyperbolic G' - time relationship (potato and pea starches), consistent with an increasing proportion of amylose in the composite gels. The effects of sugars on the development of the retrogradation endotherm (Delta H) and gel rigidity (G') were less pronounced for potato and pea starches than for waxy maize or wheat starches, presumably because of their higher amylose content, which dominates the gel network properties. [References: 24].

2330 Ranhotra, GS.; Gelroth, JA.; Glaser, BK.; Lorenz, KJ. (1995) **BAKING AND NUTRITIONAL QUALITIES OF A SPELT WHEAT SAMPLE.** *Food Science & Technology-Lebensmittel-Wissenschaft & Technologie. 28(1):118-122.* English. [AMER INST BAKING MANHATTAN, KS 66502 USA].

Flours from a sample of hard red winter (HRW) wheat and spelt wheat were evaluated for milling, baking and nutritional qualities. Milling flour yield from the spelt wheat sample was consistently lower than from the corresponding HRW wheat sample, pup leaves made with spelt flour also showed lower volume and total scores. Both wheat grains tested positive for gluten and, thus, would be unsuitable for gluten-intolerant individuals. With one exception (higher zinc content), spelt wheat grain did not differ significantly from HRW wheat in the contents of nutritionally important components-protein, fiber, minerals and vitamins. Expressed on g/100g protein basis, all amino acids, except tyrosine, aspartic acid and methionine, were lower (lysine by 28%) in spelt wheat as compared to HRW wheat. The protein efficiency ratios of spelt and HRW wheat grain measured 1.3 and 1.4 (casein, 2.5) and protein digestibilities 80.1% and 78.9% (casein, 91.6%), respectively. Thus, the superior nutritional content and other claims that have been suggested for spelt wheat may be unfounded. [References: 12].

2331 Schwarz, PB.; Horsley, RD. (1995) **MALT QUALITY IMPROVEMENT IN NORTH AMERICAN SIX-ROWED BARLEY CULTIVARS SINCE 1910.** *Journal of the American Society of Brewing Chemists. 53(1):14-18.* English. [N DAKOTA STATE UNIV DEPT CEREAL SCI & FOOD TECHNOL FARGO, ND 58105 USA].

Twenty-one historical North American six-rowed malting cultivars, with dates of release from 1910 to 1990, were grown at the North Dakota Agricultural Experiment Station in Fargo during 1990, 1991, and 1992. Grain from these samples was micromalted, and the resultant samples were analyzed for 13 quality traits. The results of analysis were used to evaluate improvements in quality over time, specifically to document cases where barley breeding programs have been most successful in improving the malt quality of North American six-rowed barley. Significant differences between cultivars were observed for all malt quality traits evaluated, but improvements over time were not observed for all traits. Consistent improvements were found for 1,000-kernel weight, kernel plumpness, grain protein, soluble protein, ratio of soluble to total protein, malt extract, fine-

coarse malt extract difference, alpha-amylase activity, and diastatic power (DP). The greatest gains were made in traits for which barley breeders select. These include kernel plumpness, malt extract, wort protein, alpha-amylase activity, and DP. Improvements over time were not observed for wort viscosity and barley and malt beta-glucan contents. [References: 15].

2332 Sekhon, KS.; Nagi, HPS.; Singh, N.; Sharma, S. (1994) **EFFECT OF VITAL GLUTEN AND DISODIUM PHOSPHATE ON THE QUALITY OF FLAT BREAD AND NOODLES FROM SPROUTED WHEAT FLOUR.** *Journal of Food Science & Technology-Mysore. 31(6):505-507.* English. [PUNJAB AGR UNIV DEPT FOOD SCI & TECHNOL LUDHIANA 141004 PUNJAB INDIA].

Addition of 4% vital gluten and 0.15% disodium phosphate was found to be beneficial for getting good quality flat breads from sprouted wheats. Good quality noodles could also be prepared from moderately sprouted wheats with the addition of 2% vital gluten and 0.15% disodium phosphate. However, highly sprouted wheats, require extra addition of gluten to the flour to produce quality noodles.

2333 Simmonds, NW. (1995) **THE RELATION BETWEEN YIELD AND PROTEIN IN CEREAL GRAIN.** *Journal of the Science of Food & Agriculture. 67(3):309-315.* English. [UNIV EDINBURGH INST ECOL & RESOURCE MANAGEMENT SCH AGR W MAINS RD EDINBURGH EH9 3JG MIDLOTHIAN SCOTLAND].

An analysis of published data on genetic relations between dry grain yields y, t ha(-1)) and protein content [p, protein as a fraction (g g(-1)) of dry grain] of cereals is presented. In all, 106 usable regressions of y on p across geneotypes were assembled. The long-recognised negative relation between yield and protein concentration was fully substantiated. There is a strong positive relation between grain yield and protein yield. The linear regression coefficient of yield on protein concentration is related to yield, with slope about -15. This relation holds approximately over all cereals. The data can be used to estimate a characteristic parameter described by C = dy/d(yp) = similar to 15-25 at the mean of each experiment. The relationship is surprisingly consistent but no simple physiological interpretation is available. In discussion, the high C, the impact of strong negative regressions of y on p for breeding strategies, the fact that protein yield increases with gross grain yield but at falling p and certain socio-economic consequences are emphasized. An acute need for orderly reporting of experimental data is also emphasised; the existing literature is chaotic as to units, moisture contents and conversion factors. [References: 58].

2334 Stampfli, L.; Nersten, B. (1995) **EMULSIFIERS IN BREAD MAKING [Review].** *Food Chemistry. 52(4):353-360.* English. [UNIV CALIF DAVIS DEPT FOOD SCI & TECHNOL DAVIS, CA 95616 USA].

The literature on the application of emulsifiers for baking as dough conditioners and anti-staling agents, is reviewed. The first part of the paper is devoted to reviewing the various studies on dough handling and bread quality improvement due to emulsifiers. In the second part, emphasis is given to the presentation of the phenomenon of staling in bread. Considerable work has dealt with the application of emulsifiers in bread and bread models to understand the staling mechanism. Nevertheless, staling cannot be explained by one theory alone; it is more likely that staling is the result of numerous reactions between the different flour fractions. [References: 107].

2335 Sudhakar, V.; Singhal, RS.; Kulkarni, PR. (1995) **EFFECT OF SUCROSE ON STARCH HYDROCOLLOID INTERACTIONS.** *Food Chemistry. 52(3):281-284.* English. [UNIV BOMBAY DEPT CHEM TECHNOL DIV FOOD & FERMENTAT TECHNOL BOMBAY 400019 MAHARASHTRA INDIA].

Starch-gum interactions have a wide application in the food industry, such as in bakery products and low-calorie food formulations. In the present work, an attempt was made to study the effect of sugar (sucrose) on corn starch-xanthan and corn starch-guar interactions, using a Brabender Amylograph. Corn starch (5% w/v) was mixed individually with xanthan (0-0.25% w/v) and guar (0-0.2% w/v) in sugar solution (0-30% w/v) and heated in a Brabender Amylograph; the resulting changes were interpreted with respect to the gelatinisation temperature and cold paste viscosity. These results may find applications in starch-based sugar-containing products such as puddings where gums are used as stabilisers and syneresis inhibitors. [References: 17].

2336 Suhendro, EL.; Waniska, RD.; Rooney, LW.; Gomez, MH. (1995) **EFFECTS OF POLYOLS ON THE PROCESSING AND QUALITIES OF WHEAT TORTILLAS.** *Cereal Chemistry. 72(1):122-127.* English. [TEXAS A&M UNIV DEPT SOIL & CROP SCI CEREAL QUAL LAB COLLEGE STN, TX 77843 USA].

Effects of polyols on processing of hot-press wheat tortillas were evaluated. Hot-press wheat tortillas with 0, 2, 4, or 6% glycerol were prepared from wheat flour of 10.2, 11.0, or 11.5% protein content. Tortillas with 2, 4, or 6% propylene glycol, sorbitol, or maltitol were prepared from the 11.0% protein flour. Farinograph and alveograph values, dough mixing characteristics and machinability, rollability over time, sensory evaluation, water holding capacity, total liquid content, and water activity were determined. Low protein (10.2%) flour required less water, shorter mixing time, and yielded tortilla doughs that were less machinable compared to other flours. Water absorption decreased with increasing polyol level. Doughs containing 6% polyols, except maltitol, were stickier and less machinable than control doughs. Tortillas prepared from 10.2% protein flour with or without polyols were less rollable during storage compared to those prepared from higher protein flours. Tortillas containing glycerol had less moisture, higher liquid content, and improved shelf-stability, except when prepared from low protein flour. Water activity decreased with increasing polyol level. Propylene glycol and glycerol were more effective in decreasing water activity than sorbitol and maltitol. Formulas containing 4% polyols and greater than or equal to 11.0% protein flour had good machinability and yielded acceptable tortillas with improved rollability during storage. [References: 14].

2337 Wang, W.; Flores, RA.; Huang, CT. (1995) **PHYSICAL PROPERTIES OF TWO BIOLOGICAL CUSHIONING MATERIALS FROM WHEAT AND CORN STARCHES.** *Cereal Chemistry. 72(1):38-41.* English. [UNIV CALIF DAVIS DAVIS, CA 95616 USA].

Physical properties of two biological cushioning materials made from wheat and corn starch extrudates were compared with those of commercial plastic foam cushioning material. Characteristics measured included dimensions, bulk and true densities, and water absorption isotherms at 15, 25, and 40 degrees C. Their properties under simple compression tests and stress relaxation tests were also examined. The C-shaped extrudate from corn starch showed more radial expansion than that of the wheat starch extrudate. But the bulk density and true density of the corn starch extrudates were significantly higher than those of the wheat starch extrudates. Both biological cushioning materials showed similar water absorption isotherms at three temperatures when the equilibrium moisture contents significantly increased as relative humidities increased. The S-shaped plastic foam exhibited lower bulk and true densities. Simple compression tests and stress relaxation tests showed that the biological materials had more unrecoverable plastic deformation than the plastic foams and also indicated a difference between the two extruded cushioning materials. [References: 8].

Q02 FOOD PROCESSING AND PRESERVATION

2338 Anon. (1994) **Going with the grain(s).** *Tufts University diet and nutrition letter (USA) v. 12(1) p. 7-8.* English. (AGRIS 95-029502).

Couscous, bulgur, roasted buckwheat groats, barley, amaranth, quinoa and millet are described in this article on cooking with grains. Cooking directions and recipe suggestions are included.

2339 Dahl, R.P. (1993) **New growth in flour milling.** *Minnesota agricultural economist (USA) (no. 672) p. 1-4.* references. English. (AGRIS 95-043279).

2340 Kang, Y.S.; Steele, J.L.; Spillman, C.K.; Chung, D.S. (1992) **Finite element analysis of fracture in a wheat kernel.** *Paper-American Society of Agricultural Engineers (USA); no. 923526 7 p.* references. Paper presented at the "1992 International Winter meeting sponsored by the American Society of Agricultural Engineers," December 15-18, 1992, Nashville, Tennessee. English. (AGRIS 95-043288).

2341 Locatelli, M. (Buhler, Milan (Italy)) (1994) **[Hygienic aspects in the production process. Flour storage and preservation]. Aspetti igienici nel processo di produzione. Immagazzinamento e conservazione delle farine.** *Molini d'Italia (Italy) v. 45(1) p. 16-19.* 3 graphs. Italian. (AGRIS 95-043282).

2342 Moll, M. (1993) **[Practical application and meaning of the techniques of analysing the malted barley]. Application et signification des techniques d'analyses en vue de l'evaluation de la qualite brassicole du malt.** Versuchsstation schweizerischer Brauereien, Zurich (Switzerland). *Brauerei- und Getraenke Rundschau (Switzerland) v. 104(11) p. 217-222.* 3 graphs, 1 photograph, numerous ref. French. (AGRIS 95-043450).

2343 Monti, M. (Molino Monti S.n.c., Sassoleone, Bologna (Italy)) (1994) **[Considerations before the conditioning and milling of "hard grains" [Triticum aestivum]]. Considerazioni da fare prima del condizionamento e della macinazione dei grani "hard" [grano tenero].** *Molini d'Italia (Italy) v. 45(7-8) p. 22-29.* 18 graphs. Italian. (AGRIS 95-043280).

2344 Neumann, L. (1994) **[Recommendations of MEBAK for minimal tests range destined for securing of the quality. Testing of the brewing and malting raw materials, semi-finished products and beer]. Navrhy MEBAK na minimalni rozsah zkousek v ramci zajisteni kvality. Zkouseni pivovarskych a sladovnickych surovin, mladiny, mladeho piva, piva pred filtraci a filtrovaneho piva.** *Kvasny Prumysl (Czech Republic) v. 40(8) p. 232-237.* 10 ref. Czech. (AGRIS 95-043272).

2345 Park, K.S.; Chung, I.C.; Ha, H.C.; Kim, S.H.; Lee, J.S. (Yeungnam University, Kyeongsan (Korea Republic). College of Agriculture and Animal Science); Park, S. (Taegu University, Kyungsan (Korea Republic). College of Agriculture) (1994) **Production of protein-bound polysaccharides by solid-state fermentation of Coriolus versicolor.** *Korean Journal of Mycology (Korea Republic) v. 22(2) p. 184-189.* 2 illus.; 6 tables; 12 ref. Korean. (AGRIS 95-029504).

2346 Wilson, W.W.; Scherping, D.; Johnson, D.D.; Cobia, D. (1993) **Economics of regulating wheat cleanliness.** *North Dakota farm research (USA) v. 50(1) p. 20-26.* references. English. (AGRIS 95-029514).

2347 Zackova, J.; Kvasnicka, F. (Vysoka Skola Chemickotechnologicka,Prague (Czech Republic). Ustav Chemie Technologie Cukru) (1994) **A contribution to the raw wheat starch hydrolysis.** *Potravinarske Vedy - UZPI (Czech Republic) v. 12(6) p. 445-455.* 5 graphs, 2 tables; 12 ref. English. (AGRIS 95-043281).

Q03 FOOD CONTAMINATION AND TOXICOLOGY

2348 Carlson, P.; Jones, J.R.; Wiese, M.V. (199[illegible]) **[Identity preserved shipment alternatives for marketing Pacific Northwest TCK-free wheat to China.** *Current information series (USA); no. 972 4 p.* English. (AGRIS 95-043736).

2349 Pagliaricci, S.; Mazza, M.; Pogna, N. (Istituto Sperimentale per la Cerealicoltura, Rome (Italy)) (1994) **[Analytical methods for the determination of Triticum aestivum in Triticum durum semolina pasta]. Metodi di analisi per la determinazione di frumento tenero nelle paste di semola di grano duro.** *Molini d'Italia (Italy) v. 45(3) p. 45-47.* 1 graph; 8 ref. Italian. (AGRIS 95-043735).

2350 Soederholm, H. (1993) **Effects of milling on the recovery of ergosterol from wheat, rye, barley and oats.** *Examensarbete - Sveriges Lantbruksuniversitet, Institutionen foer Mikrobiologi (Sweden); no. 1993:3 19 p.* 15 ref. English. (AGRIS 95-029767).

Q04 FOOD COMPOSITION

2351 Koh, J.S.; Yang, Y.T. (Cheju National University, Cheju (Korea Republic). Department of Agricultural Chemistry); Koh, Y.H.; Kang, Y.J. (Cheju National University, Cheju (Korea Republic). Department of Food Technology) (1993) **Zymological characteristics of Cheju folk wine made of foxtail millet.** *Journal of the Korean Agricultural Chemical Society (Korea Republic) v. 36(4) p. 277-283.* 4 illus.; 7 tables; 26 ref. Korean. (AGRIS 95-029935).

2352 Mwaminifu, S. (ISABU, Bujumbura (Burundi). Wheat Agronomist) (1993) **Wheat on-farm research in Burundi: Varietal and nutritional status.** Proceedings of a Networkshop on Impacts of On-Farm Research in Eastern and Southern Africa; Harare (Zimbabwe); 23-26 Jun 1992. *Impacts on-farm research. Heisey, P. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Lilongwe (Malawi). Economics Program); Waddington, S. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Harare (Zimbabwe). Maize Program) p. 275-279.* CIMMYT. 5 tables; 7 ref. English. (AGRIS 95-029948).

2353 Saviotti, B.; Zefilippo, M. (Agronomica Gruppo Ferruzzi, Ravenna (Italy)) (1994) **[The quality of wheat. Quality as "agricultural and industrial" concept]. La qualita' del frumento. Qualita' come concetto "agro-industriale".** *Agronomica (Italy) (no.5) p. 22-29.* 9 tables. Italian. (AGRIS 95-029947).

2354 Teperova, D. (Vyskumny Ustav Potravinarsky, Bratislava (Slovak Republic)) (1993) **[Starch]. Poznatky o skrobe.** *Bulletin Potravinarskeho Vyskumu (Slovak Republic) v. 32(1) p. 89-96.* 6 ill.; 15 ref. Slovak. (AGRIS 95-030051).

The paper contains a survey and new information about the composition, characteristics and structure of starch, beginning from D-glucose, various levels of molecular and supermolecular structures, and ending with the structure of grain. Properties of amylose and amylopectin, their mutual ratio in different kinds of starch, and basic characteristics of grain granules are summarized.

Q51 FEED TECHNOLOGY

2355 Jones, AM.; Ingledew, WM. (1994) **FERMENTATION OF VERY HIGH GRAVITY WHEAT MASH PREPARED USING FRESH YEAST AUTOLYSATE.** *Bioresource Technology. 50(2):97-101.* English. [UNIV SASKATCHEWAN DEPT APPL MICROBIOL & FOOD SCI SASKATOON SK S7N 0W0 CANADA].

The use of autolysed spent yeast cells as a source of extra free amino nitrogen (FAN) resulted in significantly accelerated rates of sugar utilization and ethanol production under very high gravity (VHG) fermentation conditions. These rates were comparable to those obtained in urea-supplemented fermentations. Analysis of thin stillage backset from grain-based fuel ethanol plants indicated that backset contains insufficient FAN to produce maximum rates of fermentation under VHG conditions. Use of thin stillage is therefore more important as a method to conserve water usage and pollution costs than as a source of nutrients. Our results suggest that a yeast autolysate prepared from harvested spent yeast or waste yeast slurry acquired from a brewery and used in conjunction with backset may be a feasible alternative to improve industrial process economy in normal gravity and in VHG fuel alcohol fermentations. [References: 22].

2356 Verma, AK.; Agarwal, N.; Agrawal, DK. (1994) **IN VITRO DEGRADATION OF WHEAT STRAW TREATED WITH NEEM (AZADIRACHTA INDICA) SEED KERNEL CAKE WATER EXTRACT.** *Bioresource Technology. 50(2):181-182.* English. [INDIAN VET RES INST DIV ANIM NUTR IZATNAGAR 243122 UTTAR PRADESH INDIA].

The wheat straw was treated with different volumes of neem (Azadirachta indica) seed kernel cake water extract (NSKCWE) for up to three weeks at ambient temperature in sealed polythene bags. There was a gradual increase in crude protein content with the increasing volume of extract in the premix and also with the increasing time of fermentation, in comparison to that of the control. The in vitro degradation study indicated that the total volatile fatty acids (TVFA) and in vitro dry matter digestibility (IVDMD) increased with the increasing volume of NSKCWE in the premix but decreased with the increase in the treatment period. The results showed that treatment of wheat straw with NSKCWE for the shortest time period (0 days) was the best among all the treatments. [References: 6].

Q52 FEED PROCESSING AND PRESERVATION

2357 Wyss, U. (1994) **[Fermentation quality of whole plant barley-pea silages]. Gaerqualitaet von Gerste-Proteinerbsen-Ganzpflanzensilagen.** Eidg. Forschungsanstalt fuer viehwirtschaftliche Produktion, Posieux (Switzerland). *Agrarforschung (Switzerland) v.1(1) p. 19-21.* 3 tables, 3 graphs, 4 ref. German. (AGRIS 95-044564).

Q53 FEED CONTAMINATION AND TOXICOLOGY

2358 Wagner, J.J. (1993) **Scab-infested wheat or barley for feedlot cattle or sheep.** *Extension extra (USA); no. 2017 2 p.* references. English. (AGRIS 95-044601).

Q54 FEED COMPOSITION

2359 Herstad, O. (Norges Landbrukshoegskole, Aas (Norway). Inst. for Husdyrfag) (1993) **Reduced phosphorus allowance in rearing and laying feed.** *Norwegian Journal of Agricultural Sciences (Norway) v. 7(2) p. 203-212.* 5 tables; 16 ref. English. (AGRIS 95-030204).

U10 MATHEMATICAL AND STATISTICAL METHODS

2360 Barreto, H.J.; Edmeades, G.O.; Chapman, S.C.; Crossa, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT),Mexico, DF (Mexico). Programa de Maiz) (1993) **[Alpha lattice designs in breeding and agronomy: Development and analysis]. El diseno alfa latice en fitomejoramiento y agronomia: Generacion y analisis.** *[Synthesis of the experimental results of the Regional Maize Program (PRM) 1992]. Sintesis de resultados experimentales del Programa Regional de Maiz para Centro America y el Caribe (PRM) 1992. Bolanos, J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Ciudad de Guatemala (Guatemala). Programa de Maiz); Sain, G. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), San Jose (Costa Rica). Programa de Maiz); Barreto, H.J. (Centro Internacional de Mejoramiento de Maiz y Trigo (CIMMYT), Mexico, DF (Mexico). Programa de Maiz); Urbina, R. (Programa Regional de Maiz para Centro America y El Caribe (PRM), Ciudad p. 273-283.* Programa Regional de Maiz (PRM). 6 tables; 6 graphs., 6 ref. Spanish. (AGRIS 95-030697).

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