March—April, 1996

Vol. 2 No. 2

Literature Update on

Wheat, Barley, and Triticale

CIMMYT

ICARDA

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Several CIMMYT staff made important contributions to this document: Dr. Edith Hesse, Leader, Information Technology Unit (editor); Fernando García, Supervisor of Information Services, and Pedro Santamaría, Database Administrator (data processing); Corinne de Gracia, Head Librarian, Efrén Orozco, Cataloguer, and José Juan Caballero, Cataloguer (categorization); Miguel Mellado, Coordinator of Design and Photography Department, and Eliot Sánchez, Design Assistant (design); Laura González, Bilingual Secretary (production, coordination and distribution).

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Subject Headings and Reference Numbers

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.

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

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

Timothy Reeves
Director General, CIMMYT

Adel El-Beltagy
Director General, ICARDA

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 ← author; 3 ← publication year; 4 ← title in English; 6 ← source; 7 ← language of text; 8 ← organization where work was carried out)

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) **[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 ← author; 8 ← organization where work was carried out; 3 ← publication year; 4 → title in English; 5 → original title; 6 ← source; 7 ← language of text; 9 ← AGRIS Reference Number)

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

(3 → author; 4 → title in English; 5 → original title; 6 → source; 7 → language of text; 9 → AGRIS Reference Number)

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

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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

1222 **[Collaborative scientific research program: 1993-1994 annual report]. barna:maj"/u al-ta3a:wn/i al-3ilmi: al-mus"tarak: al-taqri:r/u al-sanawi: 1993-1994** (1995) Ministry of Agriculture and Agrarian Reform, Damascus (Syria); International Center for Agricultural Research in the Dry Areas, Aleppo (Syria). ICARDA. Tables; fig. 226 p. ICARDA--043. Arabic. (AGRIS 96-000016).

This report presents the results and major achievements of the joint cooperative research and training program between the Syrian Ministry of Agriculture and Agrarian Reform and ICARDA during the 1993/94 season.

C20 EXTENSION

1223 Olive, M. (Cooperative Agricole "La Brie", Melun (France)) (1994) **[Evaluation of study in cereal crop with ITCF [Institut Technique des Cereales et des Fourrages]: how to prepare the farms to live in tomorrow agriculture [Synergie 2000; model CLEAN]]. Bilan d'une action conduite en culture cerealiere avec l'ITCF [Institut Technique des Cereales et des Fourrages]: comment preparer les exploitations a vivre dans l'agriculture de demain [Synergie 2000; modele CLEAN].** Annales ANPP (France) v. 3 p. 1025-1030. ANPP. v. 3 p. 1025-1030. French. (AGRIS 96-000217).

D50 LEGISLATION

1224 Bacon, RK.; Kelly, JT.; Milus, EA. (1996) **REGISTRATION OF HAZEN WHEAT.** *Crop Science. 36(1):209-210.* English. [UNIV ARKANSAS DEPT AGRON FAYETTEVILLE, AR 72701 USA].

1225 Bruckner, PL.; Taylor, GA.; Stougaard, RN.; Jackson, GD.; Carlson, GR.; Eckhoff, JL.; Kushnak, GD.; Stallknecht, GF.; Wichman, DM.; Bowman, HF.; Mathre, DE.; Hockett, EA.; Mcguire, CF. (1996) **REGISTRATION OF NUWEST WHEAT.** *Crop Science. 36(1):209.* English. [MONTANA STATE UNIV DEPT PLANT SOIL & ENVIRONM SCI BOZEMAN, MT 59717 USA].

1226 Hole, DJ.; Albrechtsen, RS.; Clawson, SM. (1996) **REGISTRATION OF GARLAND WHEAT.** *Crop Science. 36(1):208.* English. [UTAH STATE UNIV DEPT PLANTS SOILS & BIOMETEOROL LOGAN, UT 84322 USA].

1227 Meyer, D. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Zwingelberg, H. (1995) **[Processing value of new German wheat varieties 1994]. Die Verarbeitungsqualitaet neuer Weizensorten 1994.** *Getreide Mehl und Brot (Germany) v. 49(2) p. 70-73.* 1 graph, 10 tables; 1 ref. German. (AGRIS 96-013199).

1228 Mohino Paje, A. (1995) **[Nature, structure and transference of right to supplement for hard wheat]. Naturaleza, estructura y transferencia del derecho al suplemento para el trigo duro.** 4. Congreso Nacional de Derecho Agrario; Madrid (Espana); 26-28 Oct 1994. *[Agricultural and rural law. 4th National Congress, Madrid, October 1994]. Derecho agrario. 4 Congreso Nacional, Madrid, octubre 1994. Ministerio de Agricultura, Pesca y Alimentacion, Madrid (Espana) p. 209-218.* MAPA. Spanish. (AGRIS 96-000285).

1229 Mujeebkazi, A.; Villareal, RL.; Gilchrist, LA.; Rajaram, S. (1996) **REGISTRATION OF FIVE WHEAT GERMPLASM LINES RESISTANT TO HELMINTHOSPORIUM LEAF BLIGHT.** *Crop Science. 36(1):216-217.* English. [CIMMYT APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

1230 Quick, JS.; Ellis, GE.; Normann, RM.; Shanahan, JF.; Lorenz, K. (1996) **REGISTRATION OF JULES WHEAT.** *Crop Science. 36(1):208.* English. [COLORADO STATE UNIV DEPT SOIL & CROP SCI FT COLLINS, CO 80523 USA].

1231 Quick, JS.; Ellis, GE.; Normann, RM.; Stromberger, JA.; Shanahan, JF.; Peairs, FB.; Rudolph, JB.; Lorenz, K. (1996) **REGISTRATION OF HALT WHEAT.** *Crop Science. 36(1):210.* English. [COLORADO STATE UNIV DEPT SOIL & CROP SCI FT COLLINS, CO 80523 USA].

1232 Quick, JS.; Ellis, GE.; Normann, RM.; Stromberger, JR.; Shanahan, JF.; Lorenz, K. (1996) **REGISTRATION OF AKRON WHEAT.** *Crop Science. 36(1):210-211.* English. [COLORADO STATE UNIV DEPT SOIL & CROP SCI FT COLLINS, CO 80523 USA].

1233 Quick, JS.; Nkongolo, KK.; Peairs, FB.; Rudolph, JB. (1996) **REGISTRATION OF RUSSIAN WHEAT APHID-RESISTANT WHEAT GERMPLASM CORWA1.** *Crop Science. 36(1):217.* English. [COLORADO STATE UNIV DEPT SOIL & CROP SCI FT COLLINS, CO 80523 USA].

1234 Villareal, RL.; Mujeebkazi, A.; Davila, GF.; Rajaram, S. (1996) **REGISTRATION OF FOUR SYNTHETIC HEXAPLOID WHEAT GERMPLASM LINES DERIVED FROM TRITICUM TURGIDUM X T-TAUSCHII CROSSES AND RESISTANT TO KARNAL BUNT.** *Crop Science. 36(1):218.* English. [CIMMYT APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

E10 AGRICULTURAL ECONOMICS AND POLICIES

1235 Barrantes, W.; Flores, RA.; Phillips, R.; Goodwin, B. (1995) **ECONOMIC ANALYSIS FOR THE SUBSTITUTION OF WHEAT CLASSES - A CASE STUDY FOR COSTA RICA.** *Cereal Foods World. 40(11):833-836.* English. [CONSEJO NACL PROD DIV PLANNING SAN JOSE COSTA RICA].

The main objective of this study was to analyze the economic impact of substituting hard red winter wheat (HRW) of ordinary protein levels for dark northern spring wheat (DNS) with 14% protein in the Costa Rican market. In addition to 100% substitution, partial substitutions of 75, 50, and 25% HRW wheat in blends with DNS wheat were considered. Two cost models were used to analyze economic impacts. The study showed that the substitution provides potential savings to Costa Rican wheat buyers, millers, bakers, and consumers. The amount oi: savings depend on freight free on board (FOE) price differences for the two classes of wheat. When the FOE U.S. port price difference between DNS and HRW wheats is greater than 10 cents per bushel, savings in flour prices result from substituting HRW for DNS wheat in Costa Rican milling formulas. The relationship between the indifference point and HRW wheat flour yields was estimated. [References: 7].

1236 Nabawy, S.; Shalaby, E. (Ministry of Agriculture, Cairo (Egypt). Agricultural Economics Research Inst.); Hefny, R. (1992) **An economic study of some factors affecting wheat production.** *Zagazig Journal of Agricultural Research (Egypt) v. 19(2) p. 1129-1143.* 4 tables; 3 ref. Arabic. (AGRIS 96-000353).

1237 Pali Shikhulu, J.; Dlamini, S.M.; Kunene, L.S. (1994) **Agronomic and economic perspectives of wheat production in Swaziland.** *UNISWA Journal of Agriculture (Swaziland) v. 3 p. 14-24.* 3 tables; 4 fig. English. (AGRIS 96-013221).

The economic viavility and comparative advantages of wheat production in Swaziland are discussed.

E13 INVESTMENT, FINANCE AND CREDIT

1238 Peterson, EB. (1995) **INTERNATIONAL WHEAT SUBSIDIES - WHO REALLY PROFITS - MCNALLY, MM.** *American Journal of Agricultural Economics. 77(4):1078-1080.* English. [VIRGINIA POLYTECH INST & STATE UNIV BLACKSBURG, VA 24061 USA].

E16 PRODUCTION ECONOMICS

1239 **Economic report on Scottish agriculture 1992** (1993) Scottish Office Agriculture and Fisheries Department, Edinburgh (United Kingdom). Scottish Office. many tab., fig. 78 p. English. (AGRIS 96-000688).

1240 Glaze, D.; Schoney, R. (1995) **COMPARISON OF COSTS OF WHEAT PRODUCTION IN SASKATCHEWAN AND THE US NORTHERN PLAINS.** *Canadian Journal of Agricultural Economics-Revue Canadienne d Economie Rurale. 43(3):367-385.* English. [USDA ECON RES SERV WASHINGTON, DC 20250 USA].

This paper compares 1989 average variable costs for U.S. northern plains and Saskatchewan spring wheat producers. Producers are divided into three cost groups. There are more statistically significant differences between cost groups within a country than between the two countries. Relative to other producers within the same country, low-cost producers in both countries had higher yields per bushel, most had lower variable inputs both per acre and per bushel, and most had lower debt loads. In terms of intercountry comparisons, low-cost producers in Saskatchewan and the U.S. northern plains had nearly identical average variable cash costs. While mid- and high-cost Saskatchewan producers had significantly lower average variable cash costs, they were almost entirely offset by higher fixed costs. [References: 21].

1241 Meikle, S.M. (Wye College, University of London, Ashford, Kent (United Kingdom)) (1993) **A financial appraisal of cereal varieties.** *Farm Management (United Kingdom) v. 8(7) p. 297-310.* 5 ref., 9 tab. English. (AGRIS 96-000691).

E20 ORGANIZATION, ADMINISTRATION AND MANAGEMENT OF AGRICULTURAL ENTERPRISES OR FARMS

1242 Coats, R.E. Jr. (University of Arkansas.); Franco, T. (1992) **1992 wheat program.** *FSA (USA); no. 2099 2 p.* English. (AGRIS 96-013512).

1243 Hoffmann, T.R.; Warnock, W.D.; Hinman, H.R. (1994) **1994 crop enterprise budgets: timothy-legume and alfalfa hay, sudan grass, sweet corn, and spring wheat under rill irrigation in Kittitas County, Washington.** *Extension bulletin (Washington State University. Cooperative Extension) (USA); no. 1173, rev. 48 p.* English. (AGRIS 96-000805).

E70 TRADE, MARKETING AND DISTRIBUTION

1244 Brorsen, B.W. (Oklahoma State University.); Anderson, K. (1994) **Cash wheat marketing: strategies for real people.** *Journal of agribusiness (USA) v. 12(2) p. 85-94.* references. English. (AGRIS 96-013779).

1245 Rust, C.H. (Montana State University.); Taylor, G.A.; McGuire, C.F.; Kisha, T.J. (1994) **Marketing MT7811, Montana hard white winter wheat.** *Montana agresearch (USA) v. 11(2) p. 14-18.* references. English. (AGRIS 96-013781).

1246 Wilson, WW.; Johnson, DD. (1995) **NORTH AMERICAN MALTING BARLEY TRADE - IMPACTS OF DIFFERENCES IN QUALITY AND MARKETING COSTS.** *Canadian Journal of Agricultural Economics-Revue Canadienne d Economie Rurale. 43(3):335-353.* English. [N DAKOTA STATE UNIV DEPT AGR ECON FARGO, ND 58105 USA].

Differences between U.S and Canadian marketing policies in malting barley have been identified as potential sources of trade distortions. Most important are issues related to quality control, yield differentials between feed and malting varieties, and differences in handling costs. This study analyzes effects of changes in selected marketing policies on trade flows and prices in the North American malting barley sector using a mathematical programming model Simulation results illustrate impacts of relaxed variety release requirements, increased selection rates for malting barley, reduced Canadian handling costs and the effect of increased Canadian exports of malting barley to offshore markets. The results quantify effects of these strategic issues on both the United States and Canadian barley sectors. [References: 17].

E71 INTERNATIONAL TRADE

1247 Duncan, M.; Koo, W. (1995) **The United States/Canada durum wheat war.** *Choices (Ames, Iowa) (USA) v. 10(1) p. 30-34.* references. English. (AGRIS 96-013895).

1248 Feng, L. (School of Business and Economic Studies, Leeds University, Leeds (United Kingdom)) (1993) **Comparative advantage and food grain imports in China.** *Journal of International Development (United Kingdom) v. 5(3) p. 275-289.* 18 ref., 1 fig., 13 tab. English. (AGRIS 96-001270).

1249 Mohanty, S.; Peterson, EWF.; Kruse, NC. (1995) **PRICE ASYMMETRY IN THE INTERNATIONAL WHEAT MARKET.** *Canadian Journal of Agricultural Economics-Revue Canadienne d Economie Rurale. 43(3):355-366.* English. [UNIV NEBRASKA DEPT AGR ECON LINCOLN, NE 68588 USA].

Most wheat exports are accounted for by a limited number of countries with different policy regimes and specializing, for the most part, in particular classes of wheat. Under these circumstances, there is likely to be considerable interaction among the major exporting countries in the determination of wheat prices. In this paper, price linkages between the US. and other exporting countries (Canada, the European Union, Argentina and Australia) in the would wheat market are investigated. After determining that the direction of causality is from U.S. prices to the prices of other exporting countries, the nature of the price linkages is studied. The results suggest that the major exporting countries respond asymmetrically to U.S. price changes. The degree of asymmetry differs from one exporting country to another. Argentina and the European Union show greater response to falling prices than to rising prices, while the opposite is true for Canada and Australia. [References: 40].

1250 Norris, S. (1993) **Government programs for wheat farmers in the USA 1992.** Nuffield Farming Scholarships Trust. tab., fig. 29 p. English. (AGRIS 96-001271).

F01 CROP HUSBANDRY

1251 **Eighty-fifth Annual Report, 1992-1993 [Work in progress at the Morley Research Centre is summarized]** (1993) Morley Research Centre, Norfolk (United Kingdom). Morley Research Centre. ref. at ends of papers. 176 p. English. (AGRIS 96-001515).

1252 **[Harvesting forecasting of three main cereals: hard wheat, soft wheat and barley 1994-1995]. Prevision des recoltes des trois principales cereales: ble dur, ble tendre et orge compangne agricole 1994-1995** (1995) Ministere de l'Agriculture et de la Mise en Valeur Agricole, Rabat (Maroc). Direction de la Programmation et des Affaires Economiques. 6 tables; 6 ill. 21 p. French. (AGRIS 96-014159).

1253 **[Proceedings of the 1. day of techno-economic actualization of the malting barley crop]. 1. Jornada de actualizacion tecnico economica del cultivo de cebada cervecera** (1994) *1. Jornada de actualizacion tecnico economica del cultivo de cebada cervecera; Buenos Aires (Argentina); 10 May 1994.* Secretaria de Agricultura, Ganaderia y Pesca, Buenos Aires (Argentina). Direccion de Produccion Agricola. 121 p. Spanish. (AGRIS 96-001434).

1254 **[Results of the four principal cereals : agricultural campaign 1993-94 [Morocco]]. Resultats des quatre principales cereales : campagne agricole 1993-94 [Maroc]** (1994) Ministere de l'Agriculture et de la Mise en Valeur Agricole, Rabat (Maroc). Direction de la Planification et des Affaires Economiques. Division des Statistiques et de l'Informatique. Nombreux tableaux. 55 p. French. (AGRIS 96-001474).

1255 **[Sowing wheat crops]. Les points cles pour reussir une bonne implantation [du ble]** (1995) Institut Technique des Cereales et des

Fourrages, Paris (France). *Perspectives Agricoles (France) (no.205) p. 64-67.* French. (AGRIS 96-014155).

1256 Amerasinghe, N. (Asian Development Bank, Manila (Philippines). Agriculture Dept.) (1994) **Support to the rice-wheat research system in Asia.** RAPA Publication (FAO); no. 1994/11 p. 131-141. p. 131-141. English. (AGRIS 96-014115).

1257 Aubry, C. (Institut National de la Recherche Agronomique, Thiverval Grignon (France). Centre de Grignon Massy Paris, Systemes Agraires et Developpement) (1995) **[Survey about wheat and rape crops management in Champagne Berrichonne area (France)]. Enquete en Champagne Berrichonne: les pratiques des agriculteurs.** *Perspectives Agricoles (France) (no.206) p. 22-29.* 9 ref. French. (AGRIS 96-014156).

1258 Baumer, M. (Bayerische Landesanstalt fuer Bodenkultur und Pflanzenbau Freising Muenchen, Freising (Germany)) (1994) **[Winter forms of malting barley performed well in Bavaria - good grain quality and crude protein contents]. Winterbraugerste machte heuer das Rennen - Gute Kornqualitaet und guenstige Rohproteinwerte ueberzeugten.** *Bayerisches Landwirtschaftliches Wochenblatt (Germany) v. 184(50) p. 38-39.* 3 graphs. German. (AGRIS 96-001438).

1259 Bonachela, S.; Orgaz, F.; Fereres, E. (1995) **WINTER CEREALS GROWN FOR GRAIN AND FOR THE DUAL PURPOSE OF FORAGE PLUS GRAIN.** *Field Crops Research. 44(1):1-11.* English. [CSIC INST AGR SOSTENIBLE APDO 4048 E-14080 CORDOBA SPAIN].

In many rainfed regions of Euro-Mediterranean countries, current political and socio-economic developments demand research in alternative production systems to the common cereal grain monoculture. We studied the option of producing forage in winter by growing cereals for dual purpose (forage plus grain) in a Mediterranean environment. The effect of clipping on forage and grain production was assessed between 1987 and 1990 at Granada, southern Spain, in four cereal cultivars, and in one barley cultivar under three sowing systems. Winter forage yield of cereals, all clipped once at the stage of lemma primordia, was highly variable (25 to 311 g m(-2) of herbage dry matter), with considerable differences among cultivars, sowing systems and seasons. Treatments that had higher forage production were those of either longer crop duration before clipping date (with higher leaf numbers on the main stem and tiller numbers per plant) or higher plant density. Forage production was not related to grain yield reductions due to winter clipping. Averaged over cultivars, sowing systems and seasons, clipping reduced grain yield by 1%, but yielded some 127 g m(-2) of dry matter per season in a period of pasture shortage. Nevertheless, the responses to winter clipping differed among seasons. In 1987/88, clipped cereals produced more dry matter and grain than the control. In contrast, in the last two seasons, clipping reduced dry matter and grain production. Early sowing modified the response to clipping in these last two seasons. Grain yield of early sown barley was not reduced by clipping in 1988/89 and was even increased in 1989/90. The dual-purpose target for cereals could be an alternative to traditional grain monoculture in some Mediterranean environments, provided that adaptations of the traditional crop management to dual purpose, such as the optimization of sowing date and cultivar, are undertaken. [References: 35].

1260 Bonachela, S.; Orgaz, F.; Fereres, E. (1995) **WINTER CEREALS GROWN FOR GRAIN AND FOR THE DUAL PURPOSE OF FORAGE PLUS GRAIN .2. WATER USE AND WATER-USE EFFICIENCY.** *Field Crops Research. 44(1):13-24.* English. [CSIC INST AGR SOSTENIBLE APDO 4048 E-14080 CORDOBA SPAIN].

Water use of barley (Hordeum distichon L.) and triticale (X Triticosecale Wittmack) grown for the dual purpose of forage plus grain as an alternative to traditional grain monoculture (control) was assessed at Granada, southern Spain, in two experiments during three cropping years. No significant differences in seasonal evapotranspiration (ET) and soil water depletion at maturity were found between production targets, irrespective of genotype, sowing date and year. A more efficient use of autumn and winter rainfall explained the higher water use observed in 1989/90 in early sown barley as compared to the normal sowing date. There were differences in water-use efficiency (WUE) between seasons in response to clipping: in 1987/88, clipping increased WUE in both experiments relative to the control, while it either reduced it (genotype experiment) or did not affect it (sowing system experiment) in the two following seasons. The response of WUE to clipping was a consequence of similar, differential responses between years observed in dry matter and grain production. Weather-crop interactions caused variable drought and crop water-use patterns among years, which affected the different responses to clipping observed among years. In 1987/88, the crops experienced a prolonged drought period that started around clipping, and increased in severity until anthesis, when spring rains improved growth conditions for some weeks. Forage removal decreased water use and reduced plant water deficit, therefore allowing for enhanced growth and increased water use around anthesis. Thus, clipped cereals had higher grain numbers, dry matter and grain yield than the control at harvest. However, the water-use partitioning observed in the clipping-anthesis period of 1987/88 did not occur in following two seasons. This was possibly due to higher soil evaporation losses after forage removal for clipped cereals in 1988/89, and higher water availability in the clipping-anthesis period in 1989/90. Thus, clipping, by reducing the photosynthetic surface after forage removal, yielded less biomass and grain, and resulted in lower WUE, relative to the control. Winter forage production was associated to ET in 1987/88 and 1989/90, and to WUE in 1988/89 and 1989/90, during the crop phases prior to clipping. However, the increases in ET did not imply lower water availability for subsequent crop phases, as it was the result of more efficient use of autumn and winter rainfall. [References: 27].

1261 Bridger, GM.; Klinck, HR.; Smith, DL. (1995) **TIMING AND RATE OF ETHEPHON APPLICATION TO TWO-ROW AND SIX-ROW SPRING BARLEY.** *Agronomy Journal. 87(6):1198-1206.* English. [MCGILL UNIV DEPT PLANT SCI MACDONALD CAMPUS 21111 LAKESHORE RD ST ANNE DE BELLEVUE PQ H9X 3V9 CANADA].

Ethephon (2-chloroethyl phosphonic acid) reduces lodging in barley (Hordeum vulgare L.) by shortening straw; but the optimal rate and growth stage of application, both of which may interact with cultivar and environment, are unclear, especially for two-row barley in North America. Field studies in Quebec in 1985 and 1986 evaluated the response of 'Leger' six-row and 'Birka' two-row barley to ethephon applied at varying rates, growth stages, and times of day. The two-row cultivars Rodeo and Micmac were also included in one experiment. Lodging was slight or absent in all experiments. The taller Leger was usually shortened more than Birka, largely due to greater shortening of the peduncle. Late boot applications of ethephon consistently shortened straw but the window of effective application began at the flag leaf stage and extended for more than 1 wk for Birka, while for Leger it was about 4 d, but differed phenologically between years. Heading was delayed by ethephon. In Rodeo and Birka, ethephon often reduced the degree of spike emergence from the flag leaf sheath. Incomplete spike emergence may have contributed to reduced kernel and test weights, particularly with applications from the flag leaf until the late boot stage. Ethephon increased Leger yield by up to 15% in one experiment under the favorable conditions of 1985. In 1986, a wet year, yield in one experiment was reduced by 11% by the higher ethephon rate (480 g a.i. ha(-1)), due to reduced spikes per square meter. Birka yield was reduced ($P = 0.06$) by 6% by the higher rate (480 g a.i. ha(-1)) in the 1986 application date study Harvest index of Rodeo and Birka was reduced due to reduced tiller survival following application of ethephon at 480 to 500 g a.i. ha(-1). Yield component compensation usually occurred between spikes per square meter and kernel weight, particularly for two-row cultivars. Height was reduced more by applications at 0400 h and 0600 h than later in the day Birka kernel weight was reduced with morning or evening applications, while Leger kernel weight was little affected by application time of day. In the absence of lodging and under conditions of environmental stress, ethephon applied at rates over 240 g a.i. ha(-1) may reduce yields, particularly of two-row barley, for which spike emergence may be severely reduced. [References: 36].

1262 Brohl, H. W. (1995) **[Do peas and beans relief the cereal/rape crop rotation?]. Ackerbau: Entlasten Erbsen und Bohnen die Getreide-/Raps-**

Fruchtfolge? *Agrar-Uebersicht (Germany) v. 46(2) p. 12-13.* 1 ill., 1 table. German. (AGRIS 96-014357).

1263 Castagna, R.; Borghi, B.; Difonzo, N.; Heun, M.; Salamini, F. (1995) **YIELD AND RELATED TRAITS OF EINKORN (T-MONOCOCCUM SSP MONOCOCCUM) IN DIFFERENT ENVIRONMENTS.** *European Journal of Agronomy. 4(3):371-378.* English. [IST SPERIMENTALE CEREALICOLTURA VIA MULINO 3 I-20079 SAN ANGELO LODIGIANO ITALY].

Triticum monococcum ssp. monococcum (einkorn), a widely cultivated crop in the Neolithic age, is reconsidered in modern agriculture because of the rising demand for high quality, low input cereals. Yield and yield related traits of Triticum monococcum ssp. monococcum (einkorn) were measured by growing twenty-one lines in Cologne (Germany), Milano, Ascoli Piceno and Foggia (Italy). The effects of six different seeding rates (ranging from 100 to 600 kernels m(-2)) and three different nitrogen levels (0, 80 and 120 kg ha(-1)) were tested at three Italian locations (Milano, Chieuti and Foggia). The gross grain yield (i.e., the yield of the grain with adhering glumes) was influenced by the environment, with a maximum at Cologne (4.5 t ha(-1)) and a minimum at Foggia (0.84 t ha(-1)). The three nitrogen levels did not influence grain yield or plant height. These two traits and the heading time were significantly affected by the seeding rate. The maximum gross grain yield was obtained with a seeding rate of 300 kernels m(-2). With the exception of the total biomass and the number of spikes m(-2), all other yield related traits varied significantly among the einkorn lines. In the Southern environments the long life cycle of einkorn wheat appears to be a yield-limiting factor. The observed genetic differences for important traits like earliness in this limited sample of einkorn lines, indicate that breeding programs could generate lines being better adapted to modern farming. [References: 21].

1264 Chudanov, I.A.; Popov, I.I.; Ligostaeva, L.F.; Svetkina, N.V.; Boryakova, E.A. (1994) **[Fallow predecessors of durum wheat]. Parovye predshestvenniki tverdoj pshenitsy.** *Stepnye prostory (Russian Federation) (no.8) p. 12-13.* Russian. (AGRIS 96-014172).

1265 De Villiers, O.T. (Stellenbosch Univ. (South Africa). Dept. of Botany); Laubscher, E.W. (1995) **Use of the SDSS [sodium dodecyl sulphate sedimentation] test to predict the protein content and bread volume of wheat cultivars.** *South African Journal of Plant and Soil (South Africa) v. 12(4) p. 140-142.* English. (AGRIS 96-014171).

1266 El Shazly, M.S. (Suez Canal Univ., Ismaileyah (Egypt). Faculty of Agriculture); Abd El Hakim, A.M. (1992) **Multivariate analysis of yield and the relative contributions of variables to its variation in barley.** *Zagazig Journal of Agricultural Research (Egypt) v. 19(2) p. 703-709.* 4 tables; 12 ref. English. (AGRIS 96-001439).

1267 Ervio, LR.; Jalli, H.; Kontturi, M.; Hakkola, H.; Kangas, A.; Simojoki, P. (1995) **BENEFIT OF USING PLANT GROWTH REGULATORS IN FODDER BARLEY.** *Agricultural Science in Finland. 4(4):429-443.* English. [AGR RES CTR INST PLANT PROTECT SF-31600 JOKIOINEN FINLAND].

The study was conducted to investigate the effect and benefit of applying plant growth regulators (PGR) to two easily lodging barley cultivars, Arra and Kilta, which were commonly used for fodder production all over Finland. Field trials were conducted at six experimental sites in different parts of the country. Of the PGRs tested, ethephon and mepiquat/ethephon were the most effective in shortening the culm and preventing lodging. However, neither could prevent the lodge adequately in all growing circumstances. When applied at flag-leaf stage (FS 10) they increased yield under conditions favourable for lodging. They also raised the volume weight of barley, which was important for the final price of the yield. The most important factors determining future lodging of barley were an effective temperature sum of over +5 degrees C and precipitation during the period from sowing to the beginning of tillering (FS 2). About 64-68% of the lodging risk of the cultivars studied could be predicted from weather conditions during early development of the crop. Local growing conditions and the presence of lodge had a marked impact on the results obtained with PGRs. In the case of moderate lodging the compound used determined whether a profit or loss was made on the crop. In the case of heavy lodging, compounds containing ethephon contributed to an economic return. Their application at flag-leaf stage gave a profit of FIM 70 - 390 ha(-1). Since the profitability of PGR treatments de pended on lodging, treatments are recommended for fodder barley only when lodging is expected. The lodging risk can be predicted within certain limits at the tillering stage of barley.

1268 Famera, O. (Ceska Zemedelska Univ., Prague Suchdol (Czech Republic)) (1995) **[Growing of two-rowed winter barley in the Czech Republic]. Budeme pestovat dvourady ozimy jecmen?** *Uroda (Czech Republic) v. 43(7) p. 10-11.* 2 tables. Czech. (AGRIS 96-001437).

1269 Gomezmacpherson, H.; Richards, RA. (1995) **EFFECT OF SOWING TIME ON YIELD AND AGRONOMIC CHARACTERISTICS OF WHEAT IN SOUTH-EASTERN AUSTRALIA.** *Australian Journal of Agricultural Research. 46(7):1381-1399.* English. [CIDA DEPT SUELOS & RIEGOS APDO 4240 E-14080 CORDOBA SPAIN].

The main environmental constraints to the yield of dryland wheat in south-eastern Australia are: a low and erratic rainfall throughout the growing season, the chance of frost at flowering time, and high temperatures during the grain-filling period. The aims of this work were threefold. Firstly, to determine which sowing period minimizes these constraints and results in the highest yields. Secondly, what is the optimum flowering time for a given sowing date so that maximum yield is achieved. The third aim was to determine whether any crop characteristic was associated with high yield or may limit yield in the different sowings. The experiments were conducted at three sites in New South Wales that were representative of dry (Condobolin) and cooler and wetter (Moombooldool, Wagga Wagga) sites in the south-eastern wheatbelt. In this study several sets of isogenic material, involving a total of 23 genotypes, that were similar in all respects except for flowering time, were sown early (mid-April and early May), normal (mid to late May) and late (June to mid July). Characteristics of the highest-yielding lines in each experiment are presented. The average flowering time of the highest yielding lines in all sowings had a range of only 12 days at the driest site, but a range of over 20 days at the coolest and wettest site. The optimum anthesis date (day of year, gamma) was related to sowing date (day of year, doy) at the cooler sites such that: gamma = 245+0.32 doy (r(2) = 0.86) and at Condobolin, gamma = 253+0.19 doy (r(2) = 0.91). Optimum anthesis date expressed in thermal time (degrees C days) after sowing (gamma) was related to sowing time (doy) as follows: gamma = 2709 -8.3 doy (r(2) = 0.84). It is suggested that these relationships are likely to be quite robust and should hold true for similar thermal environments in eastern Australia. There was little variation in grain yield between the earliest sowing in mid-April (108 doy) and sowings throughout May (up to 147 doy). Grain yield declined 1.3% per day that sowing was delayed after late May. Aboveground biomass was substantially higher in early sown crops. However, this did not translate into higher yields. From the evidence presented it is argued that the principal reason that greater yields were not obtained in the early sowings, particularly in the April sowing, was the greater competition for assimilates between the growing spike and the elongating stem. It is suggested that a way of overcoming this competition is to genetically shorten the stems of winter wheats. This should capitalize on the considerable advantages in terms of water use efficiency that early sowing offers and result in greater yields. Barley yellow dwarf virus, although present at the cooler, wettest site in one year, was more frequent in the later sowings than in the early sowing and was not likely to have contributed to the lower than expected yields in the early sowings. [References: 35].

1270 Gordon, DC.; Vanvuuren, MMI.; Marshall, B.; Robinson, D. *(1995)* **PLANT GROWTH CHAMBERS FOR THE SIMULTANEOUS CONTROL OF SOIL AND AIR TEMPERATURES, AND OF ATMOSPHERIC CARBON DIOXIDE CONCENTRATION.** *Global Change Biology. 1(6):455-464.* English. [SCOTTISH CROP RES INST DEPT CELLULAR & ENVIRONM PHYSIOL DUNDEE DD2 5DA SCOTLAND].

Many facilities for growing plants at elevated atmospheric concentrations of CO2 ([CO2]) neglect the control of temperature, especially of the soil. Soil and root temperatures in conventional, free-

standing pots often exceed those which would occur in the field at a given air temperature. A plant growth facility is described in which atmospheric CO2 can be maintained at different concentrations while soil and air temperatures mimic spatial and temporal patterns seen in the field. It consists of glasshouse-located chambers in which [CO2] is monitored by an infra-red gas analyser and maintained by injection of CO2 from a cylinder. Air is cooled by a heat exchange unit. Plants grow in soil in 1.2 m long containers that are surrounded by cooling coils and thermal insulation. Both [CO2] and temperature are controlled by customized software. Air temperature is programmed to follow a sine function of diurnal time. Soil temperature at a depth of 0.55 m is programmed to be constant. Temperature at 0.1 m depth varies as a damped, lagged function of air temperature; that at 1.0 m as a similar function of the 0.55 m temperature. [CO2] is maintained within 20 mu mol mol(-1) of target concentrations during daylight. A feature of the system is that plant material is labelled with a C-13 enrichment different from that of carbon in soil organic matter. The operation of the system is illustrated with data collected in an experiment with spring wheat (Triticum aestivum L., cv Tonic) grown at ambient [CO2] and at [CO2] 350 mu mol mol(-1) greater than ambient. [References: 14].

1271 Grashoff, C.; Dijkstra, P.; Nonhebel, S.; Schapendonk, AHCM.; Vandegeijn, SC. (1995) **EFFECTS OF CLIMATE CHANGE ON PRODUCTIVITY OF CEREALS AND LEGUMES MODEL EVALUATION OF OBSERVED YEAR-TO-YEAR VARIABILITY OF THE CO2 RESPONSE.** *Global Change Biology. 1(6):417-428.* English. [DLO RES INST AGROBIOL & SOIL FERTIL AB POB 14 6700 AA WAGENINGEN NETHERLANDS].

The effect of elevated [CO2] on the productivity of spring wheat, winter wheat and faba bean was studied in experiments in climatized crop enclosures in the Wageningen Rhizolab in 1991-93. Simulation models for crop growth were used to explore possible causes for the observed differences in the CO2 response. Measurements of the canopy gas exchange (CO2 and water vapour) were made continuously from emergence until harvest. At an external [CO2] of 700 mu mol mol(-1), Maximum Canopy CO2 Exchange Rate (CCFRmax) at canopy closure was stimulated by 51% for spring wheat and by 71% for faba bean. At the end of the growing season, above ground biomass increase at 700 mu mol mol(-1) was 58% (faba bean), 35% (spring wheat) and 19% (winter wheat) and the harvest index did not change. For model exploration, weather data sets for the period 1975-88 and 1991-93 were used, assuming adequate water supply and [CO2] at 350 and 700 mu mol mol(-1). For spring wheat the simulated responses (35-50%) were at the upper end of the experimental results. In agreement with experiments, simulations showed smaller responses for winter wheat and larger responses for faba bean. Further model explorations showed that this differential effect in the CO2 response may not be primarily due to fundamental physiological differences between the crops, but may be at least partly due to differences in the daily air temperatures during comparable stages of growth of these crops. Simulations also showed that variations between years in CO2 response can be largely explained by differences in weather conditions (especially temperature) between growing seasons. [References: 39].

1272 Guy, SO.; Tablasromero, H.; Heikkinen, MK. (1995) **AGRONOMIC RESPONSES OF WINTER WHEAT CULTIVARS TO MANAGEMENT SYSTEMS.** *Journal of Production Agriculture. 8(4):529-535.* English. [UNIV IDAHO DEPT PLANT SOIL & ENTOMOL SCI MOSCOW, ID 83844 USA].

Management of winter wheat (Triticum aestivum L.) should include N fertilization, crop protection, and seeding rates that allow efficient production based on cultivar and environmental yield potential. These studies were conducted to evaluate regionally grown cultivar responses to crop management systems in northern Idaho. In three environments, four cultivars were grown using management treatments (MT) similar to current recommended practices (MT3); a treatment with conservative N fertilization (MT2); a low input treatment with lower N, lower seeding rate, and minimal herbicide (MT1); and a high input treatment with higher N with split applications, plus a fungicide and growth regulator application (MT4). Data on grain yield, protein, test weight, plant height, and lodging were collected in all studies. In the two studies in 1992, leaf tissue N and soil N were analyzed and yield components were determined. Environment X MT and environment X cultivar interactions were found for grain yield, test weight, and protein. In 1991 at Moscow, the hard red wheat 'Weston' produced the highest grain yields across MTs and was the only cultivar to produce highest yields with MT4. Also in that environment, the three soft white cultivars produced higher yield and test weight and lower protein in MT2 than in MT3. In 1992 at Potlatch, limited soil water restricted yield, and MT1 had lower yields than other MTs, but protein content increased with higher N fertility. At Moscow in 1992, agronomic performance appears better in MT1 than in other treatments due to abundant early vegetative growth in the higher N fertility treatments that was followed by a soil water deficit throughout reproductive stages. Weston produced the lowest yield, heads per acre, and kernels per head at Moscow in 1992, but was highest in test weight, grain protein, and plant height. At both sites in 1992, yield components were positively correlated to yield, indicating treatment differences were influencing yield throughout several plant growth stages. High inputs (MT4) can be beneficial under some circumstances, but conservative N fertilization with conventional practices (MT2) gave the best overall agronomic performance across the tested environments and cultivars.

1273 Hossain, M. (International Rice Research Inst., Manila (Philippines). Div. of Social Sciences) (1994) **Rice-wheat production system in eastern India and Bangladesh: recent development and economic constraints.** RAPA Publication (FAO); no. 1994/11 p. 97-111. p. 97-111. English. (AGRIS 96-014113).

1274 Howell, T.A. (USDA, ARS, Conservation and Production Research Laboratory, Bushland, TX.); Steiner, J.L.; Schneider, A.D.; Evett, S.R.; Tolk, J.A. (1994) **Evapotranspiration of irrigated winter wheat, sorghum, and corn.** *American Society of Agricultural Engineers. Meeting (USA); no. 94-2066/94-2090 33 p.* references. Paper presented at the "1994 International Summer Meeting sponsored by The American Society of Agricultural Engineers," June 19-22, 1994, Kansas City, Missouri. Issue numbers not consecutive. English. (AGRIS 96-014097).

1275 Hussain, A.; Khan, S.; Mohammad, D.; Bhatti, MB.; Mufti, MU. (1995) **YIELD AND QUALITY OF FODDER OAT (AVENA SATIVA) AND BARLEY (HORDEUM VULGARE) AT VARIOUS STAGES OF HARVESTING.** *Indian Journal of Agricultural Sciences. 65(12):849-852.* English. [PAKISTAN AGR RES COUNCIL NATL AGR RES CTR ISLAMABAD 45500 PAKISTAN].

An experiment was conducted during 1990 and 1991 to evaluate yield and quality of fodder for various harvesting stages in oat (Avena sativa L.) and barley (Hordeum vulgare L. sensu late). The stages of harvesting were: repeated cutting of plants at 4-leaf, tillering, jointing and booting stages, and harvesting of plant once at ear emergence, 50% flowering, 100% flowering, early milk and early dough stages. Oat harvested at booting stage and barley at 100% flowering stage gave the maximum green-fodder yields (79.45 and 63.10 tonnes/ha respectively). In oat and barley crops, the highest dry-matter yield (15.54 and 13.75 tonnes/ha respectively) was recorded at early dough stage. In both the crops crude protein contents decreased with the advancement in crop maturity. The maximum crude protein content (14.93 and 14.37% in oat and barley respectively) was observed when the crops were cut repeatedly at 4-leaf stage, whereas the minimum at early dough stage in both the crops. Oat and barley harvested at booting stage proved better for reasonable green-fodder yield (67.32 tonnes/ha), dry-matter yield (11.66 tonnes/ha) and fodder quality (crude protein 10.33%). At this stage sufficient quantity of fodder yield with moderate quality was obtained in both the crops. [References: 6].

1276 Jackson, L.F. (University of California, Davis.); Qualset, C.O.; Wennig, R.L.; Vogt, H.; Gibbs, L.K.; Campbell, M.; Fulton, A.; Kearney, T.; Mauk, P.; Munier, D. (1994) **1994 regional barley, common and durum wheat, triticale, and oat performance tests in California.** *Agronomy progress report (USA); no. 244 50 p.* English. (AGRIS 96-014084).

1277 Jamieson, PD.; Martin, RJ.; Francis, GS.; Wilson, DR. (1995) **DROUGHT EFFECTS ON BIOMASS PRODUCTION AND RADIATION-USE EFFICIENCY IN BARLEY.** *Field Crops Research.* 43(2-

3):77-86. English. [NEW ZEALAND INST CROP & FOOD RES LTD PRIVATE BAG 4704 CHRISTCHURCH NEW ZEALAND].

Changes in biomass production of a barley crop in response to droughts of various timing and duration were analysed using a simple radiation interception model. Decreased growth rates were caused primarily by reductions in radiation-use efficiency when drought was imposed from emergence. In these treatments radiation-use efficiency was depressed even after drought was relieved. In contrast, in treatments where drought was imposed from two weeks before anthesis or later, the primary cause of reduced biomass production was a decrease in the amount of radiation intercepted, mostly associated with more rapid leaf senescence. For the later drought treatments, the radiation-use efficiency was stable and near the maximum value for unstressed crops. However, final biomass was sensitive to drought timing and, in particular, was more sensitive to maximum potential soil moisture deficit for the early than the later drought treatments. [References: 25].

1278 Kadayat, K.B.; Dhital, B.K. (Lumle Agricultural Research Centre, c/o BAPSO, P.O. Box 106, Kathmandu (Nepal)) (1995) **[Report on wheat outreach research trials of 1993/94].** *LARC Working Paper (Nepal); no. 95/43 33 p.* Lumle Agricultural Research Centre. English. (AGRIS 96-001427).

A total of eight Outreach Research trials on wheat were conducted at Outreach Research (OR) and Off Station Research (OSR) sites in winter 1993. The altitude range varied from 375-2200m asl.

1279 Khera, KL.; Sandhu, BS.; Aujla, TS.; Singh, CB.; Kumar, K. (1995) **PERFORMANCE OF WHEAT (TRITICUM AESTIVUM) IN RELATION TO SMALL CANARY GRASS (PHALARIS MINOR) UNDER DIFFERENT LEVELS OF IRRIGATION, NITROGEN AND WEED POPULATION.** *Indian Journal of Agricultural Sciences. 65(10):717-722.* English. [PUNJAB AGR UNIV DEPT SOILS LUDHIANA 141004 PUNJAB INDIA].

A 3-year field experiment was conducted during the winter season of 1986-87 to 1988-89 to evaluate the performance of wheat (Triticum aestivum L. emend. Fiori & Paol.) under different levels of irrigation, nitrogen and weed population. It was laid out on a deep, well-drained, sandy-loam soil of Ludhiana, with 18 combinations comprising 2 irrigation regimes based on irrigation water : cumulative pan evaporation (IW:PAN-E) ratio of 0.4 and 0.8, 3 levels of N (80, 120 and 160 kg N/ha) and 3 weed population intensities (0, 40 and 80 plants/m(2)) of small canary grass (Phalaris minor Retz.). Weed-population intensity of 40 and 80 plants/m(2) decreased the grain yield of wheat by 21 and 23% respectively. The nitrogen x weed population interaction was not significant. Irrigation regime had no significant effect on the grain yield of wheat. There was high depletion of soil moisture From the soil profile in the presence of weeds and higher levels of N.

1280 Kren, J. (Zemedelsky Vyzkumny Ustav, Kromeriz (Czech Republic)) (1995) **[Winter cereals and their perspective]. Ozime obiloviny a jejich perspektiva.** *Uroda (Czech Republic) v. 43(7) p. 8-9.* 4 graphs. Czech. (AGRIS 96-001479).

1281 Krenzer, G. Jr. (Oklahoma Cooperative Extension Service.) (1994) **Wheat for pasture.** *OSU extension facts (USA); no. F-2586, rev. 6 p.* English. (AGRIS 96-014165).

1282 Maddens, K.; Denoo, A.; Vanpeteghem, J.; Calus, A. (Provincie West Vlaanderen, Rumbeke (Belgium). Onderzoek en Voorlichtingscentrum voor Landen Tuinbouw) (1995) **[Cereal crops. Results of research performed in 1994 [in Belgium]]. Graangewassen. Overzicht van het onderzoek 1994.** 86 p. Dutch. (AGRIS 96-014087).

1283 Miliuviene, L.; Gaveliene, V. (Inst. of Botany, Vilnius (Lithuania)); Laeaets, K.; Rang, H. (Estonian Academy of Sciences, Tallinn (Estonia). Inst. of Chemistry) (1995) **Investigation of the effect of preparation No. 18-173 on intercalary growth of stems and yield of barley.** Estonian Academy of Sciences, Tallinn (Estonia). *Proceedings of the Estonian Academy of Sciences (Estonia); Biology v. 44(1-2) p. 32-37.* 1 fig., 2 tables; 11 ref. English. (AGRIS 96-001435).

During 1991-1993, the preparation No. 18-173 of the Institute of Chemistry, Tallinn, on spring barley 'Auksiniai-3' in field tests has been studied at the Institute of Botany, Vilnius. Preparation No. 18-173 (300 g a.i./ha) increased the yield of grain 2.8-10.5 per cent as compared to the control. With the known preparation, chloroethyl-phosphonic acid (E) (500 g a.i./ha), the yield of grain was not enhanced. The resistance of barley stems to lodging in grades were: preparation E 4.8-5.0; No. 18-173 4.2-4.9; control 3.0-4.8.

1284 Miller, T. (Mississippi State University); Williams, B.; Broome, M.; Fox, J. (1994) **Wheat.** *Mississippi State University. Cooperative Extension Service (USA); no. 1491 2 p.* references. English. (AGRIS 96-001482).

1285 Molenda, M.; Horabik, J.; Ross, IJ. (1995) **DYNAMIC LOAD RESPONSE IN A MODEL BIN AT THE START OF GRAIN DISCHARGE.** *Transactions of the ASAE. 38(6):1869-1873.* English. [UNIV KENTUCKY DEPT AGR & BIOSYST ENGN LEXINGTON, KY 40546 USA].

The dynamic response of the vertical wall and bottom loads at the start of grain discharge was influenced by wall configuration and filling method for model bins in plug flow. Experiments were conducted with wheat in cylindrical smooth wall and corrugated bins which were 0.6 m in diameter and 2.4 m high. Central spout and sprinkle filling methods were tested. The highest wall load increase was observed for the smooth wall bin when centrally filled. The corrugated wall and sprinkle Filing method produced the smallest wall load increase. A peaked response of the dynamic wall load was observed for both bin wall surfaces which were center filled. Two steps of wall load increase after the start of discharge were observed for sprinkle filling of the smooth wall bin, one occurred immediately after orifice opening and the second occurred after 1 to 2 min of discharge. [References: 17].

1286 Nass, HG.; Johnston, HW.; Blatt, CR.; Atlin, G.; Walton, RB. (1995) **AC WINSLOE WINTER WHEAT.** *Canadian Journal of Plant Science. 75(4):905-907.* English. [AGR CANADA RES CTR POB 1210 CHARLOTTETOWN PE C1A 7M8 CANADA].

AC Winsloe is a winter feed wheat (Triticum aestivum L. em. Thell.) with high grain yield, lodging resistance, and good winter survival. It is resistant to powdery mildew (caused by Erisyphe graminis D.C. ex Merat f. sp. tritici Marchal), moderately resistant to septoria leaf and glume blotch [caused by Septoria nodorum (Berk.) Perk.] and moderately resistant to fusarium head blight (caused by Fusarium graminearum Schwab and other Fusarium spp.). AC Winsloe is suitable for production in Eastern Canada, particularly in the Atlantic region.

1287 Nelson, L.A. (University of Nebraska.); Baltensperger, D.D.; Elmore, R.W.; Nordquist, P.T.; Baenziger, P.S.; Klein, R.N.; Petrisko, J. (1994) **Nebraska fall-sown small grain variety tests: August 1994.** *E.C. (Nebraska Cooperative Extension Service) (USA); no. 94-103 39 p.* English. (AGRIS 96-014161).

1288 Nelson, L.A. (University of Nebraska, Lincoln.); Baltensperger, D.D.; Elmore, R.W.; Nordquist, P.T.; Baenziger, P.S.; Klein, R.N.; Oberthur, L.E. (1993) **Nebraska fall-sown small grain variety test: 1993.** *E.C. (Nebraska Cooperative Extension Service) (USA); no. 93-103-A 36 p.* English. (AGRIS 96-001443).

1289 Paroda, R.S. (ed.); Woodhead, T. (ed.); Singh, R.B. (ed.) (1994) **Sustainability of rice wheat production systems in Asia.** FAO, Bangkok (Thailand). Regional Office for Asia and the Pacific. *RAPA Publication (FAO); no. 1994/11 212 p.* English. (AGRIS 96-014112).

1290 Pingali, P.L. (International Rice Research Inst., Manila (Philippines)); Fischer, R.A.; Woodhead, T.; Fisher, K.S. (1994) **Rice-Wheat systems research in South Asia: ecoregional emphasis and international collaboration.** RAPA Publication (FAO); no. 1994/11 p. 126-130. p. 126-130. English. (AGRIS 96-014114).

1291 Pitman, W.D. (Rosepine Research Station.); Mooso, G.D.; Alison, M.W.; Willis, C.C. (1994) **Ryegrass, wheat, and rye varieties evaluations at**

Rosepine, 1992-94. *Research progress report (Rosepine Research Station) (USA) p. 61-64.* English. (AGRIS 96-014438).

1292 Rossberg, R. (Deutsche Landwirtschafts Gesellschaft, Frankfurt am Main (Germany). Fachbereich Landwirtschaft und Laendliche Entwicklung); Mutz, W.; Deecke, U. (1995) **[Wheat: A comparison between cropping systems]. Weizen: Strategien im Vergleich.** *DLG-Mitteilungen (Germany) v. 110(5) p. 18-23.* 2 ill., 4 tables. German. (AGRIS 96-014066).

1293 Saurer, W. (Eidgenoessische Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau, Zuerich Reckenholz (Switzerland)); Haefele, Y.; Senger, B. (1995) **[Is the falling number of wheat influenced by hail damage?]. Wird die Fallzahl von Weizen durch Hagelschlag beeinflusst?** *Muehle + Mischfuttertechnik (Germany) v. 132(9) p. 127-130.* 1 ill., 8 graphs; 9 ref. German. (AGRIS 96-014167).

1294 Shin, M.G. (Hyosung Bilra 167 23 Kodeung Dong, Suwon (Korea Republic)); Kurihara, H. (Kyushu Tokai University, Kyushu (Japan)) (1995) **Effective tillering pattern and grain yield on different seeding dates in barley.** *Korean Journal of Crop Science (Korea Republic) v. 40(4) p. 460-472.* 9 ill.; 7 tables; 57 ref. Korean. (AGRIS 96-014086).

1295 Stock, HG.; Jeroch, H. (1995) **CULTIVATION CHANCES FOR TWO-ROWED WINTER-BARLEY IN THE LOW-RAINFALL PART OF MIDDLE GERMANY IN CONSIDERATION OF YIELD AND COMPOSITION.** *Bodenkultur. 46(4):303-310.* German. [LANDWIRTSCHAFTLICHEN FAK HALLE INST ACKER & PFLANZENBAU LUDWIG WUCHERER STR 2 D-06015 HALLE GERMANY].

In plotted field trials four multi-rowed and four two-rowed winter-barley varieties were grown at three different levels of N fertilization on a sandy loam soil in the Middle part of Germany in 1993 and 1994. As expected, increased N fertilization caused an increase in crude protein content, but showed only little effect on the other estimated parameters. The multi-rowed varieties were higher in grain yield than two-rowed varieties. But the 8% higher whole barley part of the latter caused a return in the relations of yield in view of whole barley yield. The two-rowed varieties were some what richer in starch and poorer in fibre than the multi-rowed ones. The first group had smaller contents of soluble pentosanes and beta-glucans too. For the crude protein content there was no difference between both types of varieties. An influence of variety on chemical composition of the grains is partially visible. Beside the better marketing qualities the improved physiological composition of the nutrients supports the eligibility for growing of two-rowed varieties.

1296 Subedi, K.D.; Budhathoki, C.B. (Lumle Agricultural Research Centre, c/o BAPSO, P.O. Box 106, Kathmandu (Nepal)) (1995) **[Survey and investigation works on wheat sterility problem at LARC, 1993/94].** *LARC Working Paper (Nepal); no. 95/13 67 p.* Lumle Agricultural Research Centre. 42 tables. English. (AGRIS 96-001428).

One field survey and five field and pot experiments were carried out during the winter season of 1993/94 at Lumle Centre and various other sites within the Research Command Area (RCA) of Lumle Agricultural Research Centre (LARC) in order to estimate the extent of problem and tackle the field problems observed. A field survey was carried out in ten different problem areas of Gorkha, Lamjung, Tanahun and Kaski Districts and at the Lumle Centre. The extent of problem ranged from 2-90. In almost all locations surveyed in the RCA, soil problems, mainly low boron, low nitrogen, and high soil pH, were observed to be the major factors responsible. At Lumle Centre, none of the varieties tested under various experiments escaped from being infected. Varieties such as Annapurna-1, 2 and 3, Kalyan Sona, Lerma Rojo-64, Lerma-52, Triveni, NL-638, WK-808, WK-807 and WK-8-4 were less affected by the cold induced sterility.

1297 Travasso, MI.; Delecolle, R. (1995) **ADAPTATION OF THE CERES-WHEAT *MODEL* FOR LARGE AREA YIELD ESTIMATION IN ARGENTINA.** *European Journal of Agronomy. 4(3):347-353.* English. [INST NACL TECNOL AGROPECUARIA CTR INVEST RECURSOS NAT INST CLIMA & AGUA RA-1712 CASTELAR ARGENTINA].

To estimate yield over large areas in the southern part of the Buenos Aires province, Argentina, the functional model CERES-wheat was calibrated with experimental plot data on the effect of water stress on a spring- wheat cultivar and then validated with several field data sets. Adjustment of genetic coefficients and some source code modifications to the growth and soil water balance submodels were necessary to improve the simulation of crop growth and yield. The revised version of CERES-wheat successfully reproduced wheat yields obtained from the different water stress treatments but was not adequate for simulating the physiological maturity or for the simulation of canopy development under stress. With independent data sets, the revised version adequately predicted observed yields and yield components with a root mean square error for grain yield of 536 kg ha(-1). The results obtained suggest the importance of having detailed initial inputs and the need to include an effect of water stress on phenology and an effect of frost damage on yield in the model. [References: 18].

1298 Van Lill, D.; Purchase, J.L. (Agricultural Research Council, Bethlehem (South Africa). Small Grain Centre); Smith, M.F.; Agenbag, G.A.; De Villiers, O.T. (1995) **Multivariate assessment of environmental effects on hard red winter wheat. I. Principle-components analysis of yield and bread-making characteristics.** *South African Journal of Plant and Soil (South Africa) v. 12(4) p. 158-163.* 3 tables; 3 fig. English. (AGRIS 96-014069).

1299 Van Lill, D.; Purchase, J.L. (Agricultural Research Council, Bethlehem (South Africa). Small Grain Centre); Smith, M.F.; Agenbag, G.A.; De Villiers, O.T. (1995) **Multivariate assessment of environmental effects on hard red winter wheat. II. Canonical correlation and canonical variate analysis of yield, biochemical and bread-making characteristics.** *South African Journal of Plant and Soil (South Africa) v. 12(4) p. 164-169.* English. (AGRIS 96-014070).

1300 Vitosh, M.L. (Michigan State University.) (1994) **Wheat fertility and fertilization.** *Extension bulletin (Michigan State University. Cooperative Extension Service) (USA); no. E-2526 4 p.* English. (AGRIS 96-014169).

1301 Winter, S.R. (Texas Agricultural Experiment Station, Bushland, TX.) (1994) **Managing wheat for grazing and grain.** *Miscellaneous publication / (USA); no. 1754 7 p.* English. (AGRIS 96-001485).

F02 PLANT PROPAGATION

1302 Bregitzer, P.; Campbell, RD.; Wu, Y. (1995) **PLANT REGENERATION FROM BARLEY CALLUS - EFFECTS OF 2, 4-DICHLOROPHENOXYACETIC ACID AND PHENYLACETIC ACID.** *Plant Cell Tissue & Organ Culture. 43(3):229-235.* English. [USDA AGR RES SERV POB 307 ABERDEEN, ID 83210 USA].

The use of the synthetic auxin 2, 4-dichlorophenoxyacetic acid (2, 4-D) has played an important role in the production and maintenance of totipotent cereal callus. However, 2, 4-D has been implicated in the loss of totipotency from barley callus. To examine the effect of 2, 4-D on barley callus, regenerability and karyotype were examined over time as influenced by cultivar differences and 2, 4-D levels, during a period in which initially vigorous plant regeneration typically declines dramatically. Higher (20.4-27.1 mu M) versus lower (6.8-13.5 mu M) concentrations of 2, 4-D were positively associated with the number of green plantlets recovered from calli maintained for 10 and 16 weeks before transfer to regeneration media, and with the longevity of regenerability. There was a positive relationship between 2, 4-D concentration and normal karyotype. We also investigated the use of phenylacetic acid for the initiation of regenerable barley callus. Very poor callus growth and plant regeneration was supported by phenylacetic acid. [References: 14].

1303 Dahleen, LS. (1995) **IMPROVED PLANT REGENERATION FROM BARLEY CALLUS CULTURES BY INCREASED COPPER LEVELS.** *Plant Cell Tissue & Organ Culture. 43(3):267-269.* English. [USDA ARS NO CROP SCI LAB POB 5677 STATE UNIV STN FARGO, ND 58102 USA].

Incorporation of cupric sulfate into callus induction, maintenance, and regeneration media significantly enhanced plant regeneration from callus cultures of barley (Hordeum vulgare L.) immature embryos. Embryos from

the cultivars 'Hector' and 'Excel' were cultured on MS medium containing 0, 0.1 (MS level), 0.5, 1.0, 5.0, 10.0, 50.0, or 100.0 mu M cupric sulfate. Plants were regenerated beginning at 8 weeks and continuing through 36 weeks. For Hector, medium containing 50 mu M copper regenerated significantly more plants than any other medium, with an average of 17 plants per embryo. In comparison, medium with MS copper levels (0.1 mu M) regenerated only 5 plants per embryo. For Excel, medium containing 5.0 mu M copper was the best, regenerating 1.4 plants per embryo. No Excel regenerants were obtained on medium with MS copper levels. Increased copper levels also increased the percentage of embryos that regenerated at least one plant, in both cultivars. The results indicate that MS copper levels are not optimized for barley callus cultures, and that improved plant regeneration can be obtained at higher copper concentrations. [References: 9].

1304 Erdelska, O.; Vidovencova, Z.; Erdelsky, K. (1996) **CLEAVAGE POLYEMBRYOS AS EXPLANTS FOR PLANT REGENERATION IN WHEAT.** *Plant Cell Reports. 15(5):342-344.* English. [SLOVAK ACAD SCI INST BOT DUBRAVSKA 14 BRATISLAVA 84223 SLOVAKIA].

The increased efficiency of embryogenic callus formation and regeneration of plantlets was the result of using immature induced polyembryos of wheat rather than single embryos as primary explants. Plant regeneration was effected via embryogenesis, organogenesis, and a combined process beginning as embryogenesis and proceeding as organogenesis. [References: 13].

1305 Fellers, JP.; Guenzi, AC.; Taliaferro, CM. (1995) **FACTORS AFFECTING THE ESTABLISHMENT AND MAINTENANCE OF EMBRYOGENIC CALLUS AND SUSPENSION CULTURES OF WHEAT (TRITICUM AESTIVUM L).** *Plant Cell Reports. 15(3-4):232-237.* English. [UNIV KENTUCKY DEPT AGRON LEXINGTON, KY 40546 USA].

Improved suspension cell culture systems are needed to facilitate the application of recombinant DNA technology for wheat germplasm enhancement, This study evaluated three wheat (Triticum aestivum L.) cultivars, and the effects of medium basal salts, 2, 4-D, sucrose, and L-proline concentrations on the establishment of rapidly growing and highly embryogenic callus and suspension cultures. Percent embryogenic calli was visually estimated and verified with light and scanning electron microscopy. The most highly embryogenic callus was produced by cultivar Bobwhite on medium with MS basal salts, 5.6 mu M 2, 4-D, 58 mM sucrose, and zero proline. The suspension cultures that produced the greatest number of regenerated plants utilized callus tissue produced on solid medium with MS basal salts, 87 mM sucrose, 9 mu M 2, 4-D, and no proline. [References: 31].

1306 Fischer, C.; Neuhaus, G. (1995) **IN VITRO DEVELOPMENT OF GLOBULAR ZYGOTIC WHEAT EMBRYOS.** *Plant Cell Reports. 15(3-4):186-191.* English. [SWISS FED INST TECHNOL INST PLANT SCI UNIV STR 2 CH-8092 ZURICH SWITZERLAND].

We have established in vitro culture conditions for globular zygotic wheat embryos (Triticum aestivum L.). Their nutritional requirements have been systematically investigated. The initial sucrose concentration, as well as the sucrose concentration during the culture, a 6-benzylaminopurine supplement, the use of nitrates and ammonium as nitrogen source have a major influence on the embryo development. Proline has an inhibitory effect on the germination. A double layer system with different media was used to give a continuous variation of the medium composition with time. These culture conditions allowed normal direct embryogenesis in up to 47% of the globular embryos. [References: 17].

1307 Henry, Y.; Marcotte, JL.; Debuyser, J. (1996) **THE EFFECT OF ANEUPLOIDY ON KARYOTYPE ABNORMALITIES IN WHEAT PLANTS REGENERATED FROM SHORT- AND LONG-TERM SOMATIC EMBRYOGENESIS.** *Plant Science. 114(1):101-109.* English. [UNIV PARIS 11 LAB BIOL DEV PLANTES IBP URA CNRS 1128 BATIMENT 630 F-91405 ORSAY FRANCE].

Somatic embryogenesis was initiated from immature embryo culture of Triticum aestivum stocks including disomic, ditelosomic and nullisomic-tetrasomic Chinese Spring wheats. Using chromosome counts of root tip cells, tissue culture-induced variation was observed in the plants regenerated after both short- (4 months) and long-term (14 months) culture, The analysis was performed in order to identify whether particular chromosome arms increased or limited the frequency of chromosome number abnormalities. Short-term regenerants from the aneuploid genotypes produced on average more plants (about 14%) with abnormal chromosome complements than did the euploid Chinese Spring line (3.5%). Most of the abnormal aneuploid karyotypes proved to arise from unbalanced chromosome number in the starting immature embryos. This also suggests that a limited range of abnormal chromosome complement did not affect regeneration, Compared with CS, ditelosomic lines such as DT 4BS, DT 6BL and DT 7DL possessed a highly significant increase in somatic chromosome number instability after short-term culture. The frequency of regenerated plants with karyotype abnormalities reached 80% after extended tissue culture time, in both the euploid and aneuploid lines, demonstrating that abnormalities were induced during the in vitro culture process. After 14 months' culture, DT 1AL, DT 2AL and DT 7BL lines were more stable than CS. The experimental results suggest that regeneration through somatic embryogenesis does not ensure normality in chromosome complement. After long-term cultures, the regeneration capacity was unchanged despite the fact that 80% of regenerated plants possessed abnormal chromosome complement. [References: 20].

1308 Hollenbach, B.; Dietz, KJ. (1995) **MOLECULAR CLONING OF EMIP, A MEMBER OF THE MAJOR INTRINSIC PROTEIN (MIP) GENE FAMILY, PREFERENTIALLY EXPRESSED IN EPIDERMAL CELLS OF BARLEY LEAVES.** *Botanica Acta. 108(5):425-431.* English. [UNIV WURZBURG JULIUS VON SACHS INST BIOWISSENSCH MITTLERER DALLENBERGWEG 64 D-97082 WURZBURG GERMANY].

Cloning and characterization of a barley gene named emip is reported that encodes a member of the major intrinsic protein family. A lambda-unizap cDNA library synthesized from poly A(+)-mRNA of leaf epidermis was screened differentially with epidermis-versus mesophyll-derived probes. One of the clones epi 3-2 was sequenced and further analyzed. The open reading frame of the full length clone codes for a polypeptide of 288 amino acids with a molecular mass of 30, 634 Da exhibiting a high degree of homology with members of the major intrinsic protein family. Hydropathy analysis predicts six potential membrane-spanning helices. mRNA levels were high in the growing zone of barley leaves and declined towards the tip of the fully expanded leaf blade. Expression was high in epidermal strips, lower in roots and very low in the leaf mesophyll. In order of decreasing response, wilting, salt shock and heat shock resulted in stimulated expression. mRNA levels remained low during slow salting up experiments. The expressional pattern suggests a role of EMIP in turgor regulation, particularly under stress. [References: 26].

1309 Oka, S.; Saito, N.; Kawaguchi, H. (1995) **HISTOLOGICAL OBSERVATIONS ON INITIATION AND MORPHOGENESIS IN IMMATURE AND MATURE EMBRYO DERIVED CALLUS OF BARLEY (HORDEUM VULGARE L).** *Annals of Botany. 76(5):487-492.* English. [NATL INST AGROBIOL RESOURCES TSUKUBA IBARAKI 305 JAPAN].

Callus was induced from immature and mature embryos of barley (cv. Haruna Nijo) on Murashige and Skoog medium containing 2 mg l(-1) 2, 4-D and 5 mg l(-1) picloram, respectively. Paraffin sections (10 mu m thick) were prepared for histology during callus initiation and plant regeneration. Meristems were regenerated from nodular compact callus (NC) derived from scutellar epidermis in immature embryos, whereas they were regenerated from NC derived from epidermal cells of leaf or coleoptile bases in mature embryos. Regardless of the explant source, regeneration was predominantly through organogenesis, although regeneration through somatic embryogenesis infrequently occurred. Thus, the callus induced from immature and mature embryos of barley was regarded as 'nodular compact' rather than 'embryogenic'. (C) 1995 Annals of Botany Company [References: 19].

1310 Rafi, MM.; Zemetra, RS.; Dempster, K. (1995) **EFFECTS OF ABSCISIC ACID ON WHEAT CALLUS CULTURES.** *Cereal Research Communications. 23(4):375-382.* English. [UNIV CALIF DAVIS DEPT LAND AIR & WATER RESOURCES DAVIS, CA 95616 USA].

In tissue culture, use of various plant growth regulators has been shown to modify callus growth and plant regeneration rates. This study examined the effects of 0.5, 1.0, 1.5 and 2.0 mu M concentrations and two modes of application of abscisic acid (ABA), namely in the medium and topical application, on callus growth and plant regeneration of two wheat (Triticum aestivum L.) genotypes, PI 137739 and 'Stephens'. Callus induction and proliferation were arrested by ABA treatments in the first month. Enhanced growth of up to 3-fold was observed in ABA treated calli compared to control when they were transferred to maintenance medium without ABA in the second month. In 'Stephens', increased plantlet production was observed when ABA was incorporated in the medium. Thus, wheat genotypes responded differently to ABA treatments with regards to calli growth and plant regeneration capability. [References: 10].

1311 Rao, AM.; Sree, KP.; Kishor, PBK. (1995) **ENHANCED PLANT REGENERATION IN GRAIN AND SWEET SORGHUM BY ASPARAGINE, PROLINE AND CEFOTAXIME.** *Plant Cell Reports. 15(1-2):72-75.* English. [KAKATIYA UNIV DEPT BOT WARANGAL 506009 ANDHRA PRADESH INDIA].

Cefotaxime (50 and 100 mg/l), a cephalosporin antibiotic and the amino acids asparagine and proline (200 mg/l) enhanced the production of embryogenic callus, increased the frequency of plant regeneration, and delayed the loss of regeneration potential in immature embryo-derived callus cultures of Sorghum bicolor (L.) Moench. Although these compounds did not promote callus induction or growth of callus, they influenced plant regeneration considerably in 10 low responding genotypes of grain and high anthocyanin containing sweet sorghums. [References: 22].

1312 Salmenkalliomarttila, M.; Kurten, U.; Kauppinen, V. (1995) **CULTURE CONDITIONS FOR EFFICIENT INDUCTION OF GREEN PLANTS FROM ISOLATED MICROSPORES OF BARLEY.** *Plant Cell Tissue & Organ Culture. 43(1):79-81.* English. [VTT BIOTECHNOL & FOOD RES POB 1505 SF-02044 ESPOO FINLAND].

Subculture regime and carbohydrate concentration of the medium had a marked effect on the regeneration of green plantlets from mechanically isolated microspores of Hordeum vulgare L. cv Kymppi. A sevenfold increase in the yield of green plants was obtained by shortening the suspension culture time of the developing proembryo mass from 4 to 3 weeks. A further twofold increase was obtained by increasing the maltose concentration of the microspore isolation medium and of the culture medium. Under optimal conditions, a mean of 169 +/- 97 green plants per spike were regenerated. [References: 10].

1313 Walmsley, AM.; Henry, RJ.; Birch, RG. (1995) **OPTIMISATION OF TISSUE CULTURE CONDITIONS FOR TRANSFORMATION STUDIES USING IMMATURE EMBRYOS OF AUSTRALIAN BARLEY CULTIVARS.** *Australian Journal of Botany. 43(5):499-504.* English. [UNIV QUEENSLAND DEPT BOT BRISBANE QLD 4072 AUSTRALIA].

Eight Australian barley cultivars were tested for efficiency of embryonic callus initiation and plant regeneration, from immature embryo explants in tissue culture. Optimisation of tissue culture conditions was performed for cultivars Bandulla, Clipper, Schooner and Tallon in an attempt to increase regeneration frequencies to levels suitable for genetic engineering of barley. Variables tested were 2, 4-D concentration, salt composition, carbon source and immature embryo explant. Optimal culture medium composition varied between cultivars. Shoot regeneration rates from culture of isolated scutellar tissues were low for all four cultivars. Halved, immature embryos produced most shoots for cultivars Clipper, Schooner and Tallon, whereas Bandulla performed best with entire immature embryo explants. Clipper (a malting barley) and Bandulla (a feed barley) are suggested as model Australian cultivars for transformation studies. Immature embryos of Bandulla produced an average of 5.3 shoots and Clipper 10.1 shoots per embryo under optimal conditions. Our results show that rates of somatic embryo and plant regeneration sufficient for use in transformation studies can be achieved for diverse Australian Barley cultivars, through systematic testing of a range of key variables including explant type and medium composition. [References: 20].

1314 Zhang, J.; Tiwari, VK.; Golds, TJ.; Blackhall, NW.; Cocking, EC.; Mulligan, BJ.; Power, JB.; Davey, MR. (1995) **PARAMETERS INFLUENCING TRANSIENT AND STABLE TRANSFORMATION OF BARLEY (HORDEUM VULGARE L) PROTOPLASTS (VOL 41, PG 125, 1995).** *Plant Cell Tissue & Organ Culture. 43(1):83.* English. [UNIV NOTTINGHAM DEPT LIFE SCI PLANT GENET MANIPULAT GRP UNIV PK NOTTINGHAM NG7 2RD ENGLAND].

F03 SEED PRODUCTION

1315 Ahmad, S.I.; Bhutta, A.R. (Federal Seed Certification Dept., Islamabad (Pakistan)) (1993) **Wheat seed health testing for Ustilago tritici and Tilletia indica.** *Pakistan Journal of Agricultural Research (Pakistan) v. 14(2 and 3) p. 222-226.* 1 table, 7 ref. English. (AGRIS 96-014652).

1316 Baek, S.B.; Lee, J.H. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station); Kim, H.B. (Dongguk University, Seoul (Korea Republic). Department of Agronomy) (1995) **Variation of immature kernel as affected by growth temperature and grain-filling period, and of seedlings obtained from barley embryo culture for shortening generation.** *Korean Journal of Crop Science (Korea Republic) v. 40(3) p. 308-313.* 4 tables; 16 ref. Korean. (AGRIS 96-014632).

1317 Chopra, K.R. (1994) **Prospects and constraints of hybrid seed development in South Asia.** RAPA Publication (FAO); no. 1994/21 p. 101-109. p. 101-109. English. (AGRIS 96-014646).

1318 Follart, J. (1995) **[Comparative laboratory evaluation of pesticides used for winter wheat seed treatment]. Az oszi buza vetomag csavazasara hasznalt keszitmenyek laboratoriumi osszehasonlito vizsgalata.** *Novenyvedelem (Hungary) v. 31(2) p. 85-87.* Hungarian. (AGRIS 96-014651).

1319 Ganguli, S.; Senmandi, S. (1995) **EMBRYO RESCUE FROM NON-VIABLE SEEDS FOR PRESERVATION OF WHEAT (TRITICUM AESTIVUM) GERMPLASM.** *Indian Journal of Agricultural Sciences. 65(11):781-784.* English. [BOSE INST DEPT BOT SEED BIOL LAB CALCUTTA 700009 W BENGAL INDIA].

An experiment was conducted during the winter season of 1992-93 to adopt a very simple method of replenishing germplasm of wheat (Triticum aestivum L. emend. Fiori & Paol.), which is under threat of extinction due to post-harvest deterioration. A high number of embryos from naturally aged stock of 50% viability could be made to germinate with root and shoot when incubated aseptically on agar + sucrose for prolonged periods (40 days). The seedlings with plumule sheath without leaf did not develop root (at least up to 40 days). Those developing root even 35 days after incubation when transferred to field developed into normal plantlets and produced viable seeds.

1320 Huet, P. (Institut National Agronomique Paris Grignon, Thiverval Grignon (France). Chaire d'Agronomie) (1994) **[Effects of a triticonazole treatment on the use of nitrogen by wheat crop]. Effets d'un traitement de semences a base de triticonazole sur l'utilisation de la fumure azotee par une culture de ble.** Annales ANPP (France) v. 2 p. 651-658. ANPP. 7 ref. v. 2 p. 651-658. French. (AGRIS 96-014650).

1321 Menezes, N.L. de; Belle, R.A. (1995) **[Cultivars identification of wheat by phenol test]. Identificacao de cultivares de trigo pelo teste de fenol.** *Ciencia Rural (Brazil) v. 25(2) p. 315-316.* 10 ref. Portuguese. (AGRIS 96-001904).

1322 Opoku, G.; Gamble, EE. (1995) **SEED QUALITY OF NORMAL AND NAKED OAC KIPPEN BARLEY.** *Plant Varieties & Seeds. 8(2):73-80.* English. [UNIV GUELPH DEPT CROP SCI GUELPH ON N1G 2W1 CANADA].

An important goal in successful production of naked OAC Kippen barley (Hordeum vulgare L.) seeds is the maintenance of high viability and vigour. Field trials were conducted during 2 years at Elora, Ontario, to determine the effect of three different times of harvest and combine cylinder speed (1000, 1300, 1600 rpm) on threshing efficiency and seed

quality of normal and naked OAC Kippen barley. The three different times of harvest consisted of swathing at physiological maturity and then combining later (swathing), direct combining at harvest maturity i.e., when seed moisture content was around 14% (normal harvest), and delayed harvesting (late harvest). There were more threshed and damaged seeds at swath and late harvest times in both years for both barley types due to lower seed moisture content. A higher percentage of threshed and damaged seeds occurred as cylinder speed increased, especially at the low seed moisture content. Moisture content at harvest also affected response of seed germination and vigour to cylinder speed. The higher the cylinder speed and lower the seed moisture content, the higher the seed damage which affected germination and vigour. High vigour was obtained by threshing at low cylinder speed (1000 rpm) and high seed moisture content for both barley types; however, yield was low and seed appearance was poor due to incomplete threshing. [References: 17].

1323 Panthee, D.R. (Lumle Agricultural Research Centre, c/o BAPSO, P.O. Box 106, Kathmandu (Nepal)) (1995) **[Seed storage research carried out at Lumle agricultural Research Centre during 1994].** *LARC Working Paper (Nepal); no. 95/45 24 p.* Lumle Agricultural Research Centre. 11 tables. English. (AGRIS 96-001896).

Changing pattern of moisture content and other quality of wheat seeds was studied under on-farm condition at high, mid and low hills, and under six different storage structure conditions. The study revealed that the relative increase in moisture content of wheat seeds may go as high as up to 50 and relative decrease in 1000 grain weight and germination percentage may go even up to 14 and 78 respectively under on-farm condition. Considering the changing pattern of moisture, insects, 1000 grains weight and germination percentage of wheat seeds jute bag with inner plastics linning and tin were the best storage structure for safe storage of wheat seeds. It was mainly because they do not allow the moisture to enter inside the structure from the surrounding. The relative decrease in germination percentage of wheat seeds in these structures was only 5 (jute bag with inner plastics lining) and 23 (tin) whereas it was about 80 in rest of the structures. In another study nine different indigenous pesticidal treatments were studied with an objective of screening the best indigenous pesticides for safe storage of wheat seeds. Bojo (Acorus calamus) was found the most effective pesticides against storage pests of wheat seeds. Wood ash and mustard oil were found to be promising and rest of them were ineffective to control the storage pests.

1324 Schaefer, K. (Hessische Landwirtschaftliche Lehr und Forschungsanstalt Eichhof, Bad Hersfeld (Germany)) (1994) **[Significance of grass seed production within crop rotation]. Wert des Grassamenbaues in der Fruchtfolge.** 35. Fachtagung des DLG-Ausschusses Graeser, Klee und Zwischenfruechte; Fulda (Germany); 02-03 Dec 1993. *(DLG working documents - Proceedings - Grasses, legumes, and catch crops). Anon. Deutsche Landwirtschafts-Gesellschaft e.V., Frankfurt a.M. (Germany) p. 59-68.* 8 graphs, 2 tables. German. (AGRIS 96-001928).

F04 FERTILIZING

1325 **[Effect of the nitrogen fertilization surplus on the environment]. Fertilisation azotee et environnement** (1995) Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgium). Station de Phytotechnie. *Agricontact (Belgium) (no.270) p. 23-25.* 6 ill. French. (AGRIS 96-014745).

1326 Abd El Gawad, H.; Sourour, A.M.; El Sissy, L.M.H.; Abo El Diffan, T. (Ministry of Agriculture, Cairo (Egypt). Soils and Water Research Inst.) (1993) **Influence of phosphorus fertilization and different sources of nitrogen fertilizers on some micronutrients uptake by wheat plants in clay and calcareous soils.** *Journal of Agricultural Sciences, Mansoura Univ. (Egypt) v. 18(11) p. 3456-3460.* 3 tables; 7 ref. English. (AGRIS 96-001998).

1327 Ayoub, M.; Mackenzie, A.; Smith, DL. (1995) **EVALUATION OF N FERTILIZER RATE AND TIMING AND WHEAT CULTIVARS ON SOIL RESIDUAL NITRATES.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(2):87-97.* English. [MCGILL UNIV DEPT PLANT SCI MACDONALD CAMPUS 21111 LAKESHORE RD ST ANNE DE BELLEVUE PQ H9X 3V9 CANADA].

Nitrogen (N) fertilizer management for production of bread quality wheat may increase nitrate residues in the soil. To assess soil nitrate levels associated with bread quality wheat (Triticum aestivum L.) production in Eastern Canada, an experiment was conducted for 2 years at each of two sires in Quebec. Four cultivars (Columbus, Katepwa, Max and Hege 155-85), four N levels (0, 60, 120 and 180 kg N ha(-1)) and two N timings (all at seeding time or 60 % at seeding and 40 % at anthesis) were combined in a factorial arrangement on a Bearbrook clay and a Ste-Rosalie clay. Residual soil NO3-N levels were measured in the 0-20 and 20-60 cm soil layers. The cultivars used have potential as bread wheats. Cultivar effects on soil nitrate levels existed only in the Ste-Rosalie soil, suggesting that the cultivars used were better adapted to the conditions on the Bearbrook soil. Changes in soil NO3-N levels over winter indicated that mineralization had occurred. Calculated balance-sheet values were larger than measured residual NO3-N in the autumn of each year, indicating that NO3-N was lost from the systems, possibly due to denitrification. Potential increases in, and thus potential pollution from, residual soil NO3-N existed only at the 180 kg N ha(-1) level. Overwinter changes in soil NO3-N levels were proportional to the inverse of the fall NO3-N levels. Differences between sires were large for many of the variables measured. [References: 28].

1328 Baethgen, WE.; Christianson, CB.; Lamothe, AG. (1995) **NITROGEN FERTILIZER EFFECTS ON GROWTH, GRAIN YIELD, AND YIELD COMPONENTS OF MALTING BARLEY.** *Field Crops Research. 43(2-3):87-99.* English. [INT FERTILIZER DEV CTR DIV RES & DEV MUSCLE SHOALS, AL 35662 USA].

Optimal strategies for using nitrogen fertilizer with malting barley (Hordeum vulgare L.) must aim to maximize yield while maintaining low N content in grain to preserve malting quality. Eleven field experiments were conducted during 1989-91 with the objective of determining the impact of N fertilizer applied at different growth stages on crop growth, grain yield, and yield components of malting barley. Treatments included single applications of N fertilizer at sowing, at Zadoks growth stages Z-22 (midtillering) or Z-30 (end of tillering) and differing levels of N applied at each of these times. High rates of N applied early in the growing season stimulated tillering but many of these tillers did not produce spikes. An effect of N on spike number was evident only in comparisons of fertilized and unfertilized treatments through a positive correlation between number of spikes at maturity and the number of tillers at Z-30. Nitrogen fertilizer applied at Z-30 resulted in 30% to 100% increases in number of kernels/spike over unfertilized plots though number of kernels/spike was negatively correlated with number of spikes/m(2), indicating compensation effects. Nitrogen applications at Z-30 were also most effective for increasing number of kernels/m(2) while kernel weight responded only slightly to N. Mean kernel weight for all site-years revealed that none of the three years presented limiting conditions for grain filling. Cumulative probability curves for yields and yield components indicated that N fertilizer applied at Z-30 gave the best results in most situations but only when sufficient N was available at sowing to ensure crop establishment and initial tiller development. In contrast, the Z-30 treatment had the least impact on yield and yield components when no fertilizer was applied at sowing. Number of kernels/spike and number of kernels/m(2) were the only two yield components with a clear association with grain yields. The research indicates that N fertilizer strategies for malting barley should ensure relatively small amounts of available N at sowing for crop establishment and initial tiller development. Additional N would then be applied at the end of tillering, the amount required depending on the crop and soil management systems used. [References: 27].

1329 Boman, RK.; Westerman, RL.; Raun, WR.; Jojola, ME. (1995) **SPRING-APPLIED NITROGEN FERTILIZER INFLUENCE ON WINTER WHEAT AND RESIDUAL SOIL NITRATE.** *Journal of Production Agriculture. 8(4):584-589.* English. [OKLAHOMA STATE UNIV DEPT AGRON STILLWATER, OK 74078 USA].

Spring fertilization may reduce N losses and immobilization compared with fall-applied N in winter wheat (Triticum aestivum L.) grain production systems, The objectives of this experiment were to determine the effects of spring applications of varying rates of three N fertilizer sources on grain yield and N concentration, and residual soil profile

ammonium-N and nitrate-N distribution. Anhydrous ammonia (AA), urea-ammonium nitrate (UAN), and UAN + dicyandiamide (DCD) (1% w/w N as DCD) were applied for three consecutive years on a sandy loam soil (Udic Argiustoll). Nitrogen was applied prior to reproductive growth at 30, 60, and 90 lb N/acre. An unfertilized check and an AA applicator check (0 N applied) were included, Anhydrous ammonia was injected in 18 in. bands using a rolling coulter applicator. The UAN and UAN + DCD mixture were broadcast sprayed. Soil cores were taken to 4 ft from each plot after harvest. Core samples were partitioned by depth and analyzed to determine ammonium-N and nitrate-N. Grain yield responses to applied N were observed, No significant grain yield reduction was attributed to wheat disturbance by the AA applicator, Grain N uptake and apparent fertilizer N recovery in the grain (based on the difference method) were greater for AA than for UAN. Anhydrous ammonia resulted in significantly greater upper profile soil nitrate-N than either UAN or UAN + DCD in 1 yr, Postemergence injection of AA into established winter wheat was an effective method for applying N when compared with broadcast UAN. Addition of DCD to UAN did not significantly affect measured plant or soil parameters.

1330 Canteromartinez, C.; Villar, JM.; Romagosa, I.; Fereres, E. (1995) **NITROGEN FERTILIZATION OF BARLEY UNDER SEMI-ARID RAINFED CONDITIONS.** *European Journal of Agronomy. 4(3):309-316.* English. [UNIV LLEIDA IRTA ROVIRA ROURE 177 E-25006 LLEIDA SPAIN].

Two barley cultivars (Hordeum vulgare L.) were grown at a site in semi-arid northeast Spain during three seasons, 1986-87, 1987-88, 1988-89, under two levels of N-fertilization (100 kg ha(-1), the normal dressing used in the area, and 50 kg ha(-1)). There was no benefit for yield from the higher rate of N fertilization; in 1987, a very dry season, the higher rate depressed yield. Nitrogen fertilization increased green area index and nitrogen uptake by the plant but did not affect any yield component. Harvest index was negatively affected by nitrogen in the driest year. The responses to nitrogen differed with cultivars. Rainfall amount and distribution of the year and probably the residual nitrogen in the soil strongly influenced the response to N-fertilization. It is concluded that less nitrogen fertilizer than at present used may improve the sustainability and stability of the cropping system without reducing the grain production in this area. [References: 29].

1331 Deffune, G.; Scofield, A.M. (1995) **[Effects of humic acids and three bio-dynamic preparations on the growth of wheat seedlings]. Efectos de los acidos humicos y de tres preparados biodinamicos en el crecimiento de plantulas de trigo.** 1. Congreso de la Sociedad Espanola de Agricultura Ecologica; Toledo (Espana); 28-29 Sep 1994. *[Ecological practices for a quality agriculture: proceedings of 1st Congress of Ecological Agriculture Spanish Society, Toledo, 28-29 September of 1994]. Practicas ecologicas para una agricultura de calidad: actas del 1er Congreso de la Sociedad Espanola de Agricultura Ecologica, Toledo, 28-29 de septiembre de 1994. Junta de Comunidades de Castilla-La Mancha, Toledo (Espana). Consejeria de Agricultura y Medio Ambiente* p. 210-212. JCCM, CAMA. 1 fig.; 6 ref. Spanish. (AGRIS 96-001945).

1332 El Ganbeehy, M.M. (Alexandria Univ. (Egypt). Faculty of Agriculture) (1993) **Wheat response to clipping and nitrogen fertilization.** *Alexandria Journal of Agricultural Research (Egypt) v. 38(3) p. 311-334.* 8 tables; 22 ref. English. (AGRIS 96-002062).

1333 Fernandez Vazquez, M. (1995) **[Wheat fertilization: nutritive elements and choice of fertilizers]. Abonado del trigo: elementos nutritivos y eleccion de abonos.** *Vida Rural (Espana) (no.22) p. 28-30.* 4 cuadros, 3 fig. Spanish. (AGRIS 96-001944).

1334 Fiez, TE.; Pan, WL.; Miller, BC. (1995) **NITROGEN USE EFFICIENCY OF WINTER WHEAT AMONG LANDSCAPE POSITIONS.** *Soil Science Society of America Journal. 59(6):1666-1671.* English. *[WASHINGTON STATE UNIV DEPT CROP & SOIL SCI PULLMAN, WA 99164 USA].*

Spatially variable N fertilizer application may reduce environmental impacts and increase the economic return of N fertilization. To achieve these benefits, N recommendations must account for within-held differences in the amount of N required to produce a unit of yield (unit N requirement, UNR). Component analysis was used to determine the sources of variation in the UNRs of Hinter wheat (Triticum aestivum L.) among landscape positions. The UNRs were divided into two components, N uptake efficiency (plant N/N supply) and N utilization efficiency (grain yield/plant N) observed in N rate trials (0-140 kg N ha(-1) fall applications) established on footslope, south backslope, shoulder, and north backslope positions of two farms for 2 yr. Variation in the UNR among the 16 landscape positions studied was most associated with differences in N uptake efficiency (r = -0.80), although N utilization efficiency (r = -0.62) also contributed to the variation. Nitrogen uptake efficiency among landscape positions declined as more fertilizer was required to reach optimum yield (r = -0.56) due to low N fertilizer uptake efficiencies (Delta plant N/Delta N fertilizer). Nitrogen fertilizer uptake efficiency was related to the degree of apparent N loss (r = -0.87), indicating that N availability limited N uptake efficiency among landscapes. Overall, low N fertilizer uptake efficiencies (<50%) and high N loss percentages (>50%) indicate the need to reduce N losses and lower UNRs, particularly on north-facing backslopes susceptible to N leaching. [References: 23].

1335 Hruby, J. (Vyzkumny Ustav Picninarsky, Troubsko (Czech Republic)); Hledik, P. (1995) **[Nitrogen fertilization of winter wheat]. Hnojeni ozime psenice dusikem.** *Uroda (Czech Republic) v. 43(7) p. 12-13.* 2 tables. Czech. (AGRIS 96-002057).

1336 Hylander, L. (1995) **Inconsistent liming effects: a causal analysis.** Sveriges Lantbruksuniv., Uppsala (Sweden). *Reports and Dissertations - Swedish University of Agricultural Sciences, Department of Soil Sciences (Sweden); no. 25 33 p.* Bibliography: p. 23-33. A dissertation bound with a collection of 4 reprints. English. (AGRIS 96-002002).

1337 Johnson, GV.; Raun, WR. (1995) **NITRATE LEACHING IN CONTINUOUS WINTER WHEAT - USE OF A SOIL-PLANT BUFFERING CONCEPT TO ACCOUNT FOR FERTILIZER NITROGEN.** *Journal of Production Agriculture. 8(4):486-491.* English. [OKLAHOMA STATE UNIV DEPT AGRON STILLWATER, OK 74078 USA].

Food and fiber production depends heavily on fertilizer N inputs to sustain high yields. Various biological processes in soils and plants have generally restricted grain crops from obtaining N use efficiencies in excess of 70%, Nitrogen that could not be accounted for in N balance studies has often been assumed to have been lost to the atmosphere by denitrification or leached from the system. We evaluated wheat (Triticum aestivum L.) grain yield and soil profile inorganic N (ammonium N + nitrate N) accumulation in four long-term Oklahoma experiments where fertilizer N was applied annually (at a wide range of N rates) for more than 23 yr. Results showed that soil profile (0-8 ft) inorganic N accumulation did not increase until N rates exceeded that required for maximum yield, We suggest that the soil-plant system is able to buffer against soil accumulation of inorganic N, Major buffering mechanisms include increased plant protein, increased plant N volatilization, and denitrification in soil when N rates exceed those required for maximum yield. Annual N fertilization rates that increased soil profile inorganic N accumulation exceeded those required for maximum yields by more than 20 lb N/acre in all experiments. This suggests the presence of a fertilization "safety zone" with regard to fertilizer N recommendations. Applying more fertilizer N than that required for maximum grain yield did not immediately pose a risk to groundwater quality. The same processes that prevent 100% use of fertilizer N by crops also prevent effective soil accumulation of inorganic N and risk of subsequent leaching to groundwater.

1338 Kausar, K.; Akbar, M.; Rasul, E.; Ahmad, A.N. (University of Agriculture, Faisalabad (Pakistan). Botany Dept.) (1993) **Physiological responses of nitrogen, phosphorus and potassium on growth and yield of wheat.** *Pakistan Journal of Agricultural Research (Pakistan) v. 14(2 and 3) p. 126-130.* 1 table, 13 ref. English. (AGRIS 96-014862).

1339 Kerschberger, M. (Landwirtschaftliche Untersuchungs und Forschungsanstalt Thueringen, Jena (Germany)); Mueller, S.; Moritz, D.;

Domey, R. (1994) **[Influence of contact fertilization with N and P on the yield of spring barley in case of P-basic fertilization]. Einfluss einer Kontaktduengung mit N und P auf den Kornertrag von Sommergerste bei erfolgter P-Grundduengung.** *Archives of agronomy and soil science (Germany) v. 38(4) p. 307-313.* 4 tables; 11 ref. German. (AGRIS 96-014740).

1340 Khasanov, R.F. (1994) **[Reserves of enriching soils with organic matter]. Rezervy obogashcheniya pochvy organikoj.** *Zemledelie (Russian Federation) (no.6) p. 21-22.* Russian. (AGRIS 96-014738).

1341 Koerschens, M. (Umweltforschungszentrum Leipzig Halle GmbH, Bad Lauchstaedt (Germany). Sektion Bodenforschung); Mueller, A. (1994) **[Sustainable soil utilization measured on yield as well as on C- and N-balances]. Nachhaltige Bodennutzung, gemessen am Ertrag sowie an C- und N-Bilanzen.** *Archives of agronomy and soil science (Germany) v. 38(5) p. 373-381.* 5 ill.; 11 ref. German. (AGRIS 96-014926).

1342 Kumar, A.; Yadav, DS. (1995) **USE OF ORGANIC MANURE AND FERTILIZER IN RICE (ORYZA SATIVA) WHEAT (TRITICUM AESTIVUM) CROPPING SYSTEM FOR SUSTAINABILITY.** *Indian Journal of Agricultural Sciences. 65(10):703-707.* English. [NARENDRA DEVA UNIV AGR & TECHNOL DEPT AGRON FAIZABAD 224229 UTTAR PRADESH INDIA].

A long-term field experiment was initiated in 1984 on a sodic soil (pH 8.8 and exchangeable sodium 27%) to study the effect of organic manures, fertilizers and their integrated use in rice (Oryza sativa L.)-wheat (Triticum aestivum L. emend. Fiori & Paol.) cropping system. During initial years (1984-87) 25-50%, substitution of fertilizers through organic sources (Farmyard manure, green-manure and wheat straw) reduced the lice yield by 6-23% compared with 100% fertilizers alone. In the following years, 25-50% N through farmyard manure or prickly sesban [Sesbania aculeata (Retz.) Pers.; syn S. cannabina Pers. var cannabina Baker] green-manure along with 50-75% fertilizers to rice gave either equal or more yield compared with 100% NPK fertilizers (120 kg N/ha, 26.2 kg P/ha, 33.2 kg K/ha) alone. Farmyard manure and green-manure of prickly sesban were found superior to wheat straw for grain yield and NPK uptake. The organic source with fertilizers decreased the soil pH, electrical conductivity and exchangeable sodium (%) at lister rate and depleted micronutrient cations (Cu, Mn, Zn, Fe) at slower rate than inorganic fertilizers alone.

1343 Lee, C.W. (Rural Development Administration, Suwon (Korea Republic). National Crop Experiment Station); Ito, S.; Sato, A.; Hoshino, T. (Tohoku National Crop Experiment Station, Morioka (Japan)) (1995) **Effect of nitrogen top-dressing method on grain quality of barley in Japanese volcanic ash soil.** *Korean Journal of Crop Science (Korea Republic) v. 40(4) p. 512-517.* 2 ill.; 3 tables; 22 ref. Korean. (AGRIS 96-014742).

1344 Maddens, K.; Denoo, A.; Calus, A. (Provincie West Vlaanderen, Rumbeke (Belgium). Provinciaal Onderzoek en Voorlichtingscentrum voor Landen Tuinbouw) (1994) **[Cereal crops. Results of research performed in 1993 [in Belgium]]. Graangewassen. Overzicht van het onderzoek 1993.** 12 ref. 84 p. Dutch. (AGRIS 96-002004).

1345 Mctaggart, IP.; Smith, KA. (1995) **THE EFFECT OF RATE, FORM AND TIMING OF FERTILIZER N ON NITROGEN UPTAKE AND GRAIN N CONTENT IN SPRING MALTING BARLEY.** *Journal of Agricultural Science. 125(Part 3):341-353.* English. [SCH AGR SAC DEPT SOILS W MAINS RD EDINBURGH EH9 3JG MIDLOTHIAN SCOTLAND].

Field experiments were carried out on six sites in eastern Scotland between 1987 and 1989 to determine the effect of nitrogen on the yield, N uptake and grain N concentration of spring barley grown for malting. The effects of fertilizer applications at rates from 0 to 150 kg N ha(-1) and the timing of application were studied, using three fertilizer forms: calcium nitrate, ammonium sulphate and ammonium nitrate. Calcium nitrate applications significantly increased grain N concentrations ($P < 0.05$), and grain yields ($P < 0.01$ and 0.05) at two sites, above the values obtained with the other fertilizers, but there was no effect at the other sites. Split applications of calcium nitrate increased yields above those from single applications in some treatments at two sites. At low rates, recovery of N-15-labelled fertilizer was greatest when applied as calcium nitrate. Recovery fell at higher rates in calcium nitrate treatments, but rose in ammonium sulphate treatments. Uptake of fertilizer N, during the period of stem elongation in June, was significantly greater ($P < 0.05$) in the calcium nitrate and ammonium nitrate treatments. Maximum uptake was usually reached by the time of anthesis. Uptake of soil N was not as great during the early sampling periods, but continued up to harvest in most treatments. There was evidence of losses, between anthesis and harvest, of fertilizer N previously taken up by the crop. The uptake of soil N remained constant over the range of fertilizer treatments except with ammonium sulphate, where there was evidence of increased uptake at higher fertilizer rates, possibly due to 'pool substitution' of N-15-labelled fertilizer. The variation in soil N uptake between sites was greater than the variation in fertilizer N uptake caused by different forms of fertilizer and different application times. [References: 41].

1346 Migahid, M.M. (Alexadria Univ. (Egypt). Faculty of Education); Sadek, L.A. (1994) **Effect of presoaking with trace elements on salt tolerance of three cultivars of wheat.** *Alexandria Journal of Agricultural Research (Egypt) v. 39(3) p. 501-516.* 4 ill. 1 table; 20 ref. English. (AGRIS 96-002061).

1347 Salomonsson, L.; Salomonsson, AC.; Olofsson, S.; Jonsson, A. (1995) **EFFECTS OF ORGANIC FERTILIZERS AND UREA WHEN APPLIED TO WINTER WHEAT.** *Acta Agriculturae Scandinavica Section B-Soil & Plant Science. 45(3):171-180.* English. [SWEDISH UNIV AGR SCI DEPT CROP PROD SCI BOX 7043 S-75007 UPPSALA SWEDEN].

In the present study, organic fertilizers, represented by slurry manure and meat bone meal, used on ecologically grown winter wheat were compared with urea in field experiments with the purpose of increasing the protein content. There were no consistent differences in protein content and yield level between the treatments with organic fertilizers and the urea treatments. The protein content was as high after a single early N application as after a split application. In treatments with meat bone meal, plant growth seemed to be slower during the early growing phase compared with the other treatments. The endogenic mould infection and content of heavy metals indicated that the grain from all fertilizer treatments was of good food-grade quality, [References: 27].

1348 Tanacs, L.; Matuz, J.; Bartok, T.; Gero, L. (1995) **EFFECT OF NPK FERTILIZATION ON THE INDIVIDUAL AMINO ACID CONTENT OF WHEAT GRAIN.** *Cereal Research Communications. 23(4):403-409.* English. [UNIV HORT & FOOD IND FAC FOOD IND SZEGED HUNGARY].

The individual amino acid content of wheat seeds from long-term NPK fertilizer trials grown on heavy-calcareous and humus-rich meadow soil in 1991 has been examined by a RP HPLC method, in order to determine the effect of increasing NPK supply. Higher N doses increased the amount of ASP, GLU, SER, HIS, GLY, THR, ARG, ALA, TYR, VAL, PHE, ILE, LEU and LYS by 6-24%. The highest values were obtained at 180 kg N/ha fertilizer level, except for ARG and HIS. Increased PK doses significantly decreased the quantity of ASP, GLU, SER, HIS, GLY, THR, ARG, ALA, TYR, CYS, VAL, PHE, ILE and LEU. When N and PK were applied together, the amount of amino acids did not change to such an extent as in the case of separate N or PK doses. The two wheat varieties studied showed significant differences only in the amount of SER, CYS and PHE. [References: 12].

1349 Thomsen, IK. (1995) **CATCH CROP AND ANIMAL SLURRY IN SPRING BARLEY GROWN WITH STRAW INCORPORATION.** *Acta Agriculturae Scandinavica Section B-Soil & Plant Science. 45(3):166-170.* English. [RES CTR FOULUM DEPT PLANT NUTR & PHYSIOL BOX 23 DK-8830 TJELE DENMARK].

Four rates of straw (0, 4, 8 and 12 t *ha(-1) yr(-1))* were incorporated in a field experiment with continuous spring barley. The experiment was conducted on a sandy soil (5.5% clay) and a sandy loam soil (11.2% clay). After eight years, the straw incorporation was combined with catch-crop growing with and without winter application of animal slurry and also spring fertilization with mineral fertilizer (0, 50, 100 or 125 kg N *ha(-1) yr(-*

1)). The combined experiment was conducted for three 1years on the sandy soil and for four years on the sandy loam soil. The effects on barley dry matter yield and N uptake are presented together with the long-term effects of the straw incorporations on crop growth and soil C and N. Grain yield on the sandy loam was unaffected by straw incorporation. On the sandy soil the highest straw application rates reduced grain yield in the unfertilized barley. When the barley received mineral fertilizer at recommended levels (100 kg N ha(-1) yr(-1)), grain yield on this soil was also unaffected by the high straw rates. Including a catch crop had a positive effect on the grain yield of barley on both soils. The total N uptake in grain and straw generally increased with straw application up to 8 t ha(-1) yr(-1). With the highest straw application rate (12 t ha(-1) yr(-1)), the total N uptake decreased but still exceeded N uptake in barley grown with straw removal. The barley accumulated higher amounts of N when a catch crop was included. The total N uptake in the barley was significantly higher after animal slurry application. The extra N uptake, however, was much lower than the amounts of N applied with the slurry. Incorporation of straw had only a small influence on N uptake after slurry application. The straw, therefore, was not able to store the applied N during winter. In the two four-year periods before the combined experiment, grain yield on the sandy loam was generally negatively affected by straw incorporations, In the second period, N uptake began to show a positive effect of the straw. On the sandy soil, grain yield and N uptake during the whole period were generally positively affected by the straw incorporations except for the highest straw rate (12 t ha(-1) yr(-1)). The sandy loam soil showed higher increases in C and N content after the repeated straw incorporations and catch-crop growing than the sandy soil, When application of animal slurry was combined with the catch crop, no further increases in soil C and N were found relative to soil where a catch crop was grown without slurry application. Large amounts of the N applied with the slurry may therefore have been lost by denitrification or nitrate leaching. [References: 11].

1350 Tiwari, C.; Singh, Y.; Singh, D. (1995) **EFFECT OF SESBANIA GREEN-MANURE AND NITROGEN FERTILIZER IN RICE (ORYZA SATIVA) WHEAT (TRITICUM AESTIVUM) CROPPING SYSTEM.** *Indian Journal of Agricultural Sciences. 65(10):708-711.* English. [RAJASTHAN AGR UNIV COLL AGR UDAIPUR 313001 INDIA].

An experiment was conducted during 1989-90 and 1990-91 to study the effect of summer green-manuring with 2 species of Sesbania, viz S. cannabina (Retz.) Pers. and S. rostrata Berm., and nitrogen in rice (Oryza saliva L.)-wheat (Triticum aestivum L. emend. Fiori & Paol.) cropping system. S. cannabina added 7.4 tonnes/ha dry biomass containing 186 kg Nka and S. rostrata added 8.5 tonnes/ha biomass containing 252 kg N/ha. N available to rice crop from S. rostraia was equivalent to 80 kg urea N. Highest rice (7 180 kg/ha) and wheat (3 549 kg/ha) yields were obtained from green-manuring with S. rostrate and 120 kg urea N/ha applied to rice crop, in this treatment the total N removal by rice and wheat crops was 179 kg/ha. This treatment left positive balance of N (270 kg N/ha) in the soil. The mineralization of N added through Sesbania species was most rapid during the first 20 days after transplanting.

1351 Withers, PJA.; Tytherleigh, ARJ.; Odonnell, FM. (1995) **EFFECT OF SULPHUR FERTILIZERS ON THE GRAIN YIELD AND SULPHUR CONTENT OF CEREALS.** *Journal of Agricultural Science. 125(Part 3):317-324.* English. [AGR DEV & ADVISORY SERV BRIDGETS RES CTR *WINCHESTER* SO21 1AP HANTS ENGLAND].

In order to determine whether cereal crops require fertilizer sulphur (S) in areas estimated as receiving < 20 kg S/ha per year from the atmosphere, the effects of applying agricultural gypsum (10, 20, 30, 40, 60 and 80 kg S/ha), ammonium sulphate (24 and 48 kg S/ha) and foliar-applied elemental S (10 kg S/ha) fertilizers were compared with a nil-S control in replicated field experiments at 12 sites in England and Wales during 1987-90. Averaged across all S treatments, significant (P less than or equal to 0.01) positive yield responses of 0.4 t/ha were obtained in winter barley at three sites *in 1990* on sandy soils in Wales (two sites) and in south-west England (one site). There was no yield advantage in applying > 10 kg/ha of S as gypsum at these sites. Yield responses were best predicted by a nitrogen:S concentration ratio greater than or equal to 17:1 in leaf tissue at anthesis and a S concentration of less than or equal to 0.1% in the grain dry matter at harvest. Significant increases in total S and sulphate-S concentrations in leaf tissue at anthesis were obtained from increasing the rates of gypsum applied at ten of the sites, but a significant increase in the concentration of S in the grain at harvest was obtained at only one site. There was no difference in effectiveness between gypsum and foliar-applied elemental sulphur when compared at a single rate of 10 kg S/ha. Comparison of the increases in leaf-S status from maximum application rates of ammonium sulphate and gypsum suggested that ammonium sulphate was the more effective S-fertilizer source. The results confirm that S deficiency is starting to appear in cereal crops in England and Wales. [References: 28].

F06 IRRIGATION

1352 Chatti, M.T. (1993) **[Experiences conducted by the "S.E.E.N." [Service of experimentation, trials and standardisation] on water needs to irrigation advice]. Experimentations menees par le Service des Experimentations, des Essais et de la Normalisation sur les besoins en eau des cultures et l'avertissement a l'irrigation.** *Hommes Terres et Eaux - Revue Marocaine des Sciences et Techniques de Developpement Rural (Maroc) v. 23(91) p. 5-12.* 3 tableaux; 5 ill. French. (AGRIS 96-015095).

1353 Ismail, S.M. (Alexandria Univ. (Egypt). Faculty of Agriculture) (1993) **Sprinkler-irrigated wheat production function and mathematical optimization.** *Alexandria Journal of Agricultural Research (Egypt) v. 38(3) p. 51-69.* 6 ill. 10 ref. English. (AGRIS 96-002220).

1354 Kijne, J.W. (International Irrigation Management Inst., Colombo (Sri Lanka)) (1994) **Irrigation and drainage for the rice-wheat system: management aspects.** RAPA Publication (FAO); no. 1994/11 p. 112-125. p. 112-125. English. (AGRIS 96-015076).

1355 Pintus, F. (International Irrigation Management Inst., Colombo (Sri Lanka)) (1995) **Impact of irrigation, salinity and cultural practices on wheat yields: a study of Fordwah/Eastern Sadiqia area, Punjab, Pakistan. Annexes.** International Irrigation Management Inst., Colombo (Sri Lanka). IIMI. 89 p. English. (AGRIS 96-015001).

1356 Pintus, F. (International Irrigation Management Inst., Lahore (Pakistan)) (1995) **Impact of irrigation, salinity and cultural practices on wheat yields: a study of Fordwah/Eastern Sadiqia area, Punjab, Pakistan.** IIMI. 55 ref. 66 p. English. (AGRIS 96-015027).

1357 Shumova, N.A. (1994) **[Estimate of irrigation rates for spring wheat sowing]. Otsenka orositel'nykh norm dlya posevov yarovoj pshenitsy.** *Vodnye resursy (Russian Federation) v. 21(2) p. 225-230.* 16 ref. Russian. (AGRIS 96-015063).

1358 Wu, J.J. (Oklahoma State University, Stillwater, OK.); Mapp, H.P.; Bernardo, D.J. (1994) **A dynamic analysis of the impact of water quality policies on irrigation investment and crop choice decisions.** *Journal of agricultural and applied economics (USA) v. 26(2) p. 506-525.* references. English. (AGRIS 96-002217).

A dynamic model is developed to analyze farmers irrigation investment and crop choice decisions under alternative water quality protection policies. The model is applied to an empirical example in the Oklahoma High Plains. The choices of crops and irrigation systems and the resulting levels of irrigation, income, and nitrogen runoff and percolation are simulated over a ten-year period. An effluent tax on nitrogen runoff and percolation is shown to be effective in reducing nitrate pollution. The efficacy of cost sharing in adopting modern irrigation technologies and restrictions on irrigation water use depends on soil type. A tax on nitrogen use is shown to be the least effective policy.

1359 Yadav, B.S.; Verma, B.L.; Deo, R. (Agricultural Research Station, Sri Ganganagar (India)) (1995) **Irrigation requirement of wheat under shallow water table condition.** *Journal of the Indian Society of Soil Science (India) v. 43(2) p. 259-261.* 2 tables; 1 ref. English. (AGRIS 96-002223).

1360 Borin, M.; Sartori, L. (1995) **BARLEY, SOYBEAN AND MAIZE PRODUCTION USING RIDGE TILLAGE, NO-TILLAGE AND CONVENTIONAL TILLAGE IN NORTH-EAST ITALY.** *Journal of Agricultural Engineering Research. 62(4):229-236.* English. [UNIV PADUA DIPARTIMENTO AGRON AMBIENTALE & PROD VEGETALI VIA GRADENIGO 6 I-35131 PADUA ITALY].

Ridge tillage can be considered as an alternative to no-tillage in climates and environments which are not very favourable for the latter. It has been conceived almost exclusively for crops such as maize and soybean and this creates difficulties if small grains are introduced into a rotation based on the ridge tillage system. This paper describes the selection and adaptation of equipment for sowing in a ridge tillage system, the evaluation of their performance, and effects on a barley-soybean-maize rotation in comparison with conventional tillage and no-tillage. The experimental site of around 4 ha, was divided into 12 plots cultivated using conventional tillage (CT), ridge tillage (RT) and no-tillage (NT). The parameters studied in each of the crop cycles included work capacity of the seed drills; analysis of the soil surface profile in the ridge following each crop operation from sowing to harvesting; uniformity of emergence in five sample areas of each plot; final plant density, grain yield and total harvested biomass. All the crops grown with RT and NT had lower densities than those obtained with CT. This led to reduced yields, apart from barley which was able to overcome poor plant density, with increased tillering supplying the same number of fertile culms as in CT. Some adaptation of the techniques and modifications to the machinery are proposed to reduce the yield losses in comparison with conventional sowing. (C) 1995 Silsoe Research Institute [References: 11].

1361 Hernanz, JL.; Giron, VS.; Cerisola, C. (1995) **LONG-TERM ENERGY USE AND ECONOMIC EVALUATION OF THREE TILLAGE SYSTEMS FOR CEREAL AND LEGUME PRODUCTION IN CENTRAL SPAIN.** *Soil & Tillage Research. 35(4):183-198.* English. [UNIV POLITECN MADRID ETSI AGRON DEPT RURAL ENGN E-28040 MADRID SPAIN].

Three different experiments have been carried out in the area to the northeast of Madrid (central Spain) over 10 years with winter wheat (Triticum aestivum L.), winter barley (Hordeum vulgare L.), . spring barley and vetch (Vicia saliva L.) grown for hay. In these experiments, three tillage systems were compared: conventional tillage (primary tillage was mouldboard ploughing to 300 mm depth), minimum tillage (primary tillage was spring tine cultivation either with a chisel or a cultivator to 150 mm depth) and zero tillage (direct drilling), in relation to energy consumption, production costs, energy efficiency and productivity, and economic returns. The experiments were performed on a Vertic Haploxeralf of a clay loam texture. The aforementioned variables were calculated considering every input (i.e. fertilisers, seeds, herbicides, machinery and fuel) including all the labour practices performed to harvesting. Post-harvesting activities were not included. The results showed that important energy and production cost savings may be achieved through minimum tillage and zero tillage, compared with conventional tillage. These energy savings ranged from 7 to 11% for cereal crops, whereas for vetch crops the reduction was 10% for minimum tillage and 15% for zero tillage. Production costs for minimum tillage were 13-24% less than for conventional tillage. For zero tillage these reductions ranged from 6 to 17%. For cereal crops, minimum tillage and zero tillage had energy productivities which were 18% and 20%, respectively, greater than that for conventional tillage. In most cases, yields of winter crops were similar, regardless of the tillage system considered. Only spring barley showed lower yields with zero tillage. For winter cereals the profitability with minimum tillage and zero tillage is higher than that with conventional tillage. However, spring barley is less profitable when using zero tillage. [References: 18].

1362 Larney, FJ.; Lindwall, CW. (1995) **ROTATION AND TILLAGE EFFECTS ON AVAILABLE SOIL WATER FOR WINTER WHEAT IN A SEMI-ARID ENVIRONMENT.** *Soil & Tillage Research. 36(3-4):111-127.* English. [AGR CANADA RES CTR POB 3000 LETHBRIDGE AB T1J 4B1 CANADA].

The recent adoption of conservation farming systems in the semi-arid Canadian prairies opens up the possibility of replacing the traditional fallow period with non-cereal crops (oilseeds, legumes). However, information on changes to soil water regimes by inclusion of these crops, especially in combination with zero tillage, is sparse. A study was initiated in 1984 on a sandy clay loam soil at Lethbridge, Alberta, to investigate the performance of winter wheat (Triticum aestivum L.) under conventional, minimum and zero tillage in monoculture and in 2-year rotations with fallow, canola (Brassica campestris L.) or lentils (Lens culinaris Medic.) /flax (Linum usitatissimum L.). Conventional tillage in the Lethbridge region is shallow cultivation (10 cm) with a wide-blade (sweep) cultivator. Continuous cropping greatly depleted soil water reserves, resulting in some crop failures. Averaged over 10 years, available water for establishment of winter wheat in fall was least after canola (45 mm), followed by continuous winter wheat (59 mm), lentils/flax (74 mm) and fallow (137 mm). In this semi-arid region, the effect of rotation on soil water was much greater than that of tillage. Zero tillage had relatively little impact on available water to 1.5 m depth. However, once the experiment had been established for 6-7 years, available water in the 0-15 cm depth under winter wheat in spring was greatest under zero tillage. Precipitation storage efficiency during the fallow year was generally unaffected by tillage system. [References: 32].

1363 Lopezfando, C.; Almendros, G. (1995) **INTERACTIVE EFFECTS OF TILLAGE AND CROP ROTATIONS ON YIELD AND CHEMICAL PROPERTIES OF SOILS IN SEMI-ARID CENTRAL SPAIN.** *Soil & Tillage Research. 36(1-2):45-57.* English. [CSIC CTR CIENCIAS MEDIOAMBIENTALES SERRANO 115 DPDO E-28006 MADRID SPAIN].

This study evaluates the potential of no-tillage practices in the management of soils in semi-arid Mediterranean areas from central Spain, Field experiments on the interactive effects of tillage and crop rotations on soil chemical properties and crop parameters were conducted on a Calcic Haploxeralf (non-calcic brown soil), The experimental design included the comparison of plots subjected simultaneously to (a) no-tillage or conventional tillage and (b) barley (Hordeum vulgare L. cv. 'Aramir') monoculture or crop rotations, The latter consisted of barley-vetch (Vicia sativa L.) or barley-sunflower (Helianthus annus L.) rotations, The results were analysed for 3 growing years. Irrespective of tillage systems, crop yield depended greatly on environmental conditions. Crop parameters in the no-tillage system were not significantly different from those under conventional tillage. When compared with conventional tillage, no-tillage favoured the surface accumulation of soil C as well as of available P and K. Crop rotations increased barley yield in comparison with a barley monoculture. The barley-sunflower rotation gave the greatest barley yield and improvement in soil fertility. Our results suggest that no-tillage can lead to a progressive improvement in soil nutrient status, but have little or no effect on crop parameters; the latter may be successfully controlled through suitable crop rotations. Of the factors examined, the environmental conditions of temperature and rainfall in the Mediterranean climate showed the greatest influence on the results between different cropping years. [References: 36].

1364 Mayor, J. Ph.; Maillard, A. (Station federale de recherches agronomiques de Changins, Nyon (Switzerland)) (1995) **[Results of an over 20 year no-tillage trial at Changins. IV. Seed stock and weed control]. Resultats d'un essai de culture sans labour depuis plus de 20 ans a Changins. IV. Stock semencier et maitrise de la flore adventice.** *Revue suisse d'agriculture (Switzerland) v. 27(4) p. 229-236.* 4 tables, 6 graphs, 3 photos, 28 ref. French. (AGRIS 96-015129).

Since 1969 a long term tillage trial has been conducted at Changins on a brown calcareous soil with 27 % clay and 44 % silt. Three no-tillage techniques are compared with conventional mouldboard ploughing. The techniques differ mainly in their working depth. The crop rotation consists of winter rape, winter wheat, maize and winter wheat. Wheat straw is removed by baling; rape straw and maize stalks are chopped. Compared to conventional ploughing, ploughless tillage did not modify considerably the density of the seed stock in the soil. It lead, however, to a bigger diversity. The reduction of the tillage depth in the unploughed plots increased the population of perennial weeds. Weed control is slightly more intensive in no-tillage systems than with conventional tillage.

1365 Nyborg, M.; Solberg, ED.; Izaurralde, RC.; Malhi, SS.; Molinaayala, M. (1995) **INFLUENCE OF LONG-TERM TILLAGE, STRAW AND N FERTILIZER ON BARLEY YIELD, PLANT-N UPTAKE AND SOIL-N BALANCE.** *Soil & Tillage Research. 36(3-4):165-174.* English. [UNIV ALBERTA DEPT RENEWABLE RESOURCES EDMONTON AB T6G 2E3 CANADA].

Long-term influence of N fertilizer, tillage and straw on crop production and soil properties are not well known in central Alberta. Field experiments were established in autumn 1979, on a Black Chemozemic soil and on a Gray Luvisolic soil in north-central Alberta to determine the long-term effect of tillage, straw and N fertilizer on yield and N uptake of barley (Hordeum vulgare L.). Fertilizer N was applied annually at 56 kg ha(-1). The 11 year averages of barley yields and N uptake under zero tillage were lower than under conventional tillage. Retention rather than removal of straw tended to reduce barley yield for the initial 6 years and 2 years at Site 1 and Site 2, respectively. A simple mathematical model of average annual plant N uptake and grain yield could account for most of the variation in the data observed at both sites ($R(2)=0.907$; $P<0.01$). Final values of soil N, calculated using a mass balance approach, agree closely with values measured at the end of the eleventh year. Conventional tillage and zero tillage, with addition of fertilizer N and retention of straw, were the only treatments with apparent but small net addition of N to soil at Site 1 (40 kg ha(-1) and 117 kg ha(-1), respectively). At Site 2, only the zero tillage treatment with addition of fertilizer and retention of straw gained soil N (29 kg ha(-1)). In conclusion, soil ecosystems functioning in subhumid environments with slight to moderate heat limitations such as those in central Alberta can adapt, within a few years, to zero tillage practices with full retention of straw. [References: 16].

1366 Radford, BJ.; Thorburn, PJ.; Key, AJ. (1995) **ENHANCEMENT OF WHEAT ESTABLISHMENT WITH MODIFIED SOWING AND FALLOW MANAGEMENT TECHNIQUES.** *Soil & Tillage Research. 36(1-2):73-89.* English. [BILOELA RES STN POB 201 BILOELA QLD 4715 AUSTRALIA].

Modified fallow management practices and modified sowing techniques were used to enhance wheat (Triticum aestivum) establishment in dry conditions. The effects of tillage, stubble management, deep sowing and press wheel pressure on wheat establishment were examined at various periods after rain. Experiments were conducted on two contrasting soil types: an Entic Pellustert and a Typic Natrustalf. On the Entic Pellustert, both tillage during the fallow and the use of a press wheel at sowing increased wheat establishment. Responses to tillage and the press wheel occurred even when there was enough post-sowing rain to wet the soil to the level of seed placement. Increase in sowing depth from 67 to 88 mm reduced establishment in most sowings. On the Typic Natrustalf, there was little establishment response to tillage, a mulch of wheat stubble or the use of press wheel pressure at sowing. However, an increase in sowing depth from 54 to 74 mm maintained a given level of establishment for an additional 10 days of soil drying after rain. Deep furrow sowing (placement of seed over 100 mm below the original soil surface) did not improve establishment on either soil type. On both soil types, soil matric potential and establishment at a particular sowing depth were significantly correlated ($R(2) = 0.91$ and 0.68, respectively), indicating that differences in establishment were caused primarily by the impact of the treatments on seed bed water levels. [References: 28].

1367 Sidhu, B.S.; Goswami, K.P.; Pareek, R.P. (Punjab Agricultural Univ., Ludhiana (India). Deptt. of Soils) (1994) **Influence of rice and wheat straw application on crop yields.** *Journal of Research - Punjab Agricultural University (India) v. 31(2) p. 147-153.* 5 tables; 15 ref. English. (AGRIS 96-002260).

F08 CROPPING PATTERNS AND SYSTEMS

1368 Aggarwal, GC.; Sidhu, AS.; Sekhon, NK.; Sandhu, KS.; Sur, HS. (1995) **PUDDLING AND N MANAGEMENT EFFECTS ON CROP RESPONSE IN A RICE-WHEAT CROPPING SYSTEM.** *Soil & Tillage Research. 36(3-4):129-139.* English. [PUNJAB AGR UNIV DEPT SOILS LUDHIANA 141004 PUNJAB INDIA].

Coarse-textured soils are puddled to reduce high percolation losses of irrigation water under rice (Oryza sativa L.). This practice, however, reduces yield of succeeding wheat (Triticum aestivum L.) owing to deterioration in soil physical conditions. The 6 year field study reported in this paper evaluated the effects of puddling level and integrated N management on the development of subsurface compaction and growth and yield of rice and the following spring wheal grown in 1 year sequence on a sandy loam soil. Treatments were combinations of three puddling levels: low (one discing and one planking), medium (two discings and one planking), and high (four discings and one planking), and three nitrogen sources: (1) 120 kg N ha(-1) from urea, (2) 60 kg N ha(-1) from urea plus sesbania (Sesbania aculeata Pers.) green manure, and (3) 60 kg N ha(-1) from urea plus 20 Mg ha(-1) farmyard manure. Percolation rate decreased from 14 mm day(-1) with low puddling to 10 mm day(-1) with high puddling, with a corresponding reduction in irrigation water requirement of rice of about 20%. Bulk density pro files in the 0-30 cm soil layer showed the formation of a compact layer at 15-20 cm depth, and bulk density increased with puddling level and cropping season. The impact of organic amendments in reducing bulk density was immediate, but the rate of increase in bulk density with time was the same in all the nitrogen sources. Organic amendments did not affect percolation rate and irrigation requirement of rice. Rice yields were not significantly affected by puddling and N source treatments throughout the study period. Residual effects of treatments on wheat yield were observed from the second season onwards. Interactive effects of puddling and N source on yields of rice and succeeding wheat were not significant. Yield differences in wheat between high and low puddling were 8% and 11% during the second and the fifth cropping season, respectively. This study indicates that medium puddling was optimum, as it reduced percolation without decreasing yield of succeeding wheat. [References: 18].

1369 Brandt, SA.; Zentner, RP. (1995) **CROP PRODUCTION UNDER ALTERNATE ROTATIONS ON A DARK BROWN CHERNOZEMIC SOIL AT SCOTT, SASKATCHEWAN.** *Canadian Journal of Plant Science. 75(4):789-794.* English. [AGR & AGRI FOOD CANADA RES BRANCH EXPTL FARM SCOTT SK S0K 4A0 CANADA].

Nine rotations of fallow (F), wheat (W), barley (B), canola (C) and alfalfa hay (H) were evaluated to determine whether alternating crops in rotation on Dark Brown soils increases yield or reduces yield variability. Enhanced yield could increase economic returns, while reduced yield variability could reduce risk of economic loss in individual years. Rotations used in the study were F-W, F-C, FW-W, F-C-W, F-W-B, F-C-B, FC-B-H, F-C-W-B-H-H, and continuous wheat. Rotation did not affect yield of wheat or canola grown on summerfallow. Yield and quality of wheat and barley grown on stubble were influenced by rotation. Wheat yield on wheat stubble averaged 1980 and 2160 kg ha(-1) in the continuous wheat and F-W-W rotations, respectively, while wheat on canola stubble averaged 2340 and 2290 kg ha(-1) in the F-C-W and F-C-W-B-H-H rotations. Most of the yield reduction with wheat on wheat stubble occurred during 1987-1991, when preseeding tillage on stubble was minimized. Leaf disease (tan spot and septoria) increased noticeably on wheat stubble during 1987-1991 compared with 1980-1986 or with wheat on canola stubble. Presumably, reduced tillage during 1987-1991 left more infected residue on the soil surface, where it could infect a succeeding wheat crop. Yield of canola relative to wheat during 1980-1991 was much higher than reported for this study during 1972-1979; this was likely due to better seedbed preparation and more effective weed control. Coefficients of variability (CV) for yield over years were 20-25% for canola; 27-30% for wheat on fallow; 24-31% for wheat on stubble; 23-34% for barley on stubble; and 51-63% for alfalfa hay. Calculated on a rotation basis, CV tended to be high in wheat monoculture rotations, particularly where summerfallow was eliminated, but tended to be lower where a mix of crops was grown. Implications for more widespread acceptance of extended cropping are discussed. [References: 21].

1370 Chudanov, I.A.; Kalimullin, A.N. (1994) **[What predecessors are better? [Improving quality of durum wheat grain under conditions of the Middle Povolzhye, Russian Federation]]. Kakie predshestvenniki luchshe? [Uluchshenie kachestva zerna tverdykh pshenits v usloviyakh**

Srednego Povolzh'ya]. *Zemledelie (Russian Federation) (no.6) p. 17-18.* Russian. (AGRIS 96-015223).

1371 Cunfer, B.M. (University of Georgia, Griffin, GA.); Rothrock, C.S. (1994) **The influence of conservation tillage and doublecropping practices on diseases of wheat in Georgia.** *Research bulletin (University of Georgia. College of Agriculture. Experiment Stations) (USA); no. 418 22 p.* references. English. (AGRIS 96-002338).

1372 Czajka, W. (Akademia Rolniczo Techniczna, Olsztyn (Poland). Katedra Ochrony Roslin) (1994) **[Effect of crop rotation and monoculture on the condition of winter wheat stem base]. Wplyw plodozmianu i monokultury na zdrowotnosc podstawy zdzbla pszenicy ozimej.** *Acta Academiae Agriculturae ac Technicae Olstenensis. Agricultura (Poland) (no.59) p. 83-90.* 4 tables; 26 ref. Polish. (AGRIS 96-002341).

The effect of winter wheat cultivation in the monoculture and in the crop rotation system on the intensity of stem base diseases: Gaeumannomyces graminis and Pseudocercosporella herpotrichoides. Microflora of stem base was also examined in winter wheat showing symptoms of these diseases. It was found that the diseases were more intensive in 3-5-year monoculture and that the pathogenic fungi developed more abundantly.

1373 Czajka, W.; Kurowski, T.P.; Cwalina, B.; Jackowski, M. (Akademia Rolniczo Techniczna, Olsztyn (Poland). Katedra Ochrony Roslin) (1994) **[Effect of crop rotation and monoculture on the health of spring wheat stem base]. Wplyw plodozmianu i monokultury na zdrowotnosc podstawy zdzbla pszenicy jarej.** *Acta Academiae Agriculturae ac Technicae Olstenensis. Agricultura (Poland) (no.59) p. 91-96.* 3 tables; 21 ref. Polish. (AGRIS 96-002342).

It was found that cultivation of spring wheat in monoculture had an adverse effect on the stem base health and intensified the development of pathogenic fungi.

1374 Dat Van Tran; Marathee, J.P. (1994) **Major issues in Asian Rice-Wheat production systems.** RAPA Publication (FAO); no. 1994/11 p. 61-67. p. 61-67. English. (AGRIS 96-015213).

1375 Ghonsikar, C.P.; Shinde, V.S. (National Agricultural Research Project, Aurangabad (India)) (1994) **Intercropping in wheat and mustard pays more than mixed cropping.** *Indian Farming (India) v. 44(8) p. 7, 9.* 2 table. English. (AGRIS 96-002340).

1376 Gill, R.B. (Punjab Agricultural Univ., Ludhiana (India)) (1994) **Sustainability issues related to rice-wheat production system in Asia.** RAPA Publication (FAO); no. 1994/11 p. 36-60. p. 36-60. English. (AGRIS 96-015220).

1377 Ju, J.I.; Kim, C.H.; Moon, C.S.; Kim, C.Y. (Rural Development Administration, Taejon (Korea Republic). Chungnam Provincial Rural Development Administration); Cho, C.H. (Dankook University, Cheonan (Korea Republic). College of Agriculture) (1995) **Growth and yield of barley broadcasted before rice harvest.** *Korean Journal of Crop Science (Korea Republic) v. 40(4) p. 428-436.* 6 ill.; 4 tables; 14 ref. Korean. (AGRIS 96-015190).

1378 Krall, JM.; Miller, SD.; Legg, DE. (1995) **INFLUENCE OF ALFALFA ESCAPES ON ESTIMATING SPRING BARLEY YIELD.** *Agronomy Journal. 87(6):1154-1156.* English. [UNIV WYOMING DEPT PLANT SOIL & INSECT SCI LARAMIE, WY 82071 USA].

In Wyoming, spring barley (Hordeum vulgare L.) can follow alfalfa (Medicago sativa L.) in irrigated rotations. To avoid serious wind erosion, this conversion should be done using conservation tillage. However, this can be complicated by alfalfa escapes. The relationship between the level of established alfalfa interference and barley is unknown. Establishment of the season-long impact of alfalfa escapes on barley yield would be important for crop-loss assessment. Forecasting the impact on production would be valuable as a decision making tool. The objective of this study was to estimate yield losses from season-long interference of alfalfa escapes and to forecast impact of alfalfa escapes on spring barley yield. Replicated field studies were conducted under sprinkler irrigation at a site near Torrington, WY. Herbicide treatments were used to provide for barley production across a range of levels of alfalfa interference. Barley yield response was regressed on various measures of alfalfa infestation. Consistency of regression over years for barley yield on end-of-season alfalfa stand or alfalfa yield allowed for simple interpretation of the expected barley yield reduction, as well as calculation of the expected barley yield given a specific level of alfalfa infestation. Use of a growing season visual assessment of alfalfa control did not result in consistency of regression slopes over years. Calculation of an expected barley yield based on models developed using alfalfa stand and alfalfa yield was accomplished. The predictors are -84.747 and -0.5577 for alfalfa plants 0.5 m(-2) and kg ha(-1) alfalfa yield, respectively. [References: 8].

1379 Laurent, F. (Institut Technique des Cereales et des Fourrages, Paris (France)); Taureau, J.C.; Lambert, M.; Fontaine, A.; Bonnefoy, M. (1995) **[Catch crops management: effect on next crop]. Gestion de l'interculture: approche au champ des effets sur la culture suivante.** *Perspectives Agricoles (France) (no.206) p. 52-62.* 6 ref., 5 tableaux, 7 graph. French. (AGRIS 96-015221).

1380 Lyon, DJ.; Baltensperger, DD. (1995) **CROPPING SYSTEMS CONTROL WINTER ANNUAL GRASS WEEDS IN WINTER WHEAT.** *Journal of Production Agriculture. 8(4):535-539.* English. [UNIV NEBRASKA PANHANDLE RES & EXT CENT 4502 AVE I SCOTTSBLUFF, NE 69361 USA].

Downy brome (Bromus tectorum L.), jointed goatgrass (Aegilops cylindrica Host), and volunteer cereal rye (Secale cereale L.) are winter annual grass weeds that are increasingly troublesome in the winter wheat (Triticum aestivum L. emend. Thell.)-fallow rotation areas of the western USA. Six dryland cropping systems-continuous no-till winter wheat, winter wheat-fallow with fall tillage, winter wheat-fallow with fall applied herbicide, winter wheat-fallow-fallow, winter wheat-sunflower-fallow, and winter wheat-prose millet-fallow-were compared for their effect on winter annual grass densities in winter wheat. Winter annual grass densities averaged 145, 4.4, and 0.4 plants/sq yard for the 1-, 2-, and 3-yr systems, respectively. Eradication of the winter annual grasses was not achieved with any of the systems. Dockage and foreign material levels in wheat grain were lower in 3-yr than in 2-yr cropping systems. Jointed goatgrass was the most persistent annual grass investigated.

1381 Malitius, O.; Bergmann, F.; Sidler, A. (Eidg. Forschungsanstalt fuer Agrarwirtschaft und Landtechnik (FAT), Taenikon (Switzerland)); Meister, E.; Weisskopf, P.; Scherrer, C.; Forrer, H. R.; Weilenmann, F. (1995) **[Cereal-dominated crop rotation: integrated and intensive managements]. Getreidebetonte Fruchtfolge: integriert und intensiv bewirtschaftet.** *Agrarforschung (Switzerland) v. 2(6) p. 235-238.* 3 tables, 4 graphs, 6 ref. German. (AGRIS 96-015192).

In the fourth period of a five-year cereal-dominated (60 %) crop rotation both production and ecological aspects of integrated (ip) and intensive (is) management systems were compared under farm conditions. The crop sequence under study was: maize, winter wheat, winter barley, oilseed rape, and winter wheat. This rotation showed a slightly reduced production potential as compared to the diversified rotation, which was due mainly to a lower nitrogen mineralisation rate in the soil. Mechanical weed control (ip) was not always effective enough, making occasional herbicide applications necessary. The selection of cereal varieties with a good and broad resistance level for the ip system made a major reduction of chemical inputs possible. However, yields reached only 84 % on average of the is variant. The gross margin was markedly lower, inspite of lower costs for pesticides and mineral nitrogen.

1382 Mediavilla, V.; Meister, E.; Walther, U.; Fried, P. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau (FAP), Zuerich Reckenholz (Switzerland)); Malitius, O.; Sidler, A.; Ott, A. (1995) **[Diversified crop rotation: integrated and intensive managements]. Vielseitige Fruchtfolge: integriert und intensiv bewirtschaftet.** *Agrarforschung (Switzerland) v. 2(6) p. 231-234.* 3 tables, 3 graphs, 6 ref. German. (AGRIS 96-015195).

In the fourth period of a five-year diversified crop rotation both the production and ecological aspects of integrated (ip) and intensive (is) management practices were compared under farm conditions. The rotation included maize, winter wheat, two years of a grass-clover mixture, and potatoes. The production potential was high compared to rotations based mainly on cereals or maize. The integrated system allowed the pesticide and mineral nitrogen inputs to be cut by half with mechanical field operations increasing only slightly. Over the whole period ip yields were only 6 % lower than for the is variant, the gross margins being similar. Crop quality was the same for the two systems. Soil structure was optimal and nitrogen mineralisation higher than in the rotations with one predominant crop.

1383 Meister, E.; Weisskopf, P.; Mediavilla, V. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau (FAP), Zuerich Reckenholz (Switzerland)); Malitius, O.; Bergmann, F.; Sidler, A. (1995) **[Which crop rotation? Intensive or integrated crop management?]. Welche Fruchtfolge? Intensiv oder integriert bewirtschaften?** *Agrarforschung (Switzerland) v. 2(6) annexe.* 20 photos, 5 ref. German. (AGRIS 96-015194).

1384 Narziss, L. (1995) **[Malting barley in the integrated plant production. Bavarian brewing industry for environmental protection]. Braugerste im integrierten Pflanzenbau. Umweltleistung der Bayerischen Brauwirtschaft.** *Brauwelt (Germany) v. 135(19-20) p. 953-957.* 3 tables; 6 ref. German. (AGRIS 96-002331).

1385 Nelson, KE.; Burgess, LW. (1995) **EFFECT OF ROTATION WITH BARLEY AND OATS ON CROWN ROT OF WHEAT IN THE NORTHERN WHEAT BELT OF NEW SOUTH WALES.** *Australian Journal of Experimental Agriculture. 35(6):765-770.* English. [UNIV SYDNEY DEPT CROP SCI FUSARIUM RES LAB SYDNEY NSW 2006 AUSTRALIA].

We investigated the incidence of Fusarium graminsarum Group 1 (infection, stem colonisation) and crown rot in 3-year crop sequences of 1 or 2 years of barley, oats, or mown oats followed by wheat, compared with 3 years of wheat. Seed was sown into the stubble of the previous crop. Stubble production was estimated for each cereal treatment. Plants of each cereal were infected by the crown rot pathogen. Oats were susceptible to infection but did not express symptoms of crown rot in 2 years of the trial. Oats can, therefore, be considered a symptomless host that may contribute to the maintenance of inoculum. The overall mean incidence of infected plants increased from 12% in 1987 to 81% in 1989. The various treatments did not significantly reduce the incidence of infected wheat plants in November of the final year. The incidence of crown rot of wheat in 1989 was greatest after 2 prior wheat crops and lowest after 1 or 2 years of mown oats. The 3 species produced a similar amount of straw by weight; however, mown oats produced significantly less. Oat straw decomposed more rapidly than that of other cereals in controlled conditions. [References: 26].

1386 Sing, R.B.; Paroda, R.S. (1994) **Sustainability and productivity of rice-wheat systems in the Asia-Pacific region: Research and technology development needs.** RAPA Publication (FAO); no. 1994/11 p. 1-35. p. 1-35. English. (AGRIS 96-015212).

1387 Singh, V.; RAMDEO.; Sharma, SK.; Siag, RK.; Verma, BL. (1995) **ECONOMICS OF LEGUME WHEAT (TRITICUM AESTIVUM) CROPPING SYSTEMS UNDER DIFFERENT LEVELS OF IRRIGATION.** *Indian Journal of Agricultural Sciences. 65(10):712-716.* English. [RAJASTHAN AGR UNIV AGR RES STN SRIGANGANGAR 335001 INDIA].

A field experiment was conducted from 1988-89 to 1992-93 to evaluate the production potential and economic returns in wheat (Triticum aestivum L. emend. Fiori & Paol.)-based cropping systems under various levels of irrigation. Greengram (Phaseolus radiatus L.) wheat, pigeonpea [Cajanus cajan (L.) Millsp.]-wheat and clusterbean [Cyamopsis tetragonoloba (L.) Taubert]-wheat cropping systems gave maximum economic yields and net returns with respectively 8, 11 and 8 irrigations during rainy and winter seasons. Among the rainy-season legumes, pigeonpea gave the maximum seed yield (1.81 tonnes/ha) with 5 irrigations applied at irrigation water : cumulative pan evaporation (IW : CPE) ratio of 5, followed by clusterbean and greengram. Pigeonpea-wheat cropping system receiving 11 irrigations showed the highest economic yield (4.61 tonnes/ha/year) and wheat-equivalent yield (5.84 tonnes/ha/year), total net return (Rs 16 831/ha/year) and consumptive use of water (863 mm). Significantly highest mean net return or Rs 13 158//ha/year was obtained from pigeonpea-wheat cropping system, followed by clusterbean-wheat and greengram-wheat. The highest mean values for cost of cultivation (Rs 8 725/ha/year), net return (Rs 46.49/ha/day), consumptive use (807 mm water) and land-use efficiency (77.53%) were recorded with pigeonpea-wheat, followed by clusterbean-wheat and greengram-wheat. Maximum water-use efficiency of 5.67 kg/ha-mm was recorded in clusterbean-wheat, whereas highest harvest index (26.4%) and production efficiency (15.36 kg/ha/day) were obtained in greengram wheat cropping system.

1388 Weisskopf, P.; Meister, E.; Ammon, H.U.; Mediavilla, V. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau (FAP), Zuerich Reckenholz (Switzerland)); Malitius, O.; Anken, Th.; Sidler, A. (1995) **[Maize-dominated crop rotation: integrated and intensive managements]. Maisbetonte Fruchtfolge: integriert und intensiv bewirtschaftet.** *Agrarforschung (Switzerland) v. 2(6) p. 240-243.* 3 tables, 3 graphs, 2 photos, 6 ref. German. (AGRIS 96-015196).

In the fourth period of a five-year maize-dominated (60 %) crop rotation both production and ecological aspects of integrated (ip) and intensive (is) management strategies were compared under farm conditions. The crop sequence under study was: maize, winter wheat, grass-clover ley, maize, and maize. The soil structure had suffered considerably during the previous rotations as compared to the diversified and cereal-dominated rotations. The top soil as well as the subsoil were very compact, which resulted in a lower nitrogen mineralisation rate and restricted root development. This lead, together with competitive weeds, to reduced yields in most crops, especially during the first years of integrated management.

1389 Westcott, MP.; Welty, LE.; Knox, ML.; Prestbye, LS. (1995) **MANAGING ALFALFA AND BERSEEM CLOVER FOR FORAGE AND PLOWDOWN NITROGEN IN BARLEY ROTATIONS.** *Agronomy Journal. 87(6):1176-1181.* English. [MONTANA STATE UNIV WESTERN AGR RES CTR 580 QUAST LN CORVALLIS, MT 59828 USA].

Annual legume plowdown systems, which utilize fall regrowth for N contributions to rotational crops, have not been adapted to irrigated, intermountain areas of the Northern Rockies. Our objective was to evaluate plowdown systems using 'Nitro' alfalfa. (Medicago saliva L.) and 'Big-bee' berseem clover (Trifolium alexandrinum L.). These two legumes were grown under five harvest management systems (zero to three forage harvests prior to fall plowdown of regrowth, or a standard three harvest system with no herbage plowdown) at two sites in Western MT differing in soil characteristics. They were assayed for forage and plowdown production and for N benefits to 'Clark' barley (Hordeum vulgare L.; syn, H. distichon L.) for two subsequent years. Maximum herbage plowdown N was 125 to over 200 kg N ha(-1) for berseem clover and 87 kg N ha(-1) for alfalfa. A two-harvest system resulted in 3.6 to 6.6 Mg ha(-1) forage and 45 to 78 kg N ha(-1) in herbage plow down. Effects of plowdown were measured directly in increased soil N availability and correlated increases in N uptake in subsequent barley; benefits were expressed in increased grain yields and/or grain N concentrations and were apparent for two successive Sears at the site of lower native fertility. Alfalfa N benefits were superior to berseem clover, though disproportionate to herbage plowdown N quantities, possibly due to greater root and crown N in alfalfa. Where the management goal is primarily forage production with moderate benefit of plowdown N, berseem clover works well in a two-harvest system; Nitro alfalfa is preferred where greater benefits of plowdown N are desired. [References: 23].

1390 Woodhead, T. (International Rice Research Inst., Los Banos (Philippines)); Huke, R.; Huke, E. (1994) **Areas, locations, and ongoing collaborative research for the rice-wheat systems of Asia.** RAPA Publication (FAO); no. 1994/11 p. 68-96. p. 68-96. English. (AGRIS 96-015214).

F30 PLANT GENETICS AND BREEDING

1391 **Wheat and barley development: Institutional support programme final report** (1995) Uganda Grain Milling Company Ltd, Kampala (Uganda); Carl Bro Group Uganda Ltd, Kampala (Uganda). 96 tables; 24 ill. 272 p. English. (AGRIS 96-002576).

The objective of the wheat and barley development project was to provide a frame work for research, agro-economic, marketing and extension activities. The strategy was to encourage experimental production to develop varieties and agronomic data to support current production activities. Cereal breeding had to develop wheat and barley lines suitable for Uganda conditions with industrial qualities. 64000 wheat and 1600 barley ilnes were screened for yield potential and resistance to diseases. Wheats were tested in highlands between 1500m to 2000m, barley at altitudes os 2000m to 2500m. Three highland varieties, K. chiriku, Pasa and Nkungu (UW11) and two barley varieties Bima and HKBL308-13 have been recommended for release. Promising wheat lines for lowlands for further testing are out before release. Wheat agronomy had to identify target areas for production technology. Low, medium potential areas and such high potential sites of Mt Elgon, Kabale, Ankole and Kabarole were identified. Production constraints are sowing methods, weed control, harvest technology and resistant varieties. Barley agronomy was tested for technicality and economics of production. Constraints include weeds, soil fertility amd seeding methods. Assessment of popularity was also done for both crops. The potential for wheat production is excellent. Malting barley can be produced but time and excellent infrastructute is required.

1392 **[INRA, national institute for agricultural research (France): research on small grain cereals]. INRA, Institut national de la recherche agronomique (France): les recherches sur les cereales a paille** (1994) Institut National de la Recherche Agronomique, Paris (France). INRA. 14 ill., 5 tableaux. 61 p. French. (AGRIS 96-015380).

1393 Abdalla, OS.; Crossa, J.; Autrique, E.; Delacy, IH. (1996) **RELATIONSHIPS AMONG INTERNATIONAL TESTING SITES OF SPRING DURUM WHEAT.** *Crop Science. 36(1):33-40.* English. [CIMMYT APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Knowledge of the relationships among international test sites is valuable information for effective targeting of germplasm exchange. Five years of grain yield data from the Elite Durum Yield Trial (EDYT), consisting of 132 trials from 32 locations in 22 countries, were studied. Pattern analysis, the combination of ordination and cluster analysis, was used to identify groupings of international test sites that represent similar selection environments and compare location association with the mega-environment designations of the International Maize and Wheat Improvement Center (CIMMYT) breeding program. Two main environmental groups and six subgroups were identified for durum wheat (Triticum turgidum L. var. durum). The major determinants of the groupings were latitude and moisture supply. Biotic and abiotic stresses influenced further delineation of the clusters. Discrepancies between mega-environment designation and pattern analysis results warrant further investigations of the underlying causes. The relationships among test sites documented in this study should provide a framework for effectively targeting germplasm and information exchange between comparable programs. [References: 31].

1394 Andrews, JL.; Blundell, MJ.; Skerritt, JH. (1996) **DIFFERENTIATION OF WHEAT-RYE TRANSLOCATION LINES USING ANTIBODY PROBES FOR GLI-B1 AND SEC-1.** *Journal of Cereal Science. 23(1):61-72.* English. [BIOTECH AUSTRALIA PTY LTD POB 20 ROSEVILLE NSW 2069 AUSTRALIA].

In order to develop both a general screen for wheat-rye chromosome 1 translocation lines and a specific assay for 1BL.1RS lines, separate monoclonal antibodies (mAbs) were isolated that recognised M(r) 40 000 gamma-secalins (808/10) and gliadins encoded on chromosome 1B (218/17), respectively. Using aqueous propan-2-ol extracts of half grain, flour or meal and a direct enzyme linked immunosorbent assay (ELISA) format, mAb 808/10 gave a positive response with lines containing IRS translocated onto either chromosome 1A, 1B or 1D, while non-translocation wheats displayed very low reactivity. Similar results were obtained with dilute saline extracts of flour or meal. The binding of mAb 808/10 to secalins was dependent on the proteins retaining some tertiary structure since the antibody response was abolished if the proteins were reduced. MAb 218/17 displayed little reaction with aqueous propan-2-ol extracts of 1BL.1RS translocation lines, but gave a positive colour response with all other wheats tested. Therefore detection of 1BL.1RS translocation lines can be achieved by a positive response to mAb *808/10* or a negative response to mAb 218/17. Alternatively, both ELISAs can be performed on a single aqueous propan-2-ol sample extract to differentiate three groups: 1BL.1RS translocation lines, cultivars carrying 1RS on wheat chromosomes 1A (or less commonly 1D), and non-translocation wheals. The methods were assessed with sets of non-1RS and 1RS translocations in American and Australian backgrounds. These ELISAs have several advantages over other immunoassays for Gli-B1 gliadins or Sec-1 secalins. They include reduced assay time because of fewer steps, enabling greater throughput of samples, and adaptability to meal, flour or half-grain samples. (C) 1996 Academic Press Limited [References: 40].

1395 Baga, M.; Chibbar, RN.; Kartha, KK. (1995) **MOLECULAR CLONING AND EXPRESSION ANALYSIS OF PEROXIDASE GENES FROM WHEAT.** *Plant Molecular Biology. 29(4):647-662.* English. [NATL RES COUNCIL CANADA INST PLANT BIOTECHNOL 110 GYMNASIUM PL SASKATOON SK S7N 0W9 CANADA].

A PCR-based screening approach was used to isolate genomic clones from wheat encoding peroxidase isozymes. Three complete genes (pox1, pox2 and pox4) and one truncated gene (pox3) were characterized. The nucleotide sequences predicted mature proteins of 31 kDa, in which all the highly conserved motifs of secreted plant peroxidases were preserved. The coding region s showed 73-83% DNA sequence identity, with *the highest* level of similarity noted for the tandemly oriented pox2 and pox3. Expression of respective pox genes in various tissues of wheat was assessed by the RT-PCR technique, which showed that all four genes are active. The primary pox1 mRNA was spliced to remove three introns, whereas processing of the other pox transcripts involved only two intervening sequences. Splicing occurred at consensus GU/AG splice sites except for the first introns of pox1, pox2 and pox4 transcripts, where processing took place at unusual GC donor sites. The RNA analysis suggested that the pox1, pox2 and pox4 genes are predominantly expressed in roots. Lower levels of expression were found for pox4 and pox3 in leaves. Infection of wheat by the powdery mildew fungus selectively induced expression of pox2 in leaves. [References: 58].

1396 Barnabas, B.; Kovacs, G.; Bado, Z. (Magyar Tud. Akad., Martonvasar (Hungary). Mezogazdasagi Kut. Int.) (1994) **[Biotechnology in wheat breeding]. Biotechnologiai modszerek a buzanemesitesban.** *Botanikai Kozlemenyek (Hungary) v. 81(1) p. 89-91.* 8 ref. Hungarian. (AGRIS 96-015616).

The anther culture technique has been succesfully involved in breeding practice and other methods are also very close to this stage. As a further step of haploid techniques haploid protoplast-cell-plant systems have been developed which are suitable for cell selection as well as for genetic transformation. The yield of fertile green plant regenerants can be increased to great extent by direct dihaploid production methoids using antimitotic drugs. Haploids or dihaploids can be produced from recalcitrant genotypes with limited adrogenic capacity by pollination with cryopreserved maize pollen and it is unnecessary to raise the plants in expensive phytotron chambers or greenhouse conditions to ensure synchronous flowering. The development of gametophytes in in vitro floret and isolated microspore cultures provides the possibility for breeders to select on gametophytic level too.

1397 Bauer, E.; Graner, A. (1995) **BASIC AND APPLIED ASPECTS OF THE GENETIC ANALYSIS OF THE YM4 VIRUS RESISTANCE LOCUS IN BARLEY.** *Agronomie. 15(7-8):469-473.* English. [FED CTR BREEDING RES CULTIVATED PLANTS INST RESISTANCE GENET D-85461 GRUNBACH GERMANY].

The barley mosaic virus complex has become one of the major pathogens of cultivated winter barley in central Europe. One resistance gene (ym4) mediates complete immunity against barley mild mosaic virus

(BaMMV) and barley yellow mosaic virus type 1 (BaYMV-1). An attempt is made to molecularly characterize the ym4 resistance locus on the long arm of barley chromosome 3 by means of RFLP and sequence-tagged-site (STS) markers. Two closely linked molecular markers have been identified which are suitable for marker-assisted selection for the resistance gene. A high resolution mapping population is being developed in order to provide the basis for positional cloning of the ym4 resistance gene. [References: 10].

1398 Belay, G.; Tesemma, T.; Bechere, E.; Mitiku, D. (1995) **NATURAL AND HUMAN SELECTION FOR PURPLE-GRAIN TETRAPLOID WHEATS IN THE ETHIOPIAN HIGHLANDS.** *Genetic Resources & Crop Evolution. 42(4):387-391.* English. [SWEDISH UNIV AGR SCI DEPT PLANT BREEDING RES BOX 7003 S-75007 UPPSALA SWEDEN].

Purple-grain tetraploid wheats (Triticum turgidum L.) are widely cultivated in the Ethiopian highlands despite the claim that they have lower industrial quality properties and market prices than the white or red/brown seed-colour types. In an attempt to find a possible explanation for this, the three seed-colour groups were compared for grain yield, other 11 agronomic traits and protein content. Five traits displayed significant differences between seed-colour groups where the purple-seed was superior; earlier maturity, shorter height, and higher fertility, tillering capacity and harvest index. Most of these are important adaptive traits to waterlogging stress on dark-clay soils (pellic vertisols) where the great bulk of the Ethiopian tetraploid wheats have been grown. Furthermore, among the three seed-colour groups, purple-seed wheat has the best malting quality for the preparation of arekie, a locally distilled spirituous liquor. It, therefore, appears that both natural and human selections have been responsible for their continued cultivation. Hence, the notion that purple-seeded wheat is the "least preferred" should be interpreted carefully not to necessarily address the whole community in Ethiopia. As to their taxonomy, all tetraploid wheat taxa (T. turgidum L. sensu lato, 2n = 4x = 28) that are found in Ethiopia, with the possible exception of T. dicoccon Shrank (locally known as Adja), may possess the purple pericarp-colour, although in varying frequencies; very low in T. polonicum L., and high in T. carthlicum Nevski and T. durum Desf. [References: 18].

1399 Blumenthal, C.; Bekes, F.; Gras, PW.; Barlow, EWR.; Wrigley, CW. (1995) **IDENTIFICATION OF WHEAT GENOTYPES TOLERANT TO THE EFFECTS OF HEAT STRESS ON GRAIN QUALITY.** *Cereal Chemistry. 72(6):539-544.* English. [CSIRO DIV PLANT IND GRAIN QUAL RES LAB POB 7 N RYDE NSW 2113 AUSTRALIA].

High-temperature stress (>35 degrees C) during the grain-filling period has the potential to modify grain quality. A consequent weakening of dough properties has been reported for many wheat genotypes. The experiment described in this article was designed to identify wheat genotypes that might be tolerant to the effects of heat stress on grain quality and to further assess the molecular basis of these changes. A diverse set of 45 wheat genotypes was exposed to 10 hr of 40 degrees C on each of three consecutive days in a phytotron. Mean values for all genotypes (with unheated control samples, all in duplicate) showed highly significant changes ($P < 0.001$) in 1,000 kernel weight (-17% difference for heat stressed minus control), protein content (17% increase), dough mixing time in a 2-g Mixograph (-13%), and resistance breakdown (17%). The general weakening of dough due to heat was accompanied by a decrease in glutenin-to-gliadin ratio and in the percentage of very large glutenin polymers. Bound lipid content increased, and there was a general reduction (-9%) in the proportion of small (B-type) starch granules. For all these attributes, reactions for individual genotypes ranged from little change (tolerance to heat stress) to considerable change (susceptible to heat stress). A group of genotypes was thus identified that should be useful in breeding attempts to stabilize wheats against heat-related variations in grain quality. Markers identified as potentially useful in breeding for tolerance include the presence of the Glu-Dld allele (glutenin subunits 5 and 10), and increases in glutenin-to-gliadin ratio and in the percentage of very large glutenin polymers. [References: 21].

1400 Brown, JKM.; Jessop, AC. (1995) **GENETICS OF AVIRULENCES IN ERYSIPHE GRAMINIS F SP HORDEI.** *Plant Pathology. 44(6):1039-1049.* English. [JOHN INNES CTR DEPT CEREALS RES COLNEY LANE NORWICH NR4 7UH NORFOLK ENGLAND].

The genetics of avirulences towards barley mildew resistances were analysed in crosses of the Erysiphe graminis f.sp. hordei isolate DH14 with CC107 and with CC138. Nine avirulences, Avr(a9), Avr(a10), Avr(a11), Avr(a12), Avr(Ab), Avr(CP), Avr(h), Avr(k) and Avr(La), segregated as single genes in one or other cross. However, F-1 segregation data were consistent with avirulence matching the Mla7 resistance gene being controlled by two genes, designated Avr(a7)1 and Avr(a7)2. Infection types of avirulent isolates differed on varieties in which Mla7 had been derived from each of the four known sources of that resistance. Linkage was detected between Avr(a7)1 and Avr(h) in the cross CC107 x DH14, and between Avr(a10) and Avr(k), Avr(a11) and Avr(La), and Avr(h) and the triadimenol response gene Tdl2 in CC138 x DH14. [References: 32].

1401 Bruins, MBM.; Snijders, CHA. (1995) **INHERITANCE OF ANTHER CULTURE DERIVED GREEN PLANTLET REGENERATION IN WHEAT (TRITICUM AESTIVUM L).** *Plant Cell Tissue & Organ Culture. 43(1):13-19.* English. [CTR PLANT BREEDING & REPROD RES DLO CPRO POB 16 6700 AA WAGENINGEN NETHERLANDS].

A study was set up to determine the inheritance and combining ability of the factors anther culture response and green plant regeneration. Reciprocal crosses were made between cultivar 'Ringo Sztar', showing high anther culture response and the cultivars 'Ciano 067' and 'Benoist H77022', showing a high level of green plant regeneration. Averaged over all genotypes, 23.0% of the anthers responded and a callus induction frequency of 77.8% was observed. Of all the embryos, 43.0% developed into plantlets, 25.6% of the regenerants being green, the result being that 3.3 green plants per 100 anthers were formed. Genotypic effects accounted for 57.7%, 86.3% and 77.5% of the total variance of anther culture response, callus induction frequency and embryo induction frequency, respectively. Additive and dominant gene action was detected for all characteristics, including green plant regeneration. No reciprocal differences were found for anther culture response, embryo induction frequency and green plant regeneration, indicating no cytoplasmic effects. A small but significant reciprocal difference was found for callus induction frequency. Embryo production was primarily correlated with anther culture response and not with the number of embryos produced per plated anther or per responding anther. Possible mechanisms for the inheritance of green plant regeneration are discussed. [References: 40].

1402 Buonocore, F.; Hickman, DR.; Caporale, C.; Porceddu, E.; Lafiandra, D.; Tatham, AS.; Shewry, PR. (1996) **CHARACTERISATION OF A NOVEL HIGH M(R) GLUTENIN SUBUNIT ENCODED BY CHROMOSOME 1D OF BREAD WHEAT.** *Journal of Cereal Science. 23(1):55-60.* English. [UNIV TUSCIA DIPARTIMENTO AGROBIOL & AGROCHIM VIA SAN CAMILLO DE LELLIS I-01100 VITERBO ITALY].

A high M(r) subunit of wheat glutenin (1Dx2.2*), having an unusually high M(r) (approximately 110 000), was purified using a combination of preparative isoelectric focusing and reversed-phase high performance liquid chromatography. Comparison of its N-terminal sequence and amino acid composition with those of the allelic subunit 1Dx2 indicate that its greater M(r) could be due to the presence of a larger central repetitive domain. Spectrofluorimetric and circular dichroism analyses suggest that an increase in the length of this domain does not affect the conformational properties of the subunit. (C) 1996 Academic Press Limited [References: 19].

1403 Busch, W.; Martin, R.; Herrmann, RG.; Hohmann, U. (1995) **REPEATED DNA SEQUENCES ISOLATED BY MICRODISSECTION .1. KARYOTYPING OF BARLEY (HORDEUM VULGARE L).** *Genome. 38(6):1082-1090.* English. [UNIV MUNICH INST BOT MENZINGER STR 67 D-80638 MUNICH GERMANY].

We report on microdissection, cloning and sequence, and Southern and fluorescence in situ hybridization (FISH) analysis of one moderately and one highly amplified repetitive DNA element, pHvMWG2314 and pHvMWG2315, respectively, isolated from barley (Hordeum vulgare L.) chromosome arm 3HL. The pHvMWG2315 sequence hybridizes to all 14 telomeric or subtelomeric regions of the barley chromosomes as determined by FISH. The 50 different hybridization sites that include intercalary signals allow the discrimination of all 14 chromosome arms and the construction of a karyotype of barley. The tandemly repeated

subtelomeric element of 331 bp exists in all Triticeae species tested (H. vulgare, Agropyron elongatum, Secale cereale, Triticum tauschii, T. turgidum, and T. aestivum). It is AT rich (66%), exhibits 84% sequence homology to subfragments of the D genome "specific" 1-kb element pAs1 of T. tauschii and 75% homology to the interspersed genome-specific DNA sequence pHcKB6 from H. chilense. The repetitive sequence pHvMWG2314 is moderately amplified in barley and highly amplified in hexaploid wheat. The in situ experiments revealed no distinct signals on barley chromosomes, indicating a dispersed character for the sequence. The significance of the results for the identification of chromosomes and chromosome aberrations in FISH experiments are discussed. [References: 37].

1404 Chalhoub, BA.; Kelly, L.; Robaglia, C.; Lapierre, HD. (1995) **EVIDENCE OF RNA RECOMBINATION IN THE GENOME 3'-TERMINAL REGION OF PAV-LIKE ISOLATES OF BARLEY YELLOW DWARF VIRUS (BYDV-PAV).** *Agronomie. 15(7-8):409-413.* English. [INRA UNITE GENET & AMELIORAT PLANTES F-78026 VERSAILLES FRANCE].

The genome 3'-terminal region of the PAV-serotype of barley yellow dwarf virus (BYDV-PAV) covers 2 subgenomic RNAs (sgRNA2 and sgRNA3). The sgRNA2 is responsible for the expression of the ORF6 (ORF: open reading frame). The sgRNA3 corresponds to the 334-terminal nucleotides and does not carry coding sequences. In a previous study, we compared the nucleotide sequences of the genome 3'-terminal region for 10 BYDV-PAV isolates differing in their geographical origins and biological properties. In the present investigation we show that the sequence homology grouping obtained for the 5' half of this region is different from that of the 3' half. Therefore, some isolates that are grouped in different clusters according to sequence homologies observed for the 5' half may be grouped in the same cluster according to the 3' half. These differences in sequence homology grouping suggest either different pressures of selection or RNA recombination. The hypothesis of RNA recombination between the 5' half of ancestors of some BYDV-PAV isolates and the 3' half of ancestors of other isolates, leading to isolates differing in their grouping according to both halves, is more favourable. This essentially relies on the fact that the 3' half of the genome 3'-terminal region covers the sgRNA3. The sgRNA3 may have some promoters or structures on its 5' terminus. Being easily recognised by the RNA polymerase, these structures may facilitate RNA recombination by strand switching during replication in mixed infection. [References: 11].

1405 Chen, PD.; Qi, LL.; Zhou, B.; Zhang, SZ.; Liu, DJ. (1995) **DEVELOPMENT AND MOLECULAR CYTOGENETIC ANALYSIS OF WHEAT-HAYNALDIA VILLOSA 6VS/6AL TRANSLOCATION LINES SPECIFYING RESISTANCE TO POWDERY MILDEW.** *Theoretical & Applied Genetics. 91(6-7):1125-1128.* English. [NANJING AGR COLL INST CYTOGENET NANJING 210095 PEOPLES REPUBLIC OF CHINA].

Several Triticum aestivum L.-Haynaldia villosa disomic 6VS/6AL translocation lines with powdery mildew resistance were developed from the hybridization between common wheat cultivar Yangmai 5 and alien substitution line 6V(6A). Mitotic and meiotic C-banding analysis, aneuploid analysis with double ditelosomic stocks, in situ hybridization, as well as the phenotypic assessment of powdery mildew resistance, were used to characterize these lines. The same translocated chromosome, with breakpoints near the centromere, appears to be present in all the lines, despite variation among the lines in their morphology and agronomic characteristics. The resistance gene, conferred by H. villosa and designated as Pm21, is a new and promising source of powdery mildew resistance in wheat breeding. [References: 23].

1406 Chen, Q.; Conner, RL.; Laroche, A. (1995) **IDENTIFICATION OF THE PARENTAL CHROMOSOMES OF THE WHEAT-ALIEN AMPHIPLOID AGROTANA BY GENOMIC IN SITU HYBRIDIZATION.** *Genome. 38(6):1163-1169.* English. [AGR & AGRI FOOD CANADA RES CTR POB 3000 LETHBRIDGE AB T1J 4B1 CANADA].

Labelled total genomic DNA from four alien species, Thinopyrum ponticum (Host) Beauv. (2n = 70, genomes J(1)J(1)J(1)J(2)J(2)), Th. bessarabicum (Savul. & Rayss) Love (2n = 14, genome J), Th. elongatum (Host) Beauv. (2n = 14, genome E), Haynaldia villosa (L.) Schur. (2n = 14, genome V), were used as probes in combination with blocking wheat DNA for in situ hybridization of the chromosomes of Agrotana, a wheat-alien hybrid (2n = 56) of unknown origin. The results showed that genomic DNA probes from Th. ponticum and Th. bessarabicum both clearly revealed 16 alien and 40 wheat chromosomes in Agrotana, indicating that the J genome present in these two species has a high degree of homology with the alien chromosomes in Agrotana. Biotinylated genomic DNA probe from Th. elongatum identified 10 chromosomes from Agrotana, while some regions of six other chromosomes yielded a weak or no signal. The probe from H. villosa produced no differential labelling of the chromosomes of Agrotana. The genomic formula of Agrotana was designated as AABBDDJJ. We suggest that the alien parent donor species of Agrotana is Th. ponticum rather than Th. bessarabicum. Genomic relationships of the three Thinopyrum species are discussed in relation to the distribution of GISH signals in the chromosomes of Agrotana. [References: 38].

1407 Chen, XM.; Line, RF.; Jones, SS. (1995) **CHROMOSOMAL LOCATION OF GENES FOR RESISTANCE TO PUCCINIA STRIIFORMIS IN WINTER WHEAT CULTIVARS HEINES VII, CLEMENT, MORO, TYEE, IKES, AND DAWS.** *Phytopathology. 85(11):1362-1367.* English. [USDA ARS PULLMAN, WA 99164 USA].

The winter wheat (Triticum aestivum) cultivars Heines VII, Clement, Moro, See, Tres, and Daws have been reported to have stripe rust resistant genes Yr2 and YrHVII, Yr9 and YrCle, Yr10 and YrMor, YrTye, YrTr1 and YrTr2, and YrDa1 and YrDa2, respectively. To confirm the existence of the genes and determine their chromosomal location, the cultivars were crossed with the seedling susceptible cultivar Chinese Spring and a set of 21 Chinese Spring aneuploids. Monosomic F-1 plants were allowed to self-pollinate to produce F-2 seed. Seedlings of F-2 plants and their parents were inoculated with selected North American races of Puccinia striiformis. The results confirmed that Yr2 is on chromosome 7B and Yr9 and Yr10 are on chromosome 1B, and showed the tentative location of the following genes: YrHVII on chromosome 4A, YrCle and YrMor on chromosome 4B, YrTye and YrTr1 on chromosome 6D, YrTr2 on chromosome 3A, YrDa1 on chromosome 1A, and YrDa2 on chromosome 5D. [References: 28].

1408 Chernysheva, S.V.; Bykov, O.D. (1993) **[Influence of drought on variability of morphophysiological characters of photosynthesis and productivity in common spring wheat]. Vliyanie zasukhi na izmenchivost' morfofiziologicheskikh priznakov fotosinteza i produktivnosti myagkoj yarovoj pshenitsy.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 149-158.* 21 ref. Russian. (AGRIS 96-015627).

Quantitative evaluation is made of a number of morphological, physiological and economic characters in the samples of common spring wheat of different origin and various levels of resistance to drought under favourable and arid conditions of the Central Volga river area. The analysis of variability of morphophysiological characters in representative sets of wheat genotypes under conditions differed in their stress effect level is shown to be quite promising for solution of the problems of ecological and special plant physiology.

1409 Chernysheva, S.V.; Bykov, O.D. (1993) **[The relation between variability of morphophysiological characters of photosynthesis and productivity in common spring wheat [Triticum aestivum] and its drought resistance]. Svyaz' izmenchivosti morfofiziologicheskikh priznakov fotosinteza i produktivnosti myagkoj yarovoj pshenitsy s ee zasukhoustojchivost'yu.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 158-166.* 8 ref. Russian. (AGRIS 96-015628).

The estimation has been performed with respect to relative variability in a number of morphophysiological characters of a flag leaf and an ear at its earing stage as well as in those of an ear at the stage of grain maturity under a change of environmental conditions from favourable ones to severe drought. It is shown that there is a relation between relative variability of characters and resistance of samples (or their groups) to

drought both by intervarietal and environmental components of general phenotypic variability of characters.

1410 Chibani, F. (Institut National de Recherches Scientifiques et Techiques, Tunis (Tunisie). Centre de Biologie et de Ressources Genetiques); Trigui, N.; Raies, A.; Marrakchi, M. (1992) **[Electrophoresis of barley varieties grown in Tunisia [hordeins]]. Etude electrophoretique des varietes d'orge cultivees en Tunisie [hordeines].** Colloque International. Complexes d'especes, flux de genes et ressources genetiques des plantes. [International Colloquium. Plant species complexes, gene flow and genetic resources]; Paris (France); 8-10 Jan 1992. *[Plant species complexes, gene flow and genetic resources. Proceedings of the international colloquium, Paris (France), January 8-10, 1992, as homage to Jean Pernes, professor at University Paris-11]. Complexes d'especes, flux de genes et ressources genetiques des plantes. Actes du colloque international, Paris (France), 8-10 janvier 1992, organise en hommage a Jean Pernes, professeur a l'universite de Paris-11. Bureau des Ressources Genetiques, Paris (France) p. 99-107.* BRG. 19 ref. French. (AGRIS 96-002551).

1411 Cho, C.H.; Chong, K.J.; Han, O.K. (Dankook University, Cheonan (Korea Republic). College of Agriculture) (1995) **Inheritance of liguleless and its genetic effects on other agronomic characters in barley.** *Korean Journal of Breeding (Korea Republic) v. 27(2) p. 155-162.* 1 illus.; 8 tables; 10 ref. Korean. (AGRIS 96-002564).

1412 Christiansen, JL.; Jorgensen, JR.; Stolen, O. (1995) **STIMULATION OF REGROWTH IN BARLEY BY APPLICATION OF CYTOKININ.** *Acta Agriculturae Scandinavica Section B-Soil & Plant Science. 45(4):258-260.* English. [ROYAL VET & AGR UNIV DEPT AGR SCI THORVALDSENSVEJ 40 DK-1871 FREDERIKSBERG C DENMARK].

The ability of cytokinin to stimulate regrowth in spring barley (Hordeum vulgare cv. Alexis) after cutting was investigated under glasshouse conditions. Application of 6-Benzyl-aminopurine (BA) to the irrigation water, from heading to termination of the trial, four weeks after grain ripening, significantly increased both tiller number and biomass after cutting at grain maturity. Cutting at earlier growth stages had no significant effect on these characteristics. [References: 9].

1413 Cooke, RJ. (1995) **ALLELIC VARIABILITY AT THE GLU-1 LOCI IN WHEAT VARIETIES.** *Plant Varieties & Seeds. 8(2):97-106.* English. [NLAB HUNTINGDON RD CAMBRIDGE CB3 0LE ENGLAND].

The high molecular weight (HMW) glutenin sub-unit composition of 697 wheat varieties from 20 countries was analysed and the alleles at the Glu-1 loci recorded using standardised procedures. Forty-nine of the varieties were heterogeneous in their glutenin composition. The varieties could be divided into 63 groups on the basis of the HMW glutenin sub-units. The frequency of occurrence of these groups varied, with four of them accounting for over a third of the varieties tested. The distribution of glutenin alleles in various countries was found to differ, as was the overall level of gene diversity as measured by two different indices. The results are discussed in the context of the use of HMW glutenin sub-unit analysis for distinctness, uniformity and stability testing in wheat. [References: 17].

1414 Cuadrado, A.; Ceoloni, C.; Jouve, N. (1995) **VARIATION IN HIGHLY REPETITIVE DNA COMPOSITION OF HETEROCHROMATIN IN RYE STUDIED BY FLUORESCENCE IN SITU HYBRIDIZATION.** *Genome. 38(6):1061-1069.* English. [UNIV ALCALA DE HENARES DEPT CELL BIOL & GENET E-28871 MADRID SPAIN].

The molecular characterization of heterochromatin in six lines of rye has been performed using fluorescence in situ hybridization (FISH). The highly repetitive rye DNA sequences pSc119.2, pSc74, and pSc34, and the probes pTa71 and pSc794 containing the 25S-5.8S-18S rDNA (NOR) and the 5S rDNA multigene families, respectively, were used. This allowed the individual identification of all seven rye chromosomes and most chromosome arms in all lines. All varieties showed similar but not identical patterns. A standard in situ hybridization map was constructed following the nomenclature system recommended for C-bands. All FISH sites observed appeared to correspond well with C-band locations, but not all C-banding sites coincided with hybridization sites of the repetitive DNA probes used. Quantitative and qualitative differences between different varieties were found for in situ hybridization response at corresponding sites. Variation between plants and even between homologous chromosomes of the same plant was found in open-pollinated lines. In inbred lines, the in situ pattern of the homologues was practically identical and no variation between plants was detected. The observed quantitative and qualitative differences are consistent with a corresponding variation for C-bands detected both within and between cultivars. [References: 32].

1415 David, J.L. (Institut National de la Recherche Agronomique, Gif ur Yvette (France). Centre de Versailles, Genetique Vegetale); Savy, Y.; Trottet, M.; Pichon, M. (1992) **[Method of dynamic management of genetic variability. An example of experimental network of soft wheat composite populations]. Methode de gestion dynamique de la variabilite genetique. Exemple d'un reseau experimental de populations composites de ble tendre [caracteres quantitatifs, differenciation genetique].** Colloque International. Complexes d'especes, flux de genes et ressources genetiques des plantes. [International Colloquium. Plant species complexes, gene flow and genetic resources]; Paris (France); 8-10 Jan 1992. *[Plant species complexes, gene flow and genetic resources. Proceedings of the international colloquium, Paris (France), January 8-10, 1992, as homage to Jean Pernes, professor at University Paris-11]. Complexes d'especes, flux de genes et ressources genetiques des plantes. Actes du colloque international, Paris (France), 8-10 janvier 1992, organise en hommage a Jean Pernes, professeur a l'universite de Paris-11. Bureau des Ressources Genetiques, Paris (France) p. 337-350.* BRG. 14 ref. French. (AGRIS 96-002673).

1416 Deleij, FAAM.; Sutton, EJ.; Whipps, JM.; Fenlon, JS.; Lynch, JM. (1995) **FIELD RELEASE OF A GENETICALLY MODIFIED PSEUDOMONAS FLUORESCENS ON WHEAT - ESTABLISHMENT, SURVIVAL AND DISSEMINATION.** *Bio-Technology. 13(13):1488-1492.* English. [UNIV SURREY SCH BIOL SCI GUILDFORD GU2 5XH SURREY ENGLAND].

The establishment, survival and dissemination of a strain of Pseudomonas fluorescens, that was originally isolated from the phylloplane of sugar beet and genetically modified with the marker genes lacZY and kan(r)-xylE was studied during a field release experiment on wheat. The genetically modified microorganism (GMM) was released into the environment onto the seed and as a foliar spray applied at tillering. Survival as well as dissemination of the GMM was greater in the field than could be predicted from experiments that were carried out in microcosm and pot experiments under contained conditions and in comparison with previous release studies with similar GMMs. The GMM used in our field release survived and multiplied especially well in the rhizosphere and phylloplane of wheat, and was found to disseminate up to 2 m away from the inoculated areas and to depths likely to be greater than the deepest sampling of 45 cm. GMM numbers in soil declined steadily over time, but numbers increased subsequently on volunteer wheat, weeds and resown wheat plants. [References: 30].

1417 Deleon, JLD.; Carrillolaguna, M.; Rajaram, S.; Mujeebkazi, A. (1995) **RAPID IN VITRO SCREENING OF SAME SALT TOLERANT BREAD WHEATS.** *Cereal Research Communications. 23(4):383-389.* English. [UNIV AUTONOMA BAJA CALIFORNIA SUR DEPT AGRON CULTIVOS LAB APARTADO POSTAL 19-B LA PAZ BAJA CALIFORNIA MEXICO].

A collection of 14 cultivars of Triticum aestivum was screened for tolerance to concentrations of 50, 100 and 150 mM NaCl. Excised mature embryos were in vitro cultured in Murashige and Skoog medium, supplemented with 30 g/L of sucrose and varying concentrations of salts. After 8 days, the cultured seedlings were evaluated for height, root length and root number. The test set showed tolerance to NaCl at concentrations of 50 mM and 100 mM. The cultivars were classified as tolerant (0-35% inhibited) and moderate tolerant (36-68% inhibited). In relation to height and root length, at 150 mM NaCl, cvs. Kharchia and Shorawaki were tolerant. NaCl did not affect root number significantly. Anions (in the presence of Na+) and cations (in the presence of Cl) distinctly affected some parameters. For anions, either at low and at high concentrations, the ranking order of increasing inhibition was: AcO. = NO2. >> SO4= > HPO4 > Cl-. For cations, the ranking order of increasing inhibition was: Mn++ >> Ca++ > Mg++ = K+ > Na+. [References: 9].

1418 Denerypapini, S.; Morel, MH.; Holder, F.; Bonicel, J.; Vanregenmortel, MHV. (1995) **CHARACTERISATION OF POLYCLONAL AND MONOCLONAL ANTI-PEPTIDE ANTIBODIES SPECIFIC FOR SOME LOW M(R) SUBUNITS OF WHEAT GLUTENIN AND THEIR USE IN THE DETECTION OF ALLELIC VARIANTS AT GLU-3 LOCI.** *Journal of Cereal Science. 22(3):225-235.* English. [CNRS INST BIOL MOLEC & CELLULAIRE UPR 9021 15 RUE DESCARTES F-67084 STRASBOURG FRANCE].

Polyclonal and monoclonal antibodies (Mabs) were produced against the major type of N-terminal amino acid sequence of low M(r) glutenin subunits. The reactivities of these antibodies were determined using glutenin extracts of several bread wheat cultivars of known allelic composition. Analyses were performed by immunoblotting after one or two-dimensional electrophoresis. One Mab (Mab 6x1) was found to react with low M(r) glutenin subunits encoded by chromosomes 1B and 1D but not with subunits controlled by chromosome 1A. Only some of the subunits encoded at the Glu-D3 locus were recognised. In contrast, this Mab reacted with all the subunits controlled by the Glu-B3 locus. After single dimension SDS-PAGE, we observed significant differences between immunoblot patterns of cultivars expressing different low M(r), glutenin subunits from chromosome 1B. Mab6 xl is a useful reagent for analysing the allelic composition at the Glu-B3 locus. (C) 1995 Academic Press Limited [References: 29].

1419 Devos, K.M.; Gale, M.D. (Cambridge Laboratory, Colney, Norwich (United Kingdom). John Innes Center) (1992) **Genetic mapping in wheat and rye.** Instituto Nacional de Investigacao Agraria, Elvas (Portugal). Estacao Nacional de Melhoramento de Plantas. *Melhoramento (Portugal) v. 33(2) p. 393-403.* issued 1994; 3 ill. 13 ref. English. (AGRIS 96-015621).

1420 Devos, KM.; Moore, G.; Gale, MD. (1995) **CONSERVATION OF MARKER SYNTENY DURING EVOLUTION.** *Euphytica. 85(1-3):367-372.* English. [JOHN INNES CTR PLANT SCI RES CAMBRIDGE LAB NORWICH RES PK NORWICH NR4 7UH NORFOLK ENGLAND].

An aspect of cereal science that is becoming increasingly important is comparative genetics. Establishment of the relationship between genomes within polyploids, between species within tribes and between species within families will allow not only the integration of genetic maps but also the knowledge acquired of each of the species. Using a set of homoeologous probes, workers found the relationship between the three wheat genomes to be precisely collinear, after taking a few major translocation events into account. Transfer of the wheat map to rye led to the elucidation of similar relationships between the three wheat genomes and that of rye. Genome collinearity, however, extends even beyond tribes. In a comparison of the genomes of wheat, rice and maize, it was shown that despite the separation of these genomes for possibly 50 million years, gene order was still highly conserved. This collinearity between genomes can be exploited in a number of ways. [References: 23].

1421 Dhanda, SS.; Behl, RK.; Elbassam, N. (1995) **BREEDING WHEAT GENOTYPES FOR WATER DEFICIT ENVIRONMENTS.** *Landbauforschung Volkenrode. 45(4):159-167.* English. [HARYANA AGR UNIV CCS DEPT PLANT BREEDING HISAR 125004 HARYANA INDIA].

1422 Diaz, I.; Royo, J.; Delahoz, PS.; Carbonero, P. (1995) **GENE SPECIFICITY IS MAINTAINED IN TRANSIENT EXPRESSION ASSAYS WITH PROTOPLASTS DERIVED FROM DIFFERENT TISSUES OF BARLEY.** *Euphytica. 85(1-3):203-207.* English. [UNIV POLITECN MADRID ETSI AGRON DEPT BIOTECNOL BIOQUIM & BIOL MOLEC LAB E-28040 MADRID SPAIN].

In some cereal species that are still recalcitrant to stable transformation and regeneration, transient expression in isolated protoplasts is a useful tool for the study of gene expression and regulation. We have successfully applied these techniques to barley protoplasts derived from developing endosperm, aleurone, leaves and roots in order to characterize functionally cis-acting motives in two gene promoters, corresponding to trypsin inhibitorBTI-CMe and to sucrose synthase Ss1. Gene specificity is maintained in transient expression assays with protoplasts isolated from these different barley tissues and the pattern of expression parallels the mRNA levels observed for the corresponding genes in the same tissues. [References: 19].

1423 Dovidio, R.; Masci, S.; Porceddu, E. (1996) **SEQUENCE ANALYSIS OF THE 5' NON-CODING REGIONS OF ACTIVE AND INACTIVE 1AY HMW GLUTENIN GENES FROM WILD AND CULTIVATED WHEATS.** *Plant Science. 114(1):61-69.* English. [UNIV TUSCIA DIPARTIMENTO AGROBIOL & AGROCHIM VIA S CAMILLO LELLIS I-01100 VITERBO ITALY].

The genes encoding the HMW glutenin subunits belong to a small gene family where not all members are expressed in cultivated wheat varieties. In particular, the Ay HMW glutenin subunit is always absent. On the basis of nucleotide sequence comparisons of the putative promoter regions of the 1Ay gene of six different active HMW glutenin genes, it was previously hypothesized that the silencing of the 1Ay gene was caused by a few specific nucleotide substitutions in the 5' flanking region. The availability of wild wheat progenitors expressing the Ay glutenin subunit allowed us to compare the 5' flanking region of active and inactive genes. We have found a nearly perfect nucleotide sequence identity in this region between active and inactive 1Ay genes, and thus demonstrating that the inactivation of the gene encoding this subunit in cultivated wheats is not due to the 10 substitutions occurring in this region. [References: 22].

1424 Duncan, RR.; Waskom, RM.; Nabors, MW. (1995) **IN VITRO SCREENING AND FIELD EVALUATION OF TISSUE-CULTURE-REGENERATED SORGHUM (SORGHUM BICOLOR (L) MOENCH) FOR SOIL STRESS TOLERANCE.** *Euphytica. 85(1-3):373-380.* English. [UNIV GEORGIA DEPT CROP & SOIL SCI 1109 EXPT ST GRIFFIN, GA 30223 USA].

Sorghum bicolor (L.) Moench is generally quite sensitive to salt and acid (high aluminium) soil stresses, but quite tolerant of drought stress. As with any stress phenomenon, intra-specific variability exists within the genus. In vitro cell selection and somaclonal variation offer an alternative to traditional breeding methodology for generating improved breeding lines for hybrid development. A field selection protocol was developed for the three soil stresses and inter-stress evaluations were conducted in an effort to find multiple, stress-tolerant genotypes. The acid soil-drought stress, super-tolerant selections were located by the R(7) generation when exposed to a combined aluminium-drought stress field environment and when the regeneration population (number of regenerated lines from one callus source) was maintained at 15, 000 plants or higher A variant frequency of 0.1 to 0.2% for stress tolerance and acceptable agronomic traits among the surviving somaclones, provided an adequate number of phenotypes with desirable agronomic characteristics and a high level of soil stress tolerance. Subsequent research verified that the stress-tolerant regenerants had superior acid soil and drought stress tolerance to that of the donor parents, that their yield capabilities under stress were superior to their parents, and that their stress tolerance attributes were transferred in hybrid combinations. In vitro selection was not effective in increasing the number of field stress survivors. In fact, superior germplasms were developed from non-stressed callus or salt- stressed callus. In vitro selection reduced regeneration frequency and subsequent survival of plants under field stress. In vitro-stressed regenerants should be subjected only to non-stressed environments to maintain sufficient population numbers for field selection and thereafter should be subjected to stress environments during later (R(5+)) generations. The optimal strategy for the exploitation of somaclonal variation may be through short-term cell culture (< 12 months) with no attempt at in vitro selection. [References: 45].

1425 Dvorak, J.; Dubcovsky, J.; Luo, MC.; Devos, KM.; Gale, MD. (1995) **DIFFERENTIATION BETWEEN WHEAT CHROMOSOMES 4B AND 4D.** *Genome. 38(6):1139-1147.* English. [UNIV CALIF DAVIS DEPT AGRON & RANGE SCI DAVIS, CA 95616 USA].

A linkage map based on homoeologous recombination, induced by the absence of the Phl locus, between chromosome 4D of Triticum aestivum L. (genomes AABBDD) and chromosome 4B of T. turgidum L. (genomes AABB) was compared with a linkage map of chromosome 4A(m) of T. monococcum L. and a consensus map of chromosomes 4B and 4D of T. aestivum based on homologous recombination. The 4D/4B homoeologous map was only one-third the length of the homologous maps and all

intervals were reduced relative to the 4B-4D consensus map. After the homoeologous map was corrected for this overall reduction in recombination, the distribution of recombination in the short arm was similar in both types of maps. In the long arm, homoeologous recombination declined disproportionally in the distal to proximal direction. This gradient was shown to be largely caused by severe segregation distortion reflecting selection against 4D genetic material. The segregation distortion had a maximum that coincided with the centromere and likely had a polygenic cause. Chromosomes 4D and 4B were colinear and recombination between them occurred in almost all intervals where homologous recombination occurred. These findings suggest that these chromosomes are not differentiated structurally and that the differentiation is not segmental. In the presence of Phl, metaphase I chromosome pairing between chromosomes composed of homologous and differentiated regions correlated with the lengths of the homologous regions. No compensatory allocation of crossovers into the homologous regions was detected. In this respect, the present results are in dramatic contrast with the crossover allocation into the pseudoautosomal region in the mammalian male meiosis. [References: 22].

1426 Favier, JF. (1995) **A MODEL FOR GERMINATION RATE DURING DORMANCY LOSS IN HORDEUM VULGARE.** *Annals of Botany. 76(6):631-638.* English. [UNIV NEWCASTLE UPON TYNE DEPT AGR & ENVIRONM SCI NEWCASTLE UPON TYNE NE1 7RU TYNE & WEAR ENGLAND].

A quantitative model for change in germination rate of barley (Hordeum vulgare L.) during and after loss of primary dormancy is presented. Change in mean germination time on a logarithmic scale is normally distributed within the period of after-ripening and the standard deviation of this distribution is shown to be a quantitative function of after-ripening temperature. The rate of change of mean germination time is in inverse proportion to the product of the standard deviation and a parameter which is characteristic of the seed population. The latter parameter is the rate constant for change in probit cumulative germination as a negative linear function of the logarithm of mean germination time. A model based solely on dormancy loss is combined with an existing model of change in probit viability as a function of mean germination time to produce a model which predicts the time to and optimum value of mean germination rate of a population as it after-ripens. The model provides a quantitative link between the effect of pre-germination and germination environments on total and rate of germination of an initially dormant population. Experimental data from dormant barley (cv. Triumph) stored at 27, 38, 45, 50 and 60 degrees C, and germinated at 18 degrees C were used to validate the model. The data show that germination rate continues to increase after primary dormancy is lost until it reaches an upper limit determined by the intrinsic germinative vigour of the seed lot. Rate of loss of primary dormancy and increase in germination rate thus appear to be quantitatively linked as a function of after-ripening temperature and factors which may be specific to the mode of induction of dormancy within a seed lot prior to harvest. (C) 1995 Annals of Botany Company [References: 40].

1427 Ferreira, MASV.; Tooley, PW.; Hatziloukas, E.; Castro, C.; Schaad, NW. (1996) **ISOLATION OF A SPECIES-SPECIFIC MITOCHONDRIAL DNA SEQUENCE FOR IDENTIFICATION OF TILLETIA INDICA, THE KARNAL BUNT OF WHEAT FUNGUS.** *Applied & Environmental Microbiology. 62(1):87-93.* English. [USDA ARS FOREIGN DIS WEED SCI RES FREDERICK, MD 21702 USA].

Mitochondrial DNA (mtDNA) from five isolates of Tilletia indica was isolated and digested with several restriction enzymes. A 2.3-kb EcoRI fragment was chosen, cloned, and shown to hybridize with total DNA restricted with EcoRI from T, indica and not from a morphologically similar smut fungus, Tilletia barclayana. The clone was partially sequenced, and primers were designed and tested under high-stringency conditions in PCR assays. The primer pair Ti1/Ti4 amplified a 2, 3-kb fragment from total DNA of 17 T. indica isolates from India, Pakistan, and Mexico, DNA from 25 isolates of other smut fungi (T. barclayana, Tilletia foetida, Tilletia caries, Tilletia fusca, and Tilletia controversa) did not produce any bands, as detected by ethidium bromide-stained agarose gels and Southern hybridizations. The sensitivity of the assay was determined and increased by using a single nested primer in a second round of amplification, so that 1 pg of total mycelial DNA could be detected, The results indicated that the primers which originated from a cloned mtDNA sequence can be used to differentiate T. indica from other Tilletia species and have the potential to identify teliospores contaminating wheat seeds. [References: 49].

1428 Filimonov, P.N. (1993) **[Productivity of common wheat [Triticum aestivum] ear in connection with uneven-quality grain in spikelets]. Produktivnost' kolosa myagkoj pshenitsy v svyazi s raznokachestvennost'yu zerna v koloskakh.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 137-144.* 10 ref. Russian. (AGRIS 96-015626).

The paper deals with the results of a study on grain quality from individual spikelets of the wheat ear in common wheat varieties (Mironovskaya 808, Leningradka, Monakinka and the sample k-46449) separately on the left side and the right side of the ear. The data were obtained during field tests at the Pavlovsk Experiment Station of VIR in 1988-1990. According to the results kernels from the left ear half are most productive, productivity of those from the 4th spikelet on its left side being a maximum. The above characters are inherited by the offspring. It follows herefrom that the presently accepted method of breeding for productivity through screening of whole ears is of little efficiency and should be replaced by selection of individual kernels from the 4th spikelet on the left ear half.

1429 Fox, SL.; Harder, DE. (1995) **RESISTANCE TO STEM RUST IN BARLEY AND INHERITANCE OF RESISTANCE TO RACE QCC.** *Can[illegible] Journal of Plant Science. 75(4):781-788.* English. [UNIV MINNESOTA DEPT AGRON & PLANT GENET 411 BORLAUG HALL 1991 BUFORD CIRCLE ST PAUL, MN 55108 USA].

Twenty-two barley (Hordeum vulgare L.) cultivars and lines were evaluated for resistance to stem rust (Puccinia graminis Pers. f. sp. tritici Eriks. & Hem.) race QCC in field trials over a 3-yr period, and the inheritance of resistance of several genotypes to race QCC was investigated using replicated F-3 lines. Rust severities ranged from 17 to 58% between 14 different cultivars and lines which carried the stem rust resistance gene Rpg1, indicating that factors other than Rpg1 conferred resistance. Hietpas-5 (Rpg2) had moderate resistance while PI 382313 (Rpg3) had good resistance to race QCC. In the cross Hiproly-15/Peatland-9, F-2 adult plants segregated 3R : 1S to race MCC, confirming the presence of gene Rpg1 in Peatland-9. Some F-3 lines derived from F-2 plants with Rpg1 were susceptible to race QCC, however, indicating that Rpg1 was ineffective against race QCC. A second gene in Peatland-9, designated for the interim as RpgU and independent of Rpg1, was shown to confer a moderate level of resistance to race QCC. Similar segregation patterns in the presence of race QCC and pedigree analysis suggested that the cultivars Husky and Diamond contain this gene. This gene is likely present in other related cultivars such as Vantage and Bonanza. Segregation in progeny of the cross Hiproly-15/Q21861 indicated that resistance to race QCC was controlled by two recessive genes in Q21861. Gene Rpg2, tested in F-3 lines, was found to provide a moderate level of resistance to race QCC, similar to RpgU, but was less effective in the heterozygous condition. The phenotypic expression of RpgU differed from Rpg1, Rpg2, and Rpg3, suggesting that RpgU is a previously unreported gene for stem rust resistance in cultivated barley. [References: 31].

1430 Fox, SL.; Harder, DE.; Kim, WK. (1995) **USE OF VIRULENCE AND LENGTH VARIABILITY WITHIN THE RDNA REPEAT UNIT TO DISTINGUISH ISOLATES OF PUCCINIA GRAMINIS F SP TRITICI RACE QCC.** *Canadian Journal of Plant Pathology-Revue Canadienne de Phytopathologie. 17(3):197-204.* English. [UNIV MINNESOTA DEPT AGRON & PLANT GENET 411 BORLAUG HALL 1991 BUFORD CIRCLE ST PAUL, MN 55108 USA].

Eleven isolates of race QCC and single isolates of races TPM, QFC, and MCC of Puccinia graminis f. sp. tritici were obtained from disease survey collections made across Canada between 1957 and 1991. These isolates were compared based on the disease reactions on seedlings of 24 lines of Triticum aestivum containing different stem rust resistance genes. Comparisons also were made based on length variability of the intergenic

spacer region (IGR) of the ribosomal DNA (rDNA) repeat unit. Variability within the IGR was investigated using Southern blots of MspI restricted genomic DNA and using polymerase chain reaction (PCR) amplification of the region. Isolates of race QCC obtained after 1988 were virulent to barley lines containing the Rpg1 gene for stem rust resistance but were avirulent to gene Sr8b in wheat. Isolates collected prior to 1986 and avirulent to barley with gene Rpg1 were virulent to gene Sr8b. The barley-virulent isolates were found to have a length variant within the IGR that was absent from the other isolates. Both lines of evidence indicate that genetic variability exists within "race" QCC. The length variants within the IGR provided genetic markers, in addition to virulence phenotypes, that distinguished between isolates of P. graminis f. sp tritici. [References: 35].

1431 Freialdenhoven, A.; Peterhansel, C.; Kurth, J.; Kreuzaler, F.; Schulzelefert, P. (1996) **IDENTIFICATION OF GENES REQUIRED FOR THE FUNCTION OF NON-RACE-SPECIFIC MLO RESISTANCE TO POWDERY MILDEW IN BARLEY.** *Plant Cell. 8(1):5-14.* English. [JOHN INNES CTR PLANT SCI RES SAINSBURY LAB NORWICH RES PK NORWICH NR4 7UH NORFOLK ENGLAND].

Recessive alleles (mlo) of the Mlo locus in barley mediate a broad, non-race-specific resistance reaction to the powdery mildew fungus Erysiphe graminis f sp hordei. A mutational approach was used to identify genes that are required for the function of mlo. Six susceptible M(2) individuals were isolated after inoculation with the fungal isolate K1 from chemically mutagenized seed carrying the mlo-5 allele. Susceptibility in each of these individuals is due to monogenic, recessively inherited mutations in loci unlinked to mlo. The mutants identify two unlinked complementation groups, designated Ror1 and Ror2 (required for mlo-specified resistance). Both Ror genes are required for the function of different tested mlo alleles and for mlo function after challenge with different isolates of E. g. f sp hordei. A quantitative cytological time course analysis revealed that the host cell penetration efficiency in the mutants is intermediate compared with mlo-resistant and Mlo-susceptible genotypes. Ror1 and Ror2 mutants could be differentiated from each other by the same criterion. The spontaneous formation of cell wall appositions in mlo plants, a subcellular structure believed to represent part of the mlo defense, is suppressed in mlo/ror genotypes. In contrast, accumulation of major structural components in the appositions is seemingly unaltered. We conclude that there is a regulatory function for the Ror genes in mlo-specified resistance and propose a model in which the Mlo wild-type allele functions as a negative regulator and the Ror genes act as positive regulators of a non-race-specific resistance response. [References: 38].

1432 Freyer, R.; Lopez, C.; Maier, RM.; Martin, M.; Sabater, B.; Kossel, H. (1995) **EDITING OF THE CHLOROPLAST NDHB ENCODED TRANSCRIPT SHOWS DIVERGENCE BETWEEN CLOSELY RELATED MEMBERS OF THE GRASS FAMILY (POACEAE).** *Plant Molecular Biology. 29(4):679-684.* English. [UNIV FREIBURG INST BIOL 3 SCHANZLESTR 1 D-79104 FREIBURG GERMANY].

The ndhB-encoded transcript from barley chloroplasts deviates from the genomic ndhB sequence by nine C-to-U transitions, which is the maximum number of editing events for a chloroplast mRNA reported so far. Comparison with ndhB transcripts from other chloroplast species shows that six of the nine editing sites observed in barley are structurally and functionally conserved in maize, rice and tobacco. The remaining three sites, however, show divergent patterns of conservation even within the three members of the grass family. The conservation of two of these sites in tobacco but not in the closely related graminean species suggests that divergence of the ndhB editing sites is caused by the loss of preexisting editing sites rather than by gain of new sites. [References: 15].

1433 Friedt, W.; Ordon, F. (1995) **BREEDING FOR RESISTANCE TO BYMOVIRUSES IN POACEAE WITH SPECIAL CONSIDERATION FOR THE BARLEY YELLOW MOSAIC VIRUS COMPLEX.** *Agronomie. 15(7-8):453-458.* English. [UNIV GIESSEN INST CROP SCI & PLANT BREEDING LUDWIGSTR 23 D-35390 GIESSEN GERMANY].

Bymoviruses, ie BaYMV, BaMMV, WYMV, WSSMV, OMV and RNMV, cause serious damages to their host-plants, resulting in high yield losses in susceptible crops. Due to their transmission by the soil-borne fungus Polymyxa graminis, chemical measures against these diseases are neither efficient nor acceptable for economical and ecological reasons. Therefore, breeding resistant varieties is an important aim for plant breeding. Besides classical breeding methods completed by the production of DH-lines and marker-facilitated selection procedures, recombinant DNA-techniques may give way to new strategies in breeding for resistance to bymovirus in Poaceae in the near future. [References: 51].

1434 Fujita, M.; Taniguchi, Y.; Ujihara, K. (1995) **RELATIONSHIP BETWEEN YOUNG PANICLE LENGTH AT THE BEGINNING OF STEM ELONGATION STAGE AND HEADING TRAITS IN WHEAT (TRITICUM AESTIVUM L) GROWN IN THE SOUTHWESTERN PART OF JAPAN.** *Breeding Science. 45(4):487-491.* English. [MAFF SHIKOKU NATL AGR EXPT STN ZENTSUJI KAGAWA 765 JAPAN].

Early maturity has been one of the major breeding objectives in wheat (Triticum aestivum L.) in the southwestern part of Japan, because this trait is desirable for double cropping with summer crops such as rice, and for avoiding pre-harvest sprouting which often occurs in the rainy season. However, early maturing cultivars usually belong to the spring type which is prone to frost damage in early spring because of the earliness in ear primordia initiation and stem elongation. The relationship between ear primordia initiation, young panicle length, stem elongation and heading traits, i.e. vernalization requirement, photoperiodic response and narrow-sense earliness, was assessed for 32 cultivars and lines. Date of the beginning of stem elongation, which was defined as the time when the main stem length reached 20 mm, and young panicle length at that time were estimated using an exponential curve based on the records made at an interval of two weeks. There were large varietal differences in the young panicle length at the beginning of stem elongation. Cultivars and lines with a longer young panicle at the beginning of stem elongation, headed earlier than those with a shorter one in the same stem elongation class (Fig. 1). In the cultivars and lines with an early onset of stem elongation, the vernalization requrement was minimal (Fig. 2). Winter type cultivars and lines exhibiting a late onset of stem elongation were considered to be able to avoid frost damage. Cultivars and lines with a longer young panicle at the beginning of stem elongation exhibited a neutral response to photoperiod (Fig. 3, Table 1), and many of them were the relatives of Chugoku 114 which has been used as a cross parent for its early maturity and displays rapid growth under short photoperiod and low temperature conditions (Yoshida et al. 1985). These results indicated that early heading cultivars that can avoid frost damage, like the experimental line Aki 40 (Table 2), could be bred by introducing the character, which induces a longer young panicle at the beginning of stem elongation, into winter type cultivars and lines. [References: 4].

1435 Glukhovtseva, N.I.; Golovochenko, A.P.; Sanina, N.V. (1994) **[New variety of common spring wheat, obtained by hybridization, registered in Samara oblast [Russian Federation]].** *Kinel'skaya 59 - ehto pryaniki i vafli. Stepnye prostory (Russian Federation) (no.7) p. 19-20.* Russian. (AGRIS 96-015623).

1436 Goblirsch, CA.; Horsley, RD.; Schwarz, PB. (1996) **A STRATEGY TO BREED LOW-PROTEIN BARLEY WITH ACCEPTABLE KERNEL COLOR AND DIASTATIC POWER.** *Crop Science. 36(1):41-44.* English. [N DAKOTA STATE UNIV DEPT CROP & WEED SCI FARGO, ND 58105 USA].

Grain protein content is an important malt quality trait in barley (Hordeum vulgare L.). A source of low-protein used by the North Dakota six-rowed barley breeding program has been the cultivar Karl. No cultivars with Karl in their pedigree have been released from this program because all low-protein lines have had unacceptably dark kernel color, low diastatic power (DP), or both. The objective of this study was to determine why low-protein cultivars with acceptable kernel color, DP, and grain protein content have not been developed and to suggest a strategy to breed such cultivars. To fulfill these objectives, the following grain protein content, kernel color, and DP data were collected from three crosses: broad-sense heritability estimates, expected and observed gains from selection, genetic correlations between the three traits, and the correlated response of a trait when selecting for another trait. Low to medium heritability estimates for all traits, low genetic correlation between traits, and the small expected correlated changes in DP when selecting for decreased grain protein

content or a brighter kernel color suggest it should be possible to identify low-protein lines with acceptable kernel color and DP. Using independent culling, DP of selected lines in all crosses was similar when either grain protein content or kernel color was the first trait selected; therefore, either trait could be used as the primary selection trait. A strategy for developing low-protein cultivars with acceptable kernel color and DP would be to use independent culling in F-2:3 Or F-3:4 families in which grain protein content or kernel color would be the first trait and DP would be the last trait selected. The population size needed to select such lines needs to be greater than the 100 to 200 F-2:3 Or F-3:4 families currently used by the North Dakota six-rowed barley breeding program. [References: 16].

1437 Graner, A.; Bauer, E.; Kellermann, A.; Proeseler, G.; Wenzel, G.; Ordon, F. (1995) **RFLP ANALYSIS OF RESISTANCE TO THE BARLEY YELLOW MOSAIC VIRUS COMPLEX.** *Agronomie. 15(7-8):475-479.* English. [FED CTR BREEDING RES CULTIVATED PLANTS INST RESISTANCE GENET D-85461 GRUNBACH GERMANY].

The barley yellow mosaic virus complex consists of barley mild mosaic virus (BaMMV), barley yellow mosaic virus type 1 (BaYMV-1) and barley yellow mosaic virus type 2 (BaYMV-2). In an attempt to investigate the genetic basis of resistance to these pathogens, a series of genes, including 3 novel previously undescribed ones, have been identified in cultivated barley (Hordeum vulgare). They vary in their specificity for individual members of this virus complex and were localized within the barley genome using a set of mapped RFLP markers. Along with previously characterized resistance genes, 9 different genes have now been described in barley. These form 2 major complexes on the long arms of chromosomes 3 and 4 consisting of 4 and 3 loci, respectively. [References: 18].

1438 Gubler, F.; Kalla, R.; Roberts, JK.; Jacobsen, JV. (1995) **GIBBERELLIN-REGULATED EXPRESSION OF A MYB GENE IN BARLEY ALEURONE CELLS - EVIDENCE FOR MYB TRANSACTIVATION OF A HIGH-PL ALPHA-AMYLASE GENE PROMOTER.** *Plant Cell. 7(11):1879-1891.* English. [COOPERAT RES CTR PLANT SCI POB 475 CANBERRA ACT AUSTRALIA].

Functional analysis of a barley high-pl alpha-amylase gene promoter has identified a gibberellin (GA) response complex in the region between -174 and -108, The sequence of the central element, TAACAAA, is very similar to the c-Myb and v-Myb consensus binding site. We investigated the possibility that a GA-regulated Myb transactivates alpha-amylase gene expression in barley aleurone cells, A cDNA clone, GAmyb, which encodes a novel Myb, was isolated from a barley aleurone cDNA library, RNA blot analysis revealed that GAmyb expression in isolated barley aleurone layers is up-regulated by GA. The kinetics of GAmyb expression indicates that it is an early event in GA-regulated gene expression and precedes alpha-amylase gene expression, Cycloheximide blocked alpha-amylase gene expression but failed to block GAmyb gene expression, indicating that protein synthesis is not required for GAmyb gene expression. Gel mobility shift experiments with recombinant GAMyb showed that GAMyb binds specifically to the TAACAAA box in vitro, We demonstrated in transient expression experiments that GAMyb activates transcription of a high-pl alpha-amylase promoter fused to a beta-glucuronidase reporter gene in the absence of GA. Our results indicate that the GAMyb is the sole GA-regulated transcription factor required for transcriptional activation of the high-pl alpha-amylase promoter. We therefore postulate that GAMyb is a part of the GA-response pathway leading to alpha-amylase gene expression in aleurone cells. [References: 69].

1439 Han, F.; Ullrich, SE.; Chirat, S.; Menteur, S.; Jestin, L.; Sarrafi, A.; Hayes, PM.; Jones, BL.; Blake, TK.; Wesenberg, DM.; Kleinhofs, A.; Kilian, A. (1995) **MAPPING OF BETA-GLUCAN CONTENT AND BETA-GLUCANASE ACTIVITY LOCI IN BARLEY GRAIN AND MALT.** *Theoretical & Applied Genetics. 91(6-7):921-927.* English. [WASHINGTON STATE UNIV DEPT CROP & SOIL SCI PULLMAN, WA 99164 USA].

Genetic study of beta-glucan content and beta-glucanase activity has been facilitated by recent developments in quantitative trait loci (QTL) analysis. QTL for barley and malt beta-glucan content and for green and finished malt beta-glucanase activity were mapped using a 123-point molecular marker linkage map from the cross of Steptoe/Morex. Three QTL for barley beta-glucan, 6 QTL for malt beta-glucan, 3 QTL for beta-glucanase in green malt and 5 QTL for beta-glucanase in finished malt were detected by interval mapping procedures. The QTL with the largest effects on barley beta-glucan, malt beta-glucan, green malt beta-glucanase and finished malt beta-glucanase were identified on chromosomes 2, 1, 4 and 7, respectively. A genome map-based approach allows for dissection of relationships among barley and malt beta-glucan content, green and finished malt beta-glucanase activity, and other malting quality parameters. [References: 26].

1440 Harlan, J.R. (1992) **[Composite cross 2 of barley]. [Croisement composite 2 de l'orge].** Colloque International. Complexes d'especes, flux de genes et ressources genetiques des plantes. [International Colloquium. Plant species complexes, gene flow and genetic resources]; Paris (France); 8-10 Jan 1992. *[Plant species complexes, gene flow and genetic resources. Proceedings of the international colloquium, Paris (France), January 8-10, 1992, as homage to Jean Pernes, professor at University Paris-11]. Complexes d'especes, flux de genes et ressources genetiques des plantes. Actes du colloque international, Paris (France), 8-10 janvier 1992, organise en hommage a Jean Pernes, professeur a l'universite de Paris-11. Bureau des Ressources Genetiques, Paris (France) p. 25-27.* BRG. English. (AGRIS 96-002550).

1441 Harwood, WA.; Bean, SJ.; Chen, DF.; Mullineaux, PM.; Snape, JW. (1995) **TRANSFORMATION STUDIES IN HORDEUM VULGARE USING A HIGHLY REGENERABLE MICROSPORE SYSTEM.** *Euphytica. 85(1-3):113-118.* English. [JOHN INNES CTR PLANT SCI RES NORWICH NR4 7UH NORFOLK ENGLAND].

A highly regenerable, isolated microspore system for barley, Hordeum vulgare L. cv. Igri, has been developed which is amenable to transformation studies using particle bombardment. The system allows DNA to be delivered to microspores at the single cell stage and both transient and stable transformation events have been demonstrated. The potential advantages of using isolated microspores as the target tissue in routine transformation systems are discussed. [References: 24].

1442 Heim, U.; Manteuffel, R.; Baumlein, H.; Steinbiss, HH.; Wobus, U. (1995) **TRANSIENT EXPRESSION OF A LYSINE-RICH VICILIN GENE OF VICIA FABA IN BARLEY ENDOSPERM DETECTED BY IMMUNOLOGICAL TISSUE PRINTING AFTER PARTICLE BOMBARDMENT.** *Plant Cell Reports. 15(1-2):125-128.* English. [INST PFLANZENGENET & KULTURPFLANZENFORSCH CORRENSSTR 3 D-06466 GATERSLEBEN GERMANY].

Using immunological tissue printing we detected transient expression of a faba bean vicilin gene with or without introns driven by the B1 hordein promoter in barley endosperm after particle bombardment. The described method generally allows the analysis of transient expression of genes without depending on reporter gene constructs and specifically suggests correct splicing of dicot introns by a monocot splicing machinery. [References: 23].

1443 Helm, J.L. (North Dakota State University.) (1994) **1994 North Dakota durum wheat variety performance descriptions.** *NDSU Extension Service : [publication] (USA); no. AE-1067 4 p.* English. (AGRIS 96-015591).

1444 Hylton, CM.; Denyer, K.; Keeling, PL.; Chang, MT.; Smith, AM. (1996) **THE EFFECT OF WAXY MUTATIONS ON THE GRANULE-BOUND STARCH SYNTHASES OF BARLEY AND MAIZE ENDOSPERMS.** *Planta. 198(2):230-237.* English. [JOHN INNES CTR COLNEY LANE NORWICH NR4 7UH NORFOLK ENGLAND].

The effects of waxy mutations on starch-granule-bound starch synthases (EC 2.4.1.18) in the developing endosperm of barley (Hordeum vulgare L.) and maize (Zea mag's L.) have been investigated. Three granule-bound starch synthases in barley endosperm were identified by use of antibodies to known starch synthases, by reconstitution and assay of individual proteins from sodium dodecyl sulphate-polyacrylamide gels of granule-bound proteins, and by partial purification of proteins released by enzymic digestion of starch. These are proteins of 60, 77 and 90 kDa. Use of antibodies to known starch synthases and partial purification of proteins released by enzymic digestion of starch indicated that there may be at least four granule-bound starch synthases in maize endosperm: proteins of 59, 74, 77 and 83 kDa. Mutations at the waxy loci of both species affected only

the 60- (barley) and 59-(maize) kDa isoforms. No evidence was found that other putative isoforms are altered in abundance or activity by the mutations. The contribution of our results to understanding of the starch synthase activity of intact starch granules and the mechanism of amylose synthesis is discussed. [References: 24].

1445 Inagaki, MN.; Tahir, M. (1995) **COMPARISON OF CROSSABILITIES OF TETRAPLOID WHEAT WITH HORDEUM BULBOSUM AND MAIZE.** *Cereal Research Communications. 23(4):339-343.* English. [CIMMYT INT MAIZE & WHEAT IMPROVEMENT CTR LISBOA 27 APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

The crossabilities of twenty tetraploid wheat (Triticum turgidum L. var. durum) varieties with Hordeum bulbosum L. and maize (Zea mays L.) were compared. The embryo formation frequencies had variations ranging from 0.0% to 26.3% in crosses with H. bulbosum, and 0.0% to 20.6% in crosses with maize. A significant correlation coefficient ($r=0.540$, $P<0.05$) was obtained for embryo formation frequencies between H. bulbosum and maize crosses, indicating that some genetic factor(s) controls the crossabilities in these crosses. In comparison with the results previously published on hexaploid wheat (T. aestivum L.), it is also supposed that absence of D genome in tetraploid wheat results in the crossability variation in crosses with maize. [References: 12].

1446 Iqbal, MJ.; Rayburn, AL. (1995) **IDENTIFICATION OF THE 1 RS RYE CHROMOSOMAL SEGMENT IN WHEAT BY RAPD ANALYSIS.** *Theoretical & Applied Genetics. 91(6-7):1048-1053.* English. [UNIV ILLINOIS DEPT AGRON 320 PABL 1201 W GREGORY AVE URBANA, IL 61801 USA].

The introgression of rye DNA into the wheat genome was studied using random decamer and specific primers with the polymerase chain reaction (PCR). DNA from paired near-isolines in Chisholm and Arkan backgrounds differing with respect to the presence of a 1 RS.1 BL translocation was amplified with 120 arbitrary sequence primers. Two of the primers (OPR 19 and OPJ07) amplified rye-specific DNA fragments. The OPR19 primer amplified a 1.35-kb fragment that appeared to be specific to the 1 RS.1 BL translocation, based on its presence only in lines carrying the 1 RS. 1 BL translocation. A fragment of the same size was also amplified in 1 RS.1 AL translocation lines. This 1 RS. 1 BL marker locus was designated Ximc 1. The other primer, OPJ07, amplified a 1.2-kb DNA sequence, that was designated Ximc 2, specific to the wheat-rye translocation in various wheat backgrounds. The sequences of the two marker loci were found to be different from each other. The Ximc I locus was a low-copy sequence which was also present in Balboa rye genomic DNA. Through the use of specific primers, the presence of the rye-specific marker was confirmed in hexaploid as well as in tetraploid wheat backgrounds. The use of RAPDs for the study of smaller alien introgressions into wheat is discussed. [References: 35].

1447 Jahne, A.; Becker, D.; Lorz, H. (1995) **GENETIC ENGINEERING OF CEREAL CROP PLANTS - A REVIEW.** *Euphytica. 85(1-3):35-44.* English. [AMP II ZENTRUM ANGEW MOLEK BIOL PFLANZEN INST ALLGEMEINE BOT OHNHORSTSTR 18 D-22609 HAMBURG GERMANY].

Many aspects of basic and applied problems in plant biology can be investigated by transformation techniques. In dicotyledonous species, the ability to generate transgenic plants provides the tools for an understanding of plant gene function and regulation as well as for the directed transfer of genes of agronomic interest. For many dicotyledonous plants Agrobacterium tumefaciens can be routinely used to introduce foreign DNA into their genome. However, cereals seem to be recalcitrant to Agrobacterium-mediated transformation. In cereals, many efforts have been made in recent years to establish reliable transformation techniques. Several transformation techniques have been developed but to date only three methods have been found to be suitable for obtaining transgenic cereals: transformation of totipotent protoplasts, particle bombardment of regenerable tissues and, more recently, tissue electroporation. The current state of transformation methods used for cereals will be reviewed. [References: 74].

1448 Kato, T.; Sasaki, A.; Takeda, G. (1995) **GENETIC VARIATION OF BETA-GLUCAN CONTENTS AND BETA-GLUCANASE ACTIVITIES IN BARLEY, AND THEIR RELATIONSHIPS TO MALTING QUALITY.** *Breeding Science. 45(4):471-477.* English. [NATL AGR RES CTR TSUKUBA IBARAKI 305 JAPAN].

To improve the quality of malting barley, we analysed the genetic variation in grain and malt (1-3, 1-4)-beta-D-glucan ("beta-glucan") contents, malt (1-3, 1-3)-beta-D-glucanase (EC 3, 2. 1, 73) ("beta-glucanase") activity, and the relationship between these characteristics and malting quality. Although the malt beta-glucan content showed wide variations, few varieties and lines exhibited a malt beta-glucan content lower than that of the high quality variety "Mikamo golden", Grain beta-glucan content and beta-glucanase activity were significantly correlated with the malt beta-glucan content. Many varieties and lines displayed a low grain beta-glucan content or high beta-glucanase activity. Therefore it may be possible to reduce the malt beta-glucan content by improving the grain beta-glucan content and beta-glucanase activity genetically, Grain and malt beta-glucan contents of waxy varieties were conspicuously higher than those of the non-waxy varieties, There was a significant correlation between the malt beta-glucan content and Kolbach index. The relationship between the grain beta-glucan content and the malting quality was not significant. However, in most of the non-malting barley varieties the grain beta-glucan content was high. On the other hand, the beta-glucanase activity of malting barley was not appreciably higher than that of non-malting barley. Therefore, there is much room to improve the beta-glucanase activity genetically. In addition, the beta-glucanase activity also shelved a positive correlation with the diastatic power. Varieties with a high lysine content exhibited a high diastatic power but a low beta-glucanase activity. [References: 12].

1449 Kehlenbeck, H.; Schonbeck, F. (1995) **EFFECTS OF INDUCED RESISTANCE ON DISEASE SEVERITY/YIELD RELATIONS IN MILDEWED BARLEY.** *Journal of Phytopathology-Phytopathologische Zeitschrift. 143(9):561-567.* English. [UNIV HANNOVER INST PFLANZENKRANKHEITEN & PFLANZENSCHUTZ HERRENHAUSER STR 2 D-30419 HANNOVER GERMANY].

Field experiments showed that the treatment of winter barley with microbial metabolites produced by a Bacillus subtilis strain led to increased yields in spite of a remaining mildew infection. Disease severity/yield relations obtained on a single tiller basis for either mildew infection lit EC 75 or area under disease progress curve (AUDPC) were negatively correlated for untreated plants ($R(2) = 89\%, 94\%$) while this relation did not exist for inducer-treated ones ($R(2) = 10\%, 13\%$). Despite an increasing infection density, yields of main tillers of inducer-treated plants were not decreased. On the other hand area under green leaf area curve (AUGLAC) showed a higher correlation with grain yield ($R(2) = 89\%$) of inducer-treated plants. Possible explanations for the mitigated damaging effect of powdery mildew were expected in carbohydrate metabolism, especially carbohydrate formation and translocation. Assimilation rates of flag leaves of inducer-treated barley with similar infection densities to those of untreated plants were increased over a prolonged period and even exceeded those of noninfected ones. In inducer-treated plants the export of (CO2)-C-14 from flag leaves into ears remained unimpaired by mildew infection and the allocation of assimilates to grains was highest at late stages of grain filling. Obviously plants were stimulated by inducer treatments to compensate for the damaging effect of powdery mildew and to tolerate mildew infection without yield loss. [References: 28].

1450 Kim, B.K.; Cho, C.H.; Oh, J.H.; Chung, K.W.; Chae, J.C.; Han, O.K. (Dankook University, Cheonan (Korea Republic). College of Agriculture) (1995) **Inheritance of culm length and stiffness in barley.** *Korean Journal of Breeding (Korea Republic) v. 27(2) p. 148-154.* 1 illus.; 5 tables; 21 ref. Korean. (AGRIS 96-002563).

1451 Kjaeer, B.; Jensen, J.; Giese, H. (1995) **QUANTITATIVE TRAIT LOCI FOR HEADING DATE AND STRAW CHARACTERS IN BARLEY.** *Genome. 38(6):1098-1104.* English. [RISO NATL LAB DEPT ENVIRONM SCI & TECHNOL POB 49 DK-4000 ROSKILDE DENMARK].

Quantitative trait loci (QTLs) for heading date and straw characters were examined in 79 chromosome-doubled haploid lines derived from the F-1 generation of a cross between a six-rowed winter barley and a two-

rowed spring barley. A genetic map covering 1100 cM containing 85 markers, including isozyme, morphological, RFLP, and RAPD markers, was constructed. All traits examined had two QTLs with large effects on chromosome 2. In addition, a QTL for length of the top internode was found on chromosome 6. The QTL in the chromosome segment around locus v (two row / six row) on chromosome 2 may be caused by pleiotropic effects of this locus. The same QTLs for heading date and straw length were found in both 1989 and 1991. The results indicate that two QTLs on chromosome 2 affect a group of correlated traits. [References: 40].

1452 Korzh, B.V. (1993) **[Intervarietal variability of net photosynthesis in spring wheat [Triticum aestivum]]. Mezhsortovaya izmenchivost' sutochnogo fotosinteza yarovoj pshenitsy.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 91-103.* 7 ref. Russian. (AGRIS 96-015625).

The procedure of studies is described in detail and long-standing (1982-1989) data on varietal (42 varieties) peculiarities of net photosynthesis in spring wheat plants are presented. The problems under discussion are those of regulation of biological productivity at a level of sowing, individual plant and lamina. Conditions necessary for obtaining of correlated data defining the photosynthetic index are formulated.

1453 Kosar, K.; Psota, V. (Vyzkumny Ustav Pivovarsky a Sladarsky, Prague (Czech Republic)) (1995) **[Newly certified varieties of malting barley]. Nove povolene odrudy sladovnickeho jecmene.** *Kvasny Prumysl (Czech Republic) v. 41(7) p. 212-213.* 1 table. Czech. (AGRIS 96-002562).

1454 Kovacs, M.; Barnabas, B.; Kranz, E. (1995) **ELECTRO-FUSED ISOLATED WHEAT (TRITICUM AESTIVUM L) GAMETES DEVELOP INTO MULTICELLULAR STRUCTURES.** *Plant Cell Reports. 15(3-4):178-180.* English. [HUNGARIAN ACAD SCI INST AGR RES DEPT CELL BIOL H-2462 MARTONVASAR HUNGARY].

The electrofusion-mediated fertilization of single egg cells of wheat with isolated individually selected wheat sperm cells was successfully carried out for the first time. On average the fusion frequency was 30% but under optimal conditions it was possible to reach as much as 55%. Two days after electric fusion 60% of the fusion products started to divide, 88.5% of them forming multicellular structures and in a few cases microcalluses. The culture of single unfertilized egg cells with or without the application of AC field and electric pulses induced no cell division. The egg cells and fusion products were cultured in a maize feeder-cell system. [References: 18].

1455 Labhilili, M.; Joudrier, P.; Gautier, MF. (1995) **CHARACTERIZATION OF CDNAS ENCODING TRITICUM DURUM DEHYDRINS AND THEIR EXPRESSION PATTERNS IN CULTIVARS THAT DIFFER IN DROUGHT TOLERANCE.** *Plant Science. 112(2):219-230.* English. [INRA UNITE BIOCHIM & BIOL MOLEC CEREALES 2 PL VIALA F-34060 MONTPELLIER 01 FRANCE].

From a cDNA library prepared from roots of Triticum durum water-stressed seedlings, we have characterized four dehydrin clones. Two clones, pTd27e and pTd16, code for proteins with classical features of dehydrins, i.e. the consensus motif KIKEKLPG that is present beyond the tract of serine residues and at the carboxy terminus. The encoded proteins, Tddhn15 and Tddhn16, show similarities with Triticum aestivum sequences. Two clones, pTd25a and pTd38, code for a dehydrin which lacks the stretch of serine residues and shows sequence similarity to T. aestivum Cor proteins. To correlate T. durum drought tolerance with dehydrin gene expression, we have for four cultivars compared the accumulation of dehydrin transcripts in roots and shoots of seedlings in response to a water-stress, and under application of exogenous ABA. A water-stress time course showed that accumulation of the dehydrin transcripts is delayed in the drought-tolerant cultivars. Also, the level of accumulated transcripts appeared to be greater in the drought-tolerant cultivars than in the drought-sensitive cultivar. A similar result was observed after application of exogenous ABA. [References: 53].

1456 Labuschagne, MT.; Coetzee, MCB.; Vandeventer, CS. (1996) **BISCUIT-MAKING QUALITY PREDICTION USING HERITABILITY ESTIMATES AND CORRELATIONS.** *Journal of the Science of Food & Agriculture. 70(1):25-28.* English. [UNIV ORANGE FREE STATE DEPT PLANT BREEDING POB 339 BLOEMFONTEIN SOUTH AFRICA].

The aim of this study was to predict biscuit-making quality by using correlations between and, heritabilities of, the most important soft wheat quality characteristics. A full diallele cross was made between six spring wheats. The parents and 30 F-1 hybrids were used as experimental material. Percentage vitreous kernels, breakflour yield, farinograph absorption, farinograph development time and alkaline water retention capacity were highly heritable and were also significantly correlated with sugar-snap biscuit diameter. Selection for these characteristics should lead to improvement of biscuit-making quality. In general, softer kernels and a weak dough with a low water absorption were desirable for good biscuit-making quality. [References: 22].

1457 Langne Molnar, M.; Sutka, J. (Magyar Tud. Akad., Martonvasar (Hungary). Mezogazdasagi Kut. Int.) (1994) **[Production of fertile wheat-barley amphiploids]. Fertilis buza x arpa ampfiploidok eloallitasa.** *Botanikai Kozlemenyek (Hungary) v. 81(1) p. 83-87.* 2 tables; 17 ref. Hungarian. (AGRIS 96-015615).

With the aid of tissue culture, 190 regenerant hybrids were raised from five wheat (Triticum aestivum cv. Chinese Spring) x barley (Hordeum vulgare cv. Betzes) hybrids developed in earlier experiments in Martonvasar. The development of a fertile wheat x barley amphiploid raises the possibility of creating a new type of cereal.

1458 Langridge, P.; Karakousis, A.; Collins, N.; Kretschmer, J.; Manning, S. (1995) **A CONSENSUS LINKAGE MAP OF BARLEY.** *Molecular Breeding. 1(4):389-395.* English. [UNIV ADELAIDE DEPT PLANT SCI WAITE CAMPUS GLEN OSMOND SA 5064 AUSTRALIA].

A consensus linkage map of the barley genome was constructed. The map is based on six doubled haploid and one F-2 population. The mapping data for three of the doubled haploid populations was obtained via the GrainGenes database. To allow merger of the maps, only RFLP markers that produce a single scorable band were included. Although this reduced the available markers by about half, the resultant map contains a total of 587 markers including 87 of known function. As expected, gene order was highly conserved between maps and all but two discrepancies were found in closely linked markers and are likely to result from the small population sizes used for some maps. The consensus map allows the rapid localisation of markers between published maps and should facilitate the selection of markers for high-density mapping in defined regions. [References: 12].

1459 Law, CN. (1995) **GENETIC MANIPULATION IN PLANT BREEDING - PROSPECTS AND LIMITATIONS.** *Euphytica. 85(1-3):1-12.* English. [JOHN INNES CTR PLANT SCI RES NORWICH NR4 7UH NORFOLK ENGLAND].

1460 Lazar, MD.; Michels, GJ.; Booker, JD. (1995) **REPRODUCTIVE AND DEVELOPMENTAL RATES OF TWO GREENBUG BIOTYPES IN RELATION TO TWO WHEAT HOST RESISTANCE GENES.** *Southwestern Entomologist. 20(4):467-482.* English. [TEXAS A&M UNIV TEXAS AGR EXPT STN AMARILLO RES & EXTENS CTR 6500 AMARILLO BLVD W AMARILLO, TX 79106 USA].

The reproductive and developmental parameters of biotypes C and E greenbug, Schizaphis graminum (Rondani), restricted to feeding on each of four host wheat, Triticum aestivum L., genotypes was investigated. When reared on TAM105 and TAM107 winter wheat cultivars (susceptible and resistant, respectively, to biotype C greenbug based on allelic variation at the Gb2 locus), biotype C greenbugs differed significantly in cumulative number of nymphs produced (72.60 and 19.74, respectively), intrinsic rate of increase (0.244 and 0.113, respectively), and total days required for nymphal development (5.37 and 6.73), respectively. Biotype E greenbugs reared on the same cultivars (both of which are susceptible to biotype E), exhibited significant differences in cumulative nymphs per adult (64.02 and 53.46, respectively) and in total lifespan (26.61 and 17.78, respectively), but not in intrinsic rate of increase (0.212 and 0.217, respectively). Two near-isogenic wheat breeding lines, each closely related to TAM105 and TAM107, were also evaluated. Biotype-E resistant TXGBE273 and biotyye-E-susceptible TXGBE307 are distinguished by differing alleles at the Gb3 locus. While the two breeding lines were not distinguished by any

measures of biotype C development or reproduction, biotype E aphids produced significantly more cumulative nymphs per adult on susceptible TXGBE307 (42.27) than on resistant TXGBE273 (25.00). The antibiotic factors contributing to resistance to both biotypes were generally more related to effects on reproduction than to developmental effects. Significant effects of biotype C resistance were observed on reproduction in biotype E, although that effect was offset by differences in mean generation time in one of the wheat lines. [References: 21].

1461 Lewis, SM.; Martinez, AJ.; Dubcovsky, J. (1996) **KARYOTYPE VARIATION IN SOUTH AMERICAN ELYMUS (TRITICEAE).** *International Journal of Plant Sciences. 157(1):142-150.* English. [INTA CIRN INST RECURSOS BIOL LAS CABANAS & LOS RESEROS S-N RA-1712 CASTELAR BUENOS AIRES ARGENTINA].

Karyotypes of eight tetraploid (2n = 28) South American species of Elymus, were symmetrical (arm ratios: 0.70-0.78) and uniform (intrachromosomal asymmetry index: 0.105-0.133). Significant differences in arm ratio and asymmetry index were found among tetraploid species and also among geographically isolated populations within one species. Variation was nearly continuous, and significant differences were found only between the extreme values. The opposite situation was found among three hexaploid species (2n = 42) that can be readily differentiated by significant differences in karyotype parameters. Significantly higher intrachromosomal asymmetry indexes in E. erianthus (6x, 2n = 42) and E. mendocinus (8x, 2n = 56) indicated relatively larger differences in chromosome size between the genomes of the progenitors of these polyploid species. Low variation in the tetraploid species and high variation in the hexaploid and octoploid species were also found in the number and morphology of chromosomes with secondary constrictions (CSCs). Tetraploid species with the genome formula SSHH (S from Pseudoroegneria and H from Hordeum) showed only four CSCs from the S genome of Pseudoroegneria. The presence of CSCs from both S and H genomes in synthetic SSHH tetraploids and in natural SSHHHH hexaploids indicated absence of suppression of nucleolar organizing region (NOR) activity (amphiplasty) between the NORs from the S and H genomes. On the basis of karyotype and molecular data, it was hypothesized that the nucleolar organizing regions from the H genome were eliminated or highly reduced during the evolution of the tetraploid species. [References: 33].

1462 Li, SZ.; Chen, PY.; Marquardt, RR.; Han, ZK.; Clarke, JR. (1996) **PRODUCTION OF A SENSITIVE MONOCLONAL ANTIBODY TO STERIGMATOCYSTIN AND ITS APPLICATION TO ELISA OF WHEAT.** *Journal of Agricultural & Food Chemistry. 44(1):372-375.* English. [UNIV MANITOBA FAC AGR & FOOD SCI DEPT ANIM SCI WINNIPEG MB R3T 2N2 CANADA].

A hybridoma cell line capable of secreting sensitive and specific monoclonal antibody for sterigmatocystin (STG) was produced by fusing SP2/0 myeloma cells with spleen cells of female Balb/C mice immunized with STC hemiacetal-bovine serum albumin conjugate. The concentration of STG required to inhibit 50% of the binding of the monoclonal antibody in a competitive ELISA (cELISA) was 2.5 ng/nL. The apparent affinity dissociation constant of the monoclonal antibody was 2.3 x 10(-9) +/- 1.4 x 10(-10) M(-1). The cross-reactions of STG, O-methyl-STG, STG hemiacetal, aflatoxin B-1 (AFB(1)), AFB(2), AFG(1), AFG(2), and AFB(1) hemiacetal with the antibody in the cELISA were 100, 0.4, 12.5, 0.4, 0.1, <0.1, <0.1, 6.25%, respectively. Sterigmatocystin could be detected reproducibly using the cELISA and quantified in spiked wheat samples at concentrations greater than 31 ppb using a simple methanol and aqueous potassium chloride extraction procedure. [References: 23].

1463 Li, YC.; Liu, ZQ. (1995) **HETEROSIS AND EFFECT OF THE RHT 3 GENE ON PLANT HEIGHT AND ITS COMPONENTS IN HYBRID BREAD WHEAT WITH T-TIMOPHEEVI CYTOPLASM.** *Breeding Science. 45(4):419-423.* English. [ZHANJIANG AGR COLL DEPT AGRON HUGUANG YAN ZHANJIANG 524088 GUANGDONG PEOPLES REPUBLIC OF CHINA].

The heterosis of plant height and its components of hybrid bread wheat and the effect of Rht 3 gene were investigated in this paper. The results showed that all characters of hybrids had heterosis and heterobeltiosis, but their values varied among crosses and internodes; the heterosis and heterobeltiosis of length of basal internode were larger than those of other internodes and length of spike; there were less heterosis and heterobeltiosis for all characters in the hybrids from female parents with the Rht 3 gene than those in other hybrids. The Rht 3 gene increased the effects of lengths of second and third internodes and their heterosis on plant height and changed the relationships among the components in F-1 hybrid. In the combinations from A-line with the Rht 3 gene, the R lines were much more important to determine the plant height and its components of their hybrids than A lines, and so, it was relatively easier for breeders to control these characters of hybrid wheat. In the combination from A-line without the Rht 3 gene, both A and R lines affected F-1 hybrids for the characters examined to different extent, thus, two parents should be strictly screened for those characters to make new hybrid combinations. It should be noted that the length of spike of R line was much more responsible for that of its hybrid in combinations both with and without the Rht 3 gene, and therefore, the R line with long spike should be developed in order to obtain hybrid wheat with long spike. [References: 17].

1464 Line, RF.; Chen, XM. (1995) **SUCCESSES IN BREEDING FOR AND MANAGING DURABLE RESISTANCE TO WHEAT RUSTS.** *Plant Disease. 79(12):1254-1255.* English. [WASHINGTON STATE UNIV USDA ARS PULLMAN, WA 99164 USA].

1465 Ma, H.; Singh, RP. (1996) **CONTRIBUTION OF ADULT PLANT RESISTANCE GENE YR18 IN PROTECTING WHEAT FROM YELLOW RUST.** *Plant Disease. 80(1):66-69.* English. [CIMMYT INT MAIZE & WHEAT IMPROVEMENT CTR LISBOA 27 APDO POSTAL 6-641 MEXICO CITY 06600 DF MEXICO].

Yellow, or stripe, rust of wheat (caused by Puccinia striiformis), an important disease in many wheat growing regions of the world, is best controlled through genetic resistance. The Yr18 gene is known to confer slow rusting resistance in adult plants. This study was conducted to quantify the effectiveness of Yr18 in reducing losses in grain yield and other traits under high yellow rust pressure. Fungicide-protected and nonprotected plots of two near-isogenic lines, Jupateco 73R with the Yr18 gene and Jupateco 738 without it, were sown on two planting dates during two crop seasons. Yellow rust epidemics were initiated by artificial inoculation. The area under the disease progress curve and final rust severity were significantly higher for both plantings of nonprotected plots of Jupateco 73S, confirming that the Yr18 gene does confer slow rusting in Jupateco 73R. Comparison between protected and nonprotected treatments showed that yellow rust infection caused grain yield losses of 31 to 52% in Jupateco 73R and 74 to 94% in Jupateco 73S. This indicates that the slow rusting resistance conferred by Yr18 protected grain yield in the range of 36 to 58%, depending on the year and sowing date. Grain yield losses in both cultivars were mainly associated with reductions in kernel weight and kernels per m(2) however, reductions in spikes per m(2) and kernels per spike also contributed to yield loss in Jupateco 73S. A reduction in plant height was observed in late plantings of Jupateco 738, suggesting that early yellow rust infection may affect stem elongation on susceptible cultivars. Although deployment of Yr18 alone is not recommended in areas with high yellow rust pressure, previous studies have shown that the Yr18 pyramided with other slow rusting genes, a combination commonly known as the "Yr18 complex," should provide effective control of yellow rust. [References: 24].

1466 Mahmood, A. (Cotton Research Station, Multan (Pakistan)); Shahid, M. (Rice Research Inst., Kala Shah Kaku (Pakistan)) (1993) **Inheritance and inter-relationship studies of some quantitative characteristics in wheat.** *Pakistan Journal of Agricultural Research (Pakistan) v. 14(2 and 3) p. 121-125.* 2 tables, 19 ref. English. (AGRIS 96-015620).

1467 Maximov, NG.; Kostandi, GV. (1995) **FROST HARDINESS OF PRIMARY HEXAPLOID TRITICALE STRAINS AND THEIR PARENTAL SPECIES.** *Cereal Research Communications. 23(4):391-395.* English. [PLANT BREEDING & GENET RES INST ODESSA 270036 UKRAINE].

During three seasons the frost hardiness of 10 primary hexaploid triticale strains (TPH) and their six winter durum wheat and four rye

parental cultivars was evaluated in controlled freezing tests. The average frost hardiness of THP strains was equal to 47, 8%, wheat and rye cultivars - 19, 4 and 88, 5% survived plants respectively. The hardiness of the THP strains did not always depend on the trait expression in the wheat genotypes, but in some cases it depended to a great extent on rye genotype. It is obvious that the effect of rye frost hardiness genes was additive but the expression of these genes was decreased under the influence of the wheat genome. Since the frost hardiness of the best primary triticale strains obtained in the experiment was moderate, they should be used in hybridization programs for developing secondary triticale lines in order to improve this trait through the process of genes recombination followed by selection. [References: 7].

1468 May, KW.; Kozub, GC. (1995) **SUCCESS OF A SELECTION PROGRAM FOR INCREASING GRAIN YIELD OF TWO-ROW BARLEY LINES AND EVALUATION OF THE MODIFIED AUGMENTED DESIGN (TYPE 2).** *Canadian Journal of Plant Science. 75(4):795-799.* English. [AGR & AGRI FOOD CANADA RES CTR POB 3000 LETHBRIDGE AB T1J 4B1 CANADA].

The modified augmented design (MAD) (type 2), which adjusts for environmental heterogeneity when large numbers of test lines are being evaluated in non-replicated plots, has been used in the barley (Hordeum vulgare L.) breeding program at the Lethbridge Research Centre. The superiority of test lines selected from two series of F-7 test lines selected using the MAD were evaluated in replicated MAD tests (F-8) and superior selections were further evaluated in standard replicated designs (F-9). When adjustment was indicated for individual MAD tests, the generally high relative efficiencies (RE) confirmed the effectiveness of adjustment in reducing the error variation for yield. The need for adjustment and the adjustment method differed among replicates of the MAD conducted on adjacent blocks of land. The RE from replicated MAD tests indicated the effectiveness of the MAD for reducing the variability in the tests of Fg material. Correlations of the ranks of test lines in different replicates of MAD indicated that more of the same lines in each replicate would be designated as superior with adjustment for heterogenity. The lack of significant positive rank correlations among environments and clearly identifiable improvement in the mean yield was probably the result of the narrowing range in grain yield of the test lines as well as a genotype x environment interaction. [References: 9].

1469 McGuire, C.F. (Montana State University.); Taylor, G.A.; Rust, C.H.; Kisha, T.J. (1994) **End-use quality of Montana 7811, hard white winter wheat.** *Montana agresearch (USA) v. 11(2) p. 9-13.* references. English. (AGRIS 96-015367).

1470 Mckinnon, GE.; Henry, RJ. (1995) **CONTROL OF GENE EXPRESSION FOR THE GENETIC ENG NG OF CEREAL QUALITY [Review].** *Journal of Cereal Science. 22(3):203-210.* English.

The recent success of techniques for the direct transfer of individual genes to cereal species suggests that specific modifications to grain end-use properties will be achievable in the near future. The suitability of direct gene transfer to the problem, the choice of the promoter and transformation strategy need to be considered before attempting such modifications. This review discusses these questions with reference to current knowledge of seed-specific and, in particular, endosperm-specific and abscisic acid-responsive gene promoters. This perspective is of special importance in attempts to engineer cereal proteins. (C) 1995 Academic Press Limited [References: 53].

1471 Meshi, T.; Iwabuchi, M. (1995) **PLANT TRANSCRIPTION FACTORS [Review].** *Plant & Cell Physiology. 36(8):1405-1420.* English. [KYOTO UNIV FAC SCI DEPT BOT SAKYO KU KYOTO 60601 JAPAN].

Transcriptional regulation of gene expression relies on the recognition of promoter elements by transcription factors. In the past several years, a considerable number of (putative) transcription factors have been identified in plants. Some genes coding for these factors were isolated by south-western screening with oligonucleotides as a probe or by homology-based screening, and others were initially isolated by genetic means and subsequently identified as the genes for transcription factors. These transcription factors often form families of structurally related proteins with similar DNA-binding specificities and in addition, they are sometimes involved in related phenomena. Some groups of factors homo- and/or heterodimerize to increase the length and variability of the target sequences. Transcriptional activators, in general, comprise a modular activation domain. The activities of the transcription factors are controlled by post-translational modification, like phosphorylation and glycosylation, as well as at the levels of nuclear transport, oligomerization, etc. In this review, we will summarize the current knowledge of plant transcription factors to help understand the mechanistic aspects of the transcriptional regulation of genes. [References: 314].

1472 Miedaner, T.; Fromme, FJ.; Geiger, HH. (1995) **GENETIC VARIATION FOR FOOT ROT AND FUSARIUM HEAD-BLIGHT RESISTANCES AMONG FULL-SIB FAMILIES OF A SELF-INCOMPATIBLE WINTER RYE (SECALE CEREALE L) POPULATION.** *Theoretical & Applied Genetics. 91(6-7):862-868.* English. [UNIV HOHENHEIM LANDESSAATZUCHTANSTALT D-70593 STUTTGART GERMANY].

The amount of genetic variation for resistance to foot rot caused by Pseudocercosporella herpotrichoides, Fusarium spp., and Microdochium nivale and for resistance to head blight caused by Fusarium culmolum are important parameters when estimating selection gain from recurrent selection in winter rye. One-hundred and eighty-six full-sib families of the self-incompatible population variety Halo, representing the Petkus gene pool, were tested for foot-rot resistance at five German location-year combinations (environments) and for head-blight resistance in three environments with artificial inoculation in all but one environment. Foot-rot rating was based on 25 stems per plot scored individually on a 1-9 scale. Head-blight resistance was plotwise scored on a 1-9 scale and, additionally, grain-weight per spike was measured relative to the non-inoculated control plots. Significant estimates of genotypic variance and medium-sized heritabilities (h(2) = 0.51-0.69) were observed in the combined analyses for all resistance traits. In four out of five environments, the amount of genetic variance was substantially smaller for foot-rot than for head-blight rating. Considerable environmental effects and significant genotype-environment interactions were found for both foot-rot and head-blight resistance. Coefficients of error-corrected correlation among environments were considerably closer than phenotypic correlations. No significant association was found between the resistances to both diseases (r = - 0.20 to 0.17). In conclusion, intra-population improvement by recurrent selection should lead to substantial higher foot-rot and head-blight resistances due to significant quantitative genetic variation within Halo. Selection should be carried out in several environments. Lack of correlation between foot-rot and head-blight resistance requires separate infection tests for improving both resistances. [References: 25].

1473 Miller, TE.; Reader, SM.; Purdie, KA.; Abbo, S.; Dunford, RP.; King, IP. (1995) **FLUORESCENT IN SITU HYBRIDIZATION AS AN AID TO INTRODUCING ALIEN GENETIC VARIATION INTO WHEAT.** *Euphytica. 85(1-3):275-279.* English. [JOHN INNES CTR PLANT SCI RES NORWICH NR4 7UH NORFOLK ENGLAND].

Fluorescent in situ hybridization (FISH) has been used to assess the occurrence and frequency of wheat-alien chromosome pairing in a wheat/Thinopyrum bessarabicum hybrid and in wheat/rye hybrids with different levels of chromosome pairing by examining pollen mother cells at metaphase I of meiosis. The use of FISH to identify the presence and size of alien chromatin in a wheat background is also demonstrated. The value of FISH as an aid to the introgression of alien genetic variation into wheat is discussed. [References: 22].

1474 Miralles, DJ.; Slafer, GA. (1995) **INDIVIDUAL GRAIN WEIGHT RESPONSES TO GENETIC REDUCTION IN CULM LENGTH IN WHEAT AS AFFECTED BY SOURCE-SINK MANIPULATIONS.** *Field Crops Research. 43(2-3):55-66.* English. [UNIV BUENOS AIRES FAC AGRON DEPT PROD VEGETAL CATEDRA CEREALICULTURA AV SAN MARTIN 4453 RA-1417 BUENOS AIRES DF ARGENTINA].

This paper describes the effects of Rht alleles in isogenic lines of Maringa spring wheat (Triticum aestivum L.) on number of grains per spike, average grain weight and weight of individual grains from different positions within the spike. Plants were grown under five environmental

conditions in the field (in the 1991, 1992 and 1993 growing seasons, with two sowing dates in the first two years), aiming to determine causes of lower average grain weight commonly observed in semi-dwarf (SD) compared with standard-height (SH) cultivars. The number of grains per spike was significantly greater in SD and dwarf (DD) lines than in the SH line due to differences among lines in number of grains per spikelet. Therefore, the relative contribution of proximal grains was affected negatively by Rht alleles while the contribution of distal grains was affected positively. Average grain weight was reduced with increases in the dose of Rht alleles, and this trait was negatively correlated to number of grains per spike. To understand the possible causes of this negative relationship, individual grains from specific positions within the spike were analysed. Basal grains in central spikelets were heavier than those in near apical and near basal spikelets. Within central spikelets, the ranking of individual grain weights were grains 2 > 1 > 3 > 4, numbered from the most proximal to the most distal positions. Proximal grains (1 and 2) were heaviest in SH, lightest in DD, and intermediate in the SD line. In general, the relative differences between the lines were smaller than that found for the average of all grains of the spike, in particular when grains of different positions within the central spikelets were considered. For all these grains, differences in weight due to Rht alleles were due to differences in rate of grain filling, with the effective duration of grain filling being almost unchanged. An increased source-sink relationship did not significantly modify the weight of any of the analysed grains in SD and SH lines (and just slightly increased rate of grain filling in the DD line). Therefore, the smaller grains in SD and DD lines could hardly have been due to an increased competition for assimilates. Alternatively, SD and DD lines had a greater proportion of grains from distal positions than the SH line, and these grains were always smaller than proximal grains. The reduction in average grain weight produced by Rht alleles therefore was due to a combination of effects on the potential size of each grain and on the contribution of grains from distal positions within the spike, with no effects attributed to an increased competition for assimilates. [References: 36].

1475 Muller, E.; Lorz, H.; Lutticke, S. (1996) **VARIABILITY OF TRANSGENE EXPRESSION IN CLONAL CELL LINES OF WHEAT.** *Plant Science. 114(1):71-82.* English. [UNIV HAMBURG CTR APPL MOLEC BIOL PLANTS OHNHORSTSTR 18 D-22609 HAMBURG GERMANY].

A method for polyethyleneglycol (PEG) mediated direct DNA transfer into protoplasts was successfully established for transient and stable transformation of Triticum aestivum L. cell cultures. Transgenic cell lines, which had been transformed with the neomycin phosphotransferase II gene (nptII) fused to different promoters, were selected and integration and expression of the marker gene was shown by Southern analysis and enzyme activity test. For investigation of expression stability, five nptII positive cell lines maintained under selection were protoplasted and clonal callus lines were cultivated from the genetically identical single cells without selection pressure. Marker gene activity of 271 clonal callus lines was determined and compared with the corresponding parental line. A reduction or loss of marker gene expression in up to 50% of the clonal cell lines was observed. Detailed analysis of randomly selected clones showed that the observed variability in marker gene expression occurred due to a reduction in the nptII transcript level and was associated with hypermethylation of the integrated DNA. The silencing effect was reversible by a 4 week culture phase on media supplemented with the demethylation agent 5-azacytidin. These differences in marker gene expression could be observed regardless of copy number and position of the integrated nptII gene. The significance of such observations for a stable expression of foreign genes in plant cells is discussed. [References: 44].

1476 Naranjo, T.; Maestra, B. (1995) **THE EFFECT OF PH MUTATIONS ON HOMOEOLGOUS PAIRING IN HYBRIDS OF WHEAT WITH TRITICUM LONGISSIMUM.** *Theoretical & Applied Genetics. 91(8):1265-1270.* English. [UNIV COMPLUTENSE MADRID FAC BIOL DEPT GENET E-28040 MADRID SPAIN].

Homoeologous pairing at metaphase-I was analyzed in wild-type, ph2b, and ph1b hybrids of wheat and a low-pairing type of T. longissimum in order to study the effect of ph mutations on the pairing of T. longissimum chromosomes with wheat chromosomes. Chromosomes of both species, and their arms, were identified by C-banding. The three types of hybrids, with low-, intermediate-, and high-pairing levels, respectively, exhibited a very similar pairing pattern which was characterized by the existence of two types, A-D and B-S-1, of preferential pairing. These results confirm that the S-1 genome of T. longissimum is closely related to the B genome of wheat. The possible use of ph1b and ph2b mutations in the transfer to wheat of genes from related species is discussed. [References: 34].

1477 O'Brien, L. (Sydney Univ., Narrabri (Australia). Plant Breeding Inst.) (1992) **Quality improvement in prime hard wheat.** *Chemistry in Australia (Australia) v. 59(9) p. 471-473.* 6 fig., 5 ref. English. (AGRIS 96-002684).

An outline is given of the history of the development of Australian wheat varieties. For a period, wheat breeders aimed for increased yield without taking sufficient consideration of baking quality. A breeding strategy in 1949 provided varieties with resistance to stem rust. Continued improvement has been made in the quality of hard wheat varieties, and small gains are still likely. Improvements are likely to be least for milling quality, where varieties appear to be close to the upper genetic limit achievable.

1478 Oh, S.K. (Rural Development Administration, Suwon (Korea Republic). Crop Experiment Station); Kamanoi, M. (Tokyo University of Agriculture, Tokyo (Japan)) (1995) **Chromosomal location of esterase isozyme gene in durum wheat using trisomics.** *Korean Journal of Breeding (Korea Republic) v. 27(3) p. 318-322.* 1 ill.; 2 tables; 18 ref. Korean. (AGRIS 96-015646).

1479 Okamoto, H.; Tatara, A. (1995) **EFFECTS OF LOW-DOSE GAMMA-IRRADIATION ON THE CELL CYCLE DURATION OF BARLEY ROOTS.** *Environmental & Experimental Botany. 35(3):379-388.* English. [UNIV TOKYO FAC AGR RADIAT GENET LAB BUNKYO KU 1-1-1 YAYOI TOKYO 113 JAPAN].

This study investigates the effects of 1.0 Gy or less of gamma-irradiation on the duration of the cell cycle and its component phases in the root apical meristem of two-rowed barley seedlings. Germinating seeds were irradiated with 0.25, 0.5, 0.75 and 1.0 Gy of gamma-rays, after which the mitotic index (MI) in the root apical meristem was subsequently observed and compared with corresponding non-irradiated samples (controls). The MI of the controls stayed at about 5-7% during germination from 74 to 100 hr, whereas after a 0.25- or 0.50-Gy exposure it was about 40% higher 4 hr later. Germinating seedlings were also pulse-labelled with H-3-thymidine soon after exposure, fixed at 2-hr intervals and observed by autoradiography. The durations of the cell cycle, S-phase and total duration of the G(2)-phase, prophase and metaphase were then estimated. Relative to controls, the cell cycle duration was reduced by about 1.8 and 2.5 hr with 0.25 and 0.5 Gy, respectively, being primarily due to a reduction in the S-phase. When hydroxyurea-treated seedlings were irradiated with such low-doses and then immediately treated with H-3-thymidine, the average number of silver grains per interphase cell nucleus increased relative to that of the controls. The present results suggest that the increase in the quantity of division cells at 4 and 6 hr post-exposure with 0.25 or 0.5 Gy was probably caused by a reduction in the duration of the S-phase, G(2)-phase, prophase and metaphase. [References: 17].

1480 Olsen, O.; Thomsen, KK.; Weber, J.; Duus, JO.; Svendsen, I.; Wegener, C.; Vonwettstein, D. (1996) **TRANSPLANTING TWO UNIQUE BETA-GLUCANASE CATALYTIC ACTIVITIES INTO ONE MULTIENZYME, WHICH FORMS GLUCOSE.** *Bio-Technology. 14(1):71-76.* English. [CARLSBERG LAB DEPT PHYSIOL GAMLE CARLSBERG VEJ 10 DK-2500 COPENHAGEN DENMARK].

Endo cellulases of plant pathogenic erwinias degrade cellulose as well as the cellulosic domains of barley (1-3, 1-4)-beta-glucan. Depolymerization of the latter substrate is mainly caused by (1-3, 1-4)-beta-glucanases, which hydrolyze (1-4)-beta glycosidic linkages adjacent to (1-3)-beta linkages, To construct an enzyme for efficient degradation of barley (1-3, 1-4)-beta-glucan, the sequence encoding the catalytic domain and interdomain linker of the cellulase from Erwinia carotovora subspecies atroseptica was fused to that for the heat stable Bacillus hybrid, H(A12-M)Delta Y13 (1-3, 1-4)-beta-glucanase. The chimeric enzyme secreted from Escherichia coli cells did not remain covalently assembled as judged by SDS-PAGE, However,

the glycosylated and intact enzyme (denoted CELGLU) is secreted from the yeast Pichia pastoris, CELGLU exhibits both cellulase and (1-3, 1-4)-beta-glucanase catalytic activities, and was accordingly classified a true multienzyme, HPLC and NMR analyses revealed that among the products from CELGLU, di- and trimeric oligosaccharides were identical to those produced by the parental cellulase, Tetrameric oligosaccharides, derived from the (1-3, 1-4)-beta-glucanase activity of CELGLU, were further degraded by the cellulase moiety to yield glucose and trimers, Compared with the parental enzymes, CELGLU exhibits substantially higher V-max for degradation of both soluble cellulose and barley (1-3, 1-4)-beta-glucan. These findings point to construction of multienzymes as an effective approach for engineering enzymes with novel characteristics. [References: 43].

1481 Ordon, F.; Bauer, E.; Friedt, W.; Graner, A. (1995) **MARKER-BASED SELECTION FOR THE YM4 BAMMV-RESISTANCE GENE IN BARLEY USING RAPDS.** *Agronomie. 15(7-8):481-485.* English. [UNIV GIESSEN INST CROP SCI & PLANT BREEDING LUDWIGSTR 23 D-35390 GIESSEN GERMANY].

Studies to identify an RAPD marker linked to the BaMMV/BaYMV resistance gene ym4 were carried out on F-1 anther derived doubled haploid (DH) barley lines from a cross between the BaMMV/BaYMV susceptible cultivar 'Igri' and the resistant cultivar 'Franka' (ym4). For initial primer screening, bulked segregant analysis was used. Out of 148 decamer primers screened, only primer OP-Z04 revealed polymorphism resulting in an additional 660 bp band in the susceptible bulk. Linkage analysis carried out on 287 DH lines revealed that OP-Z04H660 is very closely linked to ym4 facilitating efficient marker-based selection for BaMMV/BaYMV resistance encoded by this gene. Additional studies showed that OP-Z04H660 can discriminate perfectly between resistant (ym4) and susceptible commercial barley cultivars. [References: 18].

1482 Otani, M.; Shimada, T. (1995) **EFFECT OF SYNTHETIC MEDIUM ON MICROSPORE-*DERIVED* EMBRYOID FORMATION OF TETRAPLOID WHEAT SPECIES.** *Cereal Research Communications. 23(4):345-350.* English. [ISHIKAWA AGR COLL AGR RESOURCES RES INST NONOICHI ISHIKAWA 921 JAPAN].

Anther culture of 3 genotypes of tetraploid wheat (Triticum durum, T. dicoccum and T. turgidum) were cultured on four kinds of media (three synthetic media (C17, W14 and MN6) and Potato-2 medium). Genotypic differences were obtained in the microspore-derived embryoid formation on each medium. The C17 medium containing 0.26M maltose as a carbohydrate source was the most effective for the microspore-derived embryoid formation in tetraploid wheat. Green plants were obtained in T. durum var, agricunum T. dicoccum var. farrum, T. persicum var. stramineum. [References: 16].

1483 Parry, DW.; Rezanoor, HN.; Pettitt, TR.; Hare, MC.; Nicholson, P. (1995) **ANALYSIS OF MICRODOCHIUM NIVALE ISOLATES FROM WHEAT IN THE UK DURING 1993.** *Annals of Applied Biology. 126(3):449-455.* English. [HARPER ADAMS COLL CROP & ENVIRONM RES CTR NEWPORT TF10 8NB SHROPS ENGLAND].

A total of 144 isolates of Microdochium nivale from stem bases of winter wheat were taken from 30 sites and 91 isolates from grain were taken from seven sites throughout the UK. Identification by polymerase chain reaction (PCR) amplification of the internal transcribed spacer (ITS) region followed by restriction enzyme digestion of the PCR product revealed that 70% of stem base isolates were M. nivale var. majus and 30% var. nivale while 93% grain isolates were var. majus and 7% var. nivale. Almost all isolates were resistant to the benzimidazole fungicide benomyl. Perithecial production in vitro was more common in var. majus isolates and occurred in almost all grain isolates, but was less common in stem base isolates. The implications of the findings in terms of epidemiology and chemical control of this important cereal pathogen are discussed. [References: 16].

1484 Pedersen, C.; Lindelaursen, I. (1995) **THE RELATIONSHIP BETWEEN PHYSICAL AND GENETIC DISTANCES AT THE HOR1 AND HOR2 LOCI OF BARLEY ESTIMATED BY TWO-COLOUR FLUORESCENT IN SITU HYBRIDIZATION.** *Theoretical & Applied Genetics. 91(6-7):941-946.* English. [RISO NATL LAB DEPT ENVIRONM SCI & TECHNOL POB 49 DK-4000 ROSKILDE DENMARK].

The hordeins are the major class of storage proteins in barley. They are encoded by multigene families. The B- and C-hordein loci have been mapped physically to the distal end of chromosome 5 (1I) of cultivated barley by fluorescent in situ hybridization. Based on measurements of chromosomal distances between the two hordein loci, the relationship between genetic and physical distances has been estimated to be about 1 mega base pairs per centiMorgan. This is four times higher than the mean value for the barley genome as a whole and confirms the tendency to increased recombination in distal chromosome regions. The resolving power of two-colour FISH is discussed. It is concluded that the method is suitable for estimating the relationship between genetic and physical distances of regions of about 10 Mbp or larger. [References: 35].

1485 Penner, GA.; Stebbing, JA.; Legge, B. (1995) **CONVERSION OF AN RFLP MARKER FOR THE BARLEY STEM RUST RESISTANCE GENE RPG1 TO A SPECIFIC PCR-AMPLIFIABLE POLYMORPHISM.** *Molecular Breeding. 1(4):349-354.* English. [AGR & AGRI FOOD CANADA WINNIPEG RES CTR 195 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

The Rpg1 gene in barley has provided satisfactory levels of stem rust resistance for the last 50 years. The appearance of a new race of stem rust that is virulent to Rpg1 has resulted in efforts to incorporate new stem rust resistance genes into barley. Marker-assisted selection may provide the only means of combining this useful gene with resistance genes for which no virulent races have been identified. Several RFLP markers have been identified as linked to the Rpg1 locus. One of these, ABG704 was converted into a post-amplification restriction polymorphism. To generate a specific PCR-amplifiable polymorphism the sequence of the ABG704 locus from four barley cultivars was determined. Primers were developed that can detect a single-base difference between resistant and susceptible cultivars. The successful conversion of an RFLP marker to an allele-specific PCR-based marker not only demonstrates that this type of conversion is possible for cereals, but also results in an immediately useful marker for application to plant breeding programmes. [References: 11].

1486 Pickering, RA.; Hill, AM.; Michel, M.; Timmermanvaughan, GM. (1995) **THE TRANSFER OF A POWDERY MILDEW RESISTANCE GENE FROM HORDEUM BULBOSUM L TO BARLEY (H-VULGARE L) CHROMOSOME 2(21).** *Theoretical & Applied Genetics. 91(8):1288-1292.* English. [NEW ZEALAND INST CROP & FOOD RES LTD PRIVATE BAG 4704 CHRISTCHURCH NEW ZEALAND].

Hordeum bulbosum L. is a source of disease resistance genes that would be worthwhile transferring to barley (H. vulgare L.). To achieve this objective, selfed seed from a tetraploid H. vulgar-e x H. bulbosum hybrid was irradiated. Subsequently, a powdery mildew-resistant selection of barley phenotype (81882/83) was identified among field-grown progeny. Using molecular analyses, we have established that the H. bulbosum DNA containing the powdery mildew resistance gene had been introgressed into 81882/83 and is located on chromosome 2 (21). Resistant plants have been backcrossed to barley to remove the adverse effects of a linked factor conditioning triploid seed formation, but there remains an association between powdery mildew resistance and non-pathogenic necrotic leaf blotching. The dominant resistance gene is allelic to a gene transferred from H. bulbosum by co-workers in Germany, but non-allelic to all other known powdery mildew resistance genes in barley. We propose Mlhb as a gene symbol for this resistance. [References: 24].

1487 Plaschke, J.; Ganal, MW.; Roder, MS. (1995) **DETECTION OF GENETIC DIVERSITY IN CLOSELY RELATED BREAD WHEAT USING MICROSATELLITE MARKERS.** *Theoretical & Applied Genetics. 91(6-7):1001-1007.* English. [INST PFLANZENGENET & KULTURPFLANZENFORSCH CORRENSSTR 3 D-06466 GATERSLEBEN GERMANY].

Wheat microsatellites (WMS) were used to estimate the extent of genetic diversity among 40 wheat cultivars and lines, including mainly European elite material. The 23 WMS used were located on 15 different chromosomes, and revealed a total of 142 alleles. The number of alleles ranged from 3 to 16, with an average of 6.2 alleles per WMS. The average

dinucleotide repeat number ranged from 13 to 41. The correlation coefficient between the number of alleles and the average number of repeats was only slight (r(s) = 0.55). Based on percentage difference a dendrogram is presented, calculated by the WMS-derived data. All but two of the wheat cultivars and lines could be distinguished. Some of the resulting groups are strongly related to the pedigrees of the appropriate cultivars. Values for co-ancestry (f) of 179 pairs of cultivars related by their pedigrees (f greater than or equal to 0.1) averaged 0.29. Genetic similarity (GS) based on WMS of the same pairs averaged 0.44. The rank correlation for these pairs was slight, with r(s) = 0.55, but highly significant ($P < 0.001$). The results suggest that a relatively small number of microsatellites can be used for the estimation of genetic diversity and cultivar identification in elite material of hexaploid bread wheat. [References: 28].

1488 Pretorius, ZA.; Roelfs, AP. (1996) **THE ROLE OF LR10, LR13, AND LR34 IN THE EXPRESSION OF ADULT-PLANT RESISTANCE TO LEAF RUST IN THE WHEAT CULTIVAR ERA.** *Plant Disease. 80(2):199-202.* English. [UNIV ORANGE FREE STATE DEPT PLANT PATHOL BLOEMFONTEIN 9300 SOUTH AFRICA].

Elucidation of the genetic basis of the highly effective resistance in Era wheat to Puccinia recondita f. sp. tritici could assist breeders in reconstructing similar Lr gene combinations in other cultivars. Attempts to relate the presence of Lr10, Lr13, and Lr34 with the expression of adult-plant resistance showed that a combination of these genes did not necessarily confer high levels of resistance to pathotype UVPrt8 of P. r. f. sp. tritici. The most resistant adult F-2 plant derived from a cross between Era and line RL6058 was homozygous for Lr10, Lr13, and Lr34, but other F-2 plants exhibiting intermediate levels of adult-plant resistance also appeared homozygous for all three genes. In the leaf rust-susceptible background of Line E, no clear relationship between Lr13 and expression of adult-plant resistance derived from Era was observed. Limited evidence was obtained that Lr10 in association with an unknown gene or Lr13 interacted with Lr34 to confer an improved level of resistance to leaf rust in certain plants. Mostly results indicated a lack of interaction among Lr10, Lr13, and Lr34. It seems unlikely that wheat breeders will be able to reconstruct a similar Era-type of leaf rust resistance by combining Lr10, Lr13, and Lr34. [References: 25].

1489 Pyl'nev, V.M.; Pyl'nev, V.V.; Khassan Radzhaa (1994) **[The effect of heterozygosis on ear productivity of winter soft wheat]. Vliyanie geterozigotnosti na produktivnost' kolosa ozimoj myagkoj pshenitsy.** *Izvestiya Timiryazevskoj sel'skokhozyajstvennoj akademii (Russian Federation) (no.2) p. 63-71.* 27 ref. Russian. (AGRIS 96-015630).

In all parts of the ear of F1 hybrids of winter soft wheat the number of developed flowers, coarseness of grains, the weight of grain from a plant increase, the highest growth of ear productivity being found in peripheral (lower and upper) parts of the ear. So, the nature of changes in ear productivity with the increase in plant heterozygosis is the same as its change with the increase in the level of ear nutrition (due to lower sowing rate, higher doses of mineral fertilizers, pinching, etc.) and it corresponds to the nature of ear productivity changes as a result of wheat selection for productivity.

1490 Ramage, RA.; Sutherland, MW. (1995) **HIGH AND LOW PRE-INOCULATION TEMPERATURES DECREASE THE EFFECTIVENESS OF THE LR20 AND SR15 RUST RESISTANCE GENES IN WHEAT.** *Plant Pathology. 44(5):772-778.* English. [UNIV SO QUEENSLAND FAC SCI DEPT BIOL TOOWOOMBA QLD 4350 AUSTRALIA].

Spring wheat seedlings containing Lr20 and Sr15 resistance alleles were raised at 30 degrees C, prior to inoculation with leaf rust (Puccinia recondita race 76-2, 3) and stem rust (Puccinia graminis f.sp, tritici race 343-1, 2, 3, 5, 6) pathogens, respectively. Infected plants were then grown at one of seven temperatures in the range 18-30 degrees C and infection types were scored at 10 days post-inoculation. These results were compared with those obtained for plants raised at a pre-inoculation temperature of 18 degrees C. In both 18 degrees C and 30 degrees C pre-grown plants, a progressive increase in infection type was observed on resistant lines as post-inoculation temperature increased. However, resistant lines raised at 30 degrees C had significantly higher infection types than plants raised at 18 degrees C at all post-inoculation temperatures for which some degree of resistance was still evident in the plants raised at 18 degrees C. The maximum temperature for expression of resistance was significantly higher for Lr20 than for Sr15, irrespective of pre-inoculation temperature. A lowering of the resistance expression was also evident in Sr15-bearing lines raised at a very low pre-inoculation temperature (4 degrees C). The effects of low pre-inoculation temperature on resistance were assessed in both winter and spring wheat lines, These results are discussed in the light of current ideas concerning the host membrane location of pathogen recognition events. [References: 29].

1491 Rioux, S.; Stpierre, CA.; Couture, L. (1995) **GENETIC STUDIES ON THE RESISTANCE OF WINTER WHEAT TO SPECKLED SNOW MOULD.** *Canadian Journal of Plant Science. 75(4):801-805.* English. [UNIV LAVAL DEPT PHYTOL QUEBEC CITY PQ G1K 7P4 CANADA].

Speckled snow mould (caused by Typhula ishikariensis) is a potential threat to winter wheat (Triticum aestivum L.) production in eastern Canada. Information on the inheritance of snow mould resistance is needed to develop an effective breeding strategy. In this study, the inheritance of resistance to the speckled snow mould was examined using crosses of a resistant genotype, PI 173438, and four susceptible cultivars, Lennox, Kitami-2 Norin-8 and Ena. The parental lines, and the F-1 and F-2 populations from each of the four crosses were grown in the field and in an unheated plastic greenhouse and scored for snow mould resistance. Biomass yield, survival, plant height and number of tillers/plant, all expressed as percentage of check plants, were used as indices of snow mould resistance. Generation means analysis, combining data from the field and greenhouse experiments, indicated that snow mould resistance was largely influenced by environmental conditions, and that additive genetic effects were more important than epistatic effects in controlling the expression of the disease. Dominance effects oriented towards susceptibility were detected in only one of the four crosses. Estimates of broad sense heritability in the four Fz populations ranged from 0.62 to 0.96 and from 0.34 to 0.79, respectively, when biomass yield and number of tillers/plant were used as indices of snow mould resistance. When plant height was used as an index of snow mould resistance, the heritability estimates ranged from 0.10 to 0.53. [References: 13].

1492 Ritala, A.; Aikasalo, R.; Aspegren, K.; Salmenkalliomarttila, M.; Akerman, S.; Mannonen, L.; Kurten, U.; Puupponenpimia, R.; Teeri, TH.; Kauppinen, V. (1995) **TRANSGENIC BARLEY BY PARTICLE BOMBARDMENT - INHERITANCE OF THE TRANSFERRED GENE AND CHARACTERISTICS OF TRANSGENIC BARLEY PLANTS.** *Euphytica. 85(1-3):81-88.* English. [VTT BIOTECHNOL & FOOD RES POB 1505 SF-02044 ESPOO FINLAND].

Transgenic barley plants (Hordeum vulgare L. cv. Kymppi) were obtained by particle bombardment of various tissues. Immature embryos and microspore-derived cultures were bombarded with gold particles coated with plasmid DNA carrying the gene coding for neomycin phosphotransferase II (NPTII), together with plasmid DNA containing the gene for beta-glucuronidase (GUS). Bombarded immature embryos were grown to plants without selection and NPTII activity was screened in small plantlets. One plant proved to be transgenic (T-0). This chimeric plant passed the transferred nptII gene to its T-1 progeny. The presence of the nptII gene was demonstrated by the PCR technique and enzyme activity was analyzed by an NPTII gel. assay. Four T-0 spikes and 15 T-1 offspring were transgenic. The integration and inheritance was confirmed by Southern blot hybridization. Transgenic T-2 and Tg plants were produced by isolating embryos from green grains of transgenic T-1 and T-2 plants, respectively and growing them to plants. After selfing, the ratio of transgenic to non-transgenic T-2 offspring was shown to follow the rule of Mendelian inheritance. The general performance of transgenic plants was normal and no reduction in fertility was observed. Microspore-derived cultures were bombarded one and four weeks after microspore isolation. After bombardment, cultures were grown either with or without antibiotic selection (geneticin(R) or kanamycin). When cultures were grown without selection and regenerated plants were transferred to kanamycin selection in rooting phase, one out of a total of about 1500 plants survived. This plant both carried and expressed the transferred nptII gene. The integration was confirmed by Southern blot hybridization. This plant was not fertile. [References: 24].

1493 Royo, A.; Aragues, R. (Consejo Superior de Investigaciones Cientificas, Zaragoza (Espana). Laboratorio Asociado de Agronomia y Medio Ambiente) (1995) **[Effect of salinity on various morpho-physiological characters and grain yield in barley]. Efecto de la salinidad sobre diversos caracteres morfo-fisiologicos y sobre el rendimiento en grano de la cebada.** *Investigacion Agraria. Produccion y Proteccion Vegetales (Espana) v. 10(1) p. 71-84.* 4 tab., 1 fig.; 18 ref. Spanish. (AGRIS 96-002549).

1494 Rubiales, D.; Niks, RE. (1995) **CHARACTERIZATION OF LR34, A MAJOR GENE CONFERRING NONHYPERSENSITIVE RESISTANCE TO WHEAT LEAF RUST.** *Plant Disease. 79(12):1208-1212.* English. [AGR UNIV WAGENINGEN DEPT PLANT BREEDING POB 386 6700 AJ WAGENINGEN NETHERLANDS].

Wheat leaf rust resistance gene Lr34 is claimed to contribute to durability of resistance in wheat cultivars in combination with other genes for resistance. We compared the effect of Lr34 with that of Lr12 and Lr13 (all in Thatcher background) and with the partial resistance of Akabozu and BH1146. Seedlings of all lines displayed a compatible infection type. Lr34 increased latency period and decreased infection frequency, especially at low temperature. The gene caused a small but significant increase in early abortion of sporelings. The number of haustoria per sporeling 42 h after inoculation was reduced significantly, but this was not associated with papilla formation. In adult plants the effect of Lr34 was much clearer. In the flag leaf Lr34 decreased infection frequency and increased latency period. Many infection units did not develop further than the stage in which they caused pale (nonhypersensitive) flecks. Also at the microscopic level we found no increased hypersensitivity due to Lr34. Lr34 shared features both with Lr13 and with the genes for partial resistance in Akabozu and BH1146. The main difference with Lr13 was the association of the latter with chlorosis at the macroscopic level and cell necrosis at the microscopic level. Lr34 and the partial resistance in Akabozu and BH1146 are based on reduced rates of haustorium formation in the early stages of infection, in association with no or relatively little plant cell necrosis. However, the reduction of haustorium formation in Thatcher-Lr34 appeared to be due to a low rate of intercellular hyphal development and not to papilla formation as in Akabozu and BH1146. We argue that Lr34 should be considered a major gene conferring partial resistance sensu Parlevliet. [References: 40].

1495 Salmenkalliomarttila, M.; Aspegren, K.; Akerman, S.; Kurten, U.; Mannonen, L.; Ritala, A.; Teeri, TH. (1995) **TRANSGENIC BARLEY (HORDEUM VULGARE L) BY ELECTROPORATION OF PROTOPLASTS.** *Plant Cell Reports. 15(3-4):301-304.* English. [VTT BIOTECHNOL & FOOD RES POB 1505 SF-02040 ESPOO FINLAND].

Protoplasts isolated from calli derived from cultured microspores of barley (Hordeum vulgare L. cv, Kymppi, an elite cultivar) were transformed with the neomycin phosphotransferase marker gene (nptII) by electroporation, Screening of the regenerated plants for the NPTII activity by gel assay resulted in three positive signals, Southern blot analysis and NPTII assays of second and third generation plants confirmed the genomic integration of the transferred gene and that the new trait was inherited by the progeny. [References: 25].

1496 Sasek, A.; Bradova, J.; Skorpik, M.; Sykorova, S. (Vyzkumny Ustav Rostlinne Vyroby, Prague Ruzyne (Czech Republic)); Cerny, J. (1995) **Catalogue of electrophoretic spectra of gliadins and glutenin subunits with high molecular weight in varieties of world collection of winter wheat (Triticum aestivum).** *Scientia Agriculturae Bohemica (Czech Republic) v. 25(1) p. 5-34.* 1 scheme, 4 tables; 12 ref. English. (AGRIS 96-002695).

1497 Schenk, P.; Sohn, A.; Adams, MJ.; Antoniw, JF.; Hamacher, J.; Steinbiss, HH. (1995) **MOVEMENT OF BYMOVIRUSES AND FUNCTIONS OF RNA2-ENCODED PROTEINS OF BARLEY YELLOW MOSAIC VIRUS.** *Agronomie. 15(7-8):387-391.* English. [MAX PLANCK INST ZUCHTUNGSFORSCH CARL VON LINNE WEG 10 D-50829 COLOGNE GERMANY].

Observations and experimental data that were obtained from plants infected with bymoviruses such as barley yellow mosaic virus (BaYMV), barley mild mosaic virus (BaMMV), or wheat spindle streak mosaic virus (WSSMV) suggested that long-distance transport follows the phloem pathway. Inoculation of barley roots with BaMMV via viruliferous zoospores of Polymyxa graminis and mechanical inoculation of leaves revealed that viral transport from shoots to roots occurs in less than 5 d while movement from roots to shoots could only be detected after 5-6 weeks. A model for long-distance transport of bymoviruses was developed which shows that the bymovirus infection cycle passes through 4 main stages. During these stages an up- and downward movement may be important for sufficient replication and successful transmission of bymoviruses. The 28 kDa protein of BaYMV (RNA2) may have a function in either movement or replication as it was often found associated with virus particles. The other RNA2-encoded protein of BaYMV, a 70 kDa protein, could be involved in fungal transmission. [References: 13].

1498 Scottcraig, JS.; Kerby, KB.; Stein, BD.; Somerville, SC. (1995) **EXPRESSION OF AN EXTRACELLULAR PEROXIDASE THAT IS INDUCED IN BARLEY (HORDEUM VULGARE) BY THE POWDERY MILDEW PATHOGEN (ERYSIPHE GRAMINIS F SP HORDEI).** *Physiological & Molecular Plant Pathology. 47(6):407-418.* English. [CARNEGIE INST WASHINGTON DEPT PLANT BIOL 290 PANAMA ST STANFORD, CA 94305 USA].

The intercellular wash fluids (IWF) of barley seedlings contain at least six peroxidase isozymes. Two isozymes, P8.5 and P5.2, specifically increase in both resistant and susceptible barley following inoculation with the powdery mildew pathogen, Erysiphe graminis f. sp. hordei. A polyclonal antiserum to the cationic P8.5 isozyme was used to recover a clone for this peroxidase from a cDNA expression library made from inoculated barley seedlings. This cDNA was used as a probe to examine P8.5 mRNA levels from 0 to 48 h following inoculation of resistant barley with E. graminis hordei. Accumulation of the P8.5 polypeptide and total peroxidase activity in IWF was monitored over the same time course. These experiments show that enhanced levels of peroxidase activity are correlated with elevated levels of P8.5 polypeptide and mRNA in seedlings following inoculation with the powdery mildew pathogen. Finally, increased deposition of P8.5 was observed in papillae by immunogold labeling experiments. All the data are consistent with the hypothesis that peroxidase P8.5 participates in the deposition of phenolic compounds in papillae and thereby contributes to general, nonspecific defense responses in barley. (C) 1995 Academic Press Limited [References: 31].

1499 Skadsen, RW.; Schulzelefert, P.; Herbst, JM. (1995) **MOLECULAR CLONING, CHARACTERIZATION AND EXPRESSION ANALYSIS OF TWO CATALASE ISOZYME GENES IN BARLEY.** *Plant Molecular Biology. 29(5):1005-1014.* English. [USDA AGR RES SERV CEREAL CROPS RES UNIT 501 N WALNUT ST MADISON, WI 53705 USA].

Clones representing two distinct barley catalase genes, Cat1 and Cat2, were found in a cDNA library prepared from seedling polysomal mRNA. Both clones were sequenced, and their deduced amino acid sequences were found to have high homology with maize and rice catalase genes. Cat1 had a 91% deduced amino acid sequence identity to CAT-1 of maize and 92% to CAT B of rice. Cat2 had 72 and 79% amino acid sequence identities to maize CAT-2 and -3 and 89% to CAT A of rice. Barley, maize or rice isozymes could be divided into two distinct groups by amino acid homologies, with one group homologous to the mitochondria-associated CAT-3 of maize and the other homologous to the maize peroxisomal/glyoxysomal CAT-1. Both barley CATs contained possible peroxisomal targeting signals, but neither had favorable mitochondrial targeting sequences. Cat1 mRNA occurred in whole endosperms (aleurones plus starchy endosperm), in isolated aleurones and in developing seeds, but Cat2 mRNA was virtually absent. Both mRNAs displayed different developmental expression patterns in scutella of germinating seeds. Cat2 mRNA predominated in etiolated seedling shoots and leaf blades. Barley genomic DNA contained two genes for Cat1 and one gene for Cat2. The Cat2 gene was mapped to the long arm of chromosome 4, 2.9 cM in telomeric orientation from the mlo locus conferring resistance to the powdery mildew fungus (Erysiphe graminis f.sp. hordei). [References: 39].

1500 Somers, DJ.; Gustafson, JP. (1995) **THE EXPRESSION OF ALUMINUM STRESS INDUCED POLYPEPTIDES IN A POPULATION SEGREGATING FOR ALUMINUM TOLERANCE IN WHEAT (TRITICUM AESTIVUM L).** *Genome. 38(6):1213-1220.* English. [UNIV MISSOURI DEPT AGRON PLANT SCI UNIT CURTIS HALL COLUMBIA, MO 65211 USA].

This study examined the changes in gene expression induced by aluminum (Al) stress in wheat root tips. Seedlings of Triticum aestivum L. cvs. Katepwa (Al sensitive), Maringa (Al tolerant), and Alikat (Al tolerant near isoline; 'Katepwa'*3/'Maringa') and a F-2 population derived from 'Katepwa' x 'Alikat', were grown for 3 days in either 0 or 1 mu g . mL(-1) Al. Polypeptides were labeled with S-35-methionine prior to separation by gel electrophoresis. There were a few polypeptides from whole cell lysates that showed enhanced expression in all of the genotypes in 1 mu g . mL(-1) Al, however, the whole cell lysate and microsomal polypeptide profiles also revealed numerous unique changes in gene expression in Al-sensitive 'Katepwa' at 1 mu g . mL(-1) Al; the latter cosegregated with only the Al-sensitive F-2 bulks. The microsomal polypeptide profiles of the Al-tolerant lines 'Maringa' and 'Alikat' changed marginally in the presence of Al and these changes were also reflected in the Al-tolerant F-2 bulks. The data showed that there were many changes in gene expression which cosegregated with Al sensitivity and suggest that Al tolerance in wheat may rely on constitutively expressed polypeptides. [References: 20].

1501 Sutka, J.; Farshadfar, E.; Koszegi, B.; Friebe, B.; Gill, BS. (1995) **DROUGHT TOLERANCE OF DISOMIC CHROMOSOME ADDITIONS OF AGROPYRON ELONGATUM TO TRITICUM AESTIVUM.** *Cereal Research Communications. 23(4):351-357.* English. [HUNGARIAN ACAD SCI AGR RES INST H-2462 MARTONVASAR HUNGARY].

Drought is one of the abiotic environmental stress factors that reduces wheat yield worldwide. In our experiment, chromosome addition lines of Agropyron elongatum (Host.) Beauvois to Triticum aestivum L. cv. 'Chinese Spring' were tested for drought tolerance in growth chambers in the Martonvasar phytotron by creating three different moisture regimes: E1. fully irrigated control, E2. mid-season water stress (preanthesis), E3. terminal water stress during grain filling. The data were analysed for relative water content (RWC), drought susceptibility index (DSI), multiple selection efficiency (MSE) and general adaptability. Ag. elongatum chromosome 5E is very important in controlling drought tolerance and has shown to be promising for the improvement of wheat yield stability under drought-prone conditions. [References: 20].

1502 Taketa, S.; Kato, J.; Takeda, K. (1995) **HIGH CROSSABILITY OF WILD BARLEY (HORDEUM SPONTANEUM KOCH, C.) WITH BREAD WHEAT AND THE DIFFERENTIAL ELIMINATION OF BARLEY CHROMOSOMES IN THE HYBRIDS.** *Theoretical & Applied Genetics. 91(8):1203-1209.* English. [OKAYAMA UNIV RES INST BIORESOURCES KURASHIKI OKAYAMA 710 JAPAN].

Four bread wheat (Triticum aestivum L.) cultivars, 'Aobakomugi', 'Chinese Spring', 'Norin 61' and 'Shinchunaga', were pollinated with five barley lines/cultivars consisting of three cultivated barley (Hordeum vulgare L.) lines, 'Betzes', 'Kinai 5' and OHL089, and two wild barley (Hordeum spontaneum C. Koch) lines, OUH602 and OUH324. Crossability, expressed as the percentage of embryo formation, varied from 0 to 55.4% among the cross combinations. The two wild barley lines generally had a higher crossability than the previously reported best pollinator, 'Betzes', and some Japanese wheat cultivars were better as the female parent than;Chinese Spring'. Ninety four hybrid plants were obtained from 250 embryos cultured, and their somatic chromosome numbers ranged from 21 to 36. Eighteen plants were mosaic in chromosome number. Twenty one-chromosome plants appeared most frequently (45.7%) followed by 28-chromosome plants (14.9%). C-banding analysis revealed that elimination of barley chromosomes was mainly responsible for the occurrence of aneuploid plants. In hypoploids derived from 'Betzes'-crosses, chromosome 5 was preferentially eliminated as previously reported, while in hypoploids derived from OUH602-crosses, chromosome 4 was preferentially eliminated. The wild barley line OUH602 may be a useful parent for producing a new wheat-barley addition set because of its high crossability with wheat and a different pattern of chromosome elimination. [References: 27].

1503 Taylor, G.A. (Montana State University.); Kisha, T.J.; McGuire, C.F.; Rust, C.H. (1994) **Agronomic field performance of Montana 7811, a hard white winter wheat.** *Montana agresearch (USA) v. 11(2) p. 6-8.* references. English. (AGRIS 96-015643).

1504 Thomas, WTB.; Powell, W.; Waugh, R.; Chalmers, KJ.; Barua, UM.; Jack, P.; Lea, V.; Forster, BP.; Swanston, JS.; Ellis, RP.; Hanson, PR.; Lance, RCM. (1995) **DETECTION OF QUANTITATIVE TRAIT LOCI FOR AGRONOMIC, YIELD, GRAIN AND DISEASE CHARACTERS IN SPRING BARLEY (HORDEUM VULGARE L).** *Theoretical & Applied Genetics. 91(6-7):1037-1047.* English. [SCOTTISH CROP RES INST DUNDEE DD2 5DA SCOTLAND].

Quantitative trait loci (QTLs) have been revealed for characters in a segregating population from a spring barley cross between genotypes adapted to North-West Europe. Transgressive segregation was found for all the characters, which was confirmed by the regular detection of positive and negative QTLs from both parents. A QTL for all the agronomic, yield and grain characters measured except thousand grain weight was found in the region of the dense dwarfing gene locus. There were considerable differences between the location of QTLs found in the present study and those found in previous studies of North American germ plasm, revealing the diversity between the two gene pools. Thirty-one QTLs were detected in more than one environment for the 13 characters studied, although many more were detected in just one environment. Whilst biometrical analyses suggested the presence of epistasis in the genetic control of some characters, there was little evidence of interactions between the QTLs apart from those associated with yield. QTLs of large effect sometimes masked the presence of QTLs of smaller effect. [References: 46].

1505 Tregear, JW.; Primavesi, LF.; Huttly, AK. (1995) **FUNCTIONAL ANALYSIS OF LINKER INSERTIONS AND POINT MUTATIONS IN THE ALPHA-AMY2/54 GA-REGULATED PROMOTER.** *Plant Molecular Biology. 29(4):749-758.* English. [UNIV BRISTOL DEPT AGR SCI LONG ASHTON RES STN IACR BRISTOL BS18 9AF AVON ENGLAND].

Functional analysis of a gibberellin-regulated wheat a-amylase promoter, alpha-Amy2/54, has indicated that three regions were essential for expression. By studying the ability of mutant promoters, containing a randomly inserted 22 bp excision linker, to direct expression in oat aleurone protoplasts we have refined the positions and extents of these three cia elements and also demonstrated the presence of two additional elements. By converting the linker insertions to either single base point mutations or deletions using the class IIS restriction endonuclease Bsm I we have shown that nucleotides -119 and -109 within the GARE (-121)GTAACAGAGTCTGG(-108) and nucleotide -152 within the proposed element (-156)GATTGACTTGACC(-144) are essential for high level expression from this promoter. [References: 26].

1506 Vershinin, AV.; Schwarzacher, T.; Heslopharrison, JS. (1995) **THE LARGE-SCALE GENOMIC ORGANIZATION OF REPETITIVE DNA FAMILIES AT THE TELOMERES OF RYE CHROMOSOMES.** *Plant Cell. 7(11):1823-1833.* English. [JOHN INNES CTR PLANT SCI RES COLNEY LANE NORWICH NR4 7UH NORFOLK ENGLAND].

Repetitive DNA sequences in the terminal heterochromatin of rye (Secale cereale) chromosomes have consequences for the structural and functional organization of chromosomes. The large-scale genomic organization of these regions was studied using the telomeric repeat from Arabidopsis and clones of three nonhomologous, tandemly repeated, subtelomeric DNA families with complex but contrasting higher order structural organizations. Polymerase chain reaction analysis with a single primer showed a fraction of the repeat units of one family organized in a "head-to-head" orientation. Such structures suggest evolution of chromosomes by chromatid-type breakage-fusion-bridge cycles. In situ hybridization and pulse field gel electrophoresis showed the order of the repeats and the heterogeneity in the lengths of individual arrays. After XbaI digestion and pulse field gel electrophoresis, the telomeric and two subtelomeric clones showed strong hybridization signals from 40 to 100 kb, with a maximum at 50 to 60 kb. We suggest that these fragments define a

basic higher order structure and DNA loop domains of regions of rye chromosomes consisting of arrays of tandemly organized sequences. [References: 56].

1507 Wedderburn, R.N.; Listman, G.M. (CIMMYT, Lisboa 27, Apdo. Postal 6 641, 06600 Mexico, DF (Mexico)) (1993) **Accomplishments and challenges in maize breeding at the International Maize and Wheat Improvement center.** *Plant Breeding Abstracts (United Kingdom) v. 63(8) p. 1027-1035.* 8 ref. English. (AGRIS 96-002580).

1508 Wei, JZ.; Campbell, WF.; Scoles, GJ.; Slinkard, AE.; Wang, RRC. (1995) **CYTOLOGICAL IDENTIFICATION OF SOME TRISOMICS OF RUSSIAN WILDRYE (PSATHYROSTACHYS JUNCEA).** *Genome. 38(6):1271-1278.* English. [UTAH STATE UNIV USDA ARS FORAGE & RANGE RES LAB LOGAN, UT 84322 USA].

Russian wildrye, Psathyrostachys juncea (Fisch.) Nevski (2n = 2x = 14; NsNs), is an important forage grass and a potential source of germplasm for cereal crop improvement. Because of genetic heterogeneity as a result of its self-incompatibility, it is difficult to identify trisomics of this diploid species based on morphological characters alone. Putative trisomics (2n = 2x + 1 = 15), derived from open pollination of a triploid plant by pollen grains of diploid plants, were characterized by Giemsa C-banding. Based on both karyotypic criteria and C-banding patterns, four of the seven possible primary trisomics, a double-deletion trisomic, and two tertiary trisomics were identified. [References: 30].

1509 Wei, JZ.; Campbell, WF.; Wang, RRC. (1995) **STANDARD GIEMSA C-BANDED KARYOTYPE OF RUSSIAN WILDRYE (PSATHYROSTACHYS JUNCEA) AND ITS USE IN IDENTIFICATION OF A DELETION TRANSLOCATION HETEROZYGOTE.** *Genome. 38(6):1262-1270.* English. [UTAH STATE UNIV USDA ARS FORAGE & RANGE RES LAB LOGAN, UT 84322 USA].

Ten accessions of Russian wildrye, Psathyrostachys juncea (Fisch.) Nevski (2n = 2x = 14; NsNs), collected from different geographical regions were analyzed using the C-banding technique. C-banding pattern polymorphisms were observed at all levels, i.e., within homologous chromosome pairs of the same plant, among different individuals within accessions, between different accessions of the same geographic area, and among accessions of different origins. The seven homologous groups varied in the level of C-banding pattern polymorphism; chromosomes A, B, E, and F were more variable than chromosomes C, D, and G. The polymorphisms did not hamper chromosome identification in Ps. juncea, because each chromosome pair of the Ns genome had a different basic C-banding pattern and karyotypic character. A standard C-banded karyotype of Ps. juncea is proposed based on the overall karyotypes and C-bands in the 10 accessions. The C-bands on the Ns-genome chromosomes were designated according to the rules of nomenclature used in wheat. A deletion-translocation heterozygote of Russian wildrye was identified based on the karyotype and C-banding patterns established. The chromosome F pair consisted of a chromosome having the distal segment in the long arm deleted and a translocated chromosome having the distal segment of long arm replaced by the distal segment of the long arm of chromosome E. The chromosome E pair had a normal chromosome E and a translocated chromosome having the short arm and the proximal segment of the long arm of chromosome E and the distal segment of the long arm of chromosome F. [References: 26].

1510 Wei, JZ.; Wang, RRC. (1995) **GENOME- AND SPECIES-SPECIFIC MARKERS AND GENOME RELATIONSHIPS OF DIPLOID PERENNIAL SPECIES IN TRITICEAE BASED ON RAPD ANALYSES.** *Genome. 38(6):1230-1236.* English. [UTAH STATE UNIV USDA ARS FORAGE & RANGE RES LAB LOGAN, UT 84322 USA].

Eight different genomes (*E, H, I,* P, R, St, W, and Ns) represented by 22 diploid species of the tribe Triticeae were analyzed using the random amplified polymorphic DNA (RAPD) technique. The genome relationships were obtained based on 371 RAPD fragments produced with 30 primers. The four species of the genus Psathyrostachys (having various Ns genomes) were closely related. The genomes E(e) and E(b) had a similarly close relationship and were distinct from all other genomes analyzed. Genomes P, R, and St were grouped in one cluster and genomes H and I in another. Genome W had a distant relationship with all other genomes. These results agree with the conclusions from studies of chromosome pairing and isozyme and DNA sequence analyses. Twenty-nine and 11 RAPD fragments are considered to be genome- and species-specific markers, respectively. One to six genome-specific markers were identified for each genome. These RAPD markers are useful in studies of genome evolution, analysis of genome composition, and genome identification. [References: 39].

1511 Weigel, R.; Wolf, M.; Hesemann, CU. (1995) **MITOCHONDRIAL DNA VARIATION IN PLANTS REGENERATED FROM EMBRYOGENIC CALLUS CULTURES OF CMS TRITICALE.** *Theoretical & Applied Genetics. 91(8):1237-1241.* English. [UNIV HOHENHEIM INST GENET D-70593 STUTTGART GERMANY].

The mitochondrial DNA (mtDNA) organization of primary hexaploid cytoplasmic male-sterile (CMS) triticale regenerants containing Triticum timopheevi cytoplasm was analysed by hybridization experiments and compared with the mitochondrial genome organization of the corresponding regenerants with maintainer cytoplasm. Callus cultures had been derived from immature embryos, and 623 triticale plants were regenerated via somatic embryogenesis after three to four subcultures. The chondriome of 159 regenerants was investigated with regard to somaclonal variation. Six different mitochondrial gene probes and four different restriction enzymes were used for Southern blot analyses by the non-radioactive digoxigenin labeling technique. Alloplasmic regenerants showed a gain or loss of hybridization signals up to a high percentage, while euplasmic ones revealed only minor variability with respect to band stoichiometries. In 24 cases rearrangements in the mtDNA were proved. We suppose that recombination processes and selective amplification events are responsible for these findings. [References: 35].

1512 Weiland, JJ.; Edwards, MC. (1996) **A SINGLE NUCLEOTIDE SUBSTITUTION IN THE ALPHA-A GENE CONFERS OAT PATHOGENICITY TO BARLEY STRIPE MOSAIC VIRUS STRAIN ND18.** *Molecular Plant-Microbe Interactions. 9(1):62-67.* English. [USDA ARS NO CROP SCI LAB FARGO, ND 58105 USA].

A 236-nucleotide region from the alpha a gene of strain CV42 (pathogenic to oat), when substituted for the homologous region in strain ND18 (nonpathogenic to oat), was shown previously to confer a near wild-type oat pathogenicity to this strain (Weiland and Edwards, 1994, Virology 201: 116-126). The data suggested that six amino acid substitutions in the alpha a gene were responsible for the differences in oat pathogenicity, and that threonine-724, encoded by CV42, might be a critical amino acid in determining pathogenicity of barley stripe mosaic virus (BSMV) to oat. In the present work, codons specifying T-724, I-764, and N-785 (encoded by CV42 RNA alpha) were substituted individually and in combination for those coding for P-724, T-764, and K-785 (encoded by ND18 RNA alpha), respectively, by site-directed mutagenesis. The core K-733, T-734, and K-736 positions (CV42) were substituted for Q-733, S-734, and Q-736 (ND18) as a single block. The results of inoculations with these mutants indicate that the C-2261 --> A(2261) nucleotide substitution (P-724 --> T-724) by itself is sufficient to enable strain ND18 to infect oat plants, although poorly. Additional substitution of CV42 codons into ND18 RNA alpha at the remaining five positions altered symptom type, decreased the timing of the appearance of symptoms, and increased the percentage of plants infected per inoculation. Nonetheless, all mutants accumulated to similar levels in inoculated oat protoplasts after a 24-h period. Using a recombinant RNA beta from which beta-glucuronidase could be expressed, results were obtained suggesting that the multiplication of strain ND18 and the nonpathogenic variants generated in the study was restricted in the inoculated leaf. The data indicate a potential pathway by which pathogenicity to oat evolved in BSMV. [References: 20].

1513 Xu, DP.; Duan, XL.; Wang, BY.; Hong, BM.; Ho, THD.; Wu, R. (1996) **EXPRESSION OF A LATE EMBRYOGENESIS ABUNDANT PROTEIN GENE, HVA1, FROM BARLEY CONFERS TOLERANCE TO WATER DEFICIT AND SALT STRESS IN TRANSGENIC RICE.** *Plant Physiology. 110(1):249-257.* English. [CORNELL UNIV BIOCHEM MOLEC & CELL BIOL SECT ITHACA, NY 14853 USA].

A late embryogenesis abundant (LEA) protein gene, HVA1, from barley (Hordeum volgare L.) was introduced into rice suspension cells using the Biolistic-mediated transformation method, and a large number of independent transgenic rice (Oryza sativa L.) plants were generated. Expression of the barley HVA1 gene regulated by the rice actin 1 gene promoter led to high-level, constitutive accumulation of the HVA1 protein in both leaves and roots of transgenic rice plants. Second-generation transgenic rice plants showed significantly increased tolerance to water deficit and salinity. Transgenic rice plants maintained higher growth rates than nontransformed control plants under stress conditions. The increased tolerance was also reflected by delayed development of damage symptoms caused by stress and by improved recovery upon the removal of stress conditions. We also found that the extent of increased stress tolerance correlated with the level of the HVA1 protein accumulated in the transgenic rice plants. Using a transgenic approach, this study provides direct evidence supporting the hypothesis that LEA proteins play an important role in the protection of plants under water- or salt-stress conditions. Thus, LEA genes hold considerable potential for use as molecular tools for genetic crop improvement toward stress tolerance. [References: 36].

1514 Zelenskij, M.I.; Chmeleva, Z.V.; Mogileva, G.A.; Shitova, I.P. (1993) **[On physiological spring wheat characters related with a high level of protein in grain]. O fiziologicheskikh priznakakh yarovoj pshenitsy, sopryazhennykh s vysokim soderzhaniem belka v zerne.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 87-91.* 10 ref. Russian. (AGRIS 96-015624).

Presented are the results of a triennial conjugated study of physiological characters in the course of ontogenetic development of wheat samples (area and surface density of the leaf, chlorophyll content, chloroplasts' activity) as well as protein content in the grain of corresponding specimens defined after their harvest. It is established that protein content in grain correlates negatively (-0, 30 - -0, 60) with duration of shooting-earing stage and there is a positive correlation - (+0, 46 - +0, 70) with photoreducing chloroplast activity. A conclusion is drawn that a necessary condition for high protein grain formation is the increased chloroplast activity on reduced producing.

1515 Zelenskij, M.I.; Pisareva, L.A.; Sultanova, L.M. (1993) **[Inheritance of photosynthetic characters in chlorophyll mutants of winter wheat Mironovskaya 808]. Nasledovanie fotosinteticheskikh priznakov u khlorofill'nykh mutantov ozimoj pshenitsy sorta Mironovskaya 808.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 81-86.* 10 ref. Russian. (AGRIS 96-015629).

Studies were made on inheritance of chlorophyll content and oxygen releasing activity of chloroplasts in the offspring from crosses of Mironovskaya 808 with its chlorophyll mutants Chlorina 1 and Chlorina 2 containing 60 % and 40 % of the initial form chlorophyll. A high level of chlorophyll of Mironovskaya 808 predominated on F1 generation. Heterozygous F3 families showed segregation close to 3:1. A conclusion was drawn about monogenic nature of chlorophyll content inheritance. Oxygen releasing activity of chloroplasts also reveals segregation in hybrid populations. It produces, on occasion, a heterotic effect, but on the whole its inheritance is more complicated.

1516 Zhou, H.; Arrowsmith, JW.; Fromm, ME.; Hironaka, CM.; Taylor, ML.; Rodriguez, D.; Pajeau, ME.; Brown, SM.; Santino, CG.; Fry, JE. (1995) **GLYPHOSATE-TOLERANT CP4 AND GOX GENES AS A SELECTABLE MARKER IN WHEAT TRANSFORMATION.** *Plant Cell Reports. 15(3-4):159-163.* English. [MONSANTO CO MAIL ZONE GG4H 700 CHESTERFIELD PKWY N ST LOUIS, MO 63198 USA].

The lack of alternative selectable markers in crop transformation has been a substantial barrier for commercial application of agricultural biotechnology. We have developed an efficient selection system for wheat transformation using, glyphosate-tolerant CP4 and GOX genes as a selectable marker. Immature embryos of the wheat cultivar Bobwhite were bombarded with two separate plasmids harboring the CP4/GOX and GUS genes. After a 1 week delay, the bombarded embryos were transferred to a selection medium containing 2 mM glyphosate. Embryo-derived calli were subcultured onto the same selection medium every 3 weeks consecutively for 9-12 weeks, and were then regenerated and rooted on selection media with lower glyphosate concentrations. Transgenic plants tolerant to glyphosate were recovered. ELISA assay confirmed expression of the CP4 and GOX genes in R(0) plants. Southern blot analysis demonstrated that the transgenes were integrated into the wheat genomes and transmitted to the following generation. The use of CP4 and GOX genes as a selectable marker provides an efficient, effective, anti alternative transformation selection system for wheat. [References: 29].

F40 PLANT ECOLOGY

1517 Canteromartinez, C.; Villar, JM.; Romagosa, I.; Fereres, E. (1995) **GROWTH AND YIELD RESPONSES OF TWO CONTRASTING BARLEY CULTIVARS IN A MEDITERRANEAN ENVIRONMENT.** *European Journal of Agronomy. 4(3):317-326.* English. [UNIV LLEIDA IRTA ROVIRA ROURE 177 E-25198 LLEIDA SPAIN].

The central area of the Ebro valley in northern Spain has a continental Mediterranean climate with variable rainfall, ranging from 250 to 500 mm. Water is the main factor limiting yield of rainfed agriculture. During four seasons (1985-86 to 1988-89), the performance of two barley cultivars of contrasting phenology (cvs. Dobla and Tina) was studied at El Canos (north-eastern Spain). Growth, yield and yield components, water use and root development were evaluated. Yields ranged from 1.2 to 3.0 t ha(-1) for the four experimental years which were all below average in rainfall. Total water use by the crop and ET during the pre-anthesis period were main determinants of grain yield ($r = 0.75$, $p < 0.001$). The most variable yield component across genotypes and years was the number of ears per square meter, which determined final grain yield. Dobla, a modern cultivar, had greater plasticity and responded by having greater growth rates during pre-anthesis when the number of grains per ear was determined. Dobla avoided the terminal water stress, and its grain filling period was less adversedly affected than that of Tina, a late-flowering and older cultivar. Dobla produced less leaf area but had a greater extintiction coefficient and intercepted more radiation per unit leaf area. In the very dry years, yields of both cultivars were similar; however, Dobla outyielded Tina (3.0 vs. 2.3 t ha(-1)) in 1987-88 when the rainfall approached normal. It is concluded that Dobla is a cultivar better suited for the area despite the greater stability and higher biomass production of Tina. [References: 28].

1518 Slafer, GA.; Rawson, HM. (1995) **RATES AND CARDINAL TEMPERATURES FOR PROCESSES OF DEVELOPMENT *IN* WHEAT - EFFECTS OF TEMPERATURE AND THERMAL AMPLITUDE.** *Australian Journal of Plant Physiology. 22(6):913-926.* English. [UNIV BUENOS AIRES FAC AGRON DEPT PROD VEGETAL AV SAN MARTIN 4453 RA-1417 BUENOS AIRES DF ARGENTINA].

This paper addresses three issues relating to development in wheat. Whether thermal amplitude changes rates of leaf appearance and phenological development, whether the responses of leaf appearance to a wide range of temperature can be acceptably described in terms of rates and cardinal (base and optimum) temperatures, and whether similar rates and cardinal temperatures can be applied to parallel processes of development. The two studies used a total of 22 naturally-lit growth chambers and 44 treatments, and the disparate wheat cultivars Sunset, Condor, Rosella and Cappelle Desprez. All plants were vernalised and then grown under photoperiods extended to 18 h. In the first study, thermal amplitudes varying between 0 and 14 degrees C around a common mean of 19 degrees C did not change rates of leaf appearance and had no consistent effect on phenological development at any stage to anthesis. Consequently, conclusions from data collected under one amplitude at this mean temperature can be extrapolated with confidence to another. In the second study, with six mean temperature regimes of 10-25 degrees C, rate of leaf appearance was significantly increased progressively by increasing temperature up to 19 degrees C. All cultivars had an optimum temperature for this process which approximated 22 degrees C but they differed in their base temperatures which ranged from -5.7 to -1.9 degrees C. Optimum and base values for the concurrent phase of phenological development ranged between similar extremes, but the rankings of base values amongst genotypes differed markedly for leaf

appearance and phenology. For the process of culm extension, temperature significantly, but not linearly, affected final length but not internode number. Length was unchanged by temperatures between 10 and 16 degrees C but was significantly reduced above 19 degrees C. Cultivars differed in their respective optimum and base temperatures for rate of elongation, ranging from ca 19 to 21 degrees C and from 2 to 5 degrees C. The concurrent phenological process had a higher optimum of 22-25 degrees C but again a similar range in base temperature with differing cultivar rankings. We conclude from the second study that cardinal temperatures for leaf appearance, culm elongation and phenology were different, and for each process there were cultivar differences. [References: 67].

F50 PLANT STRUCTURE

1519 Dong, B.; Rengel, Z.; Graham, RD. (1995) **ROOT MORPHOLOGY OF WHEAT GENOTYPES DIFFERING IN ZINC EFFICIENCY.** *Journal of Plant Nutrition. 18(12):2761-2773.* English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

The root morphology (root length, diameter) of the three wheat genotypes (Triticum aestivum L. cvs Excalibur and Gatcher, and T. turgidum conv. durum (Desf.) McKay cv Durati) grown in zinc (Zn)-deficient, sandy soil under controlled conditions has been measured by a root scanner coupled to a computer. Wheat plants were supplied with 0, 0.025, 0.05, 0.1, 0.2, or 0.4 mg Zn/kg soil. Excalibur has previously been identified as the Zn-efficient genotype which can take up more Zn and has higher yield in soils with low plant-available Zn. Durati is Zn-inefficient and Gatcher an intermediate genotype with respect to Zn efficiency. Root and shoot dry matter significantly increased at 0.1 mg Zn/kg soil compared to the 0 Zn level. Zinc content in shoots was lower in Durati than in Excalibur and Gatcher at sufficient supply of Zn. Zinc applications had no significant effect on root morphology at two weeks after sowing. At that time, however, the Zn-effucient genotype Excalibur developed a longer and thinner roots (greater proportion of fine roots with diameter less than or equal to 0.2 mm) than the less efficient Gatcher and Zn-inefficient Durati Hence, growing longer and thinner roots and having a greater proportion of thinner roots in the total soot biomass early in the growth period may be the two characters associated with the Zn-efficient genotypes. [References: 31].

1520 Huang, J.; Redmann, RE. (1995) **RESPONSES OF GROWTH, MORPHOLOGY, AND ANATOMY TO SALINITY AND CALCIUM SUPPLY IN CULTIVATED AND WILD BARLEY.** *Canadian Journal of Botany-Revue Canadienne de Botanique. 73(12):1859-1866.* English. [UNIV SASKATCHEWAN DEPT CROP SCI & PLANT ECOL SASKATOON SK S7N 0W0 CANADA].

Growth, morphology, and anatomy were examined in cultivated barley (Hordeum vulgare L. cv. Harringtbn), and wild barley (Hordeum jubatum L.) collected from a wild population located in Saskatoon, Sask. Plants were grown in nutrient solution plus mixed sulphate salts with low or high calcium supply and in nutrient solution alone (control), using a hydroponic system in a growth chamber. Salt stress had greater deleterious effects on growth, morphology, and anatomy of 'Harrington' than wild barley. Additional Ca supply markedly improved these parameters in 'Harrington' but not in wild barley, suggesting a greater responsiveness to Ca in the cultivated species. The wild barley population had greater leaf and tiller numbers per plant but smaller leaf area and dry mass than 'Harrington' in control solution. After 20 days of salt treatment, 'Harrington' showed a greater reduction in tiller and leaf number, shoot height and root length, and tissue dry mass than wild barley. Calcium-deficiency symptoms were found in 'Harrington' leaves in the low Ca salt treatment but not in wild barley. On the other hand, shoot height and dry mass growth were significantly increased in 'Harrington' by high Ca salt treatment, suggesting that 'Harrington' was more responsive to supplemental Ca than wild barley. Salt stress induced thicker roots with larger vessels in 'Harrington' but not in the wild barley population. [References: 44].

1521 Panthee, D.R. (Lumle Agricultural Research Centre, c/o BAPSO, P.O. Box 106, Kathmandu (Nepal)) (1995) **[Study on morphological characteristics of wheat, oil seed rape, onion, broad leaf mustard and radish varieties, 1994/95].** *LARC Working Paper (Nepal); no. 95/44 35 p.* Lumle Agricultural Research Centre. 10 tables. English. (AGRIS 96-003392).

Study on morphological characteristic of different varieties of wheat (Triticum aestivum), oilseed rape (Brassica junceae), onion (Allium cepa), broad leaf mustard (Brassica junceae var. rugosa) and radish (Raphanus sativus) was conducted during winter of 1994/95 at Lumle Centre (1670m asl) with an objective of preparing a varietal descriptor for easy identification in the field. The varieties included in the study were NL-539 and BL-1249 (wheat), Lumle Tori (oilseed rape), Mallajh Local, Early Red, Red Creole, Red Synthetic and Regal PVP (onion), Manakamana (broad leaf mustard) and 40 days (radish). Both qualitative and quantitative type of characters were found useful for variety identification in the field condition. Straw thickness, earhead shape, glume colour and seed shape were found to be most useful characters of wheat for variety identification. There were two distinct populations in Lumle Tori making it difficult to establish the standard character for the variety, therefore rigorous selection of a particular set of population is suggested. Leaf erectness, colour, waxiness, shape of the bulb and bulb skin colour were found most important characters for onion variety identification. In broad leaf mustard (BLM), anthocyanin pigmentation in veins, hypocotyl colour, growth habit and leaf pubescence were the most useful characters. Similarly in radish seedlings leaf margin serration, leaf pubescence and root shape were the most important characters for variety identification in the field.

F60 PLANT PHYSIOLOGY AND BIOCHEMISTRY

1522 **[On causes of difference in frost hardiness of winter rye and wheat [Report 3]]. O prichinakh razlichij v morozostojkosti ozimoj rzhi i pshenitsy** (1994) *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 526-532.* 22 ref. Russian. (AGRIS 96-016364).

1523 Aggarwal, G.C.; Sekhon, N.K.; Sidhu, A.S.; Mahant (Punjab Agricultural University, Ludhiana (India). Department of Soils) (1995) **Plant water status of maize and succeeding wheat grown on organically amended soils.** *Journal of The Indian Society of Soil Science (India) v. 43(2) p. 152-155.* 3 tables; 2 ill., 9 ref. English. (AGRIS 96-003584).

1524 Allen, ER.; Ming, DW.; Hossner, LR.; Henninger, DL.; Galindo, C. (1995) **GROWTH AND NUTRIENT UPTAKE OF WHEAT IN CLINOPTILOLITE-PHOSPHATE ROCK SUBSTRATES.** *Agronomy Journal. 87(6):1052-1059.* English. [ZEOPON INC POB 83 MASON CITY, IL 62664 USA].

Mixtures of zeolite and phosphate rock react to release cations and anions into soil solution through dissolution and ion exchange. These mixtures have the potential to serve as slow-release sources of nutrients in synthetic soils. The term zeoponics has been used to describe such systems. Research was conducted to monitor dry matter production and nutrient uptake of wheat (Triticum aestivum L.) in a zeoponic system containing phosphate rock and NH4- and K-saturated zeolite. The objective was to evaluate the ability of zeolite and phosphate rock to provide a balanced supply of N, P, K, and Ca for plant growth. Two zeolite samples (San Miguel and Wyoming clinoptilolite) and two phosphate rock samples (North Carolina and Tennessee phosphate rock) were combined factorially to form four zeoponic mixtures. A series of synthetic soils was formed by combining selected rates of each zeoponic mixture with acid-washed quartz sand. Zeoponic rates (ZR) were 1, 5, 10, 25, 50, 75, and 100% (v/v) of the synthetic soil. Pots were placed in a growth chamber after planting, and plants were harvested every 45 d for a 225-d period. Foliar spray supplied essential nutrients other than N, P, K, and Ca. High yields of wheat dry matter were produced through several cuttings when at least 25% of the synthetic soil was comprised of the zeoponic mixture and when the zeoponic mixture contained a high-reactivity phosphate rock (North Carolina). Tissue analyses suggested that K, and to a lesser extent N, limited wheat growth when ZR less than or equal to 10%. Calcium limited wheat growth at ZR > 10% when a low-reactivity phosphate rock (Tennessee) was used, but not when a high-reactivity phosphate rock (North Carolina) was used. Properly formulated zeoponic mixtures of San Miguel or wyoming clinoptilolite and North Carolina phosphate rock are

capable of supplying sufficient levels of N, P, K, and Ca for intensive growth of wheat. [References: 28].

1525 Ashraf, MY.; Azmi, AR.; Khan, AH.; Naqvi, SSM.; Ala, SA. (1995) **EFFECT OF WATER STRESS ON DIFFERENT ENZYMATIC ACTIVITIES IN WHEAT.** *Acta Physiologiae Plantarum. 17(4):315-320.* English. [ATOM ENERGY AGR RES CTR DIV PLANT PHYSIOL TANDOJAM 70060 PAKISTAN].

Wheat genotypes DS-4, Chakwal-86, (better performer) Pavon, DS-17 (poor performer) were raised under 0, and -0.6 MPa (PEG-6000) for 14 days and harvested to study growth parameter;, activities of selected enzymes and nucleic acid metabolism. It was observed that root and shoot lengths, root shoot dry weights and activities of enzymes, except that of peroxidase decreased in all the genotypes subjected to water stress. However, reduction in the activities of enzymes was comparatively less in better performing genotypes (DS-4 and Chakwal-86). [References: 32].

1526 Autran, J.C. (INRA, Montpellier, France.) (1994) **Size exclusion high-performance liquid chromatography for rapid examination of size differences of cereals proteins.** *High-performance liquid chromatography of cereal and legume proteins p. 326-372.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-016369).

1527 Barnes, PW.; Flint, SD.; Caldwell, MM. (1995) **EARLY-SEASON EFFECTS OF SUPPLEMENTED SOLAR UV-B RADIATION ON SEEDLING EMERGENCE, CANOPY STRUCTURE, SIMULATED STAND PHOTOSYNTHESIS AND COMPETITION FOR LIGHT.** *Global Change Biology. 1(1):43-53.* English. [SW TEXAS STATE UNIV DEPT BIOL SAN MARCOS, TX 78666 USA].

Mixtures and monocultures of wheat (Triticum aestivum) and wild oat (Avena fatua), a common weedy competitor of wheat, were exposed to enhanced solar UV-B radiation simulating a 20% reduction in stratospheric ozone to assess the timing and seasonal development of the UV-B effects on light competition in these species. Results from two years of field study revealed that UV-B enhancement had no detectable effect on the magnitude or timing of seedling emergence in either species. End-of-season measurements showed significant UV-B inhibition of leaf insertion height in wild oat in mixture and monoculture in the second year (irrigated year) but not in the first year (drought year). Leaf insertion height of wheat was not affected by UV-B in either year. The UV-B treatment had no detectable effect on monoculture or total (combined species) mixture LAI but did significantly increase (5-7%) the fractional contribution of wheat to the mixture LAI after four weeks of growth in both years. In addition, the UV-B treatment had subtle effects on LAI height profiles with early season mixtures showing significant reductions in wild oat LAI in lower canopy layers in both years while midseason Year 2 mixtures showed significant reductions in wild oat LAI in upper canopy layers. The changes in canopy structure were found to significantly increase (6-7%) the proportional simulated clear sky canopy photosynthesis and light interception of wheat in mixture. These findings, and others, indicate that the effects of UV-B enhancement on competition are realized very early in canopy development and provide additional support for the hypothesis that UV-B enhancement may shift the balance of competition between these species indirectly by altering competitive interactions for light. [References: 58].

1528 Barrierguillot, B.; Casado, P.; Maupetit, P.; Jondreville, C.; Gatel, F.; Larbier, M. (1996) **WHEAT PHOSPHORUS AVAILABILITY .1. IN VITRO STUDY - FACTORS AFFECTING ENDOGENOUS PHYTASIC ACTIVITY AND PHYTIC PHOSPHORUS CONTENT.** *Journal of the Science of Food & Agriculture. 70(1):62-68.* English. [INST TECH CEREALES & FOURRAGES F-91720 BOIGNEVILLE FRANCE].

Phytasic activity and phytic P content, which are important factors in determining the availability of P, were measured in 56 wheat samples. The different agronomic and genetic factors which could have an influence on these two variables were studied. specifically N and/or P fertilisation, date of harvest, preharvest sprouting and variety of French wheat. Phytasic activity ranged from 206 to 775 mU g(-1), with an average of 508 mU g(-1) and a standard deviation of 109 mU g(-1). Only the variety of wheat appeared as a significant factor explaining the endogenous phytasic activity (P = 0.006). The phytic P content varied between 0.92 and 2.80 g kg(-1) DM, with an average of 2.18 g kg(-1) and a standard deviation of 0.35 g kg(-1) DM. None of the factors studied significantly affected the phytic P content of the wheat. This content was correlated with the total P content (r = 0.56: P < 0.05). The activity of the endogenous phytase was independent of the quantity of its substrate, the phytic phosphorus of the kernels of wheat. [References: 25].

1529 Bertholdsson, NO.; Stoy, V. (1995) **ACCUMULATION OF BIOMASS AND NITROGEN DURING PLANT GROWTH IN HIGHLY DIVERGING GENOTYPES OF WINTER WHEAT.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(3):167-182.* English. [SVALOF WEIBULL AB NILSSON EHLE LAB S-26881 SVALOV SWEDEN].

Data are presented on the accumulation of nitrogen and total biomass into wheat plants at different stages in their ontogeny. Five genotypes of highly diverging origin and with widely deviating grain protein contents were cultivated at different nitrogen regimes (ranging between 0 and 150 kg N ha(-1)). Growth curves as polynomials were calculated from representative subsamples of plant material collected from each plot at weekly intervals, commencing early in the vegetative stage and ending at complete maturity. Dry weight and nitrogen contents were determined for above-ground plant parts and for grains, when present, and were expressed per m(2) ground area. During the first 2 years total green areas were estimated as well and leaf area indices (LAIs) calculated and fitted to polynomials. The results from these trials revealed that the two American high-protein genotypes Goertzen 5559 and Frontiersman produced distinctly less biomass (mainly carbohydrates) than the Swedish genotypes Folke, Solid, and Lantvete during the later phases of growth. The lower biomass production of the American types after anthesis appeared to be more due to a decreased photosynthetic activity and less to a decrease in green area. It was also found that the American genotypes had a higher efficiency in remobilizing previously produced and stored assimilates than the modern Swedish cultivars Folke and Solid, which were more dependent on current photosynthesis. With respect to uptake of nitrogen into biomass there was very little variation between the genotypes at the early stages of plant life, but later on clear differences developed between the American and Swedish genotypes. Thus the former accumulated considerably less nitrogen than the latter, but since the differences between the two groups were still more pronounced regarding accumulation of biomass the American types exhibited higher concentrations of nitrogen in total biomass towards the end of the growing season. This higher concentration of N seems to indicate an increased relative ability for the American types to take up nitrogen from the soil during the grain filling phase but it is uncertain whether a causal relationship actually exists with the ability to accumulate protein in the grains. Estimates of the efficiency to redistribute nitrogen to the grain did not show any significant differences between the five genotypes and the most probable explanation for the high grain protein values of the American genotypes therefore seems to be their relatively low production of carbohydrates (and biomass). In a subsequent paper results from a comprehensive field trial concerning grain and straw yields, structural yield components, soil analyses, etc. will be presented which further corroborate these conclusions. [References: 31].

1530 Carver, B.F. (Oklahoma State University, Stillwater, OK.); Ownby, J.D. (1995) **Acid soil tolerance in wheat.** *Advances in agronomy (USA) v. 54 p. 117-173.* references. English. (AGRIS 96-003619).

1531 Dolgikh, EA.; Dolgikh, VV.; Domkin, VD. (1996) **AMINOIMIDAZOLE RIBONUCLEOTIDE CARBOXYLASE AND AMINOIMIDAZOLE SUCCINOCARBOXAMIDE RIBONUCLEOTIDE SYNTHETASE IN WHEAT - STRUCTURAL ORGANIZATION AND PROPERTIES.** *Russian Journal of Plant Physiology. 43(1):10-16.* English. [ST PETERSBURG STATE UNIV INST BIOL ORANIENBAUMSKOE SH 2 ST PETERSBURG 198904 RUSSIA].

The activities and some properties of two enzymes involved in the biosynthesis of purine nucleotides, aminoimidazole ribonucleotide (AIR) carboxylase and aminoimidazole succinocarboxamide ribonucleotide (SAICAR) synthetase, were examined in extracts from wheat seedlings (Triticum aestivum L.). A procedure for the partial purification of enzymes isolated from one-day-old seedlings was developed. The K-m value of AIR

carboxylase for 4-carboxy-5-aminoimidazole ribonucleotide (CAIR) was estimated to be 0.01 mM, and the pH optimum was found to be about 7.5. The K-m values of SAICAR synthetase were estimated to be 0.007 mM for CAIR, 0.04 mM for ATP, and 1.6 mM for L-aspartic acid. The optimum pH for SAICAR synthetase functioning was 8.0-8.5. Gel filtration showed that AIR carboxylase and SAICAR synthetase in higher plants were two individual proteins with mol wts of 245 +/- 10 kD and 27-5 kD, respectively. It was concluded that, in higher plants, AIR carboxylase and SAICAR synthetase were not integrated into a single bifunctional protein, as in vertebrates. With respect to all the characteristics examined (kinetic parameters, pH optima, the ratio of AIR carboxylase to SAICAR synthetase activities, and the occurrence of the two separate proteins), wheat enzymes most closely resemble the corresponding yeast proteins. [References: 23].

1532 Elhaddad, L.; Aussenac, T.; Fabre, JL.; Sarrafi, A. (1995) **RELATIONSHIPS BETWEEN POLYMERIC GLUTENIN AND THE QUALITY CHARACTERISTICS FOR SEVEN COMMON WHEATS (TRITICUM AESTIVUM) GROWN IN THE FIELD AND GREENHOUSE.** *Cereal Chemistry. 72(6):598-601.* English. [ESA PURPAN PHYSIOL VEGETALE LAB 75 VOIE TOEC F-31076 TOULOUSE FRANCE].

Seven common wheat cultivars were grown under greenhouse and field conditions. Sodium dodecyl sulfate (SDS) extraction and size exclusion high-performance liquid chromatography (SE-HPLC) were used to separate proteins according to size (pF1-pF5 and pFi). The technological parameters such as alveograph index (W, P, G) and Zeleny volume (Z) of each genotype for each agronomic condition were measured. A high genetic variability was observed for all parameters. Differences between the two agronomic conditions were significant for most parameters, however, the interactions between genotype and agronomic conditions were significant only for a few protein fractions. The amount of certain polymeric glutenin classifies the genotypes in the same way as quality criteria (Zeleny and alveograph) do. ?he ratio of the amount of soluble polymeric glutenin excluded by column of SE-HPLC (pF1) to the amount of non-excluded ones (pF2) divides genotypes into two groups, one with HMW-glutenin subunits 5 + 10 and the other with HMW-glutenin subunits 2 + 12 (Glu-DI allelic composition). [References: 27].

1533 Flagella, Z.; Pastore, D.; Campanile, RG.; Difonzo, N. (1995) **THE QUANTUM YIELD OF PHOTOSYNTHETIC ELECTRON TRANSPORT EVALUATED BY CHLOROPHYLL FLUORESCENCE AS AN INDICATOR OF DROUGHT TOLERANCE IN DURUM WHEAT.** *Journal of Agricultural Science. 125(Part 3):325-329.* English. [UNIV BARI IST PROD & PERPARAZ ALIMENTARI SEDE FOGGIA VIA NAPOLI 25 I-71100 FOGGIA ITALY].

The chlorophyll fluorescence parameters Delta F/Fm' and Fv'/Fm', related respectively to the quantum yield of photosynthetic electron transport and to the efficiency of excitation capture by the open centres of photosystem II, have been evaluated as possible indicators of drought tolerance in durum wheat. Delta F/Fm' and Fv'/Fm' measurements were carried out on excised leaves, both control and dehydrated, of 25 cultivars. Delta F/Fm' and Fv'/Fm' values were obtained at two times after the start of fluorescence measurement: at 14 s, i.e. during the induction curve (Delta F/Fm'(14s) and Fv'/Fm'(14s)) and at 200 s, i.e. at steady state fluorescence (Delta F/Fm'(200s) and Fv'/Fm'(200s)). In dehydrated leaves a mean significant decrease of 20 % ($P < 0.001$) was observed in Delta F/Fm'(14s) values. In contrast, no great differences were observed between control and dehydrated leaves with regard to Delta F/Fm'(200s), Fv'/Fm'(14s) and Fv'/Fm'(200s). The percentage decrease of Delta F/Fm'(14s) after dehydration was correlated with the drought susceptibility index (DSI) of the cultivars, evaluated on a yield basis and a significant correlation ($r = 0.72$, $P < 0.001$) was found. [References: 20].

1534 Fodor, E.; Szabonagy, A.; Erdei, L. (1995) **THE EFFECTS OF CADMIUM ON THE FLUIDITY AND H+-ATPASE ACTIVITY OF PLASMA MEMBRANE FROM SUNFLOWER AND WHEAT ROOTS.** *Journal of Plant Physiology. 147(1):87-92.* English. [HUNGARIAN ACAD SCI BIOL RES CTR INST BIOPHYS POB 521 H-6701 SZEGED HUNGARY].

The effects of cadmium on the H+-ATPase activity and on the membrane fluidity were studied in plasma membrane prepared from roots of sunflower and wheat. Plasma membrane purified from the microsomal fraction by phase partitioning showed a decreased ATPase activity by in vivo Cd2+ treatment (30% and 90% decrease in wheat and sunflower, respectively) and the in vitro application caused an inhibition, as well. The ordering state of the membrane at the C-5 and C-16 levels of the fatty acid chains and at the membrane surface was determined by electron spin resonance (ESR) and by fluorescence spectroscopy, respectively. The presence of Cd2+ increased the ordering of the plasma membrane in both in vivo treatments and in vitro experiments. Under Cd2+ treatment, a more rigid structure of the PM was found at different depths in the membrane; changes were larger in sunflower than in wheat. The alterations can be the results of direct effects on the membrane constituents (proteins, lipids) or of the modification in lipid composition. Preliminary studies suggest that there are changes caused by Cd2+ in the fatty acid composition of the phospholipid fraction in PM, which were different in the case of wheat and sunflower. [References: 23].

1535 Giner, SA.; Denisienia, E. (1996) **PRESSURE DROP THROUGH WHEAT AS AFFECTED BY AIR VELOCITY, MOISTURE CONTENT AND FINES.** *Journal of Agricultural Engineering Research. 63(1):73-85.* English. [NATL UNIV LA PLATA FAC CIENCIAS EXACTAS CIDCA CALLE 47 & 116 RA-1900 LA PLATA ARGENTINA].

Pressure drops were measured in clean wheat beds for superficial air velocities up to 0.42 m/s at grain moisture contents in the range of 12.8-22.3% w.b. At 12.8% moisture content, pressure drops were determined in wheat for fines contents up to 10.60% (w/w). It was found that pressure drops decreased by up to 30% with moisture content and increased with fines by up to 75%. The selection of a model was made using the results of clean grain. A Shedd-type equation (model 1), the Hukill & Ives' equation (model 2), and an Ergun-type equation (model 3), all of two parameters, were examined. Model 3 behaved better than model 2 and both gave lower errors than model 1. Model 3 was simplified by considering the parameter of the quadratic term as a multiplier of that of the linear term. The resultant expression (model 4) behaved better than model 2 and was called the approximate, Ergun-type equation. With this model, the non-linear influence of grain moisture content was better predicted than with a linear model proposed previously. With regard to the effect of fines, the use of model 4 permitted a linear relationship between pressure drop ratio and fines content that was independent of air velocity, a feature that was substantially adequate to describe the experimental results. Model 4 is suggested for further work on the resistance to airflow of grain beds. (C) 1996 Silsoe Research Institute. [References: 26].

1536 Grant, RF.; Garcia, RL.; Pinter, PJ.; Hunsaker, D.; Wall, GW.; Kimball, BA.; Lamorte, RL. (1995) **INTERACTION BETWEEN ATMOSPHERIC CO2 CONCENTRATION AND WATER DEFICIT ON GAS EXCHANGE AND CROP GROWTH - TESTING OF ECOSYS WITH DATA FROM THE FREE AIR CO2 ENRICHMENT (FACE) EXPERIMENT.** *Global Change Biology. 1(6):443-454.* English. [UNIV ALBERTA DEPT SOIL SCI EDMONTON AB T6G 2E3 CANADA].

Soil water deficits are likely to influence the response of crop growth and yield to changes in atmospheric CO2 concentrations (C-a), but the extent of this influence is uncertain. To study the interaction of water deficits and C-a on crop growth, the ecosystem simulation model ecosys was tested with data for diurnal gas exchange and seasonal wheat growth measured during 1993 under high and low irrigation at C-a = 370 and 550 mu mol mol(-1) in the Free Air CO2 Enrichment (FACE) experiment near Phoenix, AZ. The model, supported by the data from canopy gas exchange enclosures, indicated that under high irrigation canopy conductance (g(c)) at C-a = 550 mu mol mol(-1) was reduced to about 0.75 that at C-a = 370 mu mol mol(-1), but that under low irrigation, g(c) was reduced less. Consequently when C-a was increased from 370 to 550 mu mol mol(-1), canopy transpiration was reduced less, and net CO2 fixation was increased more, under low irrigation than under high irrigation. The simulated effects of C-a and irrigation on diurnal gas exchange were also apparent on seasonal water use and grain yield. Simulated vs. measured seasonal water use by wheat under high irrigation was reduced by 6% vs. 4% at C-a = 550 vs. 370 mu mol mol(-1), but that under low irrigation was increased by 3%

vs. 5%. Simulated vs. measured grain yield of wheat under high irrigation was increased by 16% vs. 8%, but that under low irrigation was increased by 38% vs. 21%. In ecosys, the interaction between C-a and irrigation on diurnal gas exchange, and hence on seasonal crop growth and water use, was attributed to a convergence of simulated g(c) towards common values under both C-a as canopy turgor declined. This convergence caused transpiration to decrease comparatively less, but CO2 fixation to increase comparatively more, under high vs. low C-a. Convergence of g(c) was in turn attributed to improved turgor maintenance under elevated C-a caused by greater storage C concentrations in the leaves, and by greater rooting density in the soil. [References: 49].

1537 Grossl, PR.; Inskeep, WP. (1996) **CHARACTERIZATION OF THE HYDROPHOBIC ACID FRACTION ISOLATED FROM A WHEAT STRAW EXTRACT.** *Soil Science Society of America Journal. 60(1):158-162.* English. [UTAH STATE UNIV DEPT PLANTS SOILS & BIOMETEOROL LOGAN, UT 84322 USA].

The hydrophobic acid portion (WSE-FA) was isolated from a water-soluble extract of wheat (Triticum aestivum L.) straw and chemically characterized. This material was isolated and concentrated on a column containing Amberlite XAD-8 resin. Chemical analysis of the WSE-FA included elemental composition (C, O, H, N, S, P, and ash); titrametric evaluation of carboxylic acid and phenolic functional group content; molecular weight (MW) determination by vapor pressure osmometry (VPO); gel filtration and ultrafiltration; and UV-visible, solid-state cross-polarization magic angle spinning C-13 nuclear magnetic resonance (NMR), and Fourier-transform infrared spectroscopy. The MW of the WSE-FA was approximately 600 daltons. The C-13-NMR spectrum, the low MW relative to other humic substances, high E(4)/E(6) ratio, and the low N content suggested that the WSE-FA was comprised of small, aromatic phenolic acids, oxidized polyphenols with exposed carboxyl groups, and saccharides that were condensed during senescence. [References: 18].

1538 Huebner, F.R. (National Center for Agric. Util. Research, USDA, ARS, Peoria, IL.); Bietz, J.A. (1994) **RP-HPLC for varietal identification in cereals and legumes: wheat.** *High-performance liquid chromatography of cereal and legume proteins p. 97-120.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-016306).

1539 Jurkoniene, SV.; Maksimov, GB.; Merkys, AI. (1996) **A MODEL FOR SEPARATING GRAVITATIONAL INDUCTION AND GRAVITROPIC RESPONSE IN GRAVITROPISM.** *Russian Journal of Plant Physiology. 43(1):1-5.* English. [LITHUANIA ACAD SCI INST BOT UL ZALIUJU EZERU 47 VILNIUS 2021 LITHUANIA].

A new model for studying temporal regularities of plant gravitropism was developed on wheat (Triticum aestivum L.) coleoptile segments. In order to discriminate between gravitational induction and gravitropic response (bending), the latter was stopped immediately after segment exposure to gravitational stimulus by lowering the auxin content via segment decapitation. After an appropriate time interval, gravitropic response was triggered by treating the apical cut end of the segment with auxin. To avoid the effect of gravity in the lateral direction, the segments were placed in an inverted vertical position. The inhibition of IAA basipetal transport by 1-N-naphthylphthalamic acid and 2, 3, 5-triiodobenzoic acid did not attenuate gravitational induction. IAA basipetal transport was required for gravitropic response. [References: 10].

1540 Kalashnikov, Yu.E.; Balakhnina, T.I.; Zakrzhevskij, D.A. (1994) **[Action of soil hypoxia on oxygen activation and system of protection against oxidizing destruction in roots and leaves of barley]. Dejstvie pochvennoj gipoksii na aktivatsiyu kisloroda i sistemu zashchity ot okislitel'noj destruktsii v kornyakh i list'yakh yachmenya.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 583-588.* 19 ref. Russian. (AGRIS 96-016320).

1541 Khokhlova, L.P.; Asafova, E.V. (1994) **[Effect of calcium on the content of proline and soluble proteins in plants under low-temperature action [winter wheat]]. Vliyanie kal'tsiya na soderzhanie prolina i rastvorimykh belkov v rasteniyakh pri nizkotemperaturnom vozdejstvii.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 509-516.* 28 ref. Russian. (AGRIS 96-016359).

1542 Kholodar, AV.; Evtushenko, TV.; Shvetsov, SV.; Chekurov, VM. (1995) **PHOTOREGULATION OF GIBBERELLIN LEVEL IN WHEAT LEAF ETIOPLASTS FROM DIFFERENT CULTIVARS.** *Russian Journal of Plant Physiology. 42(6):738-740.* English. [RUSSIAN ACAD SCI INST CYTOL & GENET SIBERIAN DIV PR AKAD LAVRENT EVA 10 NOVOSIBIRSK 630090 RUSSIA].

The level of extractable gibberellins was monitored by ELISA technique in etioplasts isolated from 10 cultivars of bread wheat (Triticum aestivum L.) after etioplast red-light irradiation of various duration. Pulse (within 15 s) irradiation induced a rapid rise in the gibberellin level, which reached its highest value 15 min after irradiation. When the etioplasts were irradiated for 120 s or longer, the level of gibberellins, measured after 15 min in darkness, did not exceed the dark level in all studied cultivars, However, the period, during which the etioplasts responded to red light irradiation by the increase in the gibberellin level, varied in different cultivars from 20 to 120 s. This period was longer in the cultivars that responded to low-light growth conditions by a lengthening of their growing period. The general conclusion is that an interrelation exists between the photoregulation of gibberellin level and the photoregulation of bread wheat development. [References: 5].

1543 Kim, T.W.; Heinrich, G. (Karl Franzens University Graz, Schubertstrasse (Austria). Institute for Pflanzenphysiologie) (1995) **Strontium metabolism in higher plants: Effect of strontium on the polyamine biosynthesis during germination of wheat (Triticum aestivum L.).** *Korean Journal of Environmental Agriculture (Korea Republic) v. 14(1) p. 55-71.* 8 illus.; 1 table; 36 ref. English. (AGRIS 96-003617).

1544 Kimball, BA.; Pinter, PJ.; Garcia, RL.; Lamorte, RL.; Wall, GW.; Hunsaker, DJ.; Wechsung, G.; Wechsung, F.; Kartschall, T. (1995) **PRODUCTIVITY AND WATER USE OF WHEAT UNDER FREE-AIR CO2 ENRICHMENT.** *Global Change Biology. 1(6):429-442.* English. [USDA ARS US WATER CONSERVAT LAB 4331 EAST BROADWAY PHOENIX, AZ 85040 USA].

A free-air CO2 enrichment (FACE) experiment was conducted at Maricopa, Arizona, on wheat from December 1992 through May 1993. The FACE apparatus maintained the CO2 concentration, [CO2], at 550 mu mol mol(-1) across four replicate 25-m-diameter circular plots under natural conditions in an open field. Four matching Control plots at ambient [CO2] (about 370 mu mol mol(-1)) were also installed in the field. In addition to the two levels of [CO2], there were ample (Wet) and limiting (Dry) levels of water supplied through a subsurface drip irrigation system in a strip, split-plot design. Measurements were made of net radiation, R(n); soil heat flux, G(o); soil temperature; foliage or surface temperature; air dry and wet bulb temperatures; and wind speed. Sensible heat flux, H, was calculated from the wind and temperature measurements. Latent heat nux, lambda ET. and evapotranspiration, ET, were determined as the residual in the energy balance. The FACE treatment reduced daily total R(n) by an average 4%. Daily FACE sensible heat flux, H, was higher in the FACE plots. Daily latent heat flux, lambda ET, and evapotranspiration, ET, were consistently lower in the FACE plots than in the Control plots for most of the growing season, about 8% on the average. Net canopy photosynthesis was stimulated by an average 19 and 44% in the Wet and Dry plots, respectively, by elevated [CO2] for most of the growing season. No significant acclimation or down regulation was observed. There was little above-ground growth response to elevated [CO2] early in the season when temperatures were cool. Then, as temperatures warmed into spring, the FACE plants grew about 20% more than the Control plants at ambient [CO2], as shown by above-ground biomass accumulation. Root biomass accumulation was also stimulated about 20%. In May the FACE plants matured and senesced about a week earlier than the Controls in the Wet plots. The FACE plants averaged 0.6 degrees C warmer than the Controls from February through April in the well-watered plots, and we speculate that this temperature rise contributed to the earlier maturity. Because of the acceleration of senescence, there was a shortening of the duration of grain filling, and consequently, there was a narrowing of the final biomass and yield differences. The 20% mid-season growth advantage of FACE shrunk

to about an 8% yield advantage in the Wet plots, while the yield differences between FACE and Control remained at about 20% in the Dry plots. [References: 48].

1545 Kolupaev, Yu.E.; Trunova, T.I. (1994) **[Activity of invertase and carbohydrate content in wheat coleoptiles under hypothermal and salt stress]. Aktivnost' invertazy i soderzhanie uglevodov v koleoptilyakh pshenitsy pri gipotermicheskom i solevom stressakh.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 552-557.* 24 ref. Russian. (AGRIS 96-016361).

1546 Komarova, Eh.N.; Vyskrebentseva, Eh.I.; Trunova, T.I. (1994) **[Lectins of cellular walls in various organs of wheat seedlings under low-temperature hardening]. Lektiny kletochnykh stenok razlichnykh organov prorostkov pshenitsy pri nizkotemperaturnom zakalivanii.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 500-503.* 11 ref. Russian. (AGRIS 96-016363).

1547 Kubiczek, R.P. (Polish Academy of Sciences, Poland.); Huebner, F.R.; Bietz, J.A. (1994) **RP-HPLC for varietal identification in cereals and legumes: rye and triticale.** *High-performance liquid chromatography of cereal and legume proteins p. 121-134.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-016347).

1548 Lafiandra, D. (University of Tuscia, Viterbo, Italy.); Porceddu, E.; Colaprico, G.; Margiotta, B. (1994) **Combined reversed phase high performance liquid chromatogrphy (RP-HPLC) and electrophoretic techniques in genetics and breeding of wheat storage proteins.** *High-performance liquid chromatography of cereal and legume proteins p. 273-325.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-016353).

1549 Lee, S.Y.; Kim, C.S. (Chungnam National University, Taejon (Korea Republic). Department of Agronomy) (1995) **Cellular structural change of barley seedling on different salt concentration under hydroponic culture.** *Korean Journal of Crop Science (Korea Republic) v. 40(4) p. 481-486.* 3 ill.; 3 tables; 9 ref. Korean. (AGRIS 96-016319).

1550 Leinhos, V.; Bergmann, H. (1995) **CHANGES IN THE YIELD, LIGNIN CONTENT AND PROTEIN PATTERNS OF BARLEY (HORDEUM VULGARE CV ALEXIS) INDUCED BY DROUGHT STRESS.** *Angewandte Botanik. 69(5-6):206-210.* English. [UNIV JENA INST ERNAHRUNG & UMWELT LEHRBEREICH LEBENSMITTEL PFLANZLICHER HERKUNFT PFLANZ D-07743 JENA GERMANY].

Cultivation of barley (Hordeum vulgare cv. Alexis) in Mitscherlich pots and exposed to drought stress resulted in a diminishing of the yield, an increase of the lignin content and in a change of the protein patterns. Drought stress caused a significant decrease of the grain yield (16 %), the protein yield (22 %) in mature grain and the protein content of shoots (18 %, leaves and stems, harvested before anthesis). The lignin content of shoots of stressed plants was markedly higher (20 %) than those of well-watered controls. Drought from the shooting to the heading stage caused changes in the patterns of soluble proteins (albumins, globulins) from mature barley grain. After sodium dodecyl sulfate (SDS) polyacrylamide gel electrophoretic separation of crude protein extracts following by silver or coomassie blue protein staining, additional polypeptides with estimated apparent molecular masses of 24, 16 and 14 kDa appeared in samples derived from mature grain of stressed plants. Furthermore, a comparison of the resulting protein patterns revealed an enhanced staining of polypeptide bands with estimated molecular weights of 50, 36, 29 and 18 kDa in samples derived from mature grain of stressed plants than that of corresponding polypeptide bands in controls suggesting an enhanced synthesis of these proteins in stressed barley plants. [References: 23].

1551 Lyutova, M.I.; Kamentseva, I.E. (1994) **[Effect of thermal hardening of wheat plants on thermostability of certain enzymes]. Vliyanie teplovogo zakalivaniya rastenij pshenitsy na termostabil'nost' nekotorykh fermentov.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 595-598.* 23 ref. Russian. (AGRIS 96-016362).

1552 Machler, F.; Wasescha, MR.; Krieg, F.; Oertli, JJ. (1995) **DAMAGE BY OZONE AND PROTECTION BY ASCORBIC ACID IN BARLEY LEAVES.** *Journal of Plant Physiology. 147(3-4):469-473.* English. [ETH ZURICH INST PFLANZENWISSENSCH VERSUCHSSTN ESCHIKON CH-8315 LINDAU ZH ZH SWITZERLAND].

Barley seedlings were fumigated with acute ozone concentrations at different light intensities for 4 h. Effects on leaf conductance of H2O vapour, plasma membrane permeability and Rubisco activity were analyzed. Some of the plants were supplied with ascorbic acid by the roots, and the protective effect against damage by ozone was determined. Ozone fumigation impaired light regulation of leaf conductance and light regulation of Rubisco activity and increased the permeability of plasma membranes. High light intensity during ozone fumigation increased these effects. This was mostly due to a higher amount of ozone in the leaves at increased leaf conductance. Ascorbic acid supply protected plasma membrane permeability and light regulation of Rubisco against damage by ozone. Effects of ozone on plasma membrane permeability and Rubisco regulation were closely related, suggesting that effects on Rubisco were mediated by effects on membrane permeability. [References: 13].

1553 Marchylo, B.A. (Canadian Grain Commission, Winnipeg, Manitoba, Canada.) (1994) **RP-HPLC for varietal identification in cereals and legumes: barley.** *High-performance liquid chromatography of cereal and legume proteins p. 162-174.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-016325).

1554 Mccully, ME. (1995) **WATER EFFLUX FROM THE SURFACE OF FIELD-GROWN GRASS ROOTS - OBSERVATIONS BY CRYO-SCANNING ELECTRON MICROSCOPY.** *Physiologia Plantarum. 95(2):217-224.* English. [CARLETON UNIV DEPT BIOL OTTAWA ON K1S 5B6 CANADA].

Field-grown roots of maize, oats, barley and crabgrass collected at different times of day and night have been examined by cryo-scanning electron microscopy. Droplets and blobs (their high water content confirmed by X-ray microanalysis) were observed on the young root surfaces and within interstices of the rhizosheaths of guttating plants, particularly in the early morning, Plants collected at midday and in the afternoon had very few or none of these watery deposits. I propose that water released from the root surface during the night allows the expansion of root-cap mucilage into the surrounding soil. When transpiration resumes, the mucilage is dried and binds tightly to the surrounding soil particles, thus stabilizing the coherent rhizosheath. This nocturnal water effflux may also facilitate nutrient uptake into the root when transpiration resumes. The water efflux to the rhizosheaths may be driven by root pressure and thus differs from the passive water loss from the root thought to occur during hydraulic lift. [References: 27].

1555 Millard, MM.; Veisz, OB.; Krizek, DT.; Line, M. (1996) **THERMODYNAMIC ANALYSIS OF THE PHYSICAL STATE OF WATER DURING FREEZING IN PLANT TISSUE, BASED ON THE TEMPERATURE DEPENDENCE OF PROTON SPIN-SPIN RELAXATION.** *Plant Cell & Environment. 19(1):33-42.* English. [ARS USDA MWA NCAUR 1815 N UNIV ST PEORIA, IL 61604 USA].

Multi-proton spin-echo images were collected from cold-acclimated winter wheat crowns (Triticum aestivum L.) cv. Cappelle Desprez at 400 MHz between 4 and -4 degrees C. Water proton relaxation by the spin-spin (T-2) mechanism from individual voxels in image slices was found to be monoexponential. The temperature dependence of these relaxation rates was found to obey Arrhenius or absolute rate theory expressions relating temperature, activation energies and relaxation rates. Images whose contrast is proportional to the Arrhenius activation energy (E(a)), Gibb's free energy of activation (Delta G double dagger), enthalpy of activation (Delta H double dagger), and the entropy of activation (Delta S double dagger) for water relaxation on a voxel basis were constructed by post-image processing. These new images exhibit contrast based on activation energies rather than rates of proton relaxation. The temperature dependence of water proton T-2 relaxation rates permits prediction of changes in the physical state of water in this tissue over modest temperature ranges. A simple model is proposed to predict the freezing temperature of various tissues in wheat crowns. The average E(a) and

Delta H double dagger for water proton T-2 relaxation over the above temperature range in winter wheat tissue were -6.4 +/- 14.8 and -8.6 +/- 14.8 kT mol(-1), respectively. This barrier is considerably lower than the E(a) for proton translation in ice at 0 degrees C, which is reported to be between 46.0 and 56.5 kT mol(-1). [References: 27].

1556 Nielsen, TH.; Wischmann, B. (1995) **QUANTITATIVE ASPECTS OF THE IN VIVO REGULATION OF PYROPHOSPHATE - FRUCTOSE-6-PHOSPHATE 1-PHOSPHOTRANSFERASE BY FRUCTOSE-2, 6-BISPHOSPHATE.** *Plant Physiology. 109(3):1033-1038.* English. [ROYAL VET & AGR UNIV DEPT PLANT BIOL PLANT BIOCHEM LAB THORVALDSENSVEJ 40 DK-1871 FREDERIKSBERG C DENMARK].

Pyrophosphate:fructose-6-phosphate 1-phosphotransferase (PFP) was quantified in developing barley (Hordeum vulgare) leaves by immunostaining on western blots using a purified preparation of barley leaf PFP as standard. Fructose-2, 6-bisphosphate (Fru-2, 6-bisP) was quantified in the same tissues. Depending on age and tissue development, the concentration of PFP varied between 11 and 80 mu g PFP protein g(-1) fresh weight, which corresponds to 0.09 to 0.65 nmol g(-1) fresh weight of each of the alpha and beta PFP subunits. The level depends primarily on the maturity of the tissue. In the same tissues the concentration of Fru-2, 6-bisP varied between 0.07 and 0.46 nmol g(-1) fresh weight. Thus, the concentrations of PFP subunits and Fru-2, 6-bisP were of the same order of magnitude. In young leaf tissues the concentration of PFP subunits may exceed the concentration of Fru-2, 6-bisP. This means that the amount of Fru-2, 6-bisP present will be too low to occupy all the allosteric binding sites on PFP even though the concentration of Fru-2, 6-bisP exceeds the K-a(Fru-2, 6-bisP) by several orders of magnitude. These results are discussed in relation to Fru-2, 6-bisP as a regulator of enzyme activities under in vivo conditions. [References: 21].

1557 Novitskaya, G.V.; Suvorova, T.A. (1994) **[Variation of lipid content of membrane fractions of winter wheat seedlings under low-temperature adaptation]. Izmenenie lipidnogo sostava membrannykh fraktsij prorostkov ozimoj pshenitsy pri nizkotemperaturnoj adaptatsii.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 539-545.* 33 ref. Russian. (AGRIS 96-016360).

1558 Popineau, Y. (INRA, Nantes, France.) (1994) **Evaluation of hydrophobicity of wheat proteins and peptides by HIC and RP-HPLC.** *High-performance liquid chromatography of cereal and legume proteins p. 393-426.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-016370).

1559 Premachandra, GS.; Hahn, DT.; Rhodes, D.; Joly, RJ. (1995) **LEAF WATER RELATIONS AND SOLUTE ACCUMULATION IN TWO GRAIN SORGHUM LINES EXHIBITING CONTRASTING DROUGHT TOLERANCE.** *Journal of Experimental Botany. 46(293):1833-1841.* English. [PURDUE UNIV DEPT HORT W.LAFAYETTE, IN 47907 USA].

A drought-tolerant grain sorghum line (K886) maintained significantly higher relative water content (RWC), osmotic potential at full turgor (psi(pi(100))) and turgor pressure (psi(p)) than did a drought-susceptible line (CS3541) when the two genotypes were grown in containers and subjected to severe water stress prior to anthesis. Leaf area expansion was inhibited to a greater extent by water deficit in line CS3541 than in K886. Both the basal psi(pi(100)) and the capacity to accumulate solutes upon exposure to stress appear to play important roles in the measured genotypic differences in leaf water relations. Sap osmolarity was greater in line K886 than in CS3541 throughout the entire range of water potential induced. With the exception of proline, the baseline concentrations of each of eight solutes were higher in K886 than in CS3541. Further, when water deficit was imposed, K886 exhibited larger increases in sap osmolality than did CS3541. The concentrations of K+, sugars, Cl- and P, predominant solutes contributing to osmotic adjustment, increased with increasing stress in K886, but essentially remained constant in CS3541. The two lines exhibited large differences in the relative contributions of individual solutes to osmotic adjustment, and these contributions changed markedly during stress development both within and between lines. The most notable differences between genotypes were with respect to the contributions of sugars and K+ ions. The capacity to accumulate K+ ions and to minimize stress-induced reductions in water content, turgor and leaf expansion appear to be useful traits for inclusion in germplasm screening programmes for improved drought tolerance in sorghum. [References: 29].

1560 Reinbothe, S. (Swiss Federal Institute of Technology Zurich, Zurich, Switzerland.); Reinbothe, C.; Runge, S.; Apel, K. (1995) **Enzymatic product formation impairs both the chloroplast receptor-binding function as well as translocation competence of the NADPH: protochlorophyllide oxidoreductase, a nuclear-encoded plastid precursor protein.** *The Journal of cell biology (USA) v. 129(2) p. 299-308.* references. English. (AGRIS 96-016323).

The key enzyme of chlorophyll biosynthesis in higher plants, the light-dependent NADPH:protochlorophyllide oxidoreductase (POR, EC 1.6.99.1), is a nuclear-encoded plastid protein. Its posttranslational transport into plastids of barley depends on the intraplastidic availability of one of its substrates, protochlorophyllide (PChlide). The precursor of POR (pPOR), synthesized from a corresponding full-length barley cDNA clone by coupling in vitro transcription and translation, is enzymatically active and converts PChlide to chlorophyllide (Chlide) in a light- and NADPH-dependent manner. Chlorophyllide formed catalytically remains tightly but noncovalently bound to the precursor protein and stabilizes a transport-incompetent conformation of pPOR. As shown by in vitro processing experiments, the chloroplast transit peptide in the Chlide-pPOR complex appears to be masked and thus is unable to physically interact with the outer plastid envelope membrane. In contrast, the chloroplast transit peptide in the naked pPOR (without its substrates and its product attached to it) and in the pPOR-substrate complexes, such as pPOR-PChlide or pPOR-PChlide-NADPH, seems to react independently of the mature region of the polypeptide, and thus is able to bind to the plastid envelope. When envelope-bound pPOR-PChlide-NADPH complexes were exposed to light during a short preincubation, the enzymatically produced Chlide slowed down the actual translocation step, giving rise to the sequential appearance of two partially processed translocation intermediates. However, ongoing translocation induced by feeding the chloroplasts delta aminolevulinic acid, a precursor of PChlide, was able to override these two early blocks in translocation, suggesting that the plastid import machinery has a substantial capacity to denature a tightly folded, envelope-bound precursor protein.

1561 Robinson, DS.; Donnelly, JK.; Lawlor, SM.; Frazier, PJ.; Daniels, NWR. (1996) **WHEAT SUPEROXIDE DISMUTASE ISOENZYMES.** *Journal of Cereal Science. 23(1):93-101.* English. [UNIV LEEDS PROCTER DEPT FOOD SCI LEEDS LS2 9JT W YORKSHIRE ENGLAND].

Evidence was obtained indicating that the superoxide dismutase (SOD) A and B isoenzymes of the wheat cultivar Tonic are of the Cu/Zn type, whereas the SOD-C group are similar to manganese containing dismutases. Heat inactivation plots showed that the enzymic activity in crude extracts was relatively stable up to 50 degrees C. The thermodynamic parameters enthalpy, Delta H#, free energy, Delta G#, and entropy, Delta S#, were estimated for the thermal inactivation of extracted SOD activity and a purified SOD-C isoenzyme. The SOD-C isoenzyme was purified extensively and shown to contain two closely related tetrametic isozymes (pI6.0 and 6.1) of M(r) 80 000. A M(r) of 20 000 has been calculated for the subunits. The N-terminal amino acid sequence of the purified SOD-C could be aligned with that of the Mn-SOD enzyme of maize and showed 57% homology. (C) 1996 Academic Press Limited [References: 18].

1562 Ruiz, M.; Rodriguez Quijano, M.; Carrillo, J.M. (Universidad Politecnica de Madrid (Espana). Escuela Tecnica Superior de Ingenieros Agronomos) (1995) **[Relationships between high molecular weight glutenin subunits (HMW), different Glu-1 scores and various measures of quality in bread wheat]. Relaciones entre las subunidades de gluteninas de alto peso molecular (HMW), distintas puntuaciones Glu-1 y varios parametros de calidad en trigo harinero.** *Investigacion Agraria. Produccion y Proteccion Vegetales (Espana) v. 10(1) p. 15-29.* 5 tab., 3 fig.; 21 ref. Spanish. (AGRIS 96-003611).

1563 Samarakoon, AB.; Gifford, RM. (1995) **SOIL WATER CONTENT UNDER PLANTS AT HIGH CO2 CONCENTRATION AND INTERACTIONS WITH THE DIRECT CO2 EFFECTS - A SPECIES COMPARISON.** *Journal of Biogeography. 22(2-3):193-202.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

Wheat, maize and cotton, grown as spaced plants in large pots of soil, differed in the way high (2 X ambient) CO2 concentration affected the time-course of soil water use. For wheat, the tendency to conserve water owing to reduction in stomatal conductance in high CO2 was largely offset by the stimulation of leaf area development as the soil column dried. However, when the soil was maintained continuously wet, soil water conservation occurred because in the absence of water stress high CO2 did not maintain a greater leaf area. For maize, which has little or no photosynthetic response to CO2 concentrations above ambient but a strong stomatal response, water was conserved and the soil profile dried more slowly. Maize leaf area and dry matter growth increased in response to damper soil under high CO2, despite no growth response to CO2 in the absence of water stress. For cotton, which has a strong photosynthetic but weak stomatal response to CO2, the soil column dried faster under high CO2. Despite this drier soil, cotton still showed the greatest response to high CO2 of leaf area and dry matter growth of the three species compared. Under wet soil conditions, cotton exhibited a very large leaf area response to CO2 leading to much greater water use per plant. This contrasts with both wheat and maize which conserved water at high CO2 when wet. Despite these contrasting transpiration and growth responses, all three species exhibited a relatively similar increase in water use efficiency under high CO2 for both wet and dry conditions. It is concluded that the secondary effect of high CO2 on soil water content exerts a strong confounding influence on growth responses to CO2. In the longer term, the changed soil water status would influence hydrology, soil microbiology, nutrient relations and species composition. From indirect evidence it is proposed that the relative enhancement of growth owing to CO2 enrichment is greater under drought conditions than in wet soil because of the effect of water deficit on the intercellular CO2 concentration in the leaf, C-i. If water deficits cause C-i/C-a to decline then photosynthesis is operating in a more CO2-sensitive region of the CO2 response curve. [References: 26].

1564 Scanlon, M.G. (University of Manitoba, Winnipeg, Manitoba, Canada.) (1994) **Data handling in HPLC and use of computers.** *High-performance liquid chromatography of cereal and legume proteins p. 67-96.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-016313).

1565 Scheller, HV. (1996) **IN VITRO CYCLIC ELECTRON TRANSPORT IN BARLEY THYLAKOIDS FOLLOWS TWO INDEPENDENT PATHWAYS.** *Plant Physiology. 110(1):187-194.* English. [ROYAL VET & AGR UNIV DEPT PLANT BIOL PLANT BIOCHEM LAB 40 THORVALDSENSVEJ DK-1871 FREDERIKSBERG C DENMARK].

In vitro cyclic electron transport around PSI was studied in thylakoids isolated from barley (Hordeum volgare L.). Redox poising was obtained by using anaerobic conditions, preillumination, and the addition of 3-(3, 4-dichlorophenyl)-1, 1-dimethylurea. Postillumination rates of P700(+) re-reduction of 1 to 5 electrons s(-1) were observed, depending on the conditions. The thylakoids supported two parallel paths of cyclic electron transport that were distinguishable by differences in antimycin sensitivity, saturation characteristics, and substrate specificity. The pathway most sensitive to antimycin was not saturated at ferredoxin concentrations up to 50 mu M, whereas the more insensitive pathway was saturated at 5 mu M ferredoxin. At the lower concentration of reduced ferredoxin, the antimycin-sensitive rate of P700(+) re-reduction was lower than the antimycin-insensitive rate. The lower range of reduced ferredoxin concentrations are closer to in vivo conditions. Flavodoxin is shown to mediate cyclic electron transport. Flavodoxin was less efficient in mediating the antimycin-sensitive pathway but mediated the antimycin-insensitive pathway as efficiently as ferredoxin. Antibodies raised against ferredoxin:NADP(+) oxidoreductase had no effect on either pathway for re-reduction of P700(+). However, the ferredoxin: NADP(+) oxidoreductase inhibitor 2'-monophosphoadenosine-5'-diphosphoribose was able to inhibit the antimycin-sensitive as well as the antimycin-insensitive pathway. [References: 40].

1566 Smirnova, EG.; Muromtsev, GS.; Khavkin, EE.; Yaguzhinskii, LS. (1995) **ON THE MECHANISM OF SELECTIVITY OF CHEMICAL HYBRIDIZING AGENTS.** *Russian Journal of Plant Physiology. 42(6):833-849.* English. [RUSSIAN ACAD AGR SCI INST AGR BIOTECHNOL UL TIMIRYAZEVSKAYA 42 MOSCOW 127550 RUSSIA].

The structure and activity were compared in over two hundred chemicals selected at the Institute of Agricultural Biotechnology as highly specific hybridizing agents (gametocides, male sterilants) for wheat (Triticum aestivum L.), rye (Secale cereale I, .), and millet (Panicum miliaceum Moench.). High efficiency and selectivity of gametocidic action, that is, the inhibition of pollen development without affecting the female gametophyte, were found among chemicals belonging to widely different classes (aliphatic and aromatic hydrocarbons, alcohols and their ethers, aliphatic and aromatic mono- and dicarboxylic acids and their esters, and various electrophilic and organophosphorous compounds). Within the selected series of chemicals, high and specific sterilant activity was not obviously related to a certain chemical structure or reactivity. Hence, the assumption that the effect of selective sterilants is due to a specific lock-and-key binding to their targets, as with enzymes or hormonal receptors in plant tissues, was rejected. It follows that chemical sterilants act, in a relatively nonspecific way, as the external agents that trigger the program of specific biochemical response. Gametocide selectivity depends on two inverse effects induced by the sterilants in plant tissues: inhibition of pollen development and promotion of seed formation. Two models of selective gametocidic effect on flower development are advanced. The first model presumes that sterilants themselves or the products of their transformation alter the critical phytohormone balance in developing floral organs, thus inversely affecting the development of the androecium and gynoecium. The second model implies that pollen sterility results from the hypersensitive response of plants to nonspecific chemical effects of xenobiotics that inhibit androecium development; this response qualitatively resembles the reaction of the immune system in animals. The two models can be merged within the concept of the genetic control of cell fate, involving programmed cell death and the development of floral meristems and flower organs. [References: 38].

1567 Urchei, M.A.; Rodrigues, J.D. (1994) **[Effects of soil water potentials at different phenological phases of barley crop (Hordeum vulgare L.)]. Efeitos de potenciais de agua no solo, em diferentes estadios fenologicos da cultura da cevada (Hordeum vulgare L.).** *Scientia Agricola (Brazil) v. 51(3) p. 533-540.* 9 illus.; 24 ref. Portuguese. (AGRIS 96-003565).

1568 Urminska, D.; Michalik, I. (1996) **ISOLATION AND BIOCHEMICAL CHARACTERISTICS OF AMINOPEPTIDASES FROM WINTER WHEAT GRAIN.** *Rostlinna Vyroba. 42(1):35-39.* Czech. [VYSOKA SKOLA POLNOHOSPODARSKA A HLINKU 2 NITRA 94976 SLOVAKIA].

The aminopeptidases from wheat grain were isolated and purified by gel filtration, ion-exchange and affinity chromatography. The results confirmed that wheat aminopeptidases are neutral Cys-aminopeptidases with the optimum pH of 7.5 and they are inhibited by bestatin, leupeptin, p-chloromercuribenzoate and fenylmetyl sulphonylfluorite. Enzymes are stabilized by 2-merkaptoethanol and dithiotreitol. Wheat aminopeptidases hydrolyzed peptide bonds formed by leucine. It follows from the result of regression analysis that wheat aminopeptidases are active during the whole period of grain maturation. There is a difference between the activity of other proteases, the activity of aminopeptidases did not fall at the end of grain production. It means that high activity of aminopeptidases is necessary for grain maturation and for utilization of new proteins in grain endosperm. [References: 8].

1569 Vizarova, G.; Zatkalikova, T.; Zelenakova, E. (1995) **EFFECTS OF MERCURY ON SOME PHYSIOLOGICAL PROCESSES IN BARLEY.** *Biologia. 50(6):573-576.* English. [SLOVAK ACAD SCI INST ECOBIOL MLYNSKE NIVY 59 BRATISLAVA 81434 SLOVAKIA].

Mercury at various concentrations in soil (10, 100, 250, and 500 x 10(-6) mol.dm(3)) had negative effects on growth in young barley plants. The

growth of roots was inhibited more than the growth of the above-ground parts. Inhibiton of these processes correlated with mercury accumulation in the roots and the above-ground parts. Bioaccumulation of mercury in the plants correlated with Hg2+ ions in soil. Mercury changed the decreased or increased chlorophyll contents in defense to Hg2+ concentration. Mercury, in dependence on Hg2+ concentration in soil, caused changes, in chlorophyll content. In general it decreased chlorophyll contents, only the concentration of 100 mu M resulted in elevation of its content. [References: 13].

1570 Vothknecht, UC.; Willows, RD.; Kannangara, CG. (1995) **SINEFUNGIN INHIBITS CHLOROPHYLL SYNTHESIS BY BLOCKING THE S-ADENOSYL-METHIONINE - MG-PROTOPORPHYRIN IX O-METHYLTRANSFERASE IN GREENING BARLEY LEAVES.** *Plant Physiology & Biochemistry. 33(6):759-763.* English. [CARLSBERG LAB DEPT PHYSIOL GAMLE CARLSBERG VEJ 10 DK-2500 COPENHAGEN DENMARK].

Magnesium protoporphyrin IX O-methyltransferase (EC 2.1.1.11) transfers the methyl group from S-adenosylmethionine (SAM) to the propanoic acid side chain on the third pyrrole ring of Mg-protoporphyrin IX in the biosynthetic pathway of chlorophyll. The nucleoside analogue sinefungin from Streptomyces is a potent inhibitor of this enzyme. Chlorophyll synthesis was inhibited when dark-grown barley (Hordeum vulgare) leaves were fed with this antibiotic and illuminated. Mg-protoporphyrin IX accumulated in the sinefungin treated leaves and it is suggested that the inhibition of chlorophyll synthesis is caused mainly by an inhibition of Mg-protoporphyrin IX O-methyltransferase. [References: 21].

1571 Vovchuk, S.V.; Makarenko, O.A.; Musich, V.N.; Levitskij, A.P. (1994) **[Probable mechanisms of activating peptide hydrolase of winter wheat seedlings under hardening]. Vozmozhnye mekhanizmy aktivatsii peptidgidrolaz prorostkov ozimoj pshenitsy pri zakalivanii.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 494-499.* 9 ref. Russian. (AGRIS 96-016358).

1572 Wang, XT.; Below, FE. (1996) **CYTOKININS IN ENHANCED GROWTH AND TILLERING OF WHEAT INDUCED BY MIXED NITROGEN SOURCE.** *Crop Science. 36(1):121-126.* English. [UNIV ILLINOIS DEPT CROP SCI 1102 S GOODWIN AVE URBANA, IL 61801 USA].

Supplying wheat plants with mixtures of NO3- and NH4+ increases growth and tiller production, but the physiological basis is unclear. Our objectives were to evaluate the roles for cytokinins and N use (e.g., accumulation, distribution, and utilization of absorbed N to produce tillers) in eliciting this response. Two species of spring wheat (Triticum aestivum L. cv. Len and Triticum durum Desf. cv. Inbar) were grown hydroponically in the greenhouse with N supplied as all NO3-, all NH4+, or an equal mixture of each form. In one experiment, the synthetic cytokinin N-6-benzylaminopurine (100 mu M) was applied repeatedly (a total of five times) to the shoots during tiller initiation and development, while in another, xylem exudate was collected from cut stumps during the early stages of tiller development. Plants not sprayed with cytokinins produced more tillers and accumulated more N when grown with mixed N than with either N form alone. Cytokinin sprays did not affect tillering of mixed N plants but increased tillers in all-NO3--grown or all-NH4+-grown plants to levels close to that obtained with mixed N. For unsprayed plants, the presence of NH4+ increased the shoot/root ratio, the proportion of N in the shoot, and the efficiency with which absorbed N was used to produce tillers, compared with plants grown with all NO3-. Exogenous cytokinin appeared to mimic the effects of mixed N (and in some cases NH4+) in altering the distribution and use of N by the plant. In addition, plants grown with mixed N or all NH4+ exhibited higher concentrations and mass transfer of cytokinins in the xylem than those supplied with all NO3-. These data are consistent with the interpretation that mixed N enhancement of tillering in wheat is due to increased synthesis of cytokinins, induced in part by use of NH4+-N. [References: 47].

1573 Wieser, H. (Kurt Hess Institut fur Mehl und Eiweissforschung, Munchen, Garching, FRG.); Seilmeier, W.; Belitz, H.D. (1994) **Use of RP-HPLC for a better understanding of the structure and functionality of wheat gluten proteins.** *High-performance liquid chromatography of cereal and legume proteins p. 235-272.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-016368).

1574 Wojciechowski, S.; Chelkowski, J.; Kostecki, M. (1995) **INFLUENCE OF DEOXYNIVALENOL ON ELECTROLYTE LEAKAGE IN CEREAL SEEDLING LEAVES.** *Acta Physiologiae Plantarum. 17(4):357-360.* English. [POLISH ACAD SCI INST PLANT GENET STRZESZYNSKA 34 PL-60479 POZNAN POLAND].

Polish cultivars of wheat (Almari, Alba, Begra, Kamila, Liwilla, Parada), rye (Dankowskie Nowe), triticale (Ah-no, Malno), barley (Rudzik), and oats (Diadem, Kornes) were examined for their membranes susceptibility to deoxynivalenol (DON), applied at concentration 20-100 mu g/cm(3) (= 6.10(-5)-3.10(-4) M). Various genotypes susceptbility to DON was best differentiated after 24h-48h of incubation. Electrolytes leakage after DON application at concentration 20 mu g/cm(3) was observed only in wheat leaves. Oat leaves membranes remained stable even after application 100 mu g DON/cm(3) with only up to 7% injuries. The same DON concentration caused only low amounts of electrolyte leakage in barley cultivars. Rye and triticale membranes susceptibility to DON was intermediate between wheat and barley sensitivity. [References: 13].

1575 Yan, W.; Wallace, DH. (1996) **A MODEL OF PHOTOPERIOD X TEMPERATURE INTERACTION EFFECTS ON PLANT DEVELOPMENT [Review].** *Critical Reviews in Plant Sciences. 15(1):63-96.* English. [CORNELL UNIV DEPT PLANT BREEDING & BIOMETRY 252 EMERSON HALL ITHACA, NY 14853 USA].

The recent whole-plant research reviewed suggests the commonly applied paradigms about vernalization and photoperiodism should be replaced. A simple equation based on new paradigms predictively models with excellent fit the published days to flowering of at least six plant species. The paradigm that the response to photoperiod of the days to flowering (DTF) of crop plants is revealed adequately by comparing a range of photoperiods at just one temperature should be replaced with the following concepts. There is a base (lowest) temperature below which photoperiod gene activity does not occur, and, when the temperature is high enough to allow activity, there is always a photoperiod x temperature x genotype interaction effect on the days to flowering. Similarly, the paradigm that vernalization gene activity occurs at low temperature and promotes development should be replaced as follows. Vernalization gene activity occurs only if the temperature is above a base (lowest) temperature that allows activity of the vernalization gene(s), and this activity delays development to flowering. Development to flowering is accelerated by low-temperature vernalization, because the low temperature prevents vernalization gene activity, thereby preventing delay of the DTF. The phenomena called long-day (LD) vernalization and short-day (SD) vernalization are reinterpreted as follows. The apparent replacement by short or long daylength of a requirement for low-temperature vernalization is actually a replacement by the low temperature of a requirement for long or short day. Just as true low-temperature vernalization results from prevention of vernalization gene activity, these SD and LD promotions of the DTF occur because the photoperiod gene activity is prevented by the low temperature. Rather than requiring an environment that induces flowering, an inherent capability for rapid development to flowering is expressed, if there is no delay of the DTF by the activity of either or both of the vernalization and photoperiod gene(s). All the above-mentioned effects of temperature are due to the Q(10) effect on the specified photoperiod or vernalization gene activity. The effect of thermal time (due to the accumulated growing degree days) is the integrated Q(10) effect on all additional genes that partially control the rate of development to the reproductive stage. [References: 80].

1576 Yukawa, T.; Kobayashi, M.; Watanabe, Y.; Yamamoto, S. (1995) **STUDIES ON FRUCTAN ACCUMULATION IN WHEAT (TRITICUM AESTIVUM L).** *Japanese Journal of Crop Science. 64(4):801-806.* English. [HOKURIKU NATL AGR EXPTL STN JOETSU NIIGATA 94301 JAPAN].

The mechanisms of fructan accumulation by changes in sucrose-sucrose fructosyl transferase (SST; EC 2.4.1.99) and fructan exohydrolase (FEH; EC 3.2.1.80) under cold treatments (2 degrees C, 6 degrees C) were investigated using varieties of wheat (Triticum aestivum L. cv. Norin 61 and Yukichabo) differing in fructan accumulation. Fructan concentration increased with the increase in SST activity and decrease in FEH activity under cold treatments. The acumulation of fructans was accelerated with high activity of SST at 2 degrees C treatment, suggesting the participation of SST in fructan accumulation. The variety of Norin 61, which has tower fructan accumulation, contained higher activity of FEH, and the fructan concentration of Norin 61 decreased with increasing FEH activity from the 10th day under 6 degrees C treatment, suggesting that the varietal difference in fructan accumulation is affected largely by the level of FEH activity. The relationship between fructan accumulation and growth habit in the varieties is discussed.

1577 Yukawa, T.; Watanabe, Y. (1995) **STUDIES ON FRUCTAN ACCUMULATION IN WHEAT (TRITICUM AESTIVUM L) .3. VARIETAL DIFFERENCES IN DEGREE OF POLYMERIZATION OF FRUCTAN AND CLASSIFICATION BY CLUSTER ANALYSIS [Japanese].** *Japanese Journal of Crop Science. 64(4):692-697.* Japanese. [HOKURIKU NATL AGR EXPTL STN JOETSU NIIGATA 94301 JAPAN].

Varietal differences in degree of polymerization (DP) of fructan in basal stem including leaf sheath of 29 wheat varieties relating on pedigree of breeding were investigated. Most of the varieties contained a large amount of short-chain fructan in comparison with long-chain fructan. Varietal differences in DP distribution changed largely in accordance with the changes in short-chain fructan. In order to clarify the profiles of DP distribution of fructan in varieties, cluster analysis based on the contents of mono- and disaccharides, short- and long-chain fructan was applied. The varieties were grouped into 4 clusters, namely high and low fructan groups, Velvet and Hon-iku 49. Velvet and Hon-iku 49 are unique in that they contained a lot of long-chain fructan, implying that they are available as generic resources to increase the fructan contents which is a key factor for wintering ability.

1578 Zagdanska, B. (1995) **RESPIRATORY ENERGY DEMAND FOR PROTEIN TURNOVER AND ION TRANSPORT IN WHEAT LEAVES UPON WATER DEFICIT.** *Physiologia Plantarum. 95(3):428-436.* English. [PLANT BREEDING & ACCLIMATIZAT INST DEPT PLANT PHYSIOL & BIOCHEM POB 1019 PL-00950 WARSAW POLAND].

The effect of water stress on the respiratory energy demand for the main biosynthetic and transport processes was estimated in the leaves of spring wheat (Triticum aestivum L. cv. San Pastore) acclimated and non-acclimated to drought. ATP-consuming processes were assessed from the effects of selective inhibitors of RNA synthesis, protein synthesis and proteolysis, Ca2+ ATPase and P-type ATPases on respiration. The proportions of energy consumed by these processes were compared with the theoretical ATP production calculated from the rate of oxygen consumption measured manometrically. Respiratory energy production increased significantly in both acclimated leaves and in leaves stressed by drought. In the fully, gr own wheat leaves, Ca2+ dependent reactions and protein turnover consumed about 37% and 34% of the total respiratory energy, respectively. The costs of ion transport constituted another 15% of the total ATP production. Both acclimation and drought stress in non-acclimated leaves resulted in a decrease of leaf sensitivity towards inhibitors of RNA and protein syntheses as well as a decrease in Ca2+ mediated processes; but also in an increase of leaf sensitivity towards inhibitors of proteolysis and ouabain-sensitive ATPase in nonacclimated plants. This indicates a shift in ATP input into the energy-requiring processes towards greater expenses for ion transport upon water deficit. However, in ac climated leaves under drought stress, distribution of respiratory energy became almost the same as in control plants. [References: 55].

1579 Zajtseva, R.I.; Sudnitsyn, I.I. (1994) **[Impact of moisture pressure, specific surface and voids pattern on moisture availability for plants]. Vliyanie davleniya vlagi, udel'noj poverkhnosti i stroeniya porovogo prostranstva pochv na dostupnost' vlagi rasteniyam.** *Pochvovedenie (Russian Federation) (no.12) p. 35-42.* 23 ref. Russian. (AGRIS 96-016321).

Vegetation experiments with barley on different quartz fractions, loams, sands, serozem and chernozem revealed a good correlation between guttation and relative plant growth. These parameters may be used to specify intervals of substrate moisture conditions corresponding to categories of moisture availability for plants. A drastic decrease of gittation (2 times) and growth under excessive moistening coincides with the soil moisture capillary pressure corresponding to sharp increase of air penetrability into soil. There is a linear correlation between logarithms of the latter phenomenon and of the predominant granulometric fraction. With lower soil moisture content the critical sorption-capillary moisture pressure when guttation stops, proves to be in direct correlation with the specific surface of the soil solid phase.

F61 PLANT PHYSIOLOGY-NUTRITION

1580 Adiputra, IGK.; Anderson, JW. (1995) **EFFECT OF SULPHUR NUTRITION ON REDISTRIBUTION OF SULPHUR IN VEGETATIVE BARLEY.** *Physiologia Plantarum. 95(4):643-650.* English. [LA TROBE UNIV SCH BOT BUNDOORA VIC 3083 AUSTRALIA].

Barley plants (Hordeum vulgare cv. Clipper) were grown in nutrient solution containing 25 mu M sulphate and pulsed for 48 h with [S-35]sulphate. The plants were then returned to unlabelled 25 mu M sulphate and analysed for sulphur and S-35-label at various times. The sulphur content of each leaf increased to a maximum as it attained full expansion and then decreased by ca 38-50% over the ensuing 30 days. Expanding leaves had the highest specific radioactivity after the pulse but this declined as the leaves expanded. The first leaf to emerge during the chase also had a high specific radioactivity. The data are consistent with the proposal that the Sulphur required for early leaf development is derived from a previously formed leaf. S-35-Labelled sulphur which was delivered to fully expanded leaves did not equilibrate with endogenous sulphur and was selectively re-exported. In another experiment, barley plants were grown in 5 mu M sulphate, pulsed for 48 h with [S-35]sulphate and then grown at 0 (S-0), 5 (S-5) Or 25 mu M (S-25) unlabelled sulphate. In S-25 plants, the sulphur content of both the fully expanded leaves and the expanding leaves increased indicating that the control of sulphur allocation in these plants differed from that in plants grown continuously in 25 mu M sulphate and in plants which were grown at 0 or 5 mu M sulphate (sub-optimal for the growth of leaves L7 and L8). The export of S-35-label from fully expanded leaves during the chase was not influenced by sulphur nutrition. However, the amount of S-35-label acquired by leaves which formed during the chase increased with sulphur nutrition. In S-25 plants these leaves subsequently underwent net loss of label but the analogous leaves of S-0 and S-5 plants did not. Collectively, the data indicate that, under sulphur limiting conditions, there is no evidence of a mechanism in barley which enhances the mobilization of sulphur from fully expanded leaves to young expanding leaves. [References: 9].

1581 Aliev, DA.; Kerimov, SK.; Dzhangirov, AA.; Akhmedov, AA. (1996) **TRANSPORT AND DISTRIBUTION OF C-14-ASSIMILATES IN WHEAT GENOTYPES WITH VARIOUS PHOTOSYNTHETIC CHARACTERISTICS AND ECONOMIC YIELDS.** *Russian Journal of Plant Physiology. 43(1):49-53.* English. [AZERBAIJAN ACAD SCI KOMAROV INST BOT POTAMDARSKOE SH 40 BAKU 370073 AZERBAIJAN].

The upper three leaves of winter wheat plants with contrasting photosynthetic characteristics were exposed to (CO2)-C-14 during either the flowering or seed ripening phases, and the consequent distribution of labeled assimilates in different plant parts was determined one day after exposure and at the end of the growth period. When leaves were labeled in the flowering phase, a significant portion of the label was found in the stem as soon as 24 h after labeling. Unlike tall plant varieties, the plants of an intensive dwarf variety accumulated the most of the label in the top internode. The dwarf variety plants accumulated 22% of the label in the ear, whereas only 5-7% of the assimilates were found in the ears of tall varieties. In the subsequent period, until full ripening of the caryopses, the portion of C-14 in the ear increased to 70% at the expense of assimilates remobilized from the stem and the fed leaves. The ears of the dwarf variety contained 10-20% more assimilates than the ears of tall varieties. When (CO2)-C-14 was fed at the phase of milky ripeness, the most rapid export of assimilates from leaves and the largest import of assimilates into ears

(70%) were observed during the first day, indicating an increased sink activity of ears in this phase. It is concluded that, at the early phases of reproductive growth, the dwarf plants allocate assimilates more efficiently for the purpose of grain formation than for vegetative organ development; lower leaves of these plants participate more actively in grain filling. [References: 21].

1582 Aliev, DA.; Kerimov, SK.; Guliev, NM.; Akhmedov, AA. (1996) **CARBON METABOLISM IN WHEAT GENOTYPES WITH CONTRASTING PHOTOSYNTHETIC CHARACTERISTICS.** *Russian Journal of Plant Physiology. 43(1):42-48.* English. [AZERBAIJAN ACAD SCI KOMAROV INST BOT POTAMDARSKOW SH 40 BAKU 370073 AZERBAIJAN].

Photosynthetic carbon metabolism, photosynthetic rates, and the activities of enzymes of primary carbon fixation were studied in winter wheat genotypes with contrasting photosynthetic characteristics. The high-yield genotypes Garagylchyg-2 and Azamatli possessed higher CO2 assimilation rates than the extensive genotypes Sevindzh and Sary Bugda. A high CO2 assimilation rate was associated with high activities of ribulose-1, 5-bisphosphate (RuBP) carboxylase and carbonic anhydrase. It was shown that the rates of sucrose (the main transport metabolite in plants) biosynthesis and light-dependent CO2 release (photorespiration) correlated with the CO2 assimilation rate and the activity of RuBP oxygenase. Each genotype was characterized by a certain ratio of RuBP carboxylase to oxygenase activities, which only transiently changed when the sink-source relationships between plant organs were disturbed. [References: 19].

1583 Aliev, JA.; Guliev, NM.; Kerimov, SK.; Hidayatov, RB. (1996) **PHOTOSYNTHETIC ENZYMES OF WHEAT GENOTYPES DIFFERING IN PRODUCTIVITY.** *Photosynthetica. 32(1):77-85.* English. [AZERBAIJAN ACAD SCI INST BOT PATAMDARTSKOYE SHOSSE 40 BAKU 370073 AZERBAIJAN].

Activities of carbonic anhydrase, ribulose-1, 5-bisphosphate carboxylase (RuBPC) and ribulose-1, 5-bisphosphate oxygenase (RuBPO) were changing in a similar way during the leaf development but with individual genotypes at the same developmental phase the RuBPC/RuBPO activities ratio was stable. The ear of an intensive wheat cultivar had higher activity of these enzymes than that of an extensive cultivar. During grain maturation the period of a significant increase in the RuBPC activity in the glume of both the intensive and extensive genotypes coincided with that of a decrease in its activity in the flag leaf, and hence the photosynthetic activity of the elements of the ear and of the glume in particular played a significant role in the process of grain maturation. A close positive correlation was found between the activity of these enzymes and the productivity of wheat genotypes. Exogenous application of carbonic anhydrase stimulated the RuBPC activity, and thus the role of plant carbonic anhydrase was to accelerate the HCO3- dehydration reaction, increase the CO2 concentration in places of carboxylation, and thereby make the activity of RuBPC in a cell more effective. [References: 31].

1584 Averina, NG.; Yaronskaya, EB.; Shalygo, NV. (1996) **FORMATION OF CHLOROPHYLL BIOSYNTHESIS INTERMEDIATES IN BEAN, CUCUMBER AND BARLEY SEEDLINGS TREATED WITH 5-AMINOLEVULINIC ACID AND HOMOCYSTEINE.** *Photosynthetica. 32(1):45-52.* English. [BYELARUSSIAN ACAD SCI INST PHOTOBIOL SCORINA STR 27 MINSK 220072 BYELARUS].

Porphyrin accumulation was investigated in intact green bean (Phaseolus vulgaris), cucumber (Cucumis sativus) and barley (Hordeum vulgare) seedlings that were placed for 17 h into darkness after having been sprayed with solutions of natural metabolites of 5-aminolevulinic acid (ALA), a specific porphyrin precursor, and homocysteine, an inhibitor of S-adenosyl-L-methionine:Mg-protoporphyrin IX methyltransferase. At concentrations of 3-15 mM, homocysteine in combination with ALA, in contrast with the action of ALA alone, strengthened both the porphyrinogenesis in the dicotyledons investigated and the porphyrin-induced photodamage that resulted in plant death after 4 d of continuous irradiation of previously darkened seedlings. Further increase of the homocysteine concentrations resulted in a gradual decrease of the stimulation of porphyrin accumulation with a loss of herbicidal activity. Primary leaves of barley as monocotyledons were much less sensitive to the new herbicide compositions than the dicotyledons investigated. [References: 14].

1585 Belda, RM.; Delapuente, LS. (1995) **ANALYSIS OF NINE MATHEMATICAL FUNCTIONS AS MODELS FOR LEAF DIAGNOSIS IN WHEAT GROWN IN FIELDS.** *Journal of Plant Nutrition. 18(11):2347-2363.* English. [UNIV POLITECN VALENCIA DEPT BIOL VEGETAL CAMINO VERA 14 E-46022 VALENCIA SPAIN].

Winter wheat was grown at five different experimental sites using various nutrient combinations of two nitrogen (N) and three calcium (Ca) doses. The three youngest leaves, including the flag leaf were sampled at anthesis together with the flag leaf post-anthesis and the grain at final harvest. The leaves were weighed and their mineral nutrient contents analyzed and the grain was also weighed. Of the nine equations that were fitted the potential (log y versus log x) most consistently had the best correlation and, thus, best represents the relationships between leaf dry weights, while the inverse in both variables was best for estimating grain weight from leaf weight. The nutrient content of the leaves was related to leaf dry weight according to the following sequence of maximum R: N CR = 0.703), potassium (K) (R = 0.580), Ca (R = 0.444), phosphorus (P) (R = 0.359), iron (Fe) (R = 0.291), and magnesium (Mg) (R = 0.290). The square-root and the quadratic equations best reflected the maximum and minimum values for P and K, respectively. Highly significant relationships between Ca and Mg, and leaf dry weight were less frequent. The leaf nutrients correlated with grain weight in the following order: Mg (R max = 0.521), N (0.455), Ca (0.434), Fe (0.348), P (0.346), Mn (0.339, and K (0.323). Of these nutrients, only Ca affected grain weight according to a parabolic equation (quadratic or square-root) while the rest were best fitted by logarithmic functions, both on X and Y or one variable separately and by a straight-line in one instance. The square-root and the quadratic permit the calculation of the optimum concentration of nutrients, and thus, leaf nutritional diagnosis. The flag leaf at anthesis gives the most opportunities for this. [References: 17].

1586 Bertholdsson, NO.; Stoy, V. (1995) **YIELDS OF DRY MATTER AND NITROGEN IN HIGHLY DIVERGING GENOTYPES OF WINTER WHEAT IN RELATION TO N-UPTAKE AND N-UTILIZATION.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(5):285-295.* English. [SVALOF WEIBULL AB NILSSON EHLE LAB S-26881 SVALOV SWEDEN].

The aim of the investigation was to find out if certain North American genotypes of winter wheat with exceptionally high grain protein concentrations (GPCs) are characterized by an extraordinary ability to take up and/or distribute nitrogen from the soil to the grains. Two of these genotypes were grown in a field trial in southern Sweden together with three 'normal' Swedish genotypes (two modern cultivars and one bid landrace). They were compared with respect to accumulation of dry matter and nitrogen in both grains and straw when cultivated at three levels of N-fertilization (0.75 and 150 kg N . ha(-1)). The results of this trial demonstrated that the yields of above-ground biomass (BY) and grain (GY) were significantly lower for the American genotypes than for the Swedish ones. Also the nitrogen yields in biomass (NBY) and grain (NGY) were significantly lower in the American types but the difference between the two groups was nor so pronounced as with respect to dry matter yields. The American types were thus superior to the Swedish ones in relative ability to take up nitrogen but not in absolute terms. The GPCs of the American wheats were very high also under Swedish growth conditions but a regression analysis of the relation between GPC and GY revealed a very strong negative correlation between these parameters (r = -0.95 at 0 N and r = -0.99 at 150 N). The correlation between GPC and HI was highly negative, too, (r = -0.83 at 0 N and r = -0.89 at 150 N). The specific ability to take up nitrogen was determined by estimating the changes in soluble soil nitrogen (NO3 + NH4) in the unfertilized plots during the vegetation period. These measurements indicated that the American types were less effective in retrieving nitrogen from the soil than the Swedish ones. The analysis of the soil in the fertilized plots also demonstrated that the American types were slightly inferior to the others in their ability to recover externally applied nitrogen. The efficiency to utilize absorbed N for production of above-ground and grain biomass was also estimated from

the experimental data. The results demonstrated very clearly that the American genotypes exhibited a considerably lower nitrogen utilization efficiency than the Swedish types. Also the efficiency to allocate absorbed nitrogen into the grains (expressed as nitrogen harvest index, NHI) was examined and was found to be nearly identical for all genotypes and almost independent of the level of N fertilization. It is therefore claimed that the results reported in the present communication confirm the conclusions from parr I of this investigation, namely that the main reason for the high GPCs in the American genotypes investigated here are their relatively low dry matter production in the grain filling period. This fact does not exclude, however, that other high-protein genotypes may carry genes which in appropriate crosses can combine high-yielding ability with an improved GPC. [References: 31].

1587 Brewitz, E.; Larsson, CM.; Larsson, M. (1995) **INFLUENCE OF NITRATE SUPPLY ON CONCENTRATIONS AND TRANSLOCATION OF ABSCISIC ACID IN BARLEY (HORDEUM VULGARE).** *Physiologia Plantarum. 95(4):499-506.* English. [UNIV STOCKHOLM DEPT BOT S-10691 STOCKHOLM SWEDEN].

Spring barley (Hordeum vulgare L. cv. Golf) was grown at different nitrate supply rates, controlled by using the relative addition late technique, in order to elucidate the relationship between nitrate-N supply and root and shoot levels of abscisic acid (ABA). The plants were maintained as (1) standard cultures where nitrate was supplied at relative addition rates (RAs) of 0.03, 0.09 and 0.18 day(-1), and (2) split-root cultures al RA 0.09 day(-1) but with the nitrate distributed between the two root parts in ratios of 100:0, 80:20 and 60:40, Time-dependent changes in root and shoot concentrations of ABA (determined by radioimmunoassay using a monoclonal antibody) were observed in both standard and split-root cultures during 12 days of acclimation to the different nitrate regimes. However, the ABA responses were similar at all nitrate supply rates. Further experiments were performed with split-root cultures where the distribution of nitrate between the two root parts was reversed from 80:20 to 20:80 so that short-term effects to local perturbations of nitrate supply could be studied without altering whole-plant N absorption. Transient increases in ABA concentrations (maximum of 25 to 40% after 3 to 4 h) were observed in both subroot parts, as well as in xylem sap and shoot tissue. By pruning the root system it was demonstrated that the change in ABA had its origin in the subroot part receiving the increased nitrate supply (i.e. switched from 20 to 80% of the total nitrate supply). The data indicate that ABA responses are easily transmitted between different organs, including transmission from one set of seminal roots to another via the shoot. The data do not provide any indication that long-term nitrate supplies or general nitrogen status of barley plants affect, or are otherwise related to, the average tissue ABA concentrations of roots and shoots. [References: 36].

1588 Champigny, ML. (1995) **INTEGRATION OF PHOTOSYNTHETIC CARBON AND NITROGEN METABOLISM IN HIGHER PLANTS.** *Photosynthesis Research. 46(1-2):117-127.* English. [11 RUE DOCTEUR ROUX F-92330 SCEAUX FRANCE].

Concomitant assimilation of C and N in illuminated leaves requires the regulated partitioning of reductant and photosynthate to sustain the demands of amino acid and carbohydrate biosynthesis. The short-term responses of photosynthesis and photosynthate partitioning to N enrichment in wheat (Triticum aestivum, L.) and maize (Zea mays L.) leaves were studied in order to understand the regulatory strategy *employed in* higher plants. Transgenic tobacco plants (Tobacco plumbaginifolia) over-expressing NR or with poor NR expression were used to compare were observed in plants differing in their capacities for NO3- assimilation. Similar regulatory responses to NO3- leaves having C-4- and C-3-type photosynthesis. It was shown that the extra-C needed in the short-term to sustain amino acid synthesis was not provided by an increase in photosynthetic CO2 fixation but rather by a rapid shift in the partitioning of photosynthetic C to amino acid at the expense of sucrose biosynthesis. The modulation of three enzymes was shown to be important in this C and N interaction, namely PEPCase (EC 4.1.1.31), SPS (EC 2.4.1.14) and NADH/NR (EC 1.6.6.1). The first two enzymes were shown to share the common feature of regulatory posttranscriptional NO3– dependent phosphorylation of their proteins on a seryl-residue. While PEPCase is activated, SPS activity is decreased. In contrast the NR phosphorylation state is unchanged and all N-dependent control of NR activity is regulated at the protein level. A number of arguments support the hypothesis that Gln, the primary product of NO3- assimilation, is the metabolite effector for short-term modulation of PEPCase, and SPS in response to N enrichment. Since a major effect of NO3- on the PEPCase-protein kinase activity in concentrated wheat leaf extracts was demonstrated, the hypothesis is put forward that protein phosphorylation is the primary event allowing the short-term adaptation of leaf C metabolism to changes in N supply. [References: 46].

1589 Chernov, V.K. (1993) **[Rhythms of sap secretion and mineral absorption by spring wheat plants]. Ritmy vydeleniya pasoki i pogloshcheniya mineral'nykh veshchestv rasteniyami yarovoj pshenitsy.** *Voprosy botaniki Nizhnego Povolzh'ya (Russian Federation) (no.7) p. 103-106.* 7 ref. Russian. (AGRIS 96-016740).

1590 Christ, RA.; Korner, C. (1995) **RESPONSES OF SHOOT AND ROOT GAS EXCHANGE, LEAF BLADE EXPANSION AND BIOMASS PRODUCTION TO PULSES OF ELEVATED CO2 IN HYDROPONIC WHEAT.** *Journal of Experimental Botany. 46(292):1661-1667.* English. [UNIV BASEL INST BOT SCHONBEINSTR 6 CH-4056 BASEL SWITZERLAND].

Short-term effects of elevated CO2 during the early life phase of plants may have long lasting consequences for growth and biomass in later periods. We exposed hydroponically grown wheat seedlings to 5 d pulses of elevated CO2 while leaf expansion growth as well as shoot and root gas exchange were measured simultaneously and continuously. Shoot photosynthesis, night-time shoot respiration and below-ground respiration (largely by roots) roughly doubled when atmospheric CO2 concentration was doubled. An interruption of CO2 enrichment caused CO2 assimilation and respiration to return to control levels, However, while the response of photosynthesis was immediate, that of respiration showed a hysteresis of about 3 d. Since shoot biomass increased at elevated CO2 (with no change in allocation pattern) equal fluxes per shoot or root system after a return to control CO2 concentrations indicate substantial downward adjustment of the capacity for CO2 fixation and release in high-CO2 grown plants. Leaf expansion growth was completely unaffected by CO2 enrichment, whereas tiller initiation was significantly increased (doubled in 18 d). We conclude that leaf growth in these wheat plants was already carbon-saturated at ambient CO2 concentration at optimum mineral nutrient supply. The stimulation of growth of whole plants was exclusively due to enhanced tillering during this very early part of the life of these wheat plants. [References: 18].

1591 Daeter, W.; Hartung, W. (1995) **STRESS-DEPENDENT REDISTRIBUTION OF ABSCISIC ACID (ABA) IN HORDEUM VULGARE L LEAVES - THE ROLE OF EPIDERMAL ABA METABOLISM, TONOPLASTIC TRANSPORT AND THE CUTICLE.** *Plant Cell & Environment. 18(12):1367-1376.* English. [UNIV WURZBURG LEHRSTUHL BOT 1 JULIUS VON SACHS INST BIOWISSENSCH MITTLERER DALLENBERGWEG 64 D-97082 WURZBURG GERMANY].

When C-14-labelled abscisic acid ([C-14]ABA) was supplied to isolated protoplasts of the barley leaf at pH 6, initial rates of metabolism were about five times higher in epidermal cell protoplasts than in mesophyll cell protoplasts if equal cytosolic volumes were considered, In spite of the fact that epidermal cells make up only about 35% of the total water space in barley leaves, and despite the small cytosolic volume of these cells, in intact leaves all epidermal cells would thus metabolize half as much ABA per unit time as the mesophyll cells (0.27 and 0.51 mmol h(-1) m(-3) leaf water), Therefore, under these conditions epiderm mal cells seem to be a stronger sink than mesophyll cells for ABA that arrives via the transpiration stream, However, at an apoplastic pH of 7.25, which occurs in stressed leaves, the proportion of total metabolized ABA would be much smaller in epidermal than in mesophyll cells (0.029 and 0.204 mmol h(-1) m(-3) leaf water), Our results indicate that under conditions of slightly alkaline apoplastic pH the epidermis may serve as the main source for fast stress-dependent ABA redistribution into the guard cell apoplast, This is partly the result of ABA transport across the epidermal tonoplast, which is dependent on the apoplastic pH and possibly on the cytosolic calcium

concentration, The cuticle seems to be of no particular importance in stress-induced apoplastic ABA shifts and cannot be regarded as a significant sink for high ABA concentrations under stress. [References: 30].

1592 Dellatorre, G.; Montalbini, P. (1995) **ALLOPURINOL METABOLIC CONVERSION PRODUCTS AND XANTHINE ACCUMULATION IN ALLOPURINOL-TREATED PLANTS.** *Plant Science. 111(2):187-198.* English. [UNIV PERUGIA FAC AGR IST PATOL VEGETALE BORGO XX GIUGNO 74 I-06100 PERUGIA ITALY].

Allopurinol metabolic products and xanthine accumulation were determined in allopurinol-treated bean, broad bean and wheat plants, The results obtained demonstrate that allopurinol applied through roots undergoes two main transformations in the plants: (i) xanthine oxidase-mediated oxidation to oxipurinol and (ii) ribosyl transfer reactions with consequent synthesis of ribonucleoside derivatives of both allopurinol and oxipurinol. In bean and broad bean leaves ribosidation prevailed over oxidation, whereas in wheat leaves ribosidation conversion was negligible while xanthine oxidase-mediated oxidation was greatly in excess. Therefore, the allopurinol absorbed by wheat was almost totally available for xanthine oxidase inhibition in the plant, while in bean and broad bean, due to the high conversion to ribonucleoside which does not inhibit the enzyme, only part was available for this purpose. Consequently, in wheat leaves the same rate of xanthine accumulation, a consequence of in vivo xanthine oxidase inhibition, was achieved with concentrations about 5 times lower than in bean and broad bean applied through roots. These and previous results in tobacco plants are the first report on in vivo metabolic ribosidation of allopurinol and oxipurinol in plants. The present results are discussed in relation to the already reported allopurinol-mediated biotrophical rust fungi growth inhibition and support the proposition that this phenomenon is connected mainly with in vivo allopurinol-mediated host xanthine oxidase inhibition. [References: 32].

1593 Esyunina, A.I. (1993) **[Glycolic acid oxidase activity in various species of wheat]. Aktivnost' oksidazy glikolevoj kisloty u razlichnykh vidov pshenitsy.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 77-81.* 12 ref. Russian. (AGRIS 96-016709).

The article deals with results of a study on glycolic acid oxidase activity in various wheat species different in their ploidy, developmental progress and origin. It has been discovered that the most advanced from an evolutionary standpoint samples reveal increased activity when compared to wild and primitive representatives of the genus Triticum. Those distinctions show up most clearly at a period of early earing - flowering.

1594 Fageria, NK.; Zimmermann, FJP.; Baligar, VC. (1995) **LIME AND PHOSPHORUS INTERACTIONS ON GROWTH AND NUTRIENT UPTAKE BY UPLAND RICE, WHEAT, COMMON BEAN, AND CORN IN AN OXISOL.** *Journal of Plant Nutrition. 18(11):2519-2532.* English. [EMBRAPA NATL RICE & BEAN RES CTR CAIXA POSTAL 179 BR-74001970 GOIANIA GO BRAZIL].

Liming and phosphorus (P) applications are common practices for improving crop production in acid soils of the tropical as well as temperate regions. Four greenhouse experiments were conducted on an Oxisol (clayey, kaolinitic, isothermic, Typic Haplustox) to evaluate response of liming (0, 2, and 4 g/kg) and P application (0, 50, and 175 mg P/kg) in a factorial combination on growth and nutrient uptake by upland rice (Oryza sativa L.), wheat (Triticum aestivum L.), common bean (Phaseolus vulgaris L.), and corn (Zea mays I, .). Phosphorus application significantly ($P<0.01$) increased dry weight of tops of all the four crop species as well as dry weight of roots of wheat and corn. Liming significantly ($P<0.01$) improved growth of common bean and corn but had significant negative effects on rice growth. Maximum dry weight of tops of rice and wheat was obtained at 175 mg P/kg without lime. Maximum dry weight of tops in common bean was obtained at 4 g lime/kg with 175 mg P/kg of soil. In all the crops, increasing levels of applied P significantly increased nutrient uptake. With some exceptions, increasing levels of lime tend to reduce uptake of P, zinc (Zn), copper (Cu), manganese (Mn), and iron (Fe) and increase the uptake of calcium (Ca) and magnesium (Mg) in all the crop species. Decrease in potassium (K) uptake, due to high lime, is probably due to antagonistic effects of Ca and Mg and reduced micronutrients uptake is probably due to increased soil pH resulting in decreased availability of these elements to plants. Therefore, in these types of acid soils, one should avoid over liming. [References: 18].

1595 Farrar, JF.; Minchin, PEH.; Thorpe, MR. (1995) **CARBON IMPORT INTO BARLEY ROOTS - EFFECTS OF SUGARS AND RELATION TO CELL EXPANSION.** *Journal of Experimental Botany. 46(293):1859-1865.* English. [UNIV WALES SCH BIOL SCI BANGOR GWYNEDD WALES].

The import of photosynthate labelled with C-11 from a source leaf into the two halves of a split root system of an intact barley plant was studied. When applied to one half of a split root system sugars that are absorbed and metabolized reduce subsequent import of C-11 into that root half. The non-metabolized sugar analogue 3-O-methyl glucose has no effect on import, whilst mannose and 2-deoxyglucose inhibit both root elongation and import of C-11. EDTA, PCMBS, and apoplastic pH in the range 4-7, have little effect on partitioning. These results are interpreted in terms of a suggestion that phloem unloads directly into expanding cells in the elongation zone of root tips. [References: 32].

1596 Feierabend, J.; Dehne, S. (1996) **FATE OF THE PORPHYRIN COFACTORS DURING THE LIGHT-DEPENDENT TURNOVER OF CATALASE AND OF THE PHOTOSYSTEM II REACTION-CENTER PROTEIN D1 IN MATURE RYE LEAVES.** *Planta. 198(3):413-422.* English. [UNIV FRANKFURT INST BOT POSTFACH 11 19 32 D-60054 FRANKFURT GERMANY].

The apoprotein of the enzyme catalase (EC 1.11.1.6) was shown to exhibit a light-dependent turnover in leaves. Present results indicate that photoinactivation of the enzyme was not accompanied by a synchronous destruction and new synthesis of its heme moiety. In rye (Secale cereale L.) leaves the catalase content was not depleted in light when porphyrin synthesis was inhibited by gabaculine. Photoinactivation of purified bovine liver or rye leaf catalase in vitro was not accompanied by concomitant damage to the heme groups. Both the incorporation of delta-[H-3]aminolevulinic acid ([H-3]ALA) into catalase-heme and its apparent turnover increased with irradiance. However, the apparent half-life of the catalase-heme was much longer than that of its apoprotein. It is probable that not only degradation but also an exchange with the free heme pool contributed to the apparent turnover of radioactivity of the catalase-heme. Part of the chlorophyll (Chl) associated with photosystem II (PS II) had a preferential light-induced turnover, and repair of PS II appeared to require new Chl synthesis also in mature green rye leaves. The activity of PS II, indicated by the ratio of variable to maximal fluorescence (F-v/F-m), rapidly declined in the presence of gabaculine in light and the reaction-center proteins D1 and D2 were depleted. When segments of mature green rye leaves were labeled with [H-3]ALA and incorporation into Chl-protein complexes analysed after electrophoretic separation in the presence of Deriphat, the highest radioactivity was observed in the core complex of PS II, while PS I and the light-harvesting complex of PS II (LHC II) were unlabeled. In greening etiolated leaves highest incorporation was observed in LHC II. Both the incorporation of [H-3]ALA into the PS II core complex of green rye leaves and its turnover increased with irradiance. However, the apparent half-life of the PS II-bound labeled porphyrin compounds (mainly Chl) was considerably longer than that of the reaction-center protein D1 under identical conditions. [References: 42].

1597 Gezgin, S.; Bayrakli, F. (1995) **AMMONIA VOLATILIZATION FROM AMMONIUM SULPHATE, AMMONIUM NITRATE, AND UREA SURFACE APPLIED TO WINTER WHEAT ON A CALCAREOUS SOIL.** *Journal of Plant Nutrition. 18(11):2483-2494.* English. [SELCUK UNIV FAC AGR DEPT SOIL SCI KONYA 42031 TURKEY].

Ammonia (NH3) volatilization losses from surface-applied ammonium sulphate (AS), ammonium nitrate (AN), and urea to winter wheat and the effects of the NBPT [N-(n-butyl) thiophosphoric triamide], PG (Phosphogypsum), and PR (byproduct-Pyrite) were determined in a field experiment. Effects on grain yield and protein content of the grain were also measured. Total NH3 losses from AS, AN, and urea varied from 13.6-19.5%, 4.4-6.4%, and 3.9-12.0% depending on the compounds and their levels added to nitrogen (N) fertilizers, respectively. The compounds added to AS and AN increased NH3-N losses with respect to unamended fertilizers (control). On the other hand, while urea treatments with two

tons of PG/ha increased NH3 losses, the other compounds decreased the losses. The highest reductions of NH3 loss were observed with NBPT 0.50% and NBPT 0.25% by 63.4% and 52.8%, respectively. Although the effect of nitrogeneous fertilizers on total N losses and protein content of wheat grain was found statistically significant ($p<0.01$), as the compounds applied with N fertilizers have had no significant effect. Also, a negative and highly significant correlation ($r = -0.69^{***}$) was found between total N loss and protein content of the grain. [References: 31].

1598 Giardi, MT.; Kucera, T.; Briantais, JM.; Hodges, M. (1995) **DECREASED PHOTOSYSTEM II CORE PHOSPHORYLATION YELLOW-GREEN MUTANT OF WHEAT SHOWING MONOPHASIC FLUORESCENCE INDUCTION CURVE.** *Plant Physiology. 109(3):1059-1068.* English. [CNR INST BIOCHEM & ECOPHYSIOL PLANTS VIA SALARIA KM 29 3 I-00016 MONTEROTONDO ITALY].

In the present work we study the regulation of the distribution of the phosphorylated photosystem II (PSII) core populations present in grana regions of the thylakoids from several plant species. The heterogeneous nature of PSII core phosphorylation has previously been reported (M.T. Giardi, F. Rigoni, R. Barbato [1992] Plant Physiol 100: 1948-1954; M.T. Giardi [1993] Planta 190: 107-113). The pattern of four phosphorylated PSII core populations in the grana regions appears to be ubiquitous in higher plants. In the dark, at least two phosphorylated PSII core populations are always detected. A mutant of wheat (Triticum durum) that shows monophasic room-temperature photoreduction of: the primary quinone electron acceptor of PSII as measured by chlorophyll fluorescence increase in the presence and absence of 3-(3, 4-dichlorophenyl)-1, 1-dimethylurea and by fluorescence upon flash illumination in intact leaves also lacks the usual distribution of phosphorylated PSII core populations. In this mutant, the whole PSII core population pattern is changed, probably due to altered threonine kinase activity, which leads to the absence of light-induced phosphorylation of CP43 and D-2 proteins. The results, correlated to previous experiments in vivo, support the idea that the Functional heterogeneity observed by fluorescence is correlated in part to the PSII protein phosphorylation in the grana. [References: 56].

1599 Gifford, RM. (1995) **WHOLE PLANT RESPIRATION AND PHOTOSYNTHESIS OF WHEAT UNDER INCREASED CO2 CONCENTRATION AND TEMPERATURE - LONG-TERM VS SHORT-TERM DISTINCTIONS FOR MODELLING.** *Global Change Biology. 1(6):385-396.* English. [CSIRO DIV PLANT IND GPO BOX 1600 CANBERRA ACT 2601 AUSTRALIA].

Short- and long-term effects of elevated CO2 concentration and temperature on whole plant respiratory relationships are examined for wheat grown at four constant temperatures and at two CO2 concentrations. Whole plant CO2 exchange was measured on a 24 h basis and measurement conditions varied both to observe short-term effects and to determine the growth respiration coefficient (r(g))r dry weight maintenance coefficient (r(g)), basal (i.e. dark acclimated) respiration coefficient (r(b)), and 24 h respiration:photosynthesis ratio (R:P). There was no response of r(b) to short-term variation in CO2 concentration. For plants with adequate N-supply, r(g) was unaffected by the growth-CO2 despite a 10% reduction in the plant's N concentration (%N). However, r(m) was decreased 13%, and r(b) was decreased 20% by growth in elevated CO2 concentration relative to ambient. Nevertheless, R:P was not affected by growth in elevated CO2. Whole plant respiration responded to short-term variation of + 5 degrees C around the growth temperature with low sensitivity (Q(10) = 1.8 at 15 degrees C, 1.3 at 30 degrees C). The shape of the response of whole plant respiration to growth temperature was different from that of the short term response, being a slanted S-shape declining between 25 and 30 degrees C. While r(m) increased, r(g) decreased when growth temperature increased between 15 and 20 degrees C. Above 20 degrees C r(m) became temperature insensitive while r(g) increased with growth temperature. Despite these complex component responses, R:P increased only from 0.40 to 0.43 between 15 degrees and 30 degrees C growth temperatures. Giving the plants a step increase in temperature caused a transient increase in R:P which recovered to the pre-transient value in 3 days. It is concluded that use of a constant R:P with respect to average temperature and CO2 concentration may be a more simple and accurate way to model the responses of wheat crop respiration to 'climate change' than the more complex and mechanistically dubious functional analysis into growth and maintenance components. [References: 20].

1600 Golberg, AD.; Jonas, OA.; Pereyra, MC.; Cabeza, C.; Ledent, JF. (1995) **NITRATE REDUCTASE ACTIVITY IN NITROGEN AND WATER-STRESSED PLANTS OF BREAD WHEAT.** *Cereal Research Communications. 23(4):433-439.* English. [INTA ANGUIL EEA RA-6223 ANGUIL LA PAMPA ARGENTINA].

Effects of cessation of watering on Nitrate Reductase Activity (NRA) were studied in plants grown in bags in a greenhouse under two nitrogen regimes (application of urea or no application of nitrogen fertilizer). Nitrate Reductase Activity was reduced by water shortage only in plants well supplied with nitrogen. The effect was more marked on potential NRA (NRA+) than on actual NRA (NRA-, measured without addition of nitrate to the assay medium), and it was not associated to a reduced concentration of nitrates in the leaves. Low nitrogen level in the soil reduced strongly NRA and nitrate content of tissues. The level of nitrate present in the tissues (endogenous nitrate) seemed always to limit NRA activities, considering the lower values of actual NRA compared to potential NRA. [References: 16].

1601 Gray, GR.; Savitch, LV.; Ivanov, AC.; Huner, NPA. (1996) **PHOTOSYSTEM II EXCITATION PRESSURE AND DEVELOPMENT OF RESISTANCE TO PHOTOINHIBITION .2. ADJUSTMENT OF PHOTOSYNTHETIC CAPACITY IN WINTER WHEAT AND WINTER RYE.** *Plant Physiology. 110(1):61-71.* English. [UNIV WESTERN ONTARIO DEPT PLANT SCI LONDON ON N6A 5B7 CANADA].

Winter wheat (Triticum aestivum L. cv Monopol), spring wheat (Triticum aestivum L. cv Katepwa), and winter rye (Secale cereale L. cv Musketeer) grown at 5 degrees C and moderate irradiance (250 mu mol m(-2) s(-1)) (5/250) exhibit an increased tolerance to photoinhibition at low temperature in comparison to plants grown at 20 degrees C and 250 mu mol m(-2) s(-1) (20/250). However, 5/250 plants exhibited a higher photosystem II (PSII) excitation pressure (0.32-0.63) than 20/250 plants (0.18-0.21), measured as 1 - q(P), the coefficient of photochemical quenching. Plants grown at 20 degrees C and a high irradiance (800 mu mol m(-2) s(-1)) (20/800) also exhibited a high PSII excitation pressure (0.32-0.48). Similarly, plants grown at 20/800 exhibited a comparable tolerance to photoinhibition relative to plants grown at 5/250. In contrast to a recent report for Chlorella vulgaris (D.P. Maxwell, S. Falk, N.P.A. Huner [1995] Plant Physiol 107: 687-694), this tolerance to photoinhibition occurs in winter rye with minimal adjustment to polypeptides of the PSII light-harvesting complex, chlorophyll a/b ratios, or xanthophyll cycle carotenoids. However, Monopol winter wheat exhibited a 2.5-fold stimulation of sucrose-phosphate synthase activity upon growth at 5/250, in comparison to Katepwa spring wheat. We demonstrate that low-temperature-induced tolerance to photoinhibition is not a low-temperature-growth effect per se but, instead, reflects increased photosynthetic capacity in response to elevated PSII excitation pressure, which may be modulated by either temperature or irradiance. [References: 64].

1602 Griffiths, MW.; Kettlewell, PS.; Hocking, TJ. (1995) **EFFECTS OF FOLIAR-APPLIED SULPHUR AND NITROGEN ON GRAIN GROWTH, GRAIN SULPHUR AND NITROGEN CONCENTRATIONS AND YIELD OF WINTER WHEAT.** *Journal of Agricultural Science. 125(Part 3):331-339.* English. [HARPER ADAMS AGR COLL CROP & ENVIRONM RES CTR NEWPORT TF10 8NB SHROPS ENGLAND].

Elemental sulphur (32 kg S/ha) and urea (30 kg N/ha) were applied to the foliage of different winter wheat cultivars, half at flag leaf emergence and half at ear emergence, in factorial experiments in 1986, 1987 and 1988. There were no clear visual symptoms of S deficiency, but there was evidence from soil analysis, grain S concentration and grain N:S ratio that the crops were marginally deficient in sulphur. Disease severity was generally negligible. Leaf senescence at the end of grain growth was delayed by sulphur in two of the three years, both with and without urea in 1987, but only with urea in 1988. Sulphur, both alone and mixed with urea, increased grain S concentration from early grain growth in 1986 and 1987, but not until the end of grain growth in 1988. Urea alone reduced

yield in 1986 and 1987, but mixing S with the urea compensated for this phytotoxic effect. Yield was not significantly increased by S when compared with plots receiving neither urea nor S. [References: 29].

1603 Guglielminetti, L.; Yamaguchi, J.; Perata, P.; Alpi, A. (1995) **AMYLOLYTIC ACTIVITIES IN CEREAL SEEDS UNDER AEROBIC AND ANAEROBIC CONDITIONS.** *Plant Physiology. 109(3):1069-1076.* English. [UNIV PISA DIPARTIMENTO BIOL PIANTE AGR SEZ FISIOL VEGETALE VIA MARISCOGLIO 34 I-56124 PISA ITALY].

An adequate carbohydrate supply contributes to the survival of seeds under conditions of limited oxygen availability. The amount of soluble, readily fermentable carbohydrates in dry cereal seeds is usually very limited, with starch representing the main storage compound. Starch breakdown during the germination of cereal seeds is the result of the action of hydrolytic enzymes and only through the concerted action of alpha-amylase (EC 3.2.1.1), beta-amylase (EC 3.2.1.2), debranching enzyme (EC 3.2.1.41), and alpha-glucosidase (EC 3.2.1.20) can starch be hydrolyzed completely. We present here data concerning the complete set of starch-degrading enzymes in three cereals, rice (Oryza sativa L.), which is tolerant to anaerobiosis, and wheat(Triticum aestivum L.) and barley (Hordeum vulgare L.), which are unable to germinate under anoxia. Among the cereal seeds tested under anoxia, only rice is able to degrade nonboiled, soluble starch, reflecting the ability to degrade the starch granules in vivo. This is explained by the presence of the complete set of enzymes needed to degrade starch completely either as the result of de novo synthesis (alpha-amylase, beta-amylase) or activation of preexisting, inactive forms of the enzyme (debranching enzyme, alpha-glucosidase). These enzymes are either absent or inactive in wheat and barley seeds kept under anaerobic conditions. [References: 34].

1604 Hansen, NC.; Jolley, VD.; Brown, JC. (1995) **CLIPPING FOLIAGE DIFFERENTIALLY AFFECTS PHYTOSIDEROPHORE RELEASE BY TWO WHEAT CULTIVARS.** *Agronomy Journal. 87(6):1060-1063.* English. [BRIGHAM YOUNG UNIV DEPT AGRON & HORT PROVO, UT 84602 USA].

Recent observations of grazing-induced Fe-deficiency chlorosis in wheat (Triticum aestivum L.) grown on calcareous soil indicates that Fe deficiency should be considered one of the factors associated with decreased grain yield in grazed wheat. Quantity of phytosiderophore release by roots of Fe-deficient grasses has been closely linked to resistance to Fe-deficiency chlorosis in numerous species and could potentially explain these observations. Phytosiderophore release following clipping was determined for two wheat cultivars ('Abilene' and '2157') widely divergent in field chlorosis resistance. Plants were grown hydroponically in a complete nutrient solution containing 0.2 mg L(-1) Fe as Fe-HEDTA (N-hydroxyethylethylenediaminetriacetic acid). Phytosiderophore release was measured using an Fe-binding assay under nonaxenic conditions. Abilene and 2157 wheat responded differently to clipping of foliage. Initial response in both was reduced release of phytosiderophore, but the Fe-chlorosis resistant cultivar (Abilene) responded to clipping by quick and complete restoration of the initially suppressed phytosiderophore, whereas the susceptible cultivar (2157) did not. Clipped Abilene released more phytosiderophore per gram of root than control plants on some days, but 2157 did not. Root growth was equally suppressed by clipping in both cultivars, compared with uncut control plants. Differential effect of defoliation on phytosiderophore release by these two cultivars helps explain some of the differences in Fe-deficiency chlorosis resistance observed in the field. These results indicate that Fe-chlorosis resistant wheat cultivars should be selected when managing wheat for both forage and grain production on calcareous soils. [References: 12].

1605 Huang, J.; Redmann, RE. (1996) **CARBON BALANCE OF CULTIVATED AND WILD BARLEY UNDER SALT STRESS AND CALCIUM DEFICIENCY.** *Photosynthetica. 32(1):23-35.* English. [UNIV SASKATCHEWAN DEPT CROP SCI & PLANT ECOL SASKATOON SK S7N 0W0 CANADA].

Combined effects of mixed sulphate salinity (Na_2SO_4 + $MgSO_4$) and contrasting calcium supply on whole-plant daily carbon balance, and on growth and maintenance respiration were investigated in cultivated barley (Hordeum vulgare L. cv. Harrington) and wild barley (H. jubatum L.) grown hydroponically in a controlled environment chamber. Daily carbon balance was more positive in wild barley than in barley in the salinity plus low calcium treatment (LCa). The additional calcium in the salinity plus high calcium treatment (HCa) lessened part of the adverse effects of salinity on carbon balance in H. vulgare. The LCa treatment reduced whole-plant growth conversion efficiency (Y-g) more in H. vulgare than in H. jubatum. HCa treatment significantly improved Y-g in H. vulgare, but not in H. jubatum, relative to the LCa treatment. The maintenance coefficient (m) remained unchanged from the control in treated H. jubatum, while it showed a slight increase under HCa but a significant reduction under LCa in H. vulgare. The greater salt tolerance in H. jubatum under LCa can be attributed, at least in part, to its ability to maintain a greater Y-g than H. vulgare. Supplemental calcium ameliorated the deleterious effects of salinity on H. vulgare growth, thereby improving its salt tolerance. Differences in tissue composition could not explain the effects of salinity and calcium supply on growth and maintenance respiration components in either species. [References: 38].

1606 Kernich, GC.; Halloran, GM.; Flood, RG. (1995) **RELATIVE EFFECTS OF PHOTOPERIOD AND IRRADIANCE ON PRE-ANTHESIS DEVELOPMENT IN SPRING BARLEY (HORDEUM VULGARE L).** *Cereal Research Communications. 23(4):425-431.* English. [UNIV MELBOURNE JOINT CTR CROP IMPROVEMENT DEPT AGR PARKVILLE VIC 3052 AUSTRALIA].

This study examined the effects of changes in irradiance level and photoperiod on the duration of pre-anthesis development in three barley cultivars. The duration of the pre-anthesis period of development was compared at two photoperiods (10 and 18 h) with similar levels of daily radiation and at 18 h under differing irradiance levels. The duration of this period of two photoperiod-sensitive barley cultivars, Clipper and Galleon, was reduced by a factor of ca. 2.6 and 2.7 by the 18 h photoperiod relative in comparison to 10 h. The maximum number of spikelet primordia at the apex of the main culm was higher by a factor of 1.7 under the 10 h than the 18 h photoperiod in Clipper and Galleon. Similarly the final number of leaves on the main culm (increased by 1.6 times) and the length of the main culm (increased by a factor of 1.2) were greater under 10 h than 18 h at the same level of irradiance for Clipper and Galleon. The photoperiod-insensitive cultivar, Finlay, exhibited little response to photoperiod for both of the abovementioned characters. Under a 10 h photoperiod anthesis was delayed in all three cultivars. Further effects of irradiance and photoperiod on the durations of pre-anthesis development and plant characters are discussed. [References: 8].

1607 Maksimov, GB.; Meshkauskas, AI.; Jurkoniene, SV.; Merkys, AI. (1996) **ROLE OF CALCIUM AT DIFFERENT PHASES OF GRAVITROPIC RESPONSE.** *Russian Journal of Plant Physiology. 43(1):6-9.* English. [LITHUANIA ACAD SCI INST BOT UL ZALIUJU EZERU 47 VILNIUS 2021 LITHUANIA].

The role of calcium in gravitational induction and gravitropic response (bending) was studied in segments of decapitated etiolated wheat (Triticum aestivum L.) coleoptiles. Coleoptile treatment with EGTA prior to exposure to a lateral gravitational stimulus weakened the bending response. After, gravistimulation, EGTA did not reduce the coleoptile curvature. When EGTA-treated coleoptiles were incubated in Ca^{2+} solution prior to gravistimulation, the inhibitory influence of EGTA was overcome, and the coleoptiles manifested a typical gravitropic response. Magnesium ions were inactive in the reversion of EGTA action. When Ca^{2+} was added after gravistimulation, the coleoptile capacity for polarized growth was recovered by 75%. Calcium is assumed to be necessary for the IAA-induced coleoptile bending phase after the plant has perceived and retained information about gravistimulation. [References: 15].

1608 Manske, GGB.; Luttger, AB.; Behl, RK.; Vlek, PLG. (1995) **NUTRIENT EFFICIENCY BASED ON VA MYCORRHIZAE (VAM) AND TOTAL ROOT LENGTH OF WHEAT CULTIVARS GROWN IN INDIA.** *Angewandte Botanik. 69(3-4):108-110.* English. [INT MAIZE & WHEAT IMPROVEMENT CTR APART POSTAL 6-641 CP 06600 MEXICO CITY DF MEXICO].

In an irrigated field trial in North India, the roots of all 20 wheat lines screened were infected by the native VAM fungi in the soil showing less infection with increasing fertilizer doses. The cultivars varied in their % VAM infection and total root length. With medium fertilizer treatment, improved VAM infection at the stage of tillering resulted in higher grain yields.

1609 Massiah, AJ.; Hartley, MR. (1995) **WHEAT RIBOSOME-INACTIVATING PROTEINS - SEED AND LEAF FORMS WITH DIFFERENT SPECIFICITIES AND COFACTOR REQUIREMENTS.** *Planta. 197(4):633-640.* English. [UNIV WARWICK DEPT BIOL SCI COVENTRY CV4 7AL W MIDLANDS ENGLAND].

Distinct forms of ribosome-inactivating proteins were purified from wheat (Triticum aestivum L.) germ and leaves and termed tritin-S and tritin-L, respectively. These differ in size and charge and are antigenically unrelated. They are both RNA N-glycosidases which act on 26S rRNA in native yeast (Saccharomyces cerevisiae) ribosomes by the removal of A3024 located in a universally conserved sequence in domain VII which has previously been identified as the site of action of ricin A-chain. Tritin-S and tritin-L differ in both their ribosome substrate specificities and cofactor requirements. Tritin-S shows only barely detectable activity on ribosomes from the endosperm, its tissue of synthesis, whereas tritin-L is highly active on leaf ribosomes. Additionally, tritin-S is inactive on wheat germ, tobacco leaf and Escherichia coli ribosomes but active on rabbit reticulocyte and yeast ribosomes. Tritin-L is active on ribosomes from all of the above sources. Tritin-S, unlike tritin-L shows a marked requirement for ATP in its action. [References: 48].

1610 Mckee, IF.; Farage, PK.; Long, SP. (1995) **THE INTERACTIVE EFFECTS OF ELEVATED CO2 AND O-3 CONCENTRATION ON PHOTOSYNTHESIS IN SPRING WHEAT.** *Photosynthesis Research. 45(2):111-119.* English. [UNIV ESSEX DEPT BIOL WIVENHOE PK COLCHESTER CO4 3SQ ESSEX ENGLAND].

This study investigated the interacting effects of carbon dioxide and ozone on photosynthetic physiology in the flag leaves of spring wheat (Triticum aestivum L. cv. Wembley), at three stages of development. Plants were exposed throughout their development to reciprocal combinations of two carbon dioxide and two ozone treatments: [CO2] at 350 or 700 mu mol mol(-1), [O-3] at < 5 or 60 nmol mol(-1). Gas exchange analysis, coupled spectrophotometric assay for RuBisCO activity, and SDS-PAGE, were used to examine the relative importance of pollutant effects on i) stomatal conductance, ii) quantum yield, and iii) RuBisCO activity, activation, and concentration. Independently, both elevated [CO2] and elevated [O-3] caused a loss of RuBisCO protein and V-cmax. In combination, elevated [CO2] partially protected against the deleterious effects of ozone. It did this partly by reducing stomatal conductance, and thereby reducing the effective ozone dose. Elevated [O-3] caused stomatal closure largely via its effect on photoassimilation. [References: 40].

1611 Pearson, JN.; Rengel, Z.; Jenner, CF.; Graham, RD. (1995) **TRANSPORT OF ZINC AND MANGANESE TO DEVELOPING WHEAT GRAINS.** *Physiologia Plantarum. 95(3):449-455.* English. [UNIV ADELAIDE WAITE AGR RES INST DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

An understanding of the transport pathway used by Zn and Mn to enter developing grains may allow measures to increase the Zn and Mn content of wheat grain grown on Zn/Mn deficient soils. For this reason, transport of Zn and Mn into developing grains of wheat (Triticum aestivum L. cv. Aroona) was investigated. Detached ears (18-22 days post anthesis) were cultured for 48 h in a solution containing 185 kBq of Zn-65 and 185 kBq of Mn-54. Transport of Zn-65 to the grain was unaffected by removal of glumes but was slightly reduced after the lemma was removed. Heat girdling the peduncle slightly reduced the amount of Zn-65 transported to the grain, whilst heat girdling the rachilla reduced transport of Zn-65 to the grain to a greater degree, suggesting phloem transport to the rachilla. The transport inhibitor CCCP (carbonyl cyanide m-chlorophenyl hydrazone) blocked Zn-65 transport to grain but not to lemma and glumes. Removing glumes and lemma and heat girdling the peduncle did nor affect transport of Mn-54, but transport was slightly affected by heat girdling the rachilla, indicating xylem transport. CCCP blocked transport of Mn-54 into the grain but not to lemma and glumes. It was concluded that xylem-to-phloem transfer of Zn occurs in the rachis and to a lesser extent in peduncle and lemma. The results suggest that the lemma may be an important site for phloem loading when the concentration of Zn within the xylem is high. The data also suggest that Mn was predominantly translocated to the spikelets in the xylem, but that transport to the grain was dependent upon membrane transport before entering the grain. Phloem loading of Mn into the grain vascular system may have occurred at the site of xylem discontinuity in the floral axis. [References: 25].

1612 Pessarakli, M.; Fardad, H. (1995) **NITROGEN (TOTAL AND N-15) UPTAKE BY BARLEY AND WHEAT UNDER TWO IRRIGATION REGIMES.** *Journal of Plant Nutrition. 18(12):2655-2667.* English. [UNIV ARIZONA COLL AGR TUCSON, AZ 85721 USA].

Nitrogen (total and N-15) uptake by barley (Hordeum vulgare L., cv. 'Walfajr') and wheat (Triticum aestivum L., cv. 'Karaj I') plants subjected to water stress were studied at the College of Agriculture, University of Tehran Experimental Farm located in the city of Karaj, Iran. The treatments consisted of two irrigation intervals, 7 days (control) and 14 days (stress). The plants were at the reproductive stage of growth at the start of the N-15 treatment. Nitrogen (N-15) was applied to 1m x 1m plots selected at the center of the 2.5m x 2.5m main plots. The N-15 was provided to plants by adding 250 mg N-15 as (NH4)(2)SO4 (5.1 Atom % N-15) dissolved in water to each plot. The N-15 treatment period continued for 48 hours. The plants were harvested at 6-hour intervals during the N-15 treatment period. After each harvest, the straw and the grains were separated, oven dried at 65 degrees C and dry weights were recorded. Plant materials were ground in a Wiley Mill to pass through a 2mm sieve for chemical analysis. Total N was measured by an Auto-Analyzer after Kjeldahl digestion, and N-15 was measured using a mass spectrometer. Nitrogen (total-N and N-15) content of both plant species decreased under stress, with wheat appearing more severely affected than barley. However, nitrogen concentration was slightly higher for the stressed plants as compared with the controls. This pattern was essentially similar for both plants. [References: 38].

1613 Radzevenchuk, I.F.; Sakharova, O.V. (1993) **[Sedimentation method of evaluation of light resistance in homogenates of wheat leaves]. Sedimentatsionnyj sposob otsenki ustojchivosti gomogenatov list'ev pshenitsy k svetu.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 122-125.* 7 ref. Russian. (AGRIS 96-016741).

A method of evaluation of light resistance in homogenates of wheat leaves by the rate of sedimentation is outlined. Subsequent to light exposure (150-400 wt/m**2 during 1-4 hours) followed by a dim-out the time of complete sedimentation of chloroplasts is registered, its value serving as a criterion for evaluation of varietal light resistance. The longer is the time of sedimentation, the higher is light resistance in varieties. Examples of the above method application for a comparative characteristic of varietal material are given. The possibilities of its use in breeding work are discussed.

1614 Reid, RJ.; Brookes, JD.; Tester, MA.; Smith, FA. (1996) **THE MECHANISM OF ZINC UPTAKE IN PLANTS - CHARACTERISATION OF THE LOW-AFFINITY SYSTEM.** *Planta. 198(1):39-45.* English. [UNIV ADELAIDE DEPT BOT ADELAIDE SA 5005 AUSTRALIA].

The mechanism of zinc influx was investigated using giant algal cells (Chara corallina Klein ex Will.esk. R.D. Wood), in which it was possible to discriminate clearly between tracer zinc bound in the cell wall and actual uptake into the cell. It was shown that despite lengthy desorption, retention of zinc in slowly exchanging zinc pools in the cell wall can invalidate tracer influx measurements. A comparative study of zinc desorption from isolated cell walls of wheat (Triticum aestivum L.) roots indicated exchange characteristics similar to that of Chara. Fractionation of Chara internodal cells taken directly from cultures showed that most of the cell-associated zinc was in the cell walls. The cytoplasmic and vacuolar zinc concentrations were 56 mmol . m(-3) and 32 mmol . m(-3), respectively, for cells grown in a zinc concentration of 0.1 mmol . m(-3). Influx of Zn-65 in Chara was linear over several hours, with rapid transfer to the vacuole, but only slow efflux. Influx occurred in a biphasic manner,

which was tentatively attributed to the operation of two separate transport systems, a high-affinity system which is saturated at 0.1 mmol . m(-3) and a low-affinity system which showed a linear dependence on concentration up to at least 50 mmol . m(-3). Only the low-affinity system was examined in detail. Influx through this system showed a strong dependence on external pH with an optimum around 7 and was also stimulated by cytoplasmic acidification. Influx was sensitive to metabolic inhibition, but not to blockers of Ca2+ and K+ channels. Other characteristics included a slight sensitivity to Mn2+ and Fe2+ but little sensitivity to high concentrations of K+ or Na+. Influx was independent of membrane potential difference in cells voltage-clamped at - 65 to - 300 mV. [References: 22].

1615 Reinbothe, S.; Reinbothe, C.; Holtorf, H.; Apel, K. (1995) **TWO NADPH-PROTOCHLOROPHYLLIDE OXIDOREDUCTASES IN BARLEY - EVIDENCE FOR THE SELECTIVE DISAPPEARANCE OF PORA DURING THE LIGHT-INDUCED GREENING OF ETIOLATED SEEDLINGS.** *Plant Cell. 7(11):1933-1940.* English. [ETH ZENTRUM INST PLANT SCI UNIV STR 2 CH-8092 ZURICH SWITZERLAND].

Chlorophyll synthesis in barley is controlled by two different light-dependent NADPH:protochlorophylide oxidoreductases, termed PORA and PORE, PORA is present abundantly in etioplasts but selectively disappears soon after the beginning of illumination, This negative light effect is mediated simultaneously at three different levels, First, the concentration of porA mRNA declines drastically during illumination of dark-grown seedlings, Second, the plastids' ability to import the precursor of PORA (pPORA) is reduced during the transition from etioplasts to chloroplasts. This effect is due to a rapid decline in the plastidic level of protochlorophyllide (Pchlide), which is required for the translocation of the pPORA, Third, PORA becomes selectively destabilized in illuminated seedlings, When illuminated, PORA-Pchlide-NADPH complexes formed in the dark photoreduce their Pchlide to Chlide and become simultaneously susceptible to attack by plastid proteases, The PORA-degrading protease activity is not detectable in etioplasts but is induced during illumination, In contrast to PORA, the second Pchlide-reducing enzyme, PORE, remains operative in both illuminated and green plants, Its translocation into plastids does not depend on its substrate, Pchlide. [References: 34].

1616 Rengel, Z. (1995) **CARBONIC ANHYDRASE ACTIVITY IN LEAVES OF WHEAT GENOTYPES DIFFERING IN ZN EFFICIENCY.** *Journal of Plant Physiology. 147(2):251-256.* English. [UNIV ADELAIDE DEPT PLANT SCI GLEN OSMOND SA 5064 AUSTRALIA].

Activity of carbonic anhydrase (CA) (EC 4.2.1.1) was determined in leaf extracts of two wheat genotypes (Triticum aestivum L., cv. Warigal, and T. turgidum L. conv. durum (Desf.) MacKey, cv. Durati) differing in Zn efficiency. Generally, CA activity decreased with plant age in both genotypes. Under sufficient Zn supply, the two genotypes had the same CA activity; under Zn deficiency, however, a 2-fold higher CA activity was recorded for Zn-efficient Warigal than for Zn-inefficient Durati. When Zn-sufficient plants were transferred into solutions with low Zn supply, plants of the cv. Durati lost a greater portion of CA activity than those of the cv. Warigal. Upon re-supply of Zn to the Zn-deficient plants, Durati lost an ability to increase CA activity, while Warigal showed a saturating, curvilinear increase in CA activity under the same conditions. For any given Zn concentration in leaf tissue, Zn-efficient Warigal showed greater CA activity than Zn-inefficient Durati. An ability of Zn-efficient wheat genotypes to maintain greater CA activity under Zn deficiency may be beneficial in maintaining the photosynthetic rate and dry matter production at a higher level, a characteristic that may be especially important for wheat as a species with inherently lower CA activity compared to other species. [References: 31].

1617 Rengel, Z. (1995) **SULFHYDRYL GROUPS IN ROOT-CELL PLASMA MEMBRANES OF WHEAT GENOTYPES DIFFERING IN ZN EFFICIENCY.** *Physiologia Plantarum. 95(4):604-612.* English. [UNIV ADELAIDE WAITE AGR RES INST GLEN OSMOND SA 5064 AUSTRALIA].

Sulfhydryl groups were quantified in root-cell plasma membranes of two genotypes of wheat (Triticum aestivum cv. Warigal and I: turgidum conv. durum cv. Durati) differing in Zn efficiency. Smaller amounts of 5, 5'-dithio-bis (2-nitrobenzoic acid)-reactive sulfhydryl groups were found in Zn-deficient than in Zn-sufficient roots; and also in Zn-inefficient genotype Durati compared to Zn-efficient Warigal, regardless of Zn supply. Upon transfer of 15-day-old Zn-deficient plants into solutions containing various Zn2+ activities, a Zn-dependent increase in the amount of reactive sulfhydryl groups was evident in roots of both genotypes, but occurred only in Warigal when 20-day-old plants were used, indicating irreversible physiological damage in Durati plants due to prolonged Zn deficiency Upon transfer into solutions of increasing Zn2+ activities, the increase in total Zn concentration in roots was about an order of magnitude smaller than the increase in amounts of reactive sulfhydryl groups in the roots of both genotypes, suggesting that, in wheat roots, a relatively small amount of Zn is required for preventing oxidation of sulfhydryl groups into disulfides. The amount of reactive sulfhydryl groups in the roots is positively related to Zn efficiency of wheat genotypes and may be one of the mechanisms that, under conditions of Zn deficiency, allow better growth and productivity of Zn-efficient genotypes in comparison to Zn-inefficient ones. [References: 33].

1618 Rodriguez, D.; Goudriaan, J. (1995) **EFFECTS OF PHOSPHORUS AND DROUGHT STRESSES ON DRY MATTER AND PHOSPHORUS ALLOCATION IN WHEAT.** *Journal of Plant Nutrition. 18(11):2501-2517.* English. [UNIV BUENOS AIRES FAC AGRON CATEDRA FERTILIDAD & FERTILIZANTES AV SAN MARTIN 4453 RA-1417 BUENOS AIRES DF ARGENTINA].

The effect of phosphorus (P) and soil water availability (W) on the growth and development of wheat plants (Triticum aestivum L. cv. Minaret) was studied in a pot experiment. Four levels of P supply (0, 15, 30, and 100 mu gP/g soil) were applied before sowing. Thirty-four days after sowing (DAS), the pots were kept near 100% of field capacity (FC). From 34 DAS until one week before anthesis (67 DAS), half of the pots were maintained between 60-70% FC. Control pots were kept at 85-95% FC by weighing and watering the pots every two to three days. Shoots were harvested four times before anthesis and twice after. At each harvest, dry matter and P accumulation were measured in leaves, stems, and ears. In this study, thermal time until anthesis was inversely related to the level of P application. Phosphorus additioning affected the allocation of biomass and P in aerial plant organs. Plants growing only with soil P showed a delay in the allocation of dry matter and P into leaves and stems with respect to plants fertilized with 100 mu g P/g of soil. In this study, the final composition of the grain depended on re-mobilization from other plant organs. Evidence of independent re-mobilization of carbohydrates and P towards the ear is presented, and the pattern of plant development as well as the relationships between development and dry matter and P allocation are discussed. [References: 24].

1619 Sharma, DC.; Chatterjee, C.; Sharma, CP. (1995) **CHROMIUM ACCUMULATION AND ITS EFFECTS ON WHEAT (TRITICUM AESTIVUM L CV HD 2204) METABOLISM.** *Plant Science. 111(2):145-151.* English. [UNIV LUCKNOW DEPT BOT LUCKNOW 226007 UTTAR PRADESH INDIA].

Chromium accumulation and its effect at graded concentration on certain metabolic activities in wheat (Triticum aestivum L. cv. HD 2204) were investigated under controlled glasshouse conditions. Low concentrations of Cr(VI) supply induced interveinal chlorosis in the young leaves which turned to necrosis at later stages of growth. *Chromium* supply severely affected chlorophyll and Hill activity. The activity of catalase in young leaves was impaired by an increase in Cr(VI) supply from 0.05 to 1.0 mM. The concentration of protein nitrogen decreased and that of reducing sugars increased. Chromium accumulation was greater in stems followed by leaves at higher levels but at low levels of Cr(VI) supply, the accumulation was higher in the rachilla as compared to the stem. In response to chromium supply, grain yield was severely affected and even no seed formation was observed at 1.0 mM Cr(VI). In view of the above findings, it was concluded that chromium Cr(VI) is inhibitory to metabolism and a contributory factor in phytotoxicity of wheat. [References: 28].

1620 Siebrecht, S.; Mack, G.; Tischner, R. (1995) **FUNCTION AND CONTRIBUTION OF THE ROOT TIP IN THE INDUCTION OF NO3-,**

UPTAKE ALONG THE BARLEY ROOT AXIS. *Journal of Experimental Botany. 46(292):1669-1676.* English. [UNIV GOTTINGEN INST PFLANZENPHYSIOL UNTERE KARSPULE 2 D-37073 GOTTINGEN GERMANY].

The seminal roots of N-free-grown barley seedlings were able to take up NO3- immediately upon initial exposure; the uptake rate in the tip was half of that in the older root zones (middle and base). A lag of 60 min was required in all root zones before the uptake rates started to increase during induction with external NO3-. This increase could be prevented by the addition of pFPA; we thus assume that additional NO3- transport proteins were synthesized during NO3- induction. During the time-course of NO3- induction different uptake rates were measured in morphologically different regions of the tip (1 mm segments) indicating a regulation of NO3- induction on a narrow local scale. In NO3--grown plants, NO3- uptake as well as NO3- content increased basipetally along the root axis concomitantly with increasing vacuolization of the cells. Although NO3- uptake into the tip was only half of that into the older root zones, this NO3- uptake was very important for the entire root. Firstly, it provided the substrate for protein biosynthesis in the meristematic region: nitrate reductase activity and total soluble protein were highest in the first apical mm of the tip. Secondly, 3% of the NO3- taken up by the tip was found in the base where it induced NO3- uptake: NO3- was translocated almost exclusively basipetally and as little as 20 nmol g(-1) root fr. wt. translocated from the tip were sufficient for acceleration of NO3- induction in the root base of N-free-grown plants. This clearly shows that the induction of NO3- uptake does not depend exclusively on the availability of external NO3- but can be mediated also with internally translocated NO3-. The root tip, therefore, may be considered the NO3- sensing region of the root. [References: 35].

1621 Suzuki, A.; Burkhart, W.; Rothstein, S. (1996) **NITROGEN EFFECTS ON THE INDUCTION OF FERREDOXIN-DEPENDENT GLUTAMATE SYNTHASE AND ITS MRNA IN MAIZE LEAVES UNDER THE LIGHT.** *Plant Science. 114(1):83-91.* English. [INRA LAB METAB & NUTR PLANTES ROUTE ST CYR F-78026 VERSAILLES FRANCE].

Changes in the levels of ferredoxin (Fd)-dependent glutamate synthase (EC 1.4.7.1) and its mRNA were investigated in leaves of maize (Zea mays L. cv DEA). In etiolated leaves, detached from nitrogen-starved dark-grown seedlings, Fd-glutamate synthase was present at a low level. The enzyme protein and the activity were induced from 3- to 5-fold during the 35 h after transfer of etiolated leaves to a medium containing either 10 mM KNO3, 10 mM NH4Cl or 10 mM NH4NO3 under the continuous photosynthetic photon flux density of 300 mu mol quanta/m(2) per s. A slight increase in the activity occurred in the leaves grown in a nitrogen-free medium under continuous light. The increase in the enzyme activity was paralleled by the incorporation of L-[S-35]methionine in the medium into the Fd-glutamate synthase polypeptide under the same conditions. The production of the enzyme protein and the uptake of labeled amino acid into the enzyme protein were blocked by adding 71 mu M cycloheximide to the medium supplemented with KNO3, NH4Cl or NH4NO3. The addition of the different nitrogenous compounds under continuous darkness did not significantly alter the Fd-glutamate synthase activity and L-[S-35]methionine incorporation into the enzyme protein. A partial cDNA of 2479 base pairs long encoding maize Fd-glutamate synthase was cloned and characterized. Using this cDNA as hybridization probe, Fd-glutamate synthase mRNA was observed to be present at a low level in nitrogen-starved etiolated leaves. The mRNA increased about 5-fold when etiolated leaves were incubated under continuous light in a medium containing either 10 mM KNO3, 10 mM NH4Cl or LD mM NH4NO3. The level of mRNA was also slightly enhanced in the leaves incubated in a nitrogen-free medium under the light. The exogenous nitrogen compounds did not increase the level of the mRNA under continuous darkness. The presence of 71 mu M cycloheximide in either of the media did not significantly change the level of the transcript during the initial 6 h. The induction of mRNA in the presence of exogenous nitrogen under the light was consistent with a protein synthesis-independent process in maize leaves. [References: 42].

1622 Uprety, DC.; Mishra, RS.; Abrol, YP. (1995) **EFFECT OF ELEVATED CO2 ON THE PHOTOSYNTHESIS, GROWTH AND WATER RELATION OF BRASSICA SPECIES UNDER MOISTURE STRESS.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(4):231-237.* English. [INDIAN AGR RES INST DIV PLANT PHYSIOL NEW DELHI 110012 INDIA].

An attempt has been made to study the interactive effect of elevated CO2 and moisture stress on photosynthesis, growth and water relations of Brassica species using open top chambers. It was observed that plants responded to elevated CO2 significantly under moisture stress condition mitigating the adverse effects on photosynthesis and growth of Brassica species. Relatively drought susceptible species, viz. B. campestris and B. nigra, responded to elevated CO2 markedly as compared to less sensitive B. carinata and B. juncea plants. The water status of plants significantly improved under elevated CO2 concentration possibly by increasing stomatal resistance and/or by increased root growth. [References: 16].

1623 Xu, Q.; Henry, RL.; Guikema, JA.; Paulsen, GM. (1995) **ASSOCIATION OF HIGH-TEMPERATURE INJURY WITH INCREASED SENSITIVITY OF PHOTOSYNTHESIS TO ABSCISIC ACID IN WHEAT.** *Environmental & Experimental Botany. 35(4):441 ff.* English. [UNIV CALIF BERKELEY DEPT PLANT BIOL 451 KOSHLAND HALL BERKELEY, CA 94720 USA].

Photosynthetic responses of intact seedlings and detached leaves of wheat (Triticum aestivum L. cv. Len) exposed to 0 or 100 mu M (+/-)-ABA were investigated at 15, 25, or 35 degrees C. Photosynthetic gas exchange of intact seedlings and Chl variable fluorescence of detached leaves were nearly constant at 15 degrees C but decreased steadily over time at 35 degrees C; (+/-)-ABA accentuated the decline and was increasingly efficacious as the temperature rose. Thylakoid Chi and protein contents and PSII activity changed slowly and responded slightly to (I)-ABA at 15 degrees C but declined rapidly at 35 degrees C with (+/-)-ABA. Analyses of Chi fluorescence spectra at 77K indicated that high temperature and (+/-)-ABA altered the microenvironment of Chi beds in thylakoid membranes, shifting emission by Chi-binding proteins of PSII and causing preferential loss of PSI antenna pigments. Immunodetection levels of Chi-binding proteins, such as LHCII, LHCI, and the P700 apoproteins of PSI, declined after high temperature and (+/-)-ABA treatments; Western blots detected single bands of Chi-binding proteins in intact seedlings and multiple aberrant bands in detached leaves. Their similar effects and synergistic interactions indicate that ABA may be involved in high-temperature injury to photosynthetic processes. [References: 43].

1624 Zhang, GC.; Archambault, DJ.; Slaski, JJ.; Taylor, GJ. (1995) **EFFECTS OF PROTEIN SYNTHESIS INHIBITORS ON UPTAKE OF ALUMINIUM IN ALUMINIUM-RESISTANT AND ALUMINIUM-SENSITIVE CULTIVARS OF WHEAT.** *Journal of Plant Physiology. 147(3-4):457-462.* English. [UNIV ALBERTA DEPT BIOL SCI EDMONTON AB T6G 2E9 CANADA].

The effects of two inhibitors of protein synthesis on the kinetics of Al uptake by excised roots of Al-resistant cultivars (Atlas 66 and PT 741) and Al-sensitive cultivars (Neepawa and Scout 66) of wheat were investigated. Treatment of intact roots of the Al-sensitive cultivar, Neepawa, with cycloheximide (0 to 5 mM) showed that this inhibitor was more effective in reducing incorporation of S-35 into microsomal membrane proteins than into total proteins. Cycloheximide at 0.25 mM reduced incorporation of S-35 into microsomal membrane proteins by 68%, while a 21% reduction into total proteins was observed. Cycloheximide at 1.0 mM was sufficient to induce maximal inhibition of S-35 incorporation into both microsomal membrane (72%) and total (40%) proteins. At this concentration, cycloheximide caused quantitative differences in short-term (3 h) Al uptake between Al-resistant and Al-sensitive genotypes. A significant decrease in rates of Al uptake was observed in both Al-sensitive cultivars (24 and 29%), while no significant effect was observed in the Al-resistant cultivars. These results are in contrast to previous results from long-term experiments (6 and 12 h), where cycloheximide stimulated Al uptake in an Al-resistant cultivar, Atlas 66 (Aniol, 1984; Rincon and Gonzales, 1992). In experiments where Al uptake was measured after a 4-h pretreatment with 1.0 mM cycloheximide (7 h total exposure), a stimulation of uptake (45%) was observed in the Al-sensitive cultivar, Neepawa. Thus, time of exposure is an important experimental variable that can account for contradicting results in the literature. In both resistant and sensitive cultivars, treatment

with chloramphenicol, an inhibitor of prokaryotic protein synthesis, had no effect on the kinetics of Al uptake. Possible mechanisms whereby protein synthesis might affect Al uptake in Al-resistant and Al-sensitive genotypes are discussed. [References: 18].

F62 PLANT PHYSIOLOGY-GROWTH AND DEVELOPMENT

1625 Aksenova, L.A.; Dunaeva, M.V.; Zak, E.A.; Osipov, Yu.F.; Klyachko, N.L. (1994) **[Effect of Tween 80 on germination of seeds in winter wheat varieties which differ in drought resistance]. Vliyanie Tvina 80 na prorastanie semyan sortov ozimoj pshenitsy, razlichayushchikhsya po zasukhoustojchivosti.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 634-637.* 10 ref. Russian. (AGRIS 96-016875).

1626 Alamgir, ANM.; Akhtar, SS.; Baset, QA. (1995) **EFFECT OF SALINITY AND GA-3 ON SEED GERMINATION, AMYLASE ACTIVITY, GROWTH AND YIELD OF WHEAT.** *Bangladesh Journal of Botany. 24(2):193-196.* English. [UNIV CHITTAGONG DEPT BOT CHITTAGONG 4331 BANGLADESH].

1627 Barnes, JD.; Ollerenshaw, JH.; Whitfield, CP. (1995) **EFFECTS OF ELEVATED CO2 AND/OR O-3 ON GROWTH, DEVELOPMENT AND PHYSIOLOGY OF WHEAT (TRITICUM AESTIVUM L).** *Global Change Biology. 1(2):129-142.* English. [UNIV NEWCASTLE UPON TYNE FAC AGR & FOOD SCI DEPT AGR & ENVIRONM SCI RIDLEY BLDG NEWCASTLE UPON TYNE NE1 7RU TYNE & WEAR ENGLAND].

Two cultivars of spring wheat (Triticum aestivum L. cvs. Alexandria and Hanno) and three cultivars of winter wheat (cvs. Riband, Mercia and Haven) were grown at two concentrations of CO2 [ambient (355 mu mol mol(-1)) and elevated (708 mu mol mol(-1))] under two O-3 regimes [clean air (< 5 nmol mol(-1) O-3) and polluted air (15 nmol mol(-1) O-3 at night rising to a midday maximum of 75 nmol mol(-1))] in a phytotron at the University of Newcastle-upon-Tyne. Between the two-leaf stage and anthesis, measurements of leaf gas-exchange, non-structural carbohydrate content, visible O-3 damage, growth, dry matter partitioning, yield components and root development were made in order to examine responses to elevated CO2 and/or O-3. Growth at elevated CO2 resulted in a sustained increase in the rate of CO2 assimilation, but after roughly 6 weeks' exposure there was evidence of a slight decline in the photosynthetic rate (c.-15%) measured under growth conditions which was most pronounced in the winter cultivars. Enhanced rates of CO2 assimilation were accompanied by a decrease in stomatal conductance which improved the instantaneous water use efficiency of individual leaves. CO2 enrichment stimulated shoot and root growth to an equivalent extent, and increased tillering and yield components, however, non-structural carbohydrates still accumulated in source leaves. In contrast, long-term exposure to O-3 resulted in a decreased CO2 assimilation rate (c.-13%), partial stomatal closure, and the accumulation of fructan and starch in leaves in the light. These effects were manifested in decreased rates of shoot and root growth, with root growth more severely affected than shoot growth. In the combined treatment growth of O-3-treated plants was enhanced by elevated CO2, but there was little evidence that CO2 enrichment afforded additional protection against O-3 damage. The reduction in growth induced by O-3 at elevated CO2 was similar to that induced by O-3 at ambient CO2 despite additive effects of the individual gases on stomatal conductance that would be expected to reduce the O-3 flux by 20%, and also CO2-induced increases in the provision of substrates for detoxification and repair processes. These observations suggest that CO2 enrichment may render plants more susceptible to O-3 damage at the cellular level. Possible mechanisms are discussed. [References: 85].

1628 Bigiarini, L.; Pieri, N.; Grilli, I.; Galleschi, L.; Capocchi, A.; Fontanini, D. (1995) **HYDROLYSIS OF GLIADIN DURING GERMINATION OF WHEAT SEEDS.** *Journal of Plant Physiology. 147(2):161-167.* English. [UNIV PISA DEPT BOT SCI VIA LUCA GHINI 5 I-56126 PISA ITALY].

The in vivo degradation of gliadin has been studied using sodium dodecyl sulfate-polyacrylamide gel electrophoresis and reversed-phase high performance liquid chromatography. Both analyses show the appearance of a small number of degradation products and the early disappearance of some gliadin components during the course of germination. These components thus appear to be subject to preferential breakdown, the omega-gliadin fraction being the first to be degraded. The in vitro degradation of total gliadin or selected gliadin fractions, performed by the main endopeptidase appearing during wheat germination, reveals a transient accumulation of intermediates, which were subsequently degraded to small peptides. These data suggest that the relatively small amount of intermediates formed during wheat germination might be due to the concerted action of the cysteine proteinase and of the carboxypeptidases. Since these enzymes have high activities during the course of seed germination, they might cause a rapid degradation of intermediates before they can accumulate. [References: 34].

1629 Choudhury, NK.; Choe, HT. (1996) **PHOTOPROTECTIVE EFFECT OF KINETIN ON PIGMENT CONTENT AND PHOTOCHEMICAL ACTIVITIES OF WHEAT CHLOROPLASTS AGING IN VITRO.** *Biologia Plantarum. 38(1):61-69.* English. [MANKATO STATE UNIV DEPT BIOL SCI MANKATO, MN 56002 USA].

The effects of kinetin (Kn) on pigment content and electron transport activities (ETA) in wheat leaves in vivo and chloroplasts in vitro aging in light was investigated. Excised wheat leaves were infiltrated with Kn for 3 h under irradiation. The treatment increased zeaxanthin (Zx) content by 40% and also increased chlorophyll (Chl a, Chl b) and major carotenoid (Car) contents in the leaves (per fresh mass unit). Chloroplasts isolated from Kn treated leaves, when incubated in light for 4 h showed relatively lower pigment loss and slower loss of ETA compared to the chloroplasts of untreated leaves. These observations suggest photoprotective action of Kn. The photoprotection was more prominent when Kn was applied directly to the irradiated chloroplasts in vitro. Moreover, chloroplasts aging in vitro under irradiation without Kn treatment lost pigments and ETA. Within 3 h of irradiation, both whole chain (H2O to methylviologen) electron transport as well as photosystem (PS) 2 activity were completely lost. However, in the chloroplasts treated with Kn, the loss of pigments was slow and even after 4 h of irradiation the chloroplasts retained 15% of PS 2 and 9% of whole chain ETA. In the untreated chloroplasts, the loss of Zx after 4 h of irradiation was 49% whereas in Kn treated samples its level was 1.3 times higher than that of control. Since a higher level of Zx was maintained in Kn treated chloroplasts, photoprotective action of Kn is possibly mediated through Zx. [References: 25].

1630 Creus, CM.; Sueldo, RJ.; Barassi, CA. (1996) **AZOSPIRILLUM INOCULATION IN PREGERMINATING WHEAT SEEDS.** *Canadian Journal of Microbiology. 42(1):83-86.* English. [UNIV NACL MAR PLATA INTA FAC CIENCIAS AGRARIAS UNIDAD INTEGRADA CC 276 RA-7620 BALCARCE ARGENTINA].

Azospirillum cells were inoculated in pregerminating wheat during seed imbibition. Surface-sterilized seeds of Triticum aestivum cv. Buck Pucara were sequentially soaked for 3 h in water and 3 h in the inoculum of 3 x 10(8) Azospirillum brasilense Sp 245 cells . mL(-1), to allow bacteria to enter during imbibition. Germination and seedling growth were accomplished in sterile distilled water at 20 degrees C, in the dark. To compare with more traditional methods based on plant-Azospirillum colonization after germination, seedlings from noninoculated seeds were inoculated in parallel by immersing roots in the same inoculum, for the same period of time. Autoclaved inocula were used as controls in all cases. We observed about 5 x 10(8) Azospirillum cells . g(-1) fresh weight in 11-day-old wheat seedlings inoculated before or after seed germination. However, roots from seed-inoculated seedlings had higher both bacterial concentration and length. On the other hand, seeds inoculated during imbibition and dried to 14% water content retained 3.7 x 10(6) viable cells . g(-1) dry weight up to 27 days. Moreover, seeds stored for 30 days were not only able to germinate but also to harbor over 10(6) cells g(-1) fresh weight in roots after 7 days growth. Here we present the possibility of obtaining in a simple and inexpensive way, seeds containing high numbers of viable Azospirillum cells, which could avoid the use of external carriers or adhesives. [References: 22].

1631 Cuello, J.; Quiles, MJ.; Rosauro, J.; Sabater, B. (1995) **EFFECTS OF GROWTH REGULATORS AND LIGHT ON CHLOROPLASTS NAD(P)H DEHYDROGENASE ACTIVITIES OF SENESCENT BARLEY**

LEAVES. *Plant Growth Regulation. 17(3):225-232.* English. [UNIV ALCALA DE HENARES FAC BIOL DEPT BIOL VEGETAL E-28871 MADRID SPAIN].

The activities NADH and NADPH dehydrogenases were measured with ferricyanide as electron-acceptor (NADH-FeCN-ox and NADPH-FeCN-ox, respectively) in mitochondria-free chloroplasts of barley leaf segments after receiving various treatments affecting senescence. NADPH-FeCN-ox declined during senescence in the dark, in a way similar to chlorophyll and Hill reaction, and increased when leaf segments were incubated at light. These results suggest that NADPH-FeCN-ox is related to some photosynthetic electron transporter activity (probably ferredoxin-NADP(+) oxidoreductase). In contrast, NADH-FeCN-ox is notably stable during senescence in the dark and at light. This activity increased during incubation with kinetin or methyl-jasmonate (Me-JA) but decreased when leaf segments were treated with abscisic acid (ABA). The effects of the inhibitors of protein synthesis cycloheximide and chloramphenicol suggest that the changes of NAD(P)H dehydrogenase activities may depend on protein synthesis in chloroplasts. In senescent leaf, chloroplast NADH dehydrogenase might be a way td dissipate NADH produced in the degradation of excess carbon which is released from the degradation of amino acids. [References: 23].

1632 Dominguez, F.; Cejudo, FJ. (1995) **PATTERN OF ENDOPROTEOLYSIS FOLLOWING WHEAT GRAIN GERMINATION.** *Physiologia Plantarum. 95(2):253-259.* English. [UNIV SEVILLA INST BIOQUIM VEGETAL & FOTOSINTESIS APARTADO 553 E-41080 SEVILLE SPAIN].

Following cereal grain germination the starch and storage proteins accumulated in the starchy endosperm are mobilized by the concerted action of hydrolytic enzymes, such as amylases and proteases, that are produced and secreted by the scutellum and the aleurone layer. We have studied the pattern of endoproteolytic activities following wheat (Triticum aestivum cv. Chinese Spring) grain germination using SDS-PAGE containing a gradient of polyacrylamide copolymerized with gelatin, an artificial substrate for plant proteases. Total proteolytic activity increased as seedling growth proceeded and reached a maximum 5-7 days after imbibition. Up to 20 proteolytic bands could be detected in extracts from these grains. The bands were arbitrarily classified into 3 groups; endoproteases of groups I and II showed higher activity at pH 6.5, while those of group III had maximum activity at pH 4.0. Most of group II and III endoproteases were produced by the aleurone layer and scutellum and secreted to the starchy endosperm. The synthesis of most of the proteases of group III, but not of group II, was activated by exogenous GA(3) in de-embryonated wheat grains. Based on activation by thiol-reagents and inhibition by thiol-protease inhibitors, it was determined that GA(3)-induced proteases were thiol-proteases. [References: 30].

1633 Fardad, H.; Pessarakli, M. (1995) **BIOMASS PRODUCTION AND WATER USE EFFICIENCY OF BARLEY AND WHEAT PLANTS WITH DIFFERENT IRRIGATION INTERVALS AT VARIOUS WATER LEVELS.** *Journal of Plant Nutrition. 18(12):2643-2654.* English. [UNIV TEHERAN COLL AGR KARAJ IRAN].

Biomass production in terms of dry-matter yield of both straw and grains of barley (*Hordeum vulgare* L., cv. 'Walfajr') and wheat (Triticum aestivum L., cv. 'Karaj I') plants subjected to water stress were studied at the College of Agriculture, University of Tehran Experimental farm located in the city of Karaj, Iran. The treatments consisted of two irrigation intervals, 7 and 14 days. Six water levels, 100, 80, 60, 40, 20, and 0% of the crops' total water requirements were used at each irrigation interval. The experimental units consisted of 2.5m x 2.5m plots replicated three times for each treatment. A 1m x 1m sub-plot at the center of each 2.5m x 2.5m plot was selected and the plants were harvested to prevent border effects. After each harvest, the straw and the grains were separated and weighed. Total dry-matter yield of straw and grains significantly decreased by decreasing applied water levels (especially, at the lower water levels, 40, 20, and 0%) and increasing irrigation intervals for both plants. Water use efficiency (WUE) was higher at the higher applied water levels for the straw than for the grains for barley, however, the trend was reverse for wheat plants. The WUE decreased for straw by deceasing applied water in both barley and wheat plants. [References: 32].

1634 Fenn, LB.; Hasanein, B.; Burks, CM. (1995) **CALCIUM-AMMONIUM EFFECTS ON GROWTH AND YIELD OF SMALL GRAINS.** *Agronomy Journal. 87(6):1041-1046.* English. [TEXAS A&M UNIV TEXAS AGR EXPT STN 1380 A&M CIRCLE EL PASO, TX 79927 USA].

Calcium (Ca++) is known to stimulate potassium (K+) and ammonium (NH4+) absorption rates by plants. Increased NH4+ absorption stimulates plant growth and development. However, little is known about the effect of Ca++ with NH4+ on small-grain crops. The objective of this research was to examine the effect of Ca++/NH4+ on growth and development of wheat (Triticum aestivum L.), oat (Avena sativa L.), and barley (Hordeum vulgare L.). Treatments consisted of growing small grains using complete nutrient solutions with a molar ratio of 0, 0.30, 0.60, 1.20 and 1.80 Ca++/NH4+, and a check with NO3–N. Plants were grown in the greenhouse to seedling (30 d), intermediate (elongating, 60 d), and mature (booting, 90 d) growth stages on a NO3- nutrient solution and then treated for 7 d with the Ca++/NH4+ fertilizer solutions. One set of plants was fertilized solely with the Ca++/NH4+ solution and another with a NO3-fertilizer solution. The addition of Ca++ with NH4+ to small grains resulted in increased N absorption, grain yield, tiller formation, dry matter, and grain weight per unit of plant dry matter, but the extent varied with the crop. Calcium apparently caused a redirection of foliar metabolites to grains. Short-term treatments with Ca++/NH4+ at different growth stages showed the least results at the seedling stage, whereas maximum results were obtained at the intermediate growth stage (initiation of jointing) and good stimulation of plant growth and tillering at the mature (booting) stage. Calcium increased NH4+ absorption, leading to increased tillering, increased weight per head of grain produced, and consequently higher grain yields. Calcium added with NH4+-N increases plant N use efficiency by more rapid absorption, greater rates of tillering, greater metabolite deposition in seeds, and possibly increases in photosynthesis. [References: 21].

1635 Gan, YT.; Stobbe, EH.; Njue, C. (1996) **EVALUATION OF SELECTED NONLINEAR REGRESSION MODELS IN QUANTIFYING SEEDLING EMERGENCE RATE OF SPRING WHEAT.** *Crop Science. 36(1):165-168.* English. [AGR & AGRI FOOD CANADA SEMIARID PRAIRIE AGR RES CTR SWIFT CURRENT SK S9H 3X2 CANADA].

Fast and uniform seedling emergence increases yield potential of spring wheat (Triticum aestivum L.) in short-season areas. An accurate method of quantifying rate of seedling emergence is needed. In this study, we compared the relative effectiveness of the Gompertz, Logistic, and Weibull models in quantifying emergence rate of spring wheat. 'Roblin' wheat was grown in a growth room under five soil water potential: -0.002, -0.165, -0.41, -1.00, and -1.45 MPa. Daily-recorded emergence data were fitted to each of the models. The analyses of stability and accuracy functions, residual sum of squares, and variance showed that the Weibull model was not appropriate in quantifying rate of emergence. The Gompertz and Logistic models functioned in a similar way with great stability and accuracy in most cases. The Gompertz predictions most closely fitted the observed set of responses with residual points scattered around zero. For lognormally distributed emergence patterns common under field conditions, the Gompertz model provided the most appropriate characterization of emergence. [References: 9].

1636 Grass, L.; Burris, JS. (1995) **EFFECT OF HEAT STRESS DURING SEED DEVELOPMENT AND MATURATION ON WHEAT (TRITICUM DURUM) SEED QUALITY .1. SEED GERMINATION AND SEEDLING VIGOR.** *Canadian Journal of Plant Science. 75(4):821-829.* English. [INRA CRRA BP 589 SETTAT MOROCCO].

Two wheat cultivars, Marzak and Oum-rabia, were subjected to three temperature regimes (20/15, 28/21, 36/29 degrees C) beginning 10 d after anthesis to maturity. As expected, high temperature resulted in low values of both seed yield and physical traits of seed quality. The effect of temperature on seed germination was not consistent among the two cultivars. High temperature during seed development and maturity had no effect on seed germination of Oum-rabia, whereas it decreased seed germination of Marzak. In contrast to seed germination, seed vigor was adversely affected by heat stress. This decline in seed vigor was reflected in reduced shoot and root dry weight, increased shoot/root ratio, reduced

root length, low root number per seedling, and high seed conductivity. Excised embryo culture showed marked differences in the embryo growth potential. Although embryos from all treatments had germinated, a delay of 24-48 h was observed in the germination of embryos excised from seeds grown under high temperature conditions. Also, their shoot and radicle development over time lagged behind that of embryos isolated from seeds grown under cool temperature conditions. Exposing seeds to high temperature during development and maturity also resulted in low embryo oxygen uptake. Results presented in this study show that the growing conditions, in this instance temperature, of the parent plant affect the quality of its seed. [References: 36].

1637 Grass, L.; Burris, JS. (1995) **EFFECT OF HEAT STRESS DURING SEED DEVELOPMENT AND MATURATION ON WHEAT (TRITICUM DURUM) SEED QUALITY .2. MITOCHONDRIAL RESPIRATION AND NUCLEOTIDE POOLS DURING EARLY GERMINATION.** *Canadian Journal of Plant Science. 75(4):831-839.* English. [INRA CRRA BP 589 SETTAT MOROCCO].

Marzak and Oum-rabia wheat seeds were produced under three temperature regimes (20:15, 28:21, 36:29 degrees C) starting 10 d after anthesis through harvest. Nucleotide levels and respiratory activity of mitochondria isolated from imbibing embryos were determined. Mitochondrial structure from the radicle meristem region of imbibed embryos was examined under electron microscopy. Embryos from low-temperature treatments showed rapid accumulation of adenosine triphosphate (ATP) and higher energy levels and rates of oxygen uptake than embryos from high-temperature treatments. Embryos from medium-temperature treatments exhibited intermediate values. Parallel to these metabolic changes during early seed germination, results from electron microscopy revealed visible differences in mitochondrial structure. Mitochondria from the low-temperature regime were well developed with visible membranes and cristae; those from the high-temperature regime were degenerating. These results provide clear evidence of the influence of parent temperature conditions on the seed metabolism during early stages of germination. [References: 30].

1638 Huang, J.; Redmann, RE. (1995) **SALT TOLERANCE OF HORDEUM AND BRASSICA SPECIES DURING GERMINATION AND EARLY SEEDLING GROWTH.** *Canadian Journal of Plant Science. 75(4):815-819.* English. [UNIV SASKATCHEWAN DEPT CROP SCI & PLANT ECOL SASKATOON SK S7N 0W0 CANADA].

Germination response and early seedling growth of barley (Hordeum vulgare L. 'Franklin', 'Harrington' and 'Abee'), wild barley (H.jubatum L.), canola (Brassica napus L,. 'Excel') and wild mustard (B. kaber L. C. Wheeler) were investigated in iso-osmotic solutions of salts (NaCl, Na2SO4 + MgSO4) and polyethylene glycol (PEG) with osmotic potentials close to -0.9 MPa. Germination of Harrington and wild barley was reduced most by the non-penetrating solute PEG, suggesting that ion penetration might have reduced osmotic stress in the salt treatments. Wild barley was more salt tolerant than Harrington based on seedling growth relative to control plants. Of the three barley cultivars, Franklin was similar in salt tolerance to Harrington, while Abee was the most sensitive to all osmotica tested. Barley varieties had the lowest germination rate and poorest seedling growth in the PEG treatment. Compared with canola, wild mustard showed consistently greater tolerance to all osmotica during germination and early seedling growth. Germination of the Brassica species was more sensitive to NaCl than to mixed sulphate salts. Additional calcium enhanced germination and improved seedling growth in Brassica species, especially in the PEG and NaCl treatments. [References: 31].

1639 Kameli, A.; Losel, DM. (1996) **GROWTH AND SUGAR ACCUMULATION IN DURUM WHEAT PLANTS UNDER WATER STRESS.** *New Phytologist. 132(1):57-62.* English. [UNIV SHEFFIELD DEPT ANIM & PLANT SCI SHEFFIELD S10 2TN S YORKSHIRE ENGLAND].

The effect of water stress on growth of Triticum durum L. was investigated in relation to sugar accumulation and water status of wheat plants before, during and after a period of water stress. The slight decrease in water potential in the first few days after withholding water had no detectable effect on growth. Inhibition of growth was only apparent when the water content started to decline. Dry weight continued to increase during water stress, even under severe stress (after day 27) which was associated with a sharp rise in sugar content, accounting for 20% of the gain in dry matter between days 27 and 31. The increase in leaf length and leaf area of stressed plants following re-watering, from day 31, was owing to the leaves regaining turgidity after wilting. Growth inhibition coincided with a considerable increase in sugar content. The role of growth inhibition and other factors in sugar accumulation under water stress is discussed. Photosynthesis rather than reserve starch might be the major source of sugar accumulated under water stress in durum wheat. [References: 37].

1640 Koshkin, V.A.; Ivanova, O.A.; Matvienko, I.I.; Kostina, E.D. (1993) **[Effect of the day length on morphophysiological characters in wheat and barley varieties with different photoperiodic sensitivity]. Vliyanie dliny dnya na morfofiziologicheskie priznaki sortov pshenitsy i yachmenya razlichnoj fotoperiodicheskoj chuvstvitel'nosti.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 107-113.* 13 ref. Russian. (AGRIS 96-016877).

The results of investigations on wheat and barley response to the day length revealed some differences in juvenile period duration amongst varieties with a strong or weak photoperiodic sensitivity. Day length shortening to 12-hrs contributed to a significant increase in the leaf area as well as in the number of leaves, little ears and ear kernels in the varieties with a strong photoperiodic sensitivity. Depending upon the day length no significant differences were noted by the above characters in the varieties with a weak photoperiodic sensitivity, and the same was true for net photosynthesis intensity or potential photosynthesis intensity on a per-unit basis of leaf surface and light curves of photosynthesis. At the same time the varieties with a strong photoperiodic sensitivity showed lower levels of net photosynthesis intensity, potential photosynthesis intensity and plates of light photosynthetic curves under a short day when compared to a long day.

1641 Kostrej, A.; Balogh, Z. (1996) **RELATIONSHIPS BETWEEN AIR TEMPERATURE AND HUMIDITY REGIME AND GROWTH CHARACTERISTICS OF WINTER WHEAT.** *Rostlinna Vyroba. 42(1):1-4.* Czech. [VYSOKA SKOLA POLNOHOSPODARSKA A HLINKU 2 NITRA 94976 SLOVAKIA].

Experimental results of dynamic relationships between temperature and moisture regime 2 m above soil ground, in the stand and growth characteristics of winter wheat stand were obtained by measurements made during the growing season. Relationships between air temperature (t(m)) and relative air temperature (r(m)) measured by standard way in thermometer screen (Stevenson screen) and between relative humidity in the stand (r(p)), air temperature in the stand (t(p)), leaf area index (LAI), dry matter I, weight (W), and soil moisture (V). Correlations and regressions between the above characteristics were settled as well. The data of air temperature in the thermometer screen (t(m)), LAI values, total biomass (W) and soil moisture supply (V) were used to determine t(p). The presented relationships are in Figs 1 to 3. Correlation coefficients between t(m) and LAI: r = 0.68 +/- 0.05; t(m) and t(p) : r = 0.86 +/- 0.05; t(m) and W: r = 0.47 +/- 0.06. It follows from investigation of relationships of r(m) and r(p) : r = 0.68 +/- 0.04, when r(m) - LAI: r = 0.62 +/- 0.05 and at r(m) - W: r = 0.49 +/- 0.06. Relationships between humidity in the stand (r(p)), humidity in Stevenson screen (r(m)) and soil moisture (V) can be expressed using the relationships: r(p) = 95 (1 - 3.609.0.954V); r(m) = 41.914 + 0.452 V. Their diagram is in Fig. 4. An analysis of dependences achieved showed that at one and the same r(m) average values r(p) are dependent on the degree of stand development. Water content in soil can change r(p) by 10 to 12 %. When basic humidity is high (r(m) = 95 to 96 %) r(p) is not dependent on LAI and W values as a consequence of lower transpiration velocity at r(m) close to air saturation by water vapours. With decrease oi basic humidity (r(m)), r(p) lowers Linearly at well developed stands and LAI is equal to 4 to 5 m(2).m(-2). This dependence is broken at lower LAI values; r(p) is not dependent on LAI at low water content in soil. [References: 7].

1642 Liu, JH.; Hill, RD. (1995) **POST-TRANSCRIPTIONAL REGULATION OF BIFUNCTIONAL ALPHA-AMYLASE/SUBTILISIN INHIBITOR EXPRESSION IN BARLEY EMBRYOS BY ABSCISIC**

ACID. *Plant Molecular Biology. 29(5):1087-1091.* English. [UNIV CALGARY DEPT BIOL SCI 2500 UNIV DR 1 NW CALGARY AB T2N 1N4 CANADA].

Changes in bifunctional alpha-amylase/subtilisin inhibitor (BASI) expression induced by abscisic acid (ABA) were studied using in vitro cultured barley (Hordeum vulgare cv. Bonanza) embryos. The steady-state levels of BASI mRNA and BASI protein were increased by exogenously applied ABA. Accumulation of BASI protein was preceded by an increase in message level. The results suggest that ABA does not affect BASI mRNA translation. Nuclear run-on assays demonstrated that ABA had no effect on transcriptional activity. BASI mRNA was not detectable in the embryos treated with a protein synthesis inhibitor, cycloheximide, which had no inhibitory effect on BASI transcription rate. We propose that ABA increases the stability of BASI mRNA through synthesis of a short-lived protein that protects the message. [References: 17].

1643 Martin, PK.; Koebner, RMD. (1995) **THE ROLE OF SEED SIZE IN THE NON-GENETIC VARIATION EXHIBITED IN SALT TOLERANCE STUDIES INVOLVING THE BREAD WHEAT CV CHINESE SPRING.** *Acta Societatis Botanicorum Poloniae. 64(4):371-374.* English. [JOHN INNES CTR PLANT SCI RES CEREALS RES DEPT COLNEY NR4 705 ENGLAND].

The intention of this study was to confirm the role of seed size in the non-genetic variation exhibited during salinity tolerance experiments involving the bread wheat cv. Chinese Spring. The nutrient film/rockwool hydroponics technique was utilised. This study concluded that seed size does not play a significant role in the non-genetic variation generated during a study of salinity tolerance of the bread wheat cv. Chinese Spring. [References: 8].

1644 Morison, JIL.; Long, SP. (1995) **WHEAT GROWTH UNDER GLOBAL ENVIRONMENTAL CHANGE - AN INTRODUCTION.** *Global Change Biology. 1(6):383-384.* English.

1645 Nichol, BE.; Oliveira, LA. (1995) **EFFECTS OF ALUMINUM ON THE GROWTH AND DISTRIBUTION OF CALCIUM IN ROOTS OF AN ALUMINUM-SENSITIVE CULTIVAR OF BARLEY (HORDEUM VULGARE).** *Canadian Journal of Botany-Revue Canadienne de Botanique. 73(12):1849-1858.* English. [UNIV BRITISH COLUMBIA DEPT BOT VANCOUVER BC V6T 1Z4 CANADA].

Aluminum-induced inhibition of root growth in the Al-sensitive cultivar Kearney of barley (Hordeum vulgare L.) is the result of disruption of both cell division in the meristematic region and cell expansion in the zone of elongation of the roots. In seedlings directly germinated in 50 mu M Al, inhibition of root growth is detected 48 h after initiation of germination and it results primarily from the disruption of cell elongation. In seedlings germinated for 2 days under Al-free conditions, inhibition of root growth is apparent 8 h after transfer to 50 mu M Al. In this instance, root growth inhibition is mainly the result of disruption of cell division in the meristematic region of the root. The calcium indicator dyes chlorotetracycline and Fluo-3 are used to study the distribution of intracellular calcium and its relationship to aluminum phytotoxicity. Aluminum increases both chlorotetracycline and Fluo-3 fluorescence intensities. Fluorescence of the cytosolic calcium indicator dye Fluo-3 increases primarily in the zone of elongation of the roots of seedlings directly germinated in 50 mu M aluminum. The increase in Fluo-3 fluorescence occurs concomitantly with major changes in both the length and width of the cells in the zone of elongation. The evidence suggests that changes in calcium homeostasis occurring in cells of the zone of elongation may be a major factor in the disruption of cell expansion and consequently root growth in seedlings directly germinated in 50 mu M aluminum. [References: 61].

1646 Paolillo, DJ. (1995) **THE NET ORIENTATION OF WALL MICROFIBRILS IN THE OUTER PERICLINAL EPIDERMAL WALLS OF SEEDLING LEAVES OF WHEAT.** *Annals of Botany. 76(6):589-596.* English. [CORNELL UNIV PLANT BIOL SECT ITHACA, NY 14853 USA].

Use of the dichroic stain chlor-zinc-iodine revealed that the net orientation of cellulose wall microfibrils in the outer paradermal wall of the epidermis of seedling wheat leaves is principally transverse in the extension zone. The net orientation of microfibrils changes abruptly to principally longitudinal at the end of cell elongation. The net angle of orientation of microfibrils in the extension zone was not a function of Rht-dosage (number of dwarfing alleles), and neither leaf extension rate nor estimated maximum relative elemental rate of elongation were functions of microfibril orientation. The results indicate that elongation rates are not regulated by the net angle of orientation of microfibrils and support the concept that leaf extension rate is regulated by the length of the extension zone. (C) 1995 Annals of Botany Company [References: 36].

1647 Rickman, RW.; Klepper, B.; Ball, DA. (1995) **AN ALGORITHM FOR PREDICTING CROWN ROOT AXES OF ANNUAL GRASSES.** *Agronomy Journal. 87(6):1182-1186.* English. [USDA ARS COLUMBIA PLATEAU CONSERVAT RES CTR POB 370 PENDLETON, OR 97801 USA].

Root formation by any plant determines its success or failure for creating seed for its nest generation. Those interested in managing plants for optimum harvestable yield require information about effects of their practices on root growth. Crop growth models can be convenient summarizations of such knowledge, Models of plants and environment currently describe the plant shoot more completely than they describe the root. The morphologically based root formation algorithm presented in this paper provides opportunities for improving both the description of root formation and the response of roots to their environment. The equation relating shoot and root development will be convenient for crop modeling. It can also be used as a standard for comparison of field rooting observations, as environmental effects on rooting are quantified. The equation predicts the number of root axes on a plant from the plant phyllochron interval, the timing of nodal root appearance relative to leaf appearance, and the effect of environmental stresses that reduce tillering. A comparison of algorithm predictions with observed root formation by wheat (Triticum aestivum L.) from a warm, dry seedbed revealed that few er roots were formed during the early tillering stage of development than predicted for unstressed plants, Correction for observed tillering did not reduce predicted root numbers to those observed. Observed early-season root observations were matched by using one-half of possible tillering as a stress correction. [References: 22].

1648 Saadalla, M.M. (Alexandria Univ. (Egypt). Faculty of Agriculture) (1993) **Rate and duration of grain fill as affected by heat strees in spring wheat.** *Alexandria Journal of Agricultural Research (Egypt) v. 38(2) p. 123-138.* 4 tables; 12 ref. English. (AGRIS 96-004202).

1649 Scheeren, PL.; Decarvalho, FIF.; Federizzi, LC. (1995) **WHEAT RESPONSES TO STRESSES CAUSED BY LOW LIGHT INTENSITY AND/OR WATER EXCESS IN THE SOIL.** *Pesquisa Agropecuaria Brasileira. 30(8):1041-1048.* Portuguese. [EMBRAPA CTR NACL PESQUISA TRIGO CAIXA POSTAL 569 BR-99001970 PASSAU FUNDO RS BRAZIL].

The experiment was carried out in 1987 in the greenhouse at the Faculty of Agronomy of the Federal University of Rio Grande do Sul, in Porto Alegre, RS. The objective of this work was to assess the effect of stresses caused by water excess in the soil and by light reduction on 12 wheat (Triticum aestivum L.) genotypes. Significant reductions were observed in the dry matter weight and in the ramification of roots of plants submitted to the treatment of water excess in the soil, while the treatments including shading caused significant reduction in above-ground wheat plant parts. Cultivar IAC 5-Maringa and lines PF 85845 and PF 853048 were the genotypes least affected by applied stresses. [References: 28].

1650 Sharkova, VE.; Bubolo, LS.; Kamentseva, IE. (1996) **CELL THERMOTOLERANCE AND THE FORMATION OF HEAT-SHOCK GRANULES IN WHEAT LEAVES.** *Russian Journal of Plant Physiology. 43(1):76-81.* English. [RUSSIAN ACAD SCI KOMAROV BOT INST UL PROF POPOVA 2 ST PETERSBURG 197376 RUSSIA].

The thermotolerance of potential photosynthetic activity (measured by (CO2)-C-14 incorporation), cytoplasmic streaming, and leaf cell ultrastructure was monitored following the heating of intact wheat (Triticum aestivum L.) shoots at 40 or 42.5 degrees C for 10 min. Heating at 40 degrees C inhibited photosynthetic activity by 71%, but enhanced the thermotolerance of photosynthesis and cytoplasmic streaming, as was later

revealed by the additional heating of excised leaves. Visible damage to cell ultrastructure was not observed after 40 degrees C heating, although sparse heat-shock granules appeared in 2% of the chloroplasts. After one day, these granules disappeared. After two days, the thermotolerance of photosynthesis declined, and its activity was restored to the original level. Heating at 42.5 degrees C resulted in the prevention of cytoplasmic streaming, almost complete inhibition of photosynthetic activity, and prominent destructive changes in fine subcellular structure. Abundant heat-shock granules were produced in the cytoplasm, chloroplasts, and mitochondria of all leaf tissues. Within two days after the heat shock, the thermotolerance of photosynthesis and cytoplasmic streaming was restored to that in untreated leaves. The time required for granule disappearance depended on their location inside the cell. Heat-shock granule accumulation in wheat leaves was correlated with some disturbances appearing in the cell ultrastructural organization. It is suggested that heat-shock granule accumulation was not directly related to the acquisition of thermotolerance by cells and the recovery of heat-induced disturbances in physiological processes and fine subcellular structure. [References: 14].

1651 Shayakhmetov, IF.; Shakirova, FM. (1996) **SOMATIC EMBRYOGENESIS IN WHEAT CELL SUSPENSION CULTURES IN THE PRESENCE OF ABSCISIC ACID.** *Russian Journal of Plant Physiology. 43(1):88-90.* English. [RUSSIAN ACAD SCI BASHKIR SCI CTR DEPT BIOCHEM & CYTOL PR OKTYABRYA 69 UFA 450054 RUSSIA].

The effects of 7.6 mu M ABA added to Murashige and Skoog nutrient medium on the growth rate and the initiation of embryogenic cell aggregates were studied on suspension cultures of spring hard wheat (Triticum durum L., cv. Khar'kovskaya 46). For 28 days of culturing, ABA substantially decreased the total cell volume, lowered the content of endogenous IAA three times, and prevented early formation of root primordia known to hinder further embryogenesis. ABA is suggested to facilitate maturation of embryoids by shifting the hormonal balance in cultured cells. [References: 11].

1652 Slafer, GA. (1995) **WHEAT DEVELOPMENT AS AFFECTED BY RADIATION AT TWO TEMPERATURES.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(4):249-263.* English. [UNIV BUENOS AIRES FAC AGRON DEPT PROD VEGETAL AV SAN MARTIN 4453 RA-1417 BUENOS AIRES DF ARGENTINA].

A wheat cultivar (Condor) was grown in two experiments (thermal regimes 18/13 and 21/16 degrees C) under low (298 mu E m(-2) s(-1)) radiation regimes during either an early phase from seedling emergence to terminal spikelet initiation (S-1), a late phase from terminal spikelet initiation to anthesis (S-2), or for the full period from seedling emergence to anthesis (S-12), or high (560 mu E m(-2) s(-1)) radiation throughout the growing period (S-0) to determine whether developmental events are affected by radiation. The main developmental events considered in this study were the timing of terminal spikelet initiation and anthesis, the final number of leaf and spikeler primordia initiated in the apex and the rare of leaf appearance. Number of grains per spike and culm height were also measured. The duration of each phenophase was not affected by radiation intensity. Temperature affected the rate of wheat development, but the acceleration of development due to temperature during the seedling emergence-terminal spikelet initiation phase only slightly reduced (from 24.8 to 23.2 days). Differences in time from terminal spikelet initiation to anthesis were greater than in the earlier phases, having been the duration reduced from 24.6 to 20.0 days due to high temperature. Associated with the lack of effect of radiation on phasic development and the negligible effect of temperature on the duration of the early phases of development, final leaf number was practically unchanged in this study by either the radiation level or the growing temperature. Thus, radiation did not affect the rate of leaf initiation. The number of spikelets was affected by neither the treatments nor the thermal environment. The rates of leaf appearance were accelerated by temperature. Radiation, on the other hand, did nor significantly alter the rates of leaf appearance in any of the treatments. As expected from many sources in the literature, the number of grains per spike was significantly affected by radiation during the phase from terminal spikelet initiation to anthesis. Due to the lack of significant effects of radiation on the developmental patterns of wheat, the changes in number of grains per spike were due to changes in the number of grains born in each spikelet. The results of the present study were compared with others available in the literature on the effects (or lack of them) of radiation and CO2 concentration on phasic development, plastochron and phyllochron in wheat to reach the general conclusion that the rate of developmental events in wheat, in contrast to other plants, is almost completely independent of the availability of assimilates, with a possible exception for the Equatorial latitudes. [References: 45].

1653 Slafer, GA.; Rawson, HM. (1995) **DEVELOPMENT IN WHEAT AS AFFECTED BY TIMING AND LENGTH OF EXPOSURE TO LONG PHOTOPERIOD.** *Journal of Experimental Botany. 46(293):1877-1886.* English. [UNIV BUENOS AIRES FAC AGRON DEPT PROD VEGETAL AV SAN MARTIN 4453 RA-1417 BUENOS AIRES DF ARGENTINA].

Seeds of a spring wheat (Triticum aestivum L. cv. 'Condor') were vernalized and then grown at 19 degrees C in two naturally-lit environments, one with a moderate (12 h) and the other with long (18 h) photoperiod. Treatments consisted of transfers of plants from the moderate to the long photoperiod chamber on different occasions, or for periods of different durations, The main objectives were to determine whether wheat development responds to current and previous photoperiodic environments and whether there is a juvenile phase when the plants are insensitive to photoperiod. Plants under constant 18 h photoperiod had fewer leaves which appeared faster than those under constant 12 h photoperiod (i.e. phyllochron was increased from 4.4 to 5.1 d leaf(-1)). Plants transferred from 12 h to 18 h photoperiod at terminal spikelet appearance (ISA) reached anthesis 4 d earlier than plants retained at 12 h, while plants under continuous long photoperiod (18 h) completed this phase most rapidly, Thus, there was some evidence for a historic effect of photoperiod on development. Exposure to long photoperiod during the first 5 d after plant emergence accelerated the rate of development towards anthesis, suggesting that there was no juvenile period of photoperiodic insensitivity. There were, however, changes during ontogeny in the degree of sensitivity to long photoperiod, increasing from seedling emergence to a maximum c. 15 d later, and then decreasing again. Although all treatments were imposed before TSA, the response was not limited to the pre-TSA phase, suggesting that well before the terminal spikelet appeared, the plant was already committed to the initiation of this spikelet. Spikelet number decreased with delayed transfer to long photoperiod with a minimum for plants transferred to long days from 16-20 d after seedling emergence. Additionally, there was a trend for an increase in the rate of leaf appearance (decrease in phyllochron) when the plants were exposed to long days between 10 and 35 d after seedling emergence. Although the differences were small, when considered in conjunction with the effects on final leaf number they become important in explaining differences in time to anthesis. [References: 45].

1654 Smirnova, V.S. (1993) **[Effect of a low temperature stress on leaf development in winter wheat [Triticum aestivum]]. Vliyanie nizkotemperaturnogo stressa na formirovanie list'ev u ozimoj pshenitsy.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 125-132.* 10 ref. Russian. (AGRIS 96-016878).

Leaf growth and development have been studied on the basis of winter wheat varieties with different levels of frost resistance subsequent to their exposure to low temperature (from -7 degree C to -19 degree C). The experimental data obtained made it possible to establish that the exposure of plants to critical temperatures caused a significant decrease in growth rate and in formation of new leaves at all the subsequent periods of vegetation. When damaged badly, the plants of any variety in addition to a substantial decrease in growth rate and development showed generally no formation of a flag from the previous sheaths; in the upper part it was subulate in shape, twisted in a spiral and crincled, frequently from light dun to greyish-brown colour. Hence the exposure to low temperatures resulted in decreased leaf-formation activity of a vegetation cone. At the same time there was a decrease in growth rate, in vegetation cone differentiation as well as in generative organs' formation and in productivity of winter wheat.

1655 Steduto, P.; Pocuca, V.; Caliandro, A.; Debaeke, P. (1995) **AN EVALUATION OF THE CROP-GROWTH SIMULATION SUBMODEL OF EPIC FOR WHEAT GROWN IN A MEDITERRANEAN CLIMATE WITH VARIABLE SOIL-WATER REGIMES.** *European Journal of Agronomy. 4(3):335-345.* English. [CIHEAM IAMB MEDITERRANEAN AGRON INST VIA CEGLIE 23 I-70010 VALENZONO ITALY].

The EPIC model (Erosion-Productivity Impact Calculator) was used to simulate leaf area index (LAI), above-ground biomass (DM(ag)), and grain yield of wheat grown in Southern Italy under variable soil-water regimes and for two seasons (1986-87 and 1987-88). The EPIC calibration parameters, obtained from two irrigation treatments in 1987-88, were utilized in simulating the six and four other irrigation treatments in 1987-88 and 1986-87, respectively. During the calibration procedure, some inconsistencies were observed in the simulation behaviour. EPIC sets the threshold temperature for winter dormancy at 5 degrees C and adopts an algorithm that resets the accumulation of the heat units (HU) on which many growth processes are based. Furthermore, leaf area decline during senescence is governed by late autumn temperature relative to the average annual temperature. The way EPIC handles winter dormancy and the heat units of crops through winter time appears to be inadequate for the Mediterranean climate and, moreover, the threshold for the former and the constraining control on the latter are not accessible to the users for adjustment. Further, when water stress developed during vegetative growth, EPIC consistently overestimated DM(ag), LAI, and yield, as occurred with the 1986-87 simulation. An important conclusion was that, although final yield may be correctly simulated, this may be purely accidental as errors in intermediate processes may compensate each other, while biomass and LAI development in time might not be related to final yield at all. [References: 24].

1656 Stepanov, S.A.; Kumakov, V.A. (1993) **[Effect of temperature on functional activity of spring wheat apex]. Vliyanie temperatury na funktsional'nuyu aktivnost' konusa narastaniya pobega yarovoj pshenitsy.** *Voprosy botaniki Nizhnego Povolzh'ya (Russian Federation) (no.7) p. 93-103.* 7 ref. Russian. (AGRIS 96-016874).

1657 Stone, PJ.; Nicolas, ME. (1995) **COMPARISON OF SUDDEN HEAT STRESS WITH GRADUAL EXPOSURE TO HIGH TEMPERATURE DURING GRAIN FILLING IN TWO WHEAT VARIETIES DIFFERING IN HEAT TOLERANCE .1. GRAIN GROWTH.** *Australian Journal of Plant Physiology. 22(6):935-944.* English. [UNIV MELBOURNE DEPT AGR CTR CROP IMPROVEMENT PARKVILLE VIC 3052 AUSTRALIA].

Two wheat varieties differing in heat tolerance were exposed to four heat treatments in order to determine if a sudden rise from ca 20-40 degrees C caused a greater reduction of individual kernel mass than a gradual (6 degrees C h(-1)) rise over the same temperature range. For the heat sensitive variety (Oxley), the reduction of individual kernel mass following sudden heat stress (26%) was greater than that resulting from a gradual heat stress of equivalent thermal time (13%) or equal days of treatment (18%). By contrast, for the heat tolerant variety (Egret), the reduction of individual kernel mass following rapid exposure to heat stress (12%) was not significantly greater than that caused by a gradual treatment of equal days duration (10%). Nevertheless, for Egret, sudden heat stress significantly reduced mature kernel mass compared with high temperature treatment of equivalent thermal time (6%). We conclude that heat acclimation may help to mitigate wheat yield losses due to high temperature and that the ability to acclimate to high temperature varies between wheat genotypes. Comparison of wheat varieties for yield tolerance to high temperature should therefore occur under conditions that allow gradual acclimation to elevated temperature. [References: 54].

1658 Stone, PJ.; Nicolas, ME. (1995) **EFFECT OF TIMING OF HEAT STRESS DURING GRAIN FILLING ON TWO WHEAT VARIETIES DIFFERING IN HEAT TOLERANCE .1. GRAIN GROWTH.** *Australian Journal of Plant Physiology. 22(6):927-934.* English. [UNIV MELBOURNE DEPT AGR CTR CROP IMPROVEMENT PARKVILLE VIC 3052 AUSTRALIA].

Short periods of very high temperature (> 35 degrees C) are common in many of the world's wheat growing areas and can be a significant factor in reducing yield and quality of wheat. This study was designed to determine the stage at which grain growth is most sensitive to a short period of high temperature and to examine whether varietal differences in heat tolerance are expressed throughout the whole grain-filling period. Two varieties of wheat differing in heat tolerance (cvv. Egret and Oxley) were exposed to a short (5 days) period of very high temperature (40 degrees C max. for 6 h each day) at 5-day intervals throughout grain filling, starting from 15 days after anthesis (DAA) and concluding at 50 DAA. Responses of grain dry matter accumulation and water content to high temperature were monitored throughout grain filling, and the results compared with controls maintained at 21/16 degrees C day/night. Varietal differences in heat tolerance were expressed throughout the grain-filling period. Mature individual kernel mass was most sensitive to heat stress applied early in grain filling and became progressively less sensitive throughout grain filling, for both varieties. Reductions in mature kernel mass resulted primarily from reductions in duration rather than rate of grain filling. [References: 21].

1659 Stone, PJ.; Savin, R.; Wardlaw, IF.; Nicolas, ME. (1995) **THE INFLUENCE OF RECOVERY TEMPERATURE ON THE EFFECTS OF A BRIEF HEAT SHOCK ON WHEAT .1. GRAIN GROWTH.** *Australian Journal of Plant Physiology. 22(6):945-954.* English. [UNIV MELBOURNE DEPT AGR CTR CROP IMPROVEMENT PARKVILLE VIC 3052 AUSTRALIA].

The responses of wheat yield to moderately high (20-32 degrees C) and very high temperatures (> 32 degrees C) have been studied separately in the literature, but not in combination, despite the fact that this is usually how elevated temperatures occur in the field. In this study, controlled environment conditions were used in order to examine the interaction of moderately high and very high temperatures during grain filling and their effect on wheat yield. Specifically, we wished to test the hypothesis that cooler conditions would facilitate greater recovery of grain growth following a brief exposure to very high temperature. To this end, wheat was exposed to either 21/16 or 40/16 degrees C (day/night) from 15-19 days after anthesis and subsequently grown under one of three moderately high temperature regimes until maturity: 21/16, 27/22 or 30/25 degrees C. For all moderately high temperature treatments, a brief 'heat shock' significantly reduced mature individual kernel mass by 17%, on average. In the absence of 'heat shock', increasing moderately high temperature progressively reduced mature individual kernel mass by ca 2.5% for each 1 degrees C increase in average daily temperature. After a 'heat shock' event, however, there was not a progressive decline in mature individual kernel mass with increasing moderately high temperature. A short period of very high temperature applied early in grain filling therefore reduced the response of wheat to subsequent moderately high temperatures. We conclude that the reduction in yield caused by 'heat shock' is not alleviated by cool post-shock conditions. [References: 40].

1660 Volkova, A.M.; Udovenko, G.V. (1993) **[Abnormalities in formation of generative and vegetative organs in wheat under stress conditions]. Anomalii formirovaniya generativnykh i vegetativnykh organov u pshenitsy pri stressakh.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 49-55.* 9 ref. Russian. (AGRIS 96-016876).

The paper deals with morphophysiological analysis of abnormalities in the spikes and spikelets as well as stem structure in various wheat cultivars under high-temperature and salt stresses' conditions. The reasons of the above abnormalities and the linkage between their formation and alterations in wheat productivity under extreme conditions are discussed.

1661 Walter, A.; Pich, A.; Scholz, G.; Marschner, H.; Romheld, V. (1995) **DIURNAL VARIATIONS IN RELEASE OF PHYTOSIDEROPHORES AND IN CONCENTRATIONS OF PHYTOSIDEROPHORES AND NICOTIANAMINE IN ROOTS AND SHOOTS OF BARLEY.** *Journal of Plant Physiology. 147(2):191-196.* English. [UNIV HOHENHEIM INST PFLANZENERNAHRUNG 330 D-70593 STUTTGART GERMANY].

The effects of the iron (Fe) nutritional status and time of the day on the release of phytosiderophores (PS) and on concentrations of PS and their precursor nicotianamine (NA) in roots and shoots were studied over a 24-hour cycle for barley (Hordeum vulgare L. cv. Europa). Phytosiderophores were released in a diurnal rhythm with maximum rates 5 to 6 hours after

onset of the light. Compared with Fe-sufficient plants, PS release rates were up to 250 times higher in Fe-deficient plants. The dominant PS in root exudates and root and shoot extracts was epi-hydroxymugineic acid (HMA). In root extracts of Fe-deficient plants, concomitantly to release of epi-HMA, concentrations of epi-HMA decreased until the end of the highest release rate. Thereafter, epi-HMA concentrations in root extracts increased with time and were as high at the end of the light period as at the onset. In root extracts of Fe-sufficient plants, tpi-HMA concentrations were up to 10 times lower and diurnal variations in epi-HMA concentrations were not observed. Nicotianamine concentrations were 1.5 times higher in root extracts of Fe-deficient plants than of Fe-sufficient plants and were independent of time of the day. In root extracts of Fe-deficient plants NA concentrations were up to 62 times lower than epi-HMA concentrations. In shoot extracts epi-HMA and NA concentrations were similar in Fe-sufficient and Fe-deficient plants and no consistent diurnal variations were observed. Apparently, depending on Fe nutritional status, PS are synthesized in roots at constant rates over the whole light period. No marked accumulation of NA or other precursors of epi-HMA such as deoxymugineic acid (DMA) or mugineic acid (MA) occurs under Fe deficiency. [References: 34].

1662 White, EM. (1995) **EFFECTS OF MANAGEMENT AND DEVELOPMENT ON STEM CHARACTERISTICS RELATED TO LODGING IN WINTER BARLEY.** *European Journal of Agronomy. 4(3):327-334.* English. [DEPT AGR NO IRELAND PLANT TESTING STN 50 HOUSTON RD BELFAST BT6 9SH ANTRIM NORTHERN IRELAND].

In a field experiment in 1988-1989, applications of nitrogen (0, 120 and 160 kg ha(-1)) and a growth regulator (mepiquat chloride + ethephon) were used to manipulate stem structure in two cultivars of winter barley (Hordeum vulgare L.) with contrasting resistances to lodging. Ontogenetic changes during grain-filling and differences between stems having 4, 5 and 6 internodes were also examined. Dry weights and lengths of the stems were greater in the lodging- resistant cultivar Magie than in the lodging-susceptible cultivar Pipkin, were increased by nitrogen fertilizer, and were decreased by the plant growth regulator. The length of the stems did not increase during grain-filling but stem dry weight increased up to Zadoks' Growth Stages 78-85 and then decreased by about 40 per cent during ripening. During grain filling dry weight per unit length followed the same pattern as dry weight per stem. Magie had greater dry weights per unit length than Pipkin. Nitrogen fertilization had little net effect while plant growth regulator reduced dry weight per unit stem length. Cultivar, nitrogen fertilizer, plant growth regulator, number of internodes per stem and ontogeny, each had a distinctly different route by which individual internodes contributed to their effects on the whole stem. The characteristics associated with resistance to lodging in cultivars were different from those involved in the influences of nitrogen and plant growth regulator on incidences of lodging. [References: 17].

1663 Younis, S.; Ryberg, M.; Sundqvist, C. (1995) **PLASTID DEVELOPMENT IN GERMINATING WHEAT (TRITICUM AESTIVUM) IS ENHANCED BY GIBBERELLIC ACID AND DELAYED BY GABACULINE.** *Physiologia Plantarum. 95(3):336-346.* English. [GOTHENBURG UNIV INST BOT DEPT PLANT PHYSIOL CARL SKOTTSBERGS GATA 22 S-41319 GOTHENBURG SWEDEN].

Etioplast development and protochlorophyllide (Pchlide) accumulation was studied in wheat seedlings (Triticum aestivum L. cv. Walde, Weibull) grown in darkness on gibberellic acid (GA(3)), gabaculine (3-amino-2, 3-dihydrobenzoic acid), or on a combination of the two. The results were compared with the features of seedlings grown on water only. GA(3) enhanced shoot growth and promoted etioplast development. A correlation was observed between the appearance of prolamellar bodies (PLBs) and of phototransformable Pchlide. Gabaculine, a known tetrapyrrole biosynthesis inhibitor, delayed growth, slowed down the rate of PLB formation and caused structural alterations of the etioplasts up to 48 h of germination. Gabaculine also delayed the formation of phototransformable Pchlide as well as overall Pchlide biosynthesis, as deter mined by low-temperature fluorescence emission in vivo. The spectral blue-shift of newly formed chlorophyllide (Chlide) was delayed in irradiated dark-grown gabaculine-grown seedlings, indicating an inhibited dissociation of Chlide and NADPH-Pchlide oxidoreductase (Pchlide reductase; EC 1.3.1.33). Thus there is a close correlation between accumulation of Pchlide and etioplast development, also under conditions when development is enhanced or delayed. [References: 39].

F63 PLANT PHYSIOLOGY-REPRODUCTION

1664 Demotesmainard, S.; Doussinault, G.; Meynard, JM. (1995) **EFFECTS OF LOW RADIATION AND LOW TEMPERATURE AT MEIOSIS ON POLLEN VIABILITY AND GRAIN SET IN WHEAT.** *Agronomie. 15(6):357-365.* English. [INRA AGRON LAB F-78850 THIVERVAL GRIGNON FRANCE].

Wheat plants at meiosis were subjected in a growth chamber to treatments combining 2 levels of temperatures (15/18 degrees C and 1.5/8 degrees C night/day) and 2 levels of radiation (203 +/- 26 and 11 +/- 1 mu mol m(-2) s(-1) photosynthetic photon flux density). Pollen viability at anthesis (fluorochromatic reaction) decreased in response to low radiation, but was not affected by chilling. There was no interaction between radiation and temperature. Varieties Moulin and Pernel had qualitatively the same response, but Moulin was more sensitive. These results were validated in 2 field experiments on Pernel. In the first, plants were exposed to -2 degrees C for 1 h on 3 consecutive days at different stages around meiosis. Cooling slightly reduced grain set, but there was no difference in the sensitivity of the developmental stages. In the second field experiment, plants were shaded at meiosis to receive 30% of the solar radiation. Shading strongly reduced kernel number per ear and induced sterility.

1665 Filatova, I.A. (1993) **[Study of microsporogenesis in some triticale forms]. Izuchenie mikrosporogeneza u nekotorykh form tritikale.** *Voprosy botaniki Nizhnego Povolzh'ya (Russian Federation) (no.7) p. 85-93.* Russian. (AGRIS 96-016934).

1666 Mouritzen, P.; Holm, PB. (1995) **ISOLATION AND CULTURE OF BARLEY MEGASPOROCYTE PROTOPLASTS.** *Sexual Plant Reproduction. 8(6):321-325.* English. [CARLSBERG RES LAB 10 GL CARLSBERG VEJ DK-2500 COPENHAGEN DENMARK].

An efficient technique has been developed for the isolation of barley megasporocyte protoplasts at early meiotic prophase. Ovules were dissected out of ovaries under aseptic conditions, subjected to a brief enzymatic digestion, and then transferred to a modified Kao medium with 90 g/l sucrose and 20 mM CaCl2. A small incision was made with a scalpel through the softened epi dermal cell layer of the nucellus and the megasporocyte could then be liberated into the medium by applying gentle pressure on the nucellus. The megasporocyte appeared to be completely devoid of a wall and changed its in situ pyriform shape to completely spherical when extruded into the medium. Four to nine protoplasts could typically be isolated per spike. Protoplasts cultured in medium degenerated after a few days. Viability was dramatically improved if protoplasts were co-cultivated with barley microspores undergoing microspore embryogenesis. More than half of the protoplasts were still alive after 6 days of culture, and in some cases they survived more than 12 days of culture. Fluorescence microscopy of the cultured protoplasts stained with 4', 6-diamidino-2-phenylindole (DAPI) or aniline blue revealed that the protoplasts remained uninuclear and reformed their callose wall. [References: 24].

1667 Sharma, VK.; Rao, A.; Varshney, A.; Kothari, SL. (1995) **COMPARISON OF DEVELOPMENTAL STAGES OF INFLORESCENCE FOR HIGH FREQUENCY PLANT REGENERATION IN TRITICUM AESTIVUM L AND T-DURUM DESF.** *Plant Cell Reports. 15(3-4):227-231.* English. [UNIV RAJASTHAN DEPT BOT JAIPUR 302004 RAJASTHAN INDIA].

Whole immature inflorescences at 4 different developmental stages (0.5, 1.0, 1.5, 2.0 cm in size) of different genotypes of Triticum aestivum and T. durum were cultured to see the morphogenetic responses on Murashige and Skoog's (MS) medium supplemented with 2, 4-dichlorophenoxyacetic acid (2, 4-D) (2.5 mg/l). Very young inflorescences 0.5 and 1.0cm long formed embryogenic callus from their entire surface while. 1.5 and 2.0 cm long inflorescences formed embryogenic callus from the basal spikelets and rachis only. This embryogenic callus was maintained by regular subcultures on MS medium with 2, 4-D (2.5 mg/l) for more than a year.

Plantlets were regenerated by transferring the embryogenic callus on hormone-free MS medium. Inflorescences (0.5 and 1.0 cm long) responded best in forming callus as well as plantlets at a very high frequency. Variation in response was observed amongst the genotypes but the qualitative response of formation of embryogenic callus and later regeneration of plantlets was observed from all the genotypes. Immature young inflorescence explants could provide a suitable material for particle gun mediated genetic transformation in wheat. [References: 28].

F70 PLANT TAXONOMY AND GEOGRAPHY

1668 Frisvad, J.C. (The Technical University of Denmark, Denmark.); Seifert, K.A.; Samson, R.A.; Mills, J.T. (1994) **Penicillium tricolor, a new mould species from Canadian wheat.** *Canadian journal of botany = Journal canadien de botanique (Canada) v. 72(7) p. 933-939.* references. English. (AGRIS 96-017014).

H01 PROTECTION OF PLANTS-GENERAL ASPECTS

1669 Harvey, TL.; Martin, TJ.; Seifers, DL. (1995) **SURVIVAL OF FIVE WHEAT CURL MITE, ACERIA TOSICHILLA KEIFER (ACARI, ERIOPHYIDAE), STRAINS ON MITE RESISTANT WHEAT.** *Experimental & Applied Acarology. 19(8):459-463.* English. [KANSAS STATE UNIV AGR RES CTR HAYS, KS 67601 USA].

The survival of the wheat curl mite (WCM), Aceria tosichilla Keifer, on five sources of resistant wheat (Triticum aestivum L.) was determined for collections of mites from Kansas (including a strain adapted to 'TAM 107'), South Dakota and Texas, USA and Alberta, Canada. Sources of resistance to Aegilops squarrosa L. and Agropyron elongatum (Host) were resistant to WCMs from South Dakota and Alberta, but susceptible to WCMs from Kansas and Texas. Two wheats with resistance to rye (Secale cereale L.), PI 475772 and TAM 107, were resistant to all WCM collections except the strain from Kansas that was selected for adaptation to TAM 107. A common wheat (PI 222655) was resistant to all WCM collections except the one from Alberta, Canada. Because WCMs have overcome the resistance of TAM 107 in Kansas, the only resistance now available in commercial cultivars may be lost. Results indicate that PI 222655 is the best source of resistance to replace TAM 107 in the USA but it may not be effective in Canada. Resistance to Ae. squarrosa and A. elongatum could be deployed against WCMs in Alberta and South Dakota but these sources may not be effective in Kansas and Texas. However, one WCM collection from each location may not represent the general mite population of an area. Therefore, any new sources of resistance should be evaluated fully against WCMs from areas where they are likely to be used in commercial cultivars.

1670 Walters, DR.; Cowley, T.; Mcpherson, A. (1995) **EFFECTS OF THE TRYPANOCIDAL AGENTS BERENIL AND PENTAMIDINE ON GROWTH, ENZYME ACTIVITIES, AND POLYAMINE CONCENTRATIONS IN THE RICE BLAST PATHOGEN PYRICULARIA ORYZAE AND ON POWDERY MILDEW INFECTION OF BARLEY SEEDLINGS.** *Pesticide Biochemistry & Physiology. 53(3):147-151.* English. [SCOTTISH AGR COLL DEPT PLANT SCI AUCHINCRUIVE KA6 5HW AYR SCOTLAND].

The effects of the trypanocidal agents Berenil and pentamidine on growth and polyamine biosynthesis in the rice blast fungus Pyricularia *oryzae* were examined. Fungal growth was substantially reduced by as little as 0.02 mM pentamidine and 0.01 mM Berenil. These compounds also controlled infection of barley seedlings by the powdery mildew fungus Erysiphe graminis f.sp. hordei, with 1 mM Berenil or pentamidine reducing infection by 80 and 85%, respectively. Although both compounds reduced in vitro activity of S-adenosylmethionine decarboxylase (AdoMetDC), the effects of pentamidine were more pronounced. Neither inhibitor had any effect on the in vitro activities of ornithine decarboxylase (ODC) and spermidine/spermine acetyltransferase (SSAT). In in vivo studies, neither Berenil nor pentamidine significantly altered the activities of AdoMetDC, ODC or SSAT. Curiously, however, exposure of P. oryzae to either compound resulted in greatly increased putrescine and cadaverine concentrations and a much reduced spermine concentration. The changes in polyamine concentrations may be due, in part, to increased activity of polyamine oxidase in fungal tissue following treatment with Berenil or pentamidine. (C) 1995 Academic Press, Inc. [References: 21].

H10 PESTS OF PLANTS

1671 Anderson, JA.; Peters, DC. (1995) **INHIBITORS OF ETHYLENE BIOSYNTHESIS AND ACTION DO NOT PREVENT INJURY TO WHEAT SEEDLINGS INFESTED WITH SCHIZAPHIS GRAMINUM (HOMOPTERA, APHIDIDAE).** *Environmental Entomology. 24(6):1644-1649.* English. [OKLAHOMA STATE UNIV DEPT HORT & LANDSCAPE ARCHITECTURE STILLWATER, OK 74078 USA].

Experiments were conducted to determine whether inhibitors of ethylene bio-synthesis and action can prevent symptoms of aphid damage to wheat seedlings. 'TAM 107' wheat, Triticum aesticum L., seedlings infested with biotype G greenbugs, Schizaphis graminum (Rondani), for 6 h developed chlorosis and necrotic spots within 4 d after the aphids were removed. AVC (1 mM 2-aminoethoxyvinylglycine), an ethylene biosynthesis inhibitor, reduced ethylene production but not development of lesions or loss of chlorophyll from infested seedlings. STS [silver thiosulfate complex (0.5 mM AgNO3, 2.0 mM Na thiosulfate)], an inhibitor of ethylene action, did not prevent a reduction in chlorophyll concentration or the development of lesions. A secondary objective was to determine how the ethylene biosynthetic pathway was differentially affected by aphid biotypes previously shown to stimulate high or low levels of ethylene. 'Large' and TAM 107 wheat seedlings were infested with biotype E or G greenbugs, then harvested after 1, 6, or 48 h. Both wheat genotypes are susceptible to biotype G. TAM 107 is susceptible to biotype E and Large is resistant. Increased ethylene production 6 h after seedlings were exposed to biotype G was associated with an increase in ACC (1-aminocyclopropane-1-carboxylic acid, the immediate precursor of ethylene) and EFE (ethylene-forming-enzyme) activity in both wheat genotypes. Ethylene production, ACC content, and EFE activity declined by 48 h, concomitant with an increase in MACC (N-malonyl-ACC, an inactive conjugate of ACC). Biotype E triggered a smaller increase in ethylene production than biotype G. ACC levels were not affected by biotype E, but EFE activity increased by 33% in Large and 151% in TAM 107 after 6 h. Ethylene production from greenbug-infested wheat seedlings was controlled primarily by ACC content. Ethylene appeared to be a symptom, not a mediator of greenbug-induced injury. [References: 26].

1672 Anon. (1993) **Biological control of the Russian wheat aphid.** *Program aid (USA); no. 1507 15 p.* English. (AGRIS 96-017442).

1673 Assheuer, T.; Roessner, J. (Justus Liebig Univ., Giessen (Germany) Inst. fuer Phytopathologie und Angewandte Zoologie) (1993) **Is the abundance of plant-parasitic nematodes correlated with the root biomass of hosts?** 45th International Symposium on crop protection; Gent (Belgium); 4 May 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 58(2b) p. 719-728.* 2 ill.; 6 tables; 19 ref. English. (AGRIS 96-004828).

1674 Baker, JE.; Throne, JE. (1995) **EVALUATION OF A RESISTANT PARASITOID FOR BIOLOGICAL CONTROL OF WEEVILS IN INSECTICIDE-TREATED WHEAT.** *Journal of Economic Entomology. 88(6):1570-1579.* English. [USDA ARS N CENT REG US GRAIN MKT RES LAB 1515 COLL AVE MANHATTAN, KS 66502 USA].

Interaction of a resistant strain of Anisopteromalus calandrae (Howard) (Hymenoptera: Pteromalidae) and a host, the rice weevil, Sitophilus oryzae (L.) (Coleoptera: Curculionidae), on wheat treated with malathion was studied in the laboratory. Based oil dose response and serial time-response bioassays, malathion concentration had no significant effect on longevity fecundity, or effectiveness of the Bamberg strain of A, calandrae parasitizing S. oryzae in wheat. Suppression of the immature weevil population exceeded 90% on malathion-treated wheat. Bamberg A. calandrae were more successful parasitizing the Savannah laboratory strain of S, oryzae compared with the Bamberg strain of S. oryzae, possibly because of the larger size of the Savannah weevils. The Bamberg strain of S. oryzae (12 times resistant at the LD(99) based on vial bioassays) was more tolerant of malathion applied to wheat than was the susceptible

Savannah strain of S. oryzae, However. malathion concentration had no significant effect on emergence of adults of either weevil strain when wheat containing immatures was treated. Although oviposition was significantly reduced, both weevil strains oviposited on wheat treated with malathion. These results indicate that the ecology of host development (for example, protected weevil larvae feeding within grain kernels) may be primarily responsible for development of the resistance in Bamberg A, calandrae by providing a food source when the parasitoid is under selection pressure. Use of the resistant strain of A. calandrae in a management system for insect pests in stored grain is discussed. [References: 42].

1675 Balhadere, P.; Evans, AAF. (1995) **HISTOPATHOGENESIS OF SUSCEPTIBLE AND RESISTANT RESPONSES OF WHEAT, BARLEY AND WILD GASSES TO MELOIDOGYNE NAASI.** *Fundamental & Applied Nematology. 18(6):531-538.* English. [UNIV LONDON IMPERIAL COLL SCI & TECHNOL DEPT BIOL SILWOOD PK ASCOT SL5 7PY BERKS ENGLAND].

The highly resistant responses of the wild grasses Aegilops variabilis and Hordeum chilense infected by the root-knot nematode Meloidogyne naasi, were studied using light microscopy, in comparison with the susceptible responses in two cereal cultivars, Triticum aestivum cv. Chinese Spring and Hordeum vulgare cv. Doubler, together with the partially resistant response of barley cv. Morocco. Both full resistances involve early induced hypersensitive-type responses, with a range of necrotic sites in the endodermis, thus preventing most nematodes from migrating into the stele. Such necrosis is not lethal to juveniles, but impedes any feeding and development. Differences between the resistant species were seen in the changes in the cortical and endodermal cells close to nematodes: callose deposition by A. variabilis, lignin deposition by H. chilense. The partial resistance of cv. Morocco appeared to be associated with a lower efficiency of the giant-cells as a source of nutrients. The induction of the resistance mechanisms in the three resistant hosts is discussed. [References: 26].

1676 Duffield, SJ.; Jepson, PC.; Wratten, SD.; Sotherton, NW. (1996) **SPATIAL CHANGES IN INVERTEBRATE PREDATION RATE IN WINTER WHEAT FOLLOWING TREATMENT WITH DIMETHOATE.** *Entomologia Experimentalis et Applicata. 78(1):9-17.* English. [UNIV SOUTHAMPTON SCH BIOL SCI DEPT BIOL BASSETT CRESCENT E SOUTHAMPTON SO16 7PX HANTS ENGLAND].

Experiments were conducted in 1989 and 1990 to investigate the mechanism underlying patterns of invertebrate population recovery in winter wheat following treatment with the broad-spectrum insecticide dimethoate. Predation of Drosophila pupae and artificially induced aphid populations was monitored at different distances into plots treated with dimethoate. An initial drop in predation was recorded in all positions following treatment. Predation rate then showed a period of recovery, which progressed from the edge to the centre of the treated plots. This pattern of recovery corresponded to the numerical pattern of recovery of the predatory invertebrate groups; Carabidae, Staphylinidae and Linyphiidae. The results are discussed in terms of mechanisms to explain observed patterns of recovery of invertebrate 'prey' groups such as aphids. It is concluded that the ranking of pesticides by their toxicity alone would fail to take into account ecological processes that determine the different patterns of population change following treatment. [References: 27].

1677 Elliott, N.C.; Riedell, W.E.; Fuller, B.W. (1994) **Yield on spring wheat in relation to level of infestation by greenbugs (Homoptera: Aphididae).** *The Canadian entomologist (Canada) v. 126(1) p. 61-66.* references. English. (AGRIS 96-004871).

1678 Faulds, CB.; Williamson, G. (1995) **RELEASE OF FERULIC ACID FROM WHEAT BRAN BY A FERULIC ACID ESTERASE (FAE-III) FROM ASPERGILLUS NIGER.** *Applied Microbiology & Biotechnology. 43(6):1082-1087.* English. [AFRC INST FOOD RES DEPT FOOD MOLEC BIOCHEM NORWICH RES PK NORWICH NR4 7UA NORFOLK ENGLAND].

Ferulic acid was efficiently released from a wheat bran preparation by a ferulic acid esterase from Aspergillus niger (FAE-III) when incubated together with a Trichoderma viride xylanase (a maximum of 95% total ferulic acid released after 5 h incubation). FAE-III by itself could release ferulic acid but at a level almost 24-fold lower than that obtained in the presence of the xylanase (2 U). Release of ferulic acid was proportional to the FAE-III concentration between 0.1 U and 1.3 U, but the presence of low levels of xylanase (0.1 U) increased the amount of ferulic acid released 6-fold. Total sugar release was not influenced by the action of FAE-III on the wheat bran, but the rate of release of the apparent end-products of xylanase action (xylose and xylobiose) was elevated by the presence of the esterase. The results show that FAE-III and the xylanase act together to break down feruloylated plant cell-wall polysaccharides to give a high yield of ferulic acid. [References: 31].

1679 Gillespie, R.L. (Washington State University, Ephrata, WA.); Kemp, W.P. (1994) **Comparison of age structure of three Melanoplus spp. (Orthoptera: Acrididae) in winter wheat and adjacent rangeland.** *The Canadian entomologist (Canada) v. 126(6) p. 1277-1285.* references. English. (AGRIS 96-017303).

1680 Gulati, R.; Mathur, S. (1995) **EFFECT OF EUCALYPTUS AND MENTHA LEAVES AND CURCUMA RHIZOMES ON TYROPHAGUS PUTRESCENTIAE (SCHRANK) (ACARINA, ACARIDAE) IN WHEAT.** *Experimental & Applied Acarology. 19(9):511-518.* English. [HARYANA AGR UNIV DEPT ZOOL HISAR 125004 HARYANA INDIA].

Varying concentrations of powdered leaves of Eucalyptus and Mentha and rhizomes of Curcuma were evaluated in controlling Tyrophagus putrescentiae in wheat flour. At higher concentrations, all these plant materials significantly decreased the population build-up of the mite. Eucalyptus and Mentha leaf powders were effective at concentrations ranging from 100 to 5% in bringing about a decrease in the fecundity of the mite and reducing the egg numbers to 51.66 and 25.49 per female, respectively, as compared to 98.16 eggs per female in the controls. Rhizomes of Curcuma were effective even at a concentration of 0.1% reducing the egg laying to 7.66 eggs per female in wheat flour. These materials were more deleterious to immature stages (ova and larvae) than to the mature stages of T. putrescentiae. When tested on whole grains of wheat these plant materials showed more pronounced effects in controlling the mite population compared to that in wheat flour. Curcuma rhizomes were the most promising for possible use against T. putrescentiae. [References: 13].

1681 Havlickova, H. (1996) **DIFFERENCES IN WINTER WHEAT CULTIVARS IN APHID INFESTATION IN RELATIONSHIP TO BIOCHEMICAL CHARACTERISTICS.** *Rostlinna Vyroba. 42(1):41-45.* Czech. [VYZKUMNY USTAV ROSTLINNE VYROBY DRNOVSKA 507 CR-16106 PRAGUE CZECH REPUBLIC].

Four winter wheat cultivars of domestic origin (Hana, Regina, Viginta, Zdar) and foreign cultivar Sparta were tested in glasshouse conditions for suitability to cereal aphids Metopolophium (Walker), Rhopalosiphuin padi (L.) and Sitobion avenae (F.) in relationship to biochemical characteristics of plants. Suitability of cultivars for aphids was evaluated by aphid dry matter per tiller/spike 14 days from artificial infestation (three females M. dirhodum, R. padi per plant at the end of shooting phase - 49 GS, two females of S. avenae per spike at the beginning of anthesis - 59 GS). The content of dry matter, free amino acids and sugars in leaves and spikes of cultivars were determined in the control plants parallelly with infestation. Dry matter and basic metabolite contents in leaves of cultivars was in statistical significant positive correlation ($P < 0.001$) with reproduction of R. padi and in negative correlation ($P < 0.05$ to 0.005) with reproduction of M. dirhodum on plants. Relationship between biochemical characteristics of cultivars' spikes and reproduction of S. avenae was not confirmed. Based on differences in reproduction of aphids, a certain level of antibiosis of the Regina cultivar to aphids was associated with the low content of dry matter and metabolites, above all amino acids, in leaves and antibiosis in the Hana cultivar to M. dirhodum was connected with low level of water in leaves. The Sparta cultivar of a little development precocity, highest dry matter content, free amino acids and sugars in leaves was the best host for R. padi and a little suitable for M. dirhodum. The results obtained are discussed in relationship to differences in requirements of cereal aphids for host and resistance of cereals to aphids. [References: 21].

1682 Havlickova, H. (1995) **SOME CHARACTERISTICS OF FLAG LEAVES OF TWO WINTER WHEAT CULTIVARS INFESTED BY ROSE-GRAIN APHID, METOPOLOPHIUM DIRHODUM (WALKER).** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 102(5):530-535.* English. [RES INST CROP PROD RUZYNE 507 CR-16106 PRAGUE 6 CZECH REPUBLIC].

Physiological characteristics and amino acid metabolism of Rag leaves of the winter wheat cultivars 'Mironovskaya 808' and 'Slavia' infested by Metopolophium dirhodum (Walker) were investigated under greenhouse conditions. Artificial infestation (three aphids per leaf) from the beginning of anthesis to the mid-milk stage of plant development significantly reduced leaf area and water content, and greatly increased the sum of free amino acids. Compared to noninfested leaves, infestation by aphids increased the: levels of 10 amino acids, while those of nine were decreased. In noninfested leaves, amino acids connected with the Krebs cycle prevailed, in infested leaves proline and arginine were predominant. Several difference between cultivars in response to aphid infestation were observed. [References: 23].

1683 Hayat, MA.; Martin, JM.; Lanning, SP.; Mcguire, CF.; Talbert, LE. (1995) **VARIATION FOR STEM SOLIDNESS AND ITS ASSOCIATION WITH AGRONOMIC TRAITS IN SPRING WHEAT.** *Canadian Journal of Plant Science. 75(4):775-780.* English. [MONTANA STATE UNIV DEPT PLANT SOIL & ENVIRONM SCI BOZEMAN, MT 59717 USA].

The wheat stem sawfly (Cephus cinctus Norton) is a major insect pest of spring wheat (Triticum aestivum L.) in the Northern Great Plains of the US and Canadian Prairie provinces. The development of solid-stemmed wheat cultivars has been the main strategy to minimize losses from this insect. Solid-stemmed cultivars generally yield less than hollow-stemmed cultivars of the same era, and there are reports that degree of stem solidness is inversely related to grain yield. Our purpose was to examine the association between stem solidness and other agronomic traits and measure changes in progeny performance from three solid-stemmed parents representing different eras of cultivar development. Random, F-4-derived F-6 lines were obtained from crosses between solid-stemmed Rescue, Fortuna, and Lew and hollow-stemmed Newana and Thatcher. The random lines plus parents were evaluated in three environments. Changes during time from Rescue to Lew were in the desired direction for days to heading, plant height, and test weight, while stem-solidness score decreased for the parents themselves and in cross combination. Grain yield showed significant gains in two of three environments. A significant solid-stemmed x hollow-stemmed parent interaction was observed for stem solidness score suggesting epistatic gene action in the inheritance of this trait. The only significant associations of stem solidness score with agronomic traits were with plant height in one cross and grain protein concentration in two crosses. Results show the development of high yielding, solid-stemmed cultivars is not limited by undesirable associations between degree of stem solidness and other agronomic traits. [References: 20].

1684 Ibrahim, I.K.A.; Ibrahim, A.A.M.; Rezk, M.A. (Alexandria Univ. (Egypt). Faculty of Agriculture) (1994) **Biological and chemical control of root-knot nematodes on clover, corn and wheat.** *Alexandria Journal of Agricultural Research (Egypt) v. 39(3) p. 453-462.* 3 tables; 10 ref. English. (AGRIS 96-004821).

1685 Jmhasly, P.; Nentwig, W. (1995) **HABITAT MANAGEMENT IN WINTER WHEAT AND EVALUATION OF SUBSEQUENT SPIDER PREDATION ON INSECT PESTS.** *Acta Oecologica-International Journal of Ecology. 16(3):389-403.* English. [UNIV BERN DIV NEUROBIOL ERLACHSTR 9A CH-3012 BERN SWITZERLAND].

Density estimates, web cover and predatory importance of different spider families were investigated over one field season in relation to habitat manipulation by strip-management in a winter wheat field at Zollikofen near Berne, Switzerland. Spider densities and web cover were in most cases higher near the sown weed strips than they were away from them. The strips contained a significantly greater web cover for the sheet webs of Linyphiidae in May and at the end of July. Qualitative assessment of spiders' prey revealed high percentages (up to 92%) of Diptera and Aphidina (including pests). Quantitative evaluation of spider predation in the orb webs of Araneidae/Tetragnathidae and the sheet webs of Linyphiidae showed very small prey turnover rates e.g. Linyphiidae killed on average 1.5-1.7 aphids m(-2) 9 h daylight(-1) in wheat. Theoretical estimates of diurnal prey capture in all spider webs (including Theridiidae and Agelenidae) were calculated. Comparisons with the reduction of noxious insects by other polyphagous predators suggested that in the investigated field the importance of spiders as biological control agents is rather small. [References: 54].

1686 Lung, G. (University of Hohenheim, Stuttgart (Germany). Inst. of Plant protection) (1993) **The role of phytosiderophores as an attractive substance of root exudates from several cereals for second stage juveniles of Heterodera avenae.** 45th International Symposium on crop protection; Gent (Belgium); 4 May 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 58(2b) p. 729-735.* 3 ill.; 1 table; 6 ref. English. (AGRIS 96-004846).

1687 McLeod, M.J. (South Dakota State University) (1994) **Grasshopper management for South Dakota winter wheat producers.** *Extension extra (USA); no. 8106 2 p.* In subseries: Plant Science. English. (AGRIS 96-004872).

1688 Moral, J. del; Mejias, A.; Chacon, A. (Servicio de Investigacion y Desarrollo Tecnologico, Badajoz (Espana)); Delibes, A.; Lopez Brana, I.; Martin, J.A.; Sin, E.; Martinez, C. (1995) **[Considerations for a development of a sanity programme in relation to Mayetiola destructor Say pest in the corn fields of Badajoz [Spain]]. Consideraciones para el desarrollo de un programa de sanidad respecto a la plaga Mayetiola destructor Say en los trigales de Badajoz.** 1. Congreso de la Sociedad Espanola de Agricultura Ecologica; Toledo (Espana); 28-29 Sep 1994. *[Ecological practices for a quality agriculture: proceedings of 1st Congress of Ecological Agriculture Spanish Society, Toledo, 28-29 September of 1994]. Practicas ecologicas para una agricultura de calidad: actas del 1er Congreso de la Sociedad Espanola de Agricultura Ecologica, Toledo, 28-29 de septiembre de 1994. Junta de Comunidades de Castilla-La Mancha, Toledo (Espana). Consejeria de Agricultura y Medio Ambiente p. 120-127.* JCCM, CAMA. 4 tab.; 27 ref. Spanish. (AGRIS 96-004538).

1689 Nicol, C.M.Y. (Justus Liebig Univ., Giessen (Germany). Inst. fuer Phytopathologie und Angewandte Zoologie) (1993) **Phagodeterrency of neem products and their effects after oral intake on the desert locust, Schistocerca gregaria.** 45th International Symposium on crop protection; Gent (Belgium); 4 May 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 58(2b) p. 583-591.* 3 ill.; 3 tables; 21 ref. English. (AGRIS 96-005153).

1690 Pivnick, K.A. (1993) **Daily patterns of activity of females of the orange wheat blossom midge, Sitodiplosis mosellana (Gehn) (Diptera: Cecidomyiidae).** *The Canadian entomologist (Canada) v. 125(4) p. 725-736.* references. English. (AGRIS 96-004869).

1691 Roper, TJ.; Findlay, SR.; Lups, P.; Shepherdson, DJ. (1995) DAMAGE BY BADGERS MELES MELES TO WHEAT TRITICUM VULGARE AND BARLEY HORDEUM SATIVUM CROPS. *Journal of Applied Ecology. 32(4):720-726.* English. [UNIV SUSSEX SCH BIOL SCI BRIGHTON BN1 9QG E SUSSEX ENGLAND].

1. During 1986 and 1987 we surveyed 15 wheat and 15 barley fields for damage caused by badgers, in an area in the south of England where badger density was moderately high (7.5 adults Km(-2)). In the case of wheat, actual grain losses were estimated after the harvest by comparing the number of unharvested ears remaining in badger-damaged and undamaged areas. Direct observations of 11 radio-collared badgers from four neighbouring social groups were carried out in order to determine how and when crops were damaged. 2. Badgers damaged cereal crops by making paths through them and by flattening patches of crops while feeding on them. Paths and patches were more numerous in wheat than in barley, patches were larger in wheat; badgers commenced feeding on wheat earlier in the season; and feeding bouts were longer in wheat. Of Il

radio-collared badgers which had access to both crops, all fed on wheat but only five fed on barley. We conclude that badgers prefer wheat to barley when both are available. 3. Overall, 0.25% of the crop by area was damaged in the case of wheat and 0.05% in the case of barley. Average grain losses for wheat amounted to 7.21 kg ha(-1), or <0.1% of the total crop. Damage was not severe enough to make deterrence, for example by electric fencing, cost-effective. 4. Consumption of standing wheat began in early May, after which the time that badgers spent in wheat fields increased until September. Members of any one social group of badgers restricted their foraging to a few specific arena within the cereal fields available to them, and these areas were usually close to field edges, After the harvest, individuals ranged more widely and foraged independently of one another, gleaning spilled grain from stubble fields. In winter and early spring, wheat was taken from barns and grain stores. [References: 33].

1692 Santhi, M.; Murthy, M.M.K.; Mayuravalli, V.V.L.; Reddy, G.P.V. (Andhra Pradesh Agricultural University, Andhra Pradesh (india). Dept. of Entomology) (1993) **Synthetic pyrethroids in the control of Rhyzopertha dominica Fab. infesting wheat.** *Indian Journal of Entomology (India) v. 55(1) p. 92-94.* 1 table; 4 ref. English. (AGRIS 96-004875).

1693 Tobar, A.; Valor, H.; Talavera, M. (1995) **EFFECT OF DIFFERENT CULTIVARS, MAINLY OF WHEAT, ON THE POPULATION DENSITIES OF PRATYLENCHUS THORNEI AND MERLINIUS BREVIDENS IN DRY SOILS IN SPAIN.** *Nematologica. 41(5):642-644.* English. [CSIC ZAIDIN EXPTL STN NEMATOL GRP PROFESOR ALBAREDA 1 E-18008 GRANADA SPAIN].

1694 Walter, DE. (1996) **LIVING ON LEAVES - MITES, TOMENTA, AND LEAF DOMATIA [Review].** *Annual Review of Entomology. 41:101-114.* English. [UNIV QUEENSLAND DEPT ENTOMOL ST LUCIA QLD 4072 AUSTRALIA].

Structures on the surfaces of leaves strongly affect phylloplane mites. Glandular trichomes defend against some plant parasites but can also mire predators. However, leaves with tomenta of nonglandular trichomes are often inhabited by large populations of predatory mites. Tufts of hairs and other minute structures in the vein axils are called leaf domatia. Comparative observations and experimental data demonstrate that leaves with domatia have enhanced levels of predatory mites. By accumulating predatory mites, leaf domatia act as a kind of constitutive defense against herbivores. Mites benefit from leaf domatia by securing a safe place for oviposition and molting. Like several other plant structures, leaf domatia are the manifestation of a long-term and mutually beneficial interaction between plants and arthropods. [References: 69].

H20 PLANT DISEASES

1695 Adolf, B.; Schoefl, U.; Verreet, J.A. (Technische Univ. Muenchen, Freising Weihenstephan (Germany). Lehrstuhl fuer Phytopathologie) (1993) **Effects of infections with Septoria tritici at different growth stages of wheat (GS 25 to GS 59) on dry matter production, nitrogen uptake and yield.** 45th International Symposium on Crop Protection; Gent (Belgium); 4 May 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 58(3b) p. 1167-1174.* 4 ill.; 9 ref. English. (AGRIS 96-017952).

1696 Ahmed, HU.; Mundt, CC.; Coakley, SM. (1995) **HOST-PATHOGEN RELATIONSHIP OF GEOGRAPHICALLY DIVERSE ISOLATES OF SEPTORIA TRITICI AND WHEAT CULTIVARS.** *Plant Pathology. 44(5):838-847.* English. [OREGON STATE UNIV DEPT BOT & PLANT PATHOL 2082 CORDLEY HALL CORVALLIS, OR 97331 USA].

Pathogenic variability of 14 Septoria tritici isolates from different locations in the USA (California, Oregon, and Texas) was determined on seedlings of two sets of geographically diverse wheat cultivars under greenhouse conditions. Significant isolate effects, cultivar effects, and isolate x cultivar interactions were found, and a substantial amount of variation was accounted for by the interaction terms compared with the main effects of isolate and cultivar. All isolates were pathogenic on the cultivars tested but the degree of virulence on the individual cultivars varied among isolates. Linear contrasts between all homologous combinations (isolate x cultivar combination of same geographic location) and all heterologous combinations (isolate x cultivar combination of different locations) indicated that homologous combinations produced significantly more disease than heterologous combinations, The results demonstrate location-specific adaptation of S. tritici. Implications of pathogenic variability and local adaptation in S. tritici are discussed. [References: 40].

1697 Alizadeh, A. (Ecole Nationale Superieure Agronomique de Toulouse (France)); Sarrafi, A.; Barrault, G. (1994) **[Genetic variability for partial resistance to Xanthomonas campestris pv. hordei and pathogenicity variation of 13 pathovar strains in barley]. Variabilite genetique de la resistance partielle de l'orge a Xanthomonas campestris pv. hordei et variation de la pathogenicite de 13 souches du pathovar.** Annales ANPP (France) v. 1 p. 193-199. ANPP. 15 ref. v. 1 p. 193-199. English. (AGRIS 96-005448).

1698 Alzieu, F. (BASF France, Levallois Perret (France)); Lipatoff, V. (1994) **[Technical and economic interest of the fungicidal protection with epoxiconazole in cereals]. Interet technico-economique de la protection fongicide des cereales avec l'epoxiconazole.** Annales ANPP (France) v. 1 p. 231-236. ANPP. v. 1 p. 231-236. French. (AGRIS 96-005426).

1699 Arnold, W.R.; Johnson, D.; Daniau, P.; Longhurst, C. (DowElanco, P.O. Box 708, Greenfield, IN (USA)) (1992) **XRD-563 - a novel foliar applied fungicide for the control of powdery mildew in cereals.** *Brighton Crop Protection Conference, Pests and Diseases -1992. Volume 1. p. 443-450.* British Crop Protection Council. 4 ref. English. (AGRIS 96-005482).

1700 Atanassova, Z.; Nakamura, C.; Mori, N.; Kaneda, C.C.; Kato, H.; Jin, Y.Z.; Yoshizawa, T.; Murai, K. (1994) **Mycotoxin production and pathogenicity of Fusarium species and wheat resistance to Fusarium head blight.** *Canadian journal of botany = Journal canadien de botanique (Canada) v. 72(2) p. 161-167.* references. English. (AGRIS 96-005564).

1701 Balmas, V.; Burgess, LW.; Summerell, BA. (1995) **REACTION OF DURUM WHEAT CV YALLAROI TO CROWN AND ROOT ROT CAUSED BY FUSARIUM GRAMINEARUM GROUP 1 AND FUSARIUM CROOKWELLENSE.** *Australasian Plant Pathology. 24(4):233-237.* English. [INST SPERIMENTALE PATOL VEGETALE ROME ITALY].

The comparative pathogenicity of Fusarium *graminearum* Group 1 and Fusarium crookwellense to the durum wheat cv. Yallaroi was studied in the greenhouse. F. graminearum Group 1 was shown to cause more severe above ground symptoms of crown rot and a higher incidence of infection than F. crookwellense at all the sampling dates. F. crookwellense did, however, cause some root and crown necrosis. [References: 9].

1702 Bateman, GL.; Coskun, H. (1995) **POPULATIONS OF FUSARIUM SPP IN SOIL GROWING CONTINUOUS WINTER WHEAT, AND EFFECTS OF LONG-TERM APPLICATION OF FERTILIZERS AND OF STRAW INCORPORATION.** *Mycological Research. 99(Part 11):1391-1394.* English. [INST ARABLE CROPS RES ROTHAMSTED HARPENDEN AL5 2JQ HERTS ENGLAND].

Populations of Fusarium spp. from plots growing continuous winter wheat were estimated by dilution plating of soil samples taken in February, April and July 1993. The plots, from two sections of Broadbalk field, Rothamsted, either had the straw removed, or chopped and incorporated into the soil after every harvest since 1986; the plots also bad different fertilizer treatments. Most species were more abundant in July than in February or April. Estimated propagule numbers of F. culmorum, the only cereal pathogen found frequently, were less than in a survey of the same plots in 1964. It occurred in greatest numbers in plots treated with farmyard manure and, in July, with the largest inorganic nitrogen applications. F. oxysporum and F. solani, non-pathogenic on cereals, were mast frequent in plots treated with phosphorus, potassium and magnesium but without added nitrogen. Other non-pathogenic species, of which the most abundant was F. merismoides, showed no consistent response to any of the fertilizer treatments. The method of straw disposal had no consistent effects. The results are discussed in relation to perceived

changes in fusarium disease in the U.K. and changing cereal husbandry practices. [References: 17].

1703 Bateman, GL.; Dyer, PS.; Manzhula, L. (1995) **DEVELOPMENT OF APOTHECIA OF TAPESIA YALLUNDAE IN CONTRASTING POPULATIONS SELECTED BY FUNGICIDES.** *European Journal of Plant Pathology. 101(6):695-699.* English. [IACR ROTHAMSTED HARPENDEN AL5 2JQ HERTS ENGLAND].

Apothecia of the eyespot fungus, Tapesia yallundae, were found on 0-18% of straws in plots of wheat stubble in February-March 1994. The fungicides carbendazim, prochloraz or carbendazim plus prochloraz had been applied repeatedly to the same plots in each of the previous 9 years in which successive wheat crops had been grown. The factors most strongly correlated with the incidence of apothecia were the incidence and severity of eyespot in the preceding wheat crop and the frequency of carbendazim-resistant W-type fungus in populations recovered from that wheat crop. Plots treated with carbendazim, which had previously had more disease and more resistance to carbendazim in the pathogen population relative to untreated plots, therefore yielded most apothecia. Plots treated with prochloraz, which had selected for predominantly R-type fungus and decreased eyespot, yielded few apothecia. Single-ascospore isolates were all of the W-type and were more frequently carbendazim-sensitive than expected, except those from plots treated only with carbendazim. None showed decreased sensitivity to prochloraz. The implications of applying fungicides regularly for controlling eyespot on the capability of the eyespot fungus for genetic variation through sexual reproduction are discussed. [References: 17].

1704 Bayles, R.A.; Barnard, E.G.; Stigwood, P.L. (National Institute of Agricultural Botany, Huntingdon Road, Cambridge CB3 0LE (United Kingdom)) (1992) **Fungicide sensitivity in yellow rust of wheat (Puccinia striiformis).** *Brighton Crop Protection Conference, Pests and Diseases -1992. Volume 1. p. 165-170.* British Crop Protection Council. 3 ref. English. (AGRIS 96-005400).

1705 Bendahmane, M.; Schalk, HJ.; Gronenborn, B. (1995) **IDENTIFICATION AND CHARACTERIZATION OF WHEAT DWARF VIRUS FROM FRANCE USING A RAPID METHOD FOR GEMINIVIRUS DNA PREPARATION.** *Phytopathology. 85(11):1449-1455.* English. [SCRIPPS CLIN & RES INST DIV PLANT BIOL MB-8 10666 N TORREY PINES RD LA JOLLA, CA 92037 USA].

Using molecular analyses, we identified wheat dwarf geminivirus (WDV), a leafhopper-transmitted geminivirus prevalent in northern and eastern Europe, as the causative agent of a recent wheat dwarf outbreak in France. A novel, simple, and rapid method for purification of circular DNA from small amounts of plant tissue was described and was applied to clone the genome of WDV-F. The cloned WDV-F DNA was shown to be infectious on wheat (Triticum aestivum) following agroinoculation, and progeny virus was transmitted by leafhoppers. The DNA sequence of the WDV-F genome consists of 2, 750 bases, differs by only 1.3 and 1.4% from the WDV isolates from Sweden and Czechoslovakia, respectively, and represents a new isolate of WDV. [References: 47].

1706 Berthier, G. (Institut National de la Recherche Agronomique, La Verriere (France). Centre de Versailles, Service de Recherches Integrees sur les Productions Vegetales et la Protection des Plantes) (1994) **[Some data on wheat bunt in soil for optimizing seedling protection by seed treatment [betaxate]]. Quelques elements sur la carie du sol pour optimiser la protection de la plantule par le traitement de semence [betaxate].** Annales ANPP (France) v. 2 p. 637-640. ANPP. v. 2 p. 637-640. French. (AGRIS 96-005538).

1707 Berthon, Y. (Ciba Protection des Plantes, Rueil Malmaison (France)); Coulon, A.; Dubois, G. (1994) **[Study of complementary actions between triazoles and association of morpholines [Septoria tritici, Septoria nodorum, Drechslera teres; propiconazol, fenpropimorph, fenpropidin]]. Etudes des actions complementaires entre un fongicide de famille des triazoles et les morpholines et piperidines [Septoria tritici, Septoria nodorum, Drechslera teres; propiconazole, fenpropimorphe, fenpropidine].** Annales ANPP (France) v. 1 p. 251-257. ANPP. 5 tableaux. v. 1 p. 251-257. French. (AGRIS 96-005450).

1708 Bodson, B. (Faculte des Sciences Agronomiques, Gembloux (Belgique). UER Phytotechnie); Meeus, P.; Falisse, A. (1994) **[Nitrogen dressing and fungicide protection of winter cereals in Belgium]. Fumure azotee et protection fongicide des cereales d'hiver en Belgique.** Annales ANPP (France) v. 1 p. 279-286. ANPP. 13 ref. v. 1 p. 279-286. French. (AGRIS 96-005533).

1709 Boivin, P. (Institut Francais des Boissons de la Brasserie Malterie, Vandoeuvre les Nancy (France)); Clamagirand, V. (1994) **[Pesticide residues on malting barley and beer quality]. Les residus de traitement des orges et la qualite de la biere.** Annales ANPP (France) v. 2 p. 493-500. ANPP. v. 2 p. 493-500. French. (AGRIS 96-005453).

1710 Botte, M.C. (Bayer S.A., Puteaux (France)); de Keyzer, A.; Ambolet, B. (1994) **[Study of a new mixture combining tebuconazole and triadimenol to control cereal diseases]. Etude d'une nouvelle association a base de tebuconazole et de triadimenol pour lutter contre les maladies des cereales.** Annales ANPP (France) v. 1 p. 287-294. ANPP. 6 ref., 11 tableaux. v. 1 p. 287-294. French. (AGRIS 96-017976).

1711 Bouchot, C. (1994) **[The optimizing fungicide application on winter wheat: interest of tools to aid in the decision making]. Le raisonnement de la protection fongicide sur ble d'hiver: interet des outils d'aide a la decision "le mieux est la limite du bien".** Annales ANPP (France) v. 1 p. 181-189. ANPP. v. 1 p. 181-189. French. (AGRIS 96-005530).

1712 Braun, PW.; Turgut, I. (1995) **THE VIRULENCE STRUCTURE OF MILDEW POPULATIONS ON WILD BARLEY IN TURKEY.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 102(6):593-598.* German. [UNIV GIESSEN INST PFLANZENBAU & PFLANZENZUCHTUNG 2 LUDWIGSTR 27 D-35390 GIESSEN GERMANY].

Two mildew populations on wild barley were sampled for cleistothecia in western Turkey at the end of May in 1333. Testing the ascospore descendants on a differential, representing 23 monogenic mildew resistances, gave mean virulence complexities of 11.4 and 12.4, respectively, for the pathogen populations. Differences between the two mildew populations were indistinct, when compared for the existence of virulences. Examining the pathotype composition revealed a clear difference between the populations. In this respect, the mildew populations were highly heterogeneous. The predominant pathotype had a frequency of nearly 18 % in one population of 31 pathotypes, while its proportion was approximately 11 % in the second population with 61 pathotypes. [References: 17].

1713 Brisbane, PG.; Neate, SM.; Pankhurst, CE.; Scott, NS.; Thomas, MR. (1995) **SEQUENCE-TAGGED SITE MARKERS TO IDENTIFY RHIZOCTONIA SOLANI AG 4 OR 8 INFECTING WHEAT IN SOUTH AUSTRALIA.** *Phytopathology. 85(11):1423-1427.* English. [CSIRO DIV SOILS PRIVATE BAG 2 GLEN OSMOND SA 5064 AUSTRALIA].

Polymerase chain reaction with random amplified polymorphic DNA primers was used to generate polymorphisms from Rhizoctonia solani isolates of anastomosis groups (AG) 4 and 8. Products specific to AG 4 and 8 were selected, cloned, sequenced, and used in conjunction with a published AG 8 sequence to obtain four sequence-tagged site (STS) markers that produced different sized products from AG 4 and 8 isolates. A positive control primer (for ribosomal DNA [rDNA]) was mixed with the markers, but to obtain products from both the rDNA and the R. solani DNA, the magnesium concentration had to be increased. At the higher magnesium concentration, the specificity of one AG 8 primer changed to encompass all R. solani tested. Wheat root DNA reduced the sensitivity of the STS primers. Wheat plants were inoculated with R. solani AG 4 or 8 isolates, and DNA extracted from tissue samples was tested with mixtures of the ribosomal and AG-specific STS primers. The results yielded both ribosomal and AG-specific markers, illustrating that this technique can be used to identify R. solani within wheat roots. [References: 24].

1714 Brzezickaszymczyk, K.; Golinowski, W.; Zamorski, C. (1995) **CYTOLOGICAL CHANGES OBSERVED IN THE SUCCESSIVE PHASES OF THE WHEAT RUST CAUSED BY PUCCINIA RECONDITA F SP TRITICI AFTER THE TREATMENT WITH TILT 250EC.** *Acta Societatis Botanicorum Poloniae. 64(4):349-358.* English. [AGR UNIV WARSAW SGGW DEPT BOT UL RAKOWIECKA 26-30 PL-02528 WARSAW POLAND].

The disease process of wheat (Triticum aestivum) cv. Parada caused by rust (Puccinia recondita Rob. ex Desm. f. sp. tritici) and the effect of applying the fungicide Tilt 250EC are described. The application of spraying at the time of inoculation, during incubation and at the beginning of the actual disease is most effective, thus attests to the highest pathogen susceptibility to that chemical agent at these phases of the disease. Tilt 250EC (propikonazole) inhibits the ergosterol biosynthesis in the fungus cells. Application of the preparation caused the inhibition of the development and necrosis of the intra- and extracellular mycelium. Observed were: irregular growth of intercellular hyphae, perforation of septas, homogenization of protoplasts and collapsing of cells. In the haustoria observed were: the thickening of the cell wall, modification of the perihaustorial space, protoplast degeneration and finally the haustorium obliteration. [References: 19].

1715 Buga, SF. (1995) **THE LONG-TERM DYNAMICS OF BARLEY SEEDS INFECTION BY THE FUNGI BIPOLARIS SOROKINIANA (SACC) SHOEMAKER AND FUSARIUM SP IN BYELORUSSIA.** *Mikologiya i Fitopatologiya. 29(3):40-44.* Russian. [BELORUSSIAN PLANT PROTECT RES INST PRILUKI BYELARUS].

Recently, in the pathogenic complex of fungi, infecting barley seeds, essential changes have been noticed; the tendency towards caryopsises' infection decrease by B. sorokiniana fungi and the increase of the number of seeds, spored by Fusarium sp. Fungi is observed. This process is caused by the change of hydrothermal regime during the booting - wax ripeness of barley, division into districts of nonresistant to Fusarium spp. varieties, worsening of ecological conditions of plant growing. [References: 11].

1716 Cagnieul, P. (Du Pont de Nemours France S.A., Paris (France)) (1994) **[Septoria Diagnolab kit: a new tool to aid in the decision making [Septoria nodorum, Septoria tritici]]. Kit Diagnolab septoriose: un nouvel outil d'aide a la decision [Septoria nodorum, Septoria tritici].** Annales ANPP (France) v. 1 p. 159-163. ANPP. v. 1 p. 159-163. French. (AGRIS 96-005423).

1717 Cagnieul, P. (Du Pont de Nemours France S.A., Paris (France)); Zoghlami, M. (1994) **[Effect of application stage of the first treatment on barley with Punch Cs (flusilazole + carbendazim) on yield increase [Pyrenophora teres]]. Incidence du stade d'application du premier traitement sur orge a base de Punch Cs (flusilazole + carbendazime) sur le gain de rendement final [Pyrenophora teres].** Annales ANPP (France) v. 1 p. 245-249. ANPP. v. 1 p. 245-249. French. (AGRIS 96-005449).

1718 Caron, D. (Institut Technique des Cereales et des Fourrages, Baziege (France)); Jugnet, M.P.; Maumene, C. (1994) **[Efficacy in vitro and in fields of main fungicide active ingredients against scab]. Efficacite in vitro et en plein champ des principales matieres actives fongicides sur la fusariose des epis.** Annales ANPP (France) v. 1 p. 201-208. ANPP. v. 1 p. 201-208. French. (AGRIS 96-005424).

1719 Cavelier, N. (Institut National de la Recherche Agronomique, Le Rheu (France). Centre de Rennes, Service de Recherches Integrees sur les Productions Vegetales et la Protection des Plantes); Saur, L.; Boucherie, B. (1994) **[Effect of DMI fungicides applied on different winter wheat varieties, against the eyespot fungus Pseudocercosporella herpotrichoides [flusilazole, bromuconazole, prochloraze]]. Activite sur Pseudocercosporella herpotrichoides, agent du pietin-verse des cereales, de certains inhibiteurs de la biosynthese des sterols appliques sur differentes varietes de ble [flusilazole, bromuconazole, prochloraze].** Annales ANPP (France) v. 1 p. 103-109. ANPP. 9 ref. v. 1 p. 103-109. French. (AGRIS 96-018027).

1720 Cavelier, N.; Loree, F.; Prunier, M. (I.N.R.A., S.R.I.V., Domaine de la Motte, B.P. 29, 35650 Le Rheu (France)) (1992) **Resistance of the eyespot fungus, Pseudocercosporella herpotrichoides, to DMI fungicides.** *Brighton Crop Protection Conference, Pests and Diseases -1992. Volume 1. p. 189-194.* British Crop Protection Council. 10 ref. English. (AGRIS 96-005404).

1721 Champion, R. (1995) **[Barley. Control of loose smut]. Orge. Halte au charbon nu.** *Bulletin de la Federation Nationale des Agriculteurs Multiplicateurs de Semences (France) (no 131) p. 55-56.* French. (AGRIS 96-005446).

1722 Chen, XM.; Line, RF.; Leung, H. (1995) **VIRULENCE AND POLYMORPHIC DNA RELATIONSHIPS OF PUCCINIA STRIIFORMIS F SP HORDEI TO OTHER RUSTS.** *Phytopathology. 85(11):1335-1342.* English. [WASHINGTON STATE UNIV DEPT PLANT PATHOL PULLMAN, WA 99164 USA].

The relationships of Puccinia striiformis f. sp. hordei (stripe rust of barley) to P. striiformis f. sp. tritici (stripe rust of wheat) and P. striiformis f. sp. pone (stripe rust of bluegrass) in North America were determined by virulence and random amplified polymorphic DNA (RAPD) analyses. Their relationships to P. hordei (leaf rust of barley), P. recondita f. sp. tritici (leaf rust of wheat), and P. graminis f. sp. tritici (stem rust of wheat) were determined by RAPD assay. All isolates of P. striiformis f. sp. hordei were virulent on some cultivars of wheat, and some isolates of P. striiformis f. sp. tritici were virulent on some cultivars of barley. Isolates of P. striiformis f. sp. hordei and P. striiformis f. sp. tritici did not infect bluegrass, and isolates of P. striiformis f. sp. poae did not infect barley and wheat cultivars. Of 31 barley genotypes tested, were susceptible and 8 were resistant to all isolates of P. striiformis f. sp. hordei. The remaining 14 genotypes showed differential reactions. Fourteen races (pathotypes) of P. striiformis f. sp. hordei were identified using eleven selected barley genotypes based on avirulence/virulence patterns. A system for naming and designating races of P. striiformis f. sp. hordei was presented to distinguish races of P. striiformis f. sp. hordei from races of P. striiformis f. sp. tritici. RAPD analyses separated the isolates of P. striiformis f. sp. hordei, P. striiformis f. sp. tritici, and P. striiformis f. sp. poae. P. striiformis f. sp. hordei and P. striiformis f. sp. tritici were more closely related to each other than they were to P. striiformis f. sp. pone. Based on molecular variation, none of the three formae speciales of P. striiformis were more closely related to P. hordei, P. recondita f. sp. tritici, or P. graminis f. sp. tritici. [References: 48].

1723 Clark, W.S. (ADAS Cropping and Horticulture Development re, Brooklands Avenue, Cambridge CB2 2BL (United Kingdom)) (199. **Practical aspects of resistance to DMI fungicides in barley powd· mildew Erysiphe graminis.** *Brighton Crop Protection Conference, Pes.. ..nd Diseases -1992. Volume 1. p. 177-182.* British Crop Protection Council. 5 ref. English. (AGRIS 96-005463).

1724 Cohadon, P. (Sopra, Velizy Villacoublay (France)); Roques, J.F.; Godwin, J.R.; Heaney, S.P. (1994) **[ICIA5504, a broad spectrum fungicide with a new mode of action for the control of cereal and vine diseases [beta methoxyacrylate]]. Le ICIA5504: un fongicide a large spectre dote d'un nouveau mode d'action pour lutter contre les maladies des cereales et de la vigne [beta methoxyacrylate].** Annales ANPP (France) v. 3 p. 931-938. ANPP. 12 tableaux. v. 3 p. 931-938. French. (AGRIS 96-005539).

1725 Comas, J.; Pons, X.; Albajes, R.; Plumb, RT. (1995) **BARLEY YELLOW DWARF VIRUS STRAIN INCIDENCE IN SMALL GRAIN CEREALS IN NORTHEAST SPAIN.** *Journal of Phytopathology-Phytopathologische Zeitschrift. 143(10):609-611.* English. [ESAB URGELL 187 E-08036 BARCELONA SPAIN].

Barley yellow dwarf virus (BYDV) was detected in forage cereals and small grain cereals by indirect enzyme-linked immunosorbent assay. Samples of forage cereals collected in the winters of 1987/1988, 1988/1989 and 1989/1990 showed that this crop is a reservoir of BYDV during the end of summer and autumn. PAV-like and MAV-like isolates, in single or mixed infection, were the most common. The proportion of isolates in the infected samples was relatively stable. Samples of winter cereals collected

in the springs of 1988, 1989 and 1990 showed that PAV- and MAV-like isolates were widespread. The proportion of samples infected with PAV-like isolates was much more variable than that of MAV-like isolates. The incidence of PAV-like isolates in winter cereals is more dependent on the population of Rhopalosiphum padi, during the winter and early spring, than is the incidence of MAV-like isolates on Silobion avenae density. In northeast Spain (Lleida basin) forage cereals are a constant source of PAV- and MAV-like isolates from which BYDV inoculum is introduced into winter cereals. [References: 21].

1726 Delattre, M. (Dijon Cereales (France). Damier Vert) (1994) **[Fungicide on winter barley: 5 years of trials in Cote d'Or (France) [Helminthosporium teres; fluzilazol + fenpropimorph, flusilazol + chlorotalonil, flusilazol + carbendazim]]. Fongicide sur orge d'hiver: 5 ans d'experimentation en Cote d'Or (France) [Helminthosporium teres; fluzilazole + fenpropimorphe, flusilazole + chlorotalonil, flusilazole + carbendazime].** Annales ANPP (France) v. 1 p. 295-300. ANPP. v. 1 p. 295-300. French. (AGRIS 96-005452).

1727 Duvert, P. (Rhone Poulenc Agro, Lyon (France)); Pamart, M. (1994) **[Variability in the sensitivity of Pyrenophora teres to triazole fungicides: activity of a mixture of bromuconazole + iprodione]. Variabilite de sensibilite de Pyrenophora teres aux fongicides triazoles: effet de l'association bromuconazole + iprodione.** Annales ANPP (France) v. 1 p. 259-265. ANPP. 10 ref. v. 1 p. 259-265. French. (AGRIS 96-005451).

1728 Edwards, MC. (1995) **MAPPING OF THE SEED TRANSMISSION DETERMINANTS OF BARLEY STRIPE MOSAIC VIRUS.** *Molecular Plant-Microbe Interactions. 8(6):906-915.* English. [USDA ARS NO CROP SCI LAB FARGO, ND 58105 USA].

The specific mechanism(s) by which some plant viruses are transmitted through seed, while others are excluded, is not known, Using infectious barley stripe mosaic virus (BSMV) RNAs transcribed in vitro from full-length cDNA clones, the viral genetic determinants of seed transmission have been mapped. Both pseudorecombinant and chimeric viruses were constructed from BSMV strains ND18 (seed transmitted) and CV17 (not seed transmitted). The markedly different seed transmissibility of these two strains facilitated the identification of RNA gamma as the location of the primary determinants of seed transmission phenotype. RNA beta also played a role in seed transmission, but to a lesser extent than RNA gamma. Major genetic determinants of seed transmission on RNA gamma included the 5 ' untranslated leader, a 369-nt repeat in the gamma a gene, and the yb gene. Important determinants of symptom phenotype mapped to the RNA gamma leader and the gamma b gene as well. Some heterologous combinations of the RNA gamma leader and the gamma b gene resulted in dramatic changes in symptomatology and seed transmission, depending on the parental source of RNAs alpha and beta. These results suggest that a complex interaction of the RNA gamma leader, the gamma b gene, and RNAs alpha and beta are involved in BSMV pathogenesis. Considering the putative regulatory role of the gamma b gene (Donald and Jackson 1994, Plant Cell 6:1593-1606) and the trans effects that alterations in the gamma b gene have on RNA beta gene expression (Petty et al., 1990, EMBO J. 9:3453-3457), phenotypic effects attributed to elements of RNA gamma could result from cis or trans interactions involving the RNA gamma leader, the gamma b gene, and RNAs alpha and beta. Clearly, virus replication and movement play pivotal roles in the seed transmission of BSMV. [References: 39].

1729 Eudes, F.; Comeau, A.; Collin, J.; Asselin, A. (1995) **USE OF HEN LYSOZYME FOR PROTECTION AGAINST BACTERIAL CONTAMINATION OF IN VITRO EMBRYO CULTURES.** *Plant Cell Reports. 15(1-2):30-33.* English. [UNIV LAVAL FAC SCI AGR & ALIMENTAT DEPT PHYTOL LAVAL PQ G1K 7P4 CANADA].

Curative treatments with antibiotics and hen egg white lysozyme (HEWL) were used to salvage embryo cultures contaminated with Baccillus subtilis. The use of HEWL gave good control of Baccillus subtilis, but no control of Erwinia. HEWL was better than antibiotics, being much less phytotoxic. The antibiotics piperacillin, ampicillin and imipenem were also found to be ineffective against Erwinia, HEWL, at a final concentration of 1 mg per mt, was used as a preventive and curative agent for routine use in embryo culture of Triticum aestivum and other Triticeae, as it cured from 30% to 50% of bacterial contamination problems over a one year period. Standard in vitro culture precautions remained essential, as certain bacteria were not controlled by HEWL. [References: 15].

1730 Floquet, A. (BASF France, Levallois Perret (France)); Lipatoff, V. (1994) **[Interest of a complete fungicidal protection in cereal with epoxiconazole + fenpropimorphe [Septoria tritici, Helminthosporium teres]]. Interet d'une protection fongicide complete sur cereale a la montaison comme a l'epiaison avec epoxiconazole + fenpropimorphe [Septoria tritici, Helminthosporium teres].** Annales ANPP (France) v. 1 p. 237-244. ANPP. 5 tableaux. v. 1 p. 237-244. French. (AGRIS 96-005531).

1731 Foroughiwehr, B.; Lind, V.; Zuchner, S.; Rabenstein, F. (1995) **DIFFERENT ASSESSMENT TECHNIQUES OF LEAF BLOTCH (RHYNCHOSPORIUM SECALIS (OUD) DAVIS, J.) IN WINTER BARLEY AFTER ARTIFICIAL INOCULATION.** *Journal of Phytopathology-Phytopathologische Zeitschrift. 143(9):553-559.* English. [INST RESISTANCE GENET GRAF SEINSHEIM STR 23 D-85461 GRUBACH GERMANY].

Seven winter barley cultivars expressing different field resistance against leaf blotch (Rhynchosporium secalis) and 60 doubled haploid (DH) lines descending from an F-1 hybrid resistant x susceptible were used to develop a test for the quantitative determination of disease severity. Differences in the level of resistance could be measured very precisely after artificial infection of seedlings at the 4-leaf-stage and a subsequent incubation at 7 degrees C. The protein of six isolates was used for antiserum production which was subsequently supplied for serological testing (Enzyme-Linked-Immunosorbent-Assay) of infected leaves. The results of visible scoring of the seedlings was significantly correlated with measuring with the ELISA reader. The results of the seedling test also corresponded to field scores after natural infection. [References: 31].

1732 Fowler, J.A.P. (1994) **[Effects on soil property in occurrency of wheat take-all disease (Gaeumannomyces graminis)]. A influencia de propriedade do solo na ocorrencia do mal-do-pe Gaeumannomyces graminis do trigo Triticum aestivum L.** Universidade Federal do Parana, Curitiba (Brazil). Setor de Ciencias Agrarias. 12 illus.; 5 tables; Bibliography p. 67-72. 72 p. Portuguese. (AGRIS 96-005559).

1733 Frei, P.; Gindrat, D. (1995) **THE COMPLETE CYCLE OF EYESPOT DISEASE OF WHEAT (TAPESIA YALLUNDAE) UNDER CONTROLLED ENVIRONMENTAL CONDITIONS.** *Botanica Helvetica. 105(2):233-237.* French. [STN FED RECH AGRON CHANGINS CH-1260 NYON SWITZERLAND].

In a controlled environment simulating the growing period of winter wheat, mature apothecia of Tapesia yallundae were observed several weeks after harvest on eyespot lesions on stem bases of cultivar Arina inoculated at one node stage with ascospores or with mycelial isolates of the wheat (=W)-type of the anamorph Pseudocercosporella herpotrichoides. Isolates from lesions caused by ascospores were of the W-type. No apothecia were obtained after inoculation with single ascospore isolates of the W-type. [References: 9].

1734 Furlong, EB.; Soares, LMV.; Lasca, CC.; Kohara, EY. (1995) **MYCOTOXINS AND FUNGI IN WHEAT HARVESTED DURING 1990 IN TEST PLOTS IN THE STATE OF SAO PAULO, BRAZIL.** *Mycopathologia. 131(3):185-190.* English. [UNIV ESTADUAL CAMPINAS FAC ENGN ALIMENTOS CP 6121 BR-13081970 CAMPINAS SP BRAZIL].

Wheat from two cultivars with contrasting characteristics were harvested in ten experimental plots located in wheat producing areas of the State of Sao Paulo, Brazil. The samples (10 of each cultivar) were analyzed by a gas-chromatographic method for deoxynivalenol (DON), nivalenol (NIV), diacetoxyscirpenol (DAS), toxins T-2 (T-2) and HT-2, T-2 tetraol, T-2 triol, and by a thin-layer chromatographic method for zearalenone (ZEN), aflatoxins B-1, B-2, G(1), G(2), ochratoxin A and sterigmatocystin. No mycotoxins were detected in 13 samples. DON was found in four samples (0.47-0.59 mu g/g), NIV in three samples (0.16-0.40 mu g/g), T-2 in two samples (0.40, 0.80 mu g/g), DAS in one sample (0.60 mu g/g), and ZEN in three samples (0.04-0.21 mu g/g). The wheat samples were also examined for the incidence of fungi. Alternaria, Drechslera,

Epicoccum and Cladosporium were the prevailing genera. Among the Fusarium spp., F. semitectum was present in 19 samples and F. moniliforme in 18 samples. No F. graminearum was isolated in the samples. [References: 34].

1735 Gallenberg, D. (1995) **1995 foliar fungicides for wheat, barley and oats.** *Extension extra (USA); no. 8066 2 p.* English. (AGRIS 96-018042).

1736 Gallenberg, D.J. (South Dakota State University.) (1994) **1994 fungicide seed treatments for small grains: wheat, barley, oats, and rye.** *Extension extra (USA); no. 8064 4 p.* In subseries: Plant Science. English. (AGRIS 96-017970).

1737 Gilbert, J.; Tekauz, A. (1995) **EFFECTS OF FUSARIUM HEAD BLIGHT AND SEED TREATMENT ON GERMINATION, EMERGENCE, AND SEEDLING VIGOUR OF SPRING.** *Canadian Journal of Plant Pathology-Revue Canadienne de Phytopathologie. 17(3):252-259.* English. [AGR & AGRIFOOD CANADA WINNIPEG RES CTR 195 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

In 1993, following the worst fusarium head blight epidemic on record in southern Manitoba, two seed lots of each of the hard red spring (HRS) wheat cvs. Glenlea, Katepwa, and Roblin, the durum cv. Sceptre, and the Canada Prairie Spring (CPS) cv. AC Taber were tested for germination, emergence, dry weights of shoot and root, and response to seed cleaning and fungicide seed treatment. Seed treatment fungicides included DB-Green L, Dithane M-45, NM Drill Box, Vitaflo 280, and Vitavax S. Sound seed from 1992 and both cleaned and uncleaned seed from 1993 were used as controls. Fusarium graminearum was the predominant species isolated from the 1993 seed. Seed of Sceptre durum was of very poor quality; cleaning did not improve grade and fungicide treatment had minimal effect on germination or emergence. Cleaning reduced tombstone levels in Katepwa, Glenlea, and Roblin, and improved the grade of the latter two cultivars. Fungicide treatments generally improved germination and emergence but efficacy was dependant on temperature at germination and cultivar. Dry shoot weight in Glenlea was significantly lower than in controls after treatment with DB-Green L and Dithane M-45; no other significant differences in dry shoot weight were recorded. Dry root weight of plants from 1993 seed, treated and untreated, was significantly less than that of 1992 control seed, and seed treatment did not affect root weight. [References: 27].

1738 Godet, F. (Federation Regionale de Defense contre les Ennemis des Cultures, Fleury les Aubrais (France)); Didelot, D. (1994) **[Sensibility tests on wheat powdery mildew to fungicides [triadimenol, fenpropimorph, propiconazol]]. Tests de sensibilite de l'oidium du ble aux fongicides [triadimenol, fenpropimorphe, propiconazole].** Annales ANPP (France) v. 1 p. 143-150. ANPP. 5 ref. v. 1 p. 143-150. French. (AGRIS 96-005421).

1739 Goulart, A.C.P.; Paiva, F. de A.; Andrade, P.J.M. (1995) **[Relationship between incidence of blast in wheat heads and the presence of Pyricularia grisea in the harvested seeds]. Relacao entre a incidencia da brusone em espigas de trigo e a presenca de Pyriculari grisea nas sementes colhidas.** *Fitopatologia Brasileira (Brazil) v. 20(2) p. 184-189.* 5 tables; 20 ref. Portuguese. (AGRIS 96-005560).

1740 Gourmet, C.; Kolb, FL.; Smyth, CA.; Pedersen, WL. (1996) **USE OF IMIDACLOPRID AS A SEED-TREATMENT INSECTICIDE TO CONTROL BARLEY YELLOW DWARF VIRUS (BYDV) IN OAT AND WHEAT.** *Plant Disease. 80(2):136-141.* English. [UNIV ILLINOIS DEPT CROP SCI URBANA, IL 61801 USA].

Control of barley yellow dwarf was studied in six-row plots of two oat cultivars using three rates (0.6, 1.2, and 1.8 g a.i. kg(-1) seed) of imidacloprid, a seed-treatment insecticide. All insecticide treatments decreased the percentage of infected plants. Yield increases of up to 112% were observed in treated plots of a moderately susceptible cultivar inoculated with viruliferous aphids carrying barley yellow dwarf virus BYDV-PAV-IL. Insecticide-treated plots of a tolerant cultivar inoculated with BYDV-PAV-IL yielded up to 23% more than nontreated plots. In a similar study with four soft red winter wheat cultivars, all insecticide treatments decreased the percentage of infected plants, with the highest dose providing the most protection against BYDV infection. Yields were increased up to 21% in treated plots of a susceptible cultivar inoculated with viruliferous aphids carrying BYDV-PAV-IL. Noninoculated insecticide-treated plots also yielded an average of 14% more than noninoculated nontreated plots. [References: 37].

1741 Guo, J.Q. (1995) **[Study on transmission of barley yellow dwarf luteovirus (BYDV) by aphids: from cellular interactions of virus-aphid to risk assessment of epidemics [immuno-PCR, vector efficiency, vector specificity, clonal variations]]. Transmission par pucerons des luteovirus de la jaunisse nanisante de l'orge (JNO): de l'etude de l'interaction virus-aphide a l'estimation du risque epidemique [immuno-PCR, efficacite du vecteur, specificite du vecteur, variations clonales].** Universite de Paris 11, Orsay (France). 12 illus., 257 ref., 27 tableaux, 16 graph. 229 p. French. (AGRIS 96-005432).

1742 Gutierrez, C.; Suarezlopez, P.; Ramirezparra, E.; Sanzburgos, A.; Ponninger, J.; Xie, Q. (1995) **DNA BENDING AS A POTENTIAL REGULATORY CIS-ACTING ELEMENT OF THE GEMINIVIRUS INTERGENIC REGION.** *Agronomie. 15(7-8):415-420.* English. [UNIV AUTONOMA MADRID CSIC CTR BIOL MOLEC SEVERO OCHOA CANTO BLANCO E-28049 MADRID SPAIN].

Geminiviruses constitute a unique group of plant DNA viruses which produce important diseases both in mono- and dicotyledonous plants throughout the world. In particular, several members of the geminivirus subgroup I infect, among others, wheat (wheat dwarf virus, WDV), maize (maize streak virus, MSV) or different species of grasses. We are interested in identifying regions within the control region of the geminivirus genome which may act as regulatory elements during viral DNA replication and/or transcription. Recently, we have studied the DNA structure of the WDV large intergenic region by 2-dimensional polyacrylamide gel electrophoresis and by electron microscopy, and we have characterized a previously unidentified DNA sequence which confers intrinsic DNA bending properties. Here, we extend this study to other members of the subgroup I (SI) geminiviruses, in particular MSV. In general, DNA curvature was conferred by the presence of A-tracts separated by an integral number of helical turns. DNA bending within the regulatory regions of SI geminivirus DNA appears to be a common, though not general, situation. The possible implications of DNA bending of WDV as well as other SI geminivirus DNA as a regulatory element of viral DNA replication and/or transcription will be discussed in relation to the known effects of DNA curvature in other prokaryotic and eukaryotic replicons. [References: 31].

1743 Halama, P. (Institut Superieur d'Agriculture, Lille (France)) (1993) **[Variability of the agressiveness of Phaeosphaeria nodorum (Septoria nodorum) after sexual reproduction]. Variabilite de l'agressivite de Phaeosphaeria nodorum (Septoria nodorum) apres la reproduction sexuee.** 45th International Symposium on Crop Protection; Gent (Belgium); 4 May 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 58(3b) p. 1175-1182.* 5 tables; 20 ref. French. (AGRIS 96-017953).

1744 Hibberd, JM.; Whitbread, R.; Farrar, JF. (1996) **EFFECT OF ELEVATED CONCENTRATIONS OF CO2 ON INFECTION OF BARLEY BY ERYSIPHE GRAMINIS.** *Physiological & Molecular Plant Pathology. 48(1):37-53.* English. [UNIV SHEFFIELD ROBERT HILL INST DEPT ANIM & PLANT SCI WESTERN BANK SHEFFIELD S10 2UQ S YORKSHIRE ENGLAND].

Although there was no difference in the percentage of powdery mildew conidia that germinated on the second leaf of barley plants grown in either 350 or 700 ppm CO2, the percentage of conidia that progressed to produce colonies was lower in plants grown in 700 than in 350 ppm CO2. The lower percentage of conidia producing hyphae in 700 ppm CO2 was due to a higher proportion of the spores being arrested at the *appressorial stage*. The reduction in penetration of spores in 700 ppm CO2 was due neither to 700 ppm CO2 per se, nor to ontogenetic changes in the host tissue. Removing the epicuticular waxes from the surface of the leaf had no effect on the development of conidia on the surface of leaves in 350 or 700 ppm CO2, showing that increased epicuticular waxes were not causing the

increased resistance to primary penetration of powdery mildew in 700 ppm CO2. We relate reduced rates of primary penetration in barley grown in 700 ppm CO2 to higher rates of net photosynthesis allowing increased mobilisation of resources into resistance including the production of papillae and accumulation of silicon at the sites of appressorial penetration. Established colonies of powdery mildew grew faster in 700 ppm CO2 than in 350 ppm CO2, coincident with accumulation of host carbohydrate in the source leaf. [References: 31].

1745 Hovmoller, MS.; Munk, L.; Ostergard, H. (1995) **COMPARISON OF MOBILE AND STATIONARY SPORE-SAMPLING TECHNIQUES FOR ESTIMATING VIRULENCE FREQUENCIES IN AERIAL BARLEY POWDERY MILDEW POPULATIONS.** *Plant Pathology. 44(5):829-837.* English. [DANISH INST PLANT & SOIL SCI DEPT PLANT PATHOL & PEST MANAGEMENT LOTTENBORGVEJ 2 DK-2800 LYNGBY DENMARK].

Gene frequencies in samples of aerial populations of barley powdery mildew (Erysiphe graminis f.sp. hordei), which were collected in adjacent barley areas and in successive periods of time, were compared using mobile and stationary sampling techniques. Stationary samples were collected from trap plants in three periods within 1 week at a distance of more than 1000 m from the nearest barley field. At four dates within the same 8-day period, other samples were collected by a mobile spore trap along four sampling routes of a total distance of 130 km around the stationary stand of exposure. The samples were characterized by virulence genotypes defined according to infection types on 12 near-isogenic barley lines, and frequencies of single virulence genes were subsequently calculated. The three samples collected at the stationary site differed significantly with respect to allele frequencies at three loci. The main wind direction was different in the three sampling periods, implying different powdery mildew sources. For the mobile exposure, the differences between routes were not significant for any locus. However, the routes differed most for the loci under direct selection by host resistances genes, indicating a different distribution of source varieties along routes. There was no difference between allele frequencies at different dates, indicating that the proportions of spores from different source varieties were similar at these dates. In conclusion, samples collected by the stationary technique will mainly reflect the source varieties present in the local area, whereas samples collected by the mobile spore trap will mainly reflect sources close to the sampling route. Therefore, sampling sites as well as sampling routes should be defined such that source varieties are representative for the overall varietal distribution in the survey region considered. [References: 26].

1746 Hugerot, G. (Ministere de l'Agriculture, Saint Pouange (France). Service Regional de la Protection des Vegetaux Champagne Ardenne); Morard, V. (1994) **[Managed diseases control on winter wheat in Champagne]. Protection fongicide raisonnee du ble en Champagne.** Annales ANPP (France) v. 3 p. 1069-1076. ANPP. 5 graph. v. 3 p. 1069-1076. French. (AGRIS 96-005543).

1747 Humphreys, J.; Cooke, BM.; Storey, T. (1995) **EFFECTS OF SEED-BORNE MICRODOCHIUM NIVALE ON ESTABLISHMENT AND GRAIN YIELD OF WINTER-SOWN WHEAT.** *Plant Varieties & Seeds. 8(2):107-117.* English. [TEAGASC JOHNSTOWN CASTLE RES & DEV CTR WEXFORD IRELAND].

The relationship between seed-borne levels of Microdochium nivale and establishment, development and subsequent grain yield of winter-sown wheat under field conditions was quantified. Nine samples of different varieties of wheat were sown in a field trial at two seeding rates (400 seeds and 480 seeds m(-2)) using untreated seed in November 1991. Plant establishment in January 1992 was variable between varieties and ranged from 26% to 69%. Samples of seed from each variety were tested on potato dextrose agar and found to have levels of M. nivale ranging from 6% to 79% significantly correlated with plant establishment. Laboratory work showed seed-borne M. nivale was effectively transmitted to seedlings. At harvest, total grain yield ranged from 5.6 t ha(-1) to 9.4 t ha(-1) and was significantly correlated with establishment; the number of ears m(-2) (427 to 629) was also significantly correlated with establishment. Observed reductions in emergence and grain yield indicate the importance of effective control of seed-borne M. nivale infection in winter wheat. [References: 31].

1748 Ivanovic, D.; Osler, R.; Katis, N.; Ivanovic, M.; Ignjatovic, D. (1995) **PRINCIPAL MAIZE VIRUSES IN MEDITERRANEAN COUNTRIES.** *Agronomie. 15(7-8):443-446.* English. [MAIZE RES INST ZEMUN POLJE BELGRADE YUGOSLAVIA].

Maize plants with virus-like symptoms were sampled in fields in Greece, Yugoslavia and Italy in 1994. Disease incidence (%) and disease severity (1-6) were assessed. Leaf samples were tested by enzyme-linked immunosorbent assay (ELISA) and electroblot immunoassay (EBIA). Antisera against maize dwarf mosaic virus (MDMV), sugarcane mosaic virus (SCMV) and barley yellow dwarf viruses (BYDVs) (PAV- and RPV-like) were used in these tests. A higher disease incidence occurred in Italy and Greece than in Yugoslavia. MDMV was proved by both ELISA and EBIA in all maize genotypes in Greece, Yugoslavia and Italy. None of the samples reacted with SCMV antibodies. A total of 13.7 and 11% of individual Greek samples were positive for PAV- and RPV- respectively, while, 17.5 and 5% of Yugoslav samples were positive for PAV- and RPV- respectively. Phragmites sp, a perennial maize weed, was also positive for PAV- and RPV- by ELISA. [References: 13].

1749 Jackson, D. (Uniroyal Chemical Ltd., Slough (Royaume Uni)); De Lachadenede, J. (1994) **[Effect of seed treatment by a carboxin-thiram mixture on the cereal crops in France [Fusarium roseum, Fusarium nivale, Septoria nodorum, Helminthosporium gramineum, Ustilago nuda]]. Avantages d'un traitement des semences par une association de carboxine-thiram FS sur les cultures de cereales en France [Fusarium roseum, Fusarium nivale, Septoria nodorum, Helminthosporium gramineum, Ustilago nuda].** Annales ANPP (France) v. 2 p. 589-596. ANPP. 8 tableaux. v. 2 p. 589-596. French. (AGRIS 96-005536).

1750 Kemp, GHJ.; Pretorius, ZA.; Wingfield, MJ. (1996) **FUSARIUM GLUME SPOT OF WHEAT - A NEWLY RECORDED MITE-ASSOCIATED DISEASE IN SOUTH AFRICA.** *Plant Disease. 80(1):48-51.* English. [UNIV ORANGE FREE STATE DEPT PLANT PATHOL BLOEMFONTEIN 9300 SOUTH AFRICA].

Fusarium poae was frequently isolated from necrotic lesions on wheat glumes in South Africa. Glume infections were usually associated with the mycophageous mite Siteroptes avenae. Microscopic examination of S. avenae feeding on F. poae cultures revealed the presence of two elongated sporothecae containing microconidia of the fungus. Spray inoculation of adult wheat plants with a suspension of F. poae microconidia produced water-soaked lesions on leaves and black chaff-like symptoms and necrotic awns. When the suspension was injected through the , glumes into florets, or when F. poae-fed mites were transferred to the glumes of uninfected plants, symptoms typical of those observed in the field were reproduced. A close association appears to exist between S. avenae and F. poae and evidence suggests that both the mite and fungus are responsible for causing Fusarium glume spot of wheat in South Africa. [References: 32].

1751 Keutgen, N.; Roeb, GW.; Fuhr, F.; Reisener, HJ. (1995) **ACCUMULATION OF ASSIMILATES IN STEM-RUST-INFECTED WHEAT LEAVES.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(5):297-305.* German. [KFA JULICH GMBH FORSCHUNGSZENTRUM INST RADIOAGRON POSTFACH 1913 D-52425 JULICH GERMANY].

Using wheat plants (cv.'Prelude'), the effects of stem-rust infection on photosynthesis and assimilate partitioning were studied with the aid of the short-lived carbon isotope C-11. Photosynthesis of strongly infected leaf parts declined by about 30 % within 1 day. This rapid inhibition was caused by the formation of appressoria and the growth of infection tubes into the stomata, leading to a reduction in gas exchange. Further decline of photosynthesis to 5-10 % was accompanied by the degradation of chlorophyll. Nevertheless, during sporulation, the dry weight of the infected leaf area increased by about 50 %. With the use of C-11, the reduced export of photosynthate from the infected leaf part and the capture of labelled compounds from the apical leaf section were quantified. The enhanced storage of assimilates in stem-rust-infected

leaves can be attributed to the increase in invertase activity. [References: 16].

1752 Kiros Melese; Mengistu Huluka (Institute of Agricultural Research, Addis Abeba (Ethiopia). Debre Zeit Research Center) (1994) **Isolate Variability in Barley Scald (Rhynchosporium secalis).** 1. Annual Conference Crop Protection Society of Ethiopia; Addis Abeba (Ethiopia); 14-15 Apr 1993. *Proceedings of the First Annual Conference Crop Protection Society of Ethiopia. Eshetu Bekele; Yitbarek Semeane; Tibebu Habtewold; Mengistu Kebede; Kasahun Bekele p. 44-45.* CPSE. English. (AGRIS 96-005469).

Barley (Hordeum vulgare L.) is one of the most important food crops in Ethiopia. Barley scald caused by Rhynchosporium secalis (Oud) Davis is common in the cool and semi-humid barley growing regions and the disease has been known in Ethiopia since 1967. However, no detailed work on pathogenic variation of the fungus has been undertaken. Therefore, this investigation was initiated to study the range of pathogenicity of isolates of R. secalis in Ethiopia. Twent-four isolates of R. secalis, collected from various locations in Arsi, Bale and Shewa, were tested on ten differential host cultivars, with known genes for resistance to the disease, in a glass-house at Holetta. The plants were inoculated using single drop inoculation method and the isolates were classified into 19 pathotypes based on the pattern of reaction they induced on the differential host cultivars. Most frequent pathotypes were those inducing susceptible reaction on Steudelli and Kitchin and the least complex pathotype identified was Pathotype 13 which was able to induce susceptible reaction only on these two cultivarS. Pathotype-16 and Pathotype-7 were the most complex pathotypes and were able to cause susceptible reaction on all and 9 of the differential host cultivars, respectively. These pathotypes were collected from research stations and were isolated from improved barley cultivars of malting type. The most frequent pathotype was Pathotype-6 and was represented by four isolates procured from different locations in Arsi, Bale and Shewa. Pathogenic variation was detected among spores collected from the same field and from the same geographical location. Most effective resistant genes observed were those possessed by Turk, La-Mesita, Bey, Nigrinudum, Jet and Forrajera.

1753 Klem, K.; Tvaruzek, L. (Zemedelsky Vyzkumny Ustav, Kromeriz (Czech Republic)) (1995) **[Influence of nitrogen nutrition on epidemics of powdery mildew in cereals]. Vliv dusikate vyzivy na vyvoj epidemie padli travniho na obilovinach.** *Obilnarske Listy (Czech Republic) v. 3(3) p. 40-42.* 4 graphs. Czech. (AGRIS 96-005566).

1754 Knox, RE.; Depauw, RM.; Mccaig, TN.; Clarke, JM.; Mcleod, JG.; Fernandez, MR. (1995) **AC KARMA WHITE SPRING WHEAT.** *Canadian Journal of Plant Science. 75(4):899-901.* English. [AGR CANADA RES CTR BOX 1030 SWIFT CURRENT SK S9H 3X2 CANADA].

AC Karma, white seeded spring wheat (Triticum aestivum L.), combines high grain yield with resistance tq common bunt [caused by Tilletia laevis Kuhn in Rabenh. and T. caries (DC.) Tul. & C. Tul.] and loose smut [caused by Ustilago tritici (Pers.) Rostr.] in a semidwarf, photoperiod insensitive background. AC Karma has improved leaf rust (caused by Puccinia recondita Roberg ex Desmaz.) and stem rust (caused by P. graminis Pers.:Pers.) resistance, stronger straw and earlier maturity compared to Genesis. AC Karma is eligible for grades of the Canada Prairie Spring (white) wheat class. [References: 6].

1755 Koch, E.; Leadbeater, A.J. (CIBA GEIGY Limited, Division Plant Protection, Business Unit Control, Research and Development, 4002, Basle (Switzerland)) (1992) **Phenylpyrroles - a new class of fungicides for seed treatment.** *Brighton Crop Protection Conference, Pests and Diseases -1992. Volume 3. p. 1137-1146.* British Crop Protection Council. 7 ref. English. (AGRIS 96-005524).

1756 Kofalvi, SA.; Gao, JG.; Nassuth, A. (1995) **BIOCHEMICAL INVESTIGATION INTO THE WALL COLLAPSE OF WHEAT LEAF CELLS CAUSED BY WHEAT STREAK MOSAIC VIRUS INFECTION.** *Physiological & Molecular Plant Pathology. 47(6):379-389.* English. [UNIV GUELPH DEPT BOT GUELPH ON N1G 2W1 CANADA].

Structural and biochemical changes which occur in the walls of wheat streak mosaic virus infected wheat leaf cells were examined. Electron microscopy of freeze-fractured and fixed sections of infected tissue showed that it contained collapsed cells. To determine if degradation of wall components could be causing this collapse, we tested glucanase and xylanase activities in leaf extracts. Glucanase activity did not appear to be altered due to infection, but xylanase activity was increased. Ester-linked phenolic acids, saponified from cell walls and separated by TLC, showed a slight increase in ferulic acid content in infected tissue. Also, the ion composition of cell walls, as determined by energy dispersive X-ray analysis, was altered. Lower amounts of calcium and chloride ions, but higher amounts of potassium ions, were detected in infected cell walls. These changes, in combination with the previously determined lower peroxidase activity in infected tissue, are suggested to be at least partially responsible for the observed wall collapse. (C) 1995 Academic Press Limited [References: 34].

1757 Kofalvi, SA.; Nassuth, A. (1995) **INFLUENCE OF WHEAT STREAK MOSAIC VIRUS INFECTION ON PHENYLPROPANOID METABOLISM AND THE ACCUMULATION OF PHENOLICS AND LIGNIN IN WHEAT.** *Physiological & Molecular Plant Pathology. 47(6):365-377.* English. [UNIV GUELPH DEPT BOT GUELPH ON N1G 2W1 CANADA].

Wheat plants infected with wheat streak mosaic virus were studied for their physiological response to infection. Previous histological data suggest that wheat streak mosaic virus-induced deposits of phenolic nature are present along the bundle sheath and mesophyll cell walls. In this study, we examined this phenomenon further by analysis of phenolic compounds and enzymes involved in their synthesis. In infected plants, the amounts of free and wall-bound phenolic compounds increased slightly, and chromatography showed that the type of free phenolic compounds present had changed. The amount of lignin did not change due to infection. Enzyme assays showed that while phenylalanine ammonia lyase and tyrosine ammonia lyase activities decreased as they do in healthy plants, cinnamyl alcohol dehydrogenase activity stayed high throughout infection. In addition, peroxidase activities in infected plants decreased around the time that the leaves ceased to expand. These results suggest that the general phenylpropanoid pathway is stimulated upon infection, bur that lignification is not. (C) 1995 Academic Press Limited [References: 34].

1758 Leprince, X. (Ciba, Bale (Suisse). Division Protection des Plantes); Speich, J. (1994) **[Maintenance of fungicides efficacy on cereals. Use of fenpropimorph and fenpropidin against powdery mildew of wheat and barley]. Strategie de maintien de l'efficacite des fongicides sur cereales. Le point sur l'utilisation du fenpropimorphe et de la fenpropidine contre l'oidium du ble et de l'orge.** Annales ANPP (France) v. 1 p. 127-134. ANPP. 6 ref. v. 1 p. 127-134. French. (AGRIS 96-017973).

1759 Leroux, P. (Institut National de la Recherche Agronomique, Versailles (France). Centre de Versailles, Phytopharmacie); Marchegay, P.; Maumene, C. (1994) **[Evolution in a long-term field trial of the resistance of Pseudocercosporella herpotrichoides to prochloraz]. Evolution dans un essai pluriannuel de la resistance de Pseudocercosporella herpotrichoides au prochloraze.** Annales ANPP (France) *v. 1 p. 151-158.* ANPP. v. 1 p. 151-158. French. (AGRIS 96-005422).

1760 Liljeroth, E.; Franzon Almgren, I.; Gustafsson, M. (1994) **Effect of prehelminthosporol, a phytotoxin produced by Bipolaris sorokiniana, on barley roots.** *Canadian journal of botany = Journal canadien de botanique (Canada) v. 72(5) p. 558-563.* English. (AGRIS 96-005468).

1761 Lipatoff, V. (BASF France, Levallois Perret (France)); Couillard, N.; Delot, P. (1994) **[Interest of the combination epoxiconazole + fenpropimorph in the control of powdery mildew on wheat]. Interet de l'association epoxiconazole + fenpropimorphe dans la lutte contre l'oidium du ble.** Annales ANPP (France) v. 1 p. 121-126. ANPP. v. 1 p. 121-126. French. (AGRIS 96-017958).

1762 Lipatoff, V. (BASF France, Levallois Perret (France)); Speakman, J.B.; Barchietto, T. (1994) **[Study of the in vitro and in vivo activity of**

epoxiconazole against Septoria sp. [Septoria nodorum, Septoria tritici]]. Etude de l'activite in vitro et in vivo de l'epoxiconazole vis-a-vis de Septoria sp. [Septoria nodorum, Septoria tritici]. Annales ANPP (France) v. 1 p. 223-230. ANPP. 5 tableaux. v. 1 p. 223-230. French. (AGRIS 96-005425).

1763 Lochon, S. (Service Regional de la Protection des Vegetaux Centre, Fleury les Aubrais (France)); de La Rocque, B.; Migeon, J.L.; Murer, F.; Pillon, O.; Vergnaud, A. (1995) **[1995 cereals review [too mild autumn and winter] [France]]. Bilan d'une campagne cereales "hors normes". Automne et hiver: la douceur dangereuse [France, 1995].** *Phytoma La Defense des Vegetaux (France) (no.478) p. 53-56.* French. (AGRIS 96-018028).

1764 Lorenz, G.; Saur, R.; Schelberger, K.; Forster, B.; Kung, R.; Zobrist, P. (BASF Aktiengesellschaft, Crop Protection Division, Research and Development, 6703 Limburgerhof (Germany)) (1992) **Long term monitoring and results of wheat powdery mildew sensitivity towards fenpropimorph and strategies to avoid the development of resistance.** *Brighton Crop Protection Conference, Pests and Diseases -1992. Volume. p. 171-176.* British Crop Protection Council. 6 ref. English. (AGRIS 96-005401).

1765 Lu, P.; Marquardt, RR.; Frohlich, AA.; Mills, JT. (1995) **DEVELOPMENT OF SOLID-PHASE IMMUNOASSAYS FOR THE DETECTION AND QUANTIFICATION OF ASPERGILLUS OCHRACEUS IN WHEAT GRAIN.** *Food & Agricultural Immunology. 7(1):81-93.* English. [AGR CANADA ANIM DIS RES INST POB 11300 3851 FALLOWFIELD RD STN H NEPEAN ON K2H 8P9 CANADA].

Aspergillus ochraceus Wilhelm is a common contaminant of stored foods, especially cereal grains, which produces the mycotoxin, ochratoxin A (OA). Solid-phase immunoassays (enzyme-linked immunosorbent assay [ELISA] and immunoblotting), utilizing antibodies raised in rabbits to A. ochraceus exoantigens (ExAgs, a mixture of extracellular macromolecules), were evaluated for their ability to provide an index of the degree of A. ochraceus contamination in cereals. A. ochraceus could be readily detected with a minimal degree of interference or cross-reactivity from the wheat matrix or from other fungal species naturally present in wheat. The ELISA was sensitive, with the limits of detection for ExAgs being as low as 50 ng ml(-1) . The amounts of A. ochraceus ExAgs detected in wheat that was naturally molded and inoculated with A. ochraceus correlated favorably with other parameters indicative of the presence of the fungus. These parameters included the amount of OA ($r = 0.93$, $P < 0.05$), the percentage of A. ochraceus infection ($r = 0.89$, $P < 0.05$), the number of colony-forming units ($r = 0.68$, $P < 0.05$) and the glucosamine content ($r = 0.64$, $P < 0.05$). Immunoblotting patterns of ExAgs extracted from liquid and wheat cultures of A. ochraceus demonstrated that ExAgs consisted of several antigenic components, with the immunodominant ones having molecular weights of approximately 20 or 30 kDa. The concentration of particular components appeared to be influenced by the media on which A. ochraceus was cultivated. The data suggest that the immunoassays developed for A. ochraceus ExAgs can be used for the identification and quantitation of this fungus in grain. [References: 37].

1766 Lucas, P. (Institut National de la Recherche Agronomique, Le Rheu (France). Centre de Rennes, Pathologie Vegetale et Malherbologie); Capron, G.; Guillerm, A.Y. (1994) **[Usefulness of an experimental fungicide (Mona41100) for studying yield losses due to take-all on winter wheat crops. Impact on soil nitrogen uptake by the plants]. *Interet d'un* fongicide experimental (Mona41100) pour l'etude de la nuisibilite du pietin-echaudage en culture de ble d'hiver. Consequences sur l'utilisation de l'azote du sol par les plantes.** Annales ANPP (France) v. 1 p. 93-101. ANPP. 8 tableaux. v. 1 p. 93-101. French. (AGRIS 96-005419).

1767 Lyngkjaer, MF.; Jensen, HP.; Ostergard, H. (1995) **A JAPANESE POWDERY MILDEW ISOLATE WITH EXCEPTIONALLY LARGE INFECTION EFFICIENCY ON MLO-RESISTANT BARLEY.** *Plant Pathology. 44(5):786-790.* English. [RISO NATL LAB DEPT ENVIRONM SCI & TECHNOL PLANT GENET SECT DK-4000 ROSKILDE DENMARK].

A Japanese field isolate (Race I) of Erysiphe graminis f. sp. hordei was tested on 17 barley lines carrying the mlo powdery mildew resistance gene. Race I produced many successful infections with infection type larger than or equal to 2 on six lines (M66, MC20, SR1, SR7, Atem and Totem). On the remaining 11 lines it reacted with infection type 0. Colony numbers on the Mlo-lines were between 2.6% and 12.9% of the numbers on a susceptible cultivar Manchuria, These numbers were larger than, or similar to those produced by isolate HL3/5, which has the highest recorded infection efficiency on Mlo-resistant cultivars. The interaction between isolates and lines was highly significant. The isolate GE3, from which HL3/5 was derived by selection, gave rise to occasional colonies corresponding to less than 0.3% of the number produced on cv. Manchuria. [References: 13].

1768 Macnish, GC. (1995) **TWENTY-FIVE YEARS OF ROOT DISEASE RESEARCH - COULD SUCH A SATISFYING EXPERIENCE EVER HAPPEN AGAIN.** *Australasian Plant Pathology. 24(4):217-224.* English. [DEPT AGR ESPERANCE WA 6450 AUSTRALIA].

1769 Magboul, M.A. (King Faisal Univ. (Saudi Arabia). College of Agricultural and Food Sciences) (1994) **The effect of postinfection and leaf witness period on pycnidial density of Septoria tritici on wheat.** *Alexandria Journal of Agricultural Research (Egypt) v. 39(3) p. 431-442.* 2 ill. 1 table; 17 ref. English. (AGRIS 96-005396).

1770 Martyniuk, S.; Stachyra, A.; Wroblewska, B. (1995) **DISEASE LEVELS IN WINTER WHEAT, RYE AND TRITICALE GROWN ON SOIL ARTIFICIALLY INOCULATED WITH CEPHALOSPORIUM GRAMINEUM.** *European Journal of Plant Pathology. 101(6):701-704.* English. [INST SOIL SCI & PLANT CULTIVAT DEPT SOIL MICROBIOL PL-24100 PULAWY POLAND].

Field experiments with winter cereals grown on soil inoculated with C. gramineum showed that wheat and rye cultivars possess some resistance to the pathogen, while the triticale cultivars were the most susceptible. Higher tolerance of the tested wheat cultivars was connected mainly with slow development of disease symptoms; rye cultivars had, on average, lower percentages of plants infected by C. gramineum. The greatest variation in susceptibility to C. gramineum occurred among the selected cultivars of triticale. [References: 8].

1771 Maumene, C. (Institut Technique des Cereales et des Fourrages, Boigneville (France)); Murer, F.; Lipatoff, V. (1994) **[Efficacies of main mode of action of fungicides used to control mildew and brown rust on wheat]. Suivi des efficacites des principaux modes d'action des fongicides utilises pour la lutte contre l'oidium et la rouille brune du ble.** Annales ANPP (France) v. 1 p. 135-141. ANPP. 9 tableaux. v. 1 p. 135-141. French. (AGRIS 96-005420).

1772 McCallum, B.D.; Bernier, C.C.; Lamari, L. (1994) **Generation and utilization of chemical-resistant mutants in Pyrenophora tritici-repentis, the causal agent of tan spot of wheat.** *Canadian journal of botany = Journal canadien de botanique (Canada) v. 72(1) p. 100-105.* references. English. (AGRIS 96-005376).

1773 Meeus, P. (Centre de Recherches Agronomiques de l'Etat, Gembloux (Belgique). Station de Phytopharmacie); Bodson, B. (1994) **[Fungicide protection in winter wheat in Belgium. Comparison between treatments at "last leaf" and "ear" stages]. Protection fongicide du froment d'hiver en Belgique. Comparaison des traitements realises aux stades derniere feuille et epiaison.** Annales ANPP (France) v. 3 p. 1059-1068. ANPP. 5 tableaux. v. 3 p. 1059-1068. French. (AGRIS 96-005542).

1774 Meynard, J.M. (Institut National Agronomique Paris Grignon, Thiverval Grignon (France). Laboratoire d'Agronomie) (1994) **[Strategic decision support in plant protection. The case of disease control in the wheat crop [DECIBLE]]. L'aide a la decision strategique en protection des plantes. Exemple de la lutte contre les maladies du ble [DECIBLE].** Annales ANPP (France) v. 3 p. 989-996. ANPP. 10 ref. v. 3 p. 989-996. French. (AGRIS 96-005541).

1775 Migeon, J.L.; Mathon, M.P.; Chudzicki, A.M. (Service de la Protection des Vegetaux, Loos en Gohelle (France)) (1993) **[Prochloraz use in Northern France. First cases of practical resistance of the wheat eyespot (Pseudocercosporella herpotrichoides)]. Le prochloraze dans le nord de la France. Premiers cas de resistance pratique du pietin-verse du ble (Pseudocercosporella herpotrichoides).** 45th International Symposium on Crop Protection; Gent (Belgium); 4 May 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 58(3b) p. 1401-1409.* 3 ill.; 3 tables; 5 ref. French. (AGRIS 96-017954).

1776 Mikhailova, LA. (1995) **POPULATION STRUCTURE OF WHEAT BROWN RUST AGENT .3. ESTIMATION OF POPULATIONS SIMILARITY RATE ON THE TERRITORY OF CIS (COMMONWEALTH OF INDEPENDENT STATES) IN 1988-1990.** *Mikologiya i Fitopatologiya. 29(3):45-51.* Russian. [ALL RUSSIAN PLANT PROTECT RES INST ST PETERSBURG RUSSIA].

The Puccinia recondita f. sp. tritici phenotype composition was investigated in European and Asian parts of CIS (Former USSR). The dominant phenotypes in geographical samples of populations and degree of similarity of phenotype frequency were determined. It was supposed the possibility of isolation between pathogen population inhabiting on Caucasus, European, Eastern Syberia and Northern Kazachstan, Middle Asia regions. The approaches to determination of population areas and spore migration are discussed. [References: 9].

1777 Moerschbacher, B.M. (Institut fur Biologie III (Plant Physiology), Aachen, Germany.); Vander, P.; Springer, C.; Noll, U.; Schmittmann, G. (1994) **Photosynthesis in stem rust-infected, resistant and susceptible near-isogenic wheat leaves.** *Canadian journal of botany = Journal canadien de botanique (Canada) v. 72(7) p. 990-997.* references. English. (AGRIS 96-018044).

1778 Mugnier, J. (Rhone Poulenc Agro, Lyon (France)) (1995) **[Net blotch and spot lotch on barley. A new diagnostic approach: the PCR]. Les tache brunes des orges. Une nouvelle approche du diagnostic de l'"Helminthosporiose": la PCR.** *Phytoma La Defense des Vegetaux (France) (no 469) p. 17-20.* 5 illus., 13 ref. French. (AGRIS 96-005447).

1779 Murray, GM.; Ellison, PJ.; Watson, A. (1995) **EFFECTS OF STRIPE RUST ON THE WHEAT PLANT.** *Australasian Plant Pathology. 24(4):261-270.* English. [NEW S WALES AGR AGR RES INST WAGGA WAGGA NSW 2650 AUSTRALIA].

Stripe rust of wheat caused by Puccinia striiformis f. sp. tritici reduced kernel mass and the number of kernels per head in field epidemics from 1984 to 1987 in southern New South Wales. These epidemics began at the stem elongation stage of growth in 1984 and at booting to heading stages in the other years. The effects were greatest in very susceptible cultivars when the epidemic began before the booting stage of growth and affected more leaf area by the early milk stage of growth. Grain yield was reduced by up to 84%, kernel mass by up to 43% and kernel number by up to 72%. Stripe rust did not affect plant height, tiller number or stem dry matter at booting and anthesis. In some cases, stem dry matter was reduced at maturity. The dates of booting, heading and anthesis were not affected. The possible implications of the effect of stripe rust on grain quality arising from reduced kernel size are discussed. [References: 20].

1780 Murray, TD. (1996) **RESISTANCE TO BENZIMIDAZOLE FUNGICIDES IN THE CEREAL EYESPOT PATHOGEN, PSEUDOCERCOSPORELLA HERPOTRICHOIDES, IN THE PACIFIC NORTHWEST 1984 TO 1990.** *Plant Disease. 80(1):19-23.* English. [WASHINGTON STATE UNIV COLL AGR DEPT PLANT PATHOL PULLMAN, WA 99164 USA].

Isolates of Pseudocercosporella herpotrichoides resistant to benzimidazole fungicides were detected in commercial winter wheat fields in the Pacific Northwest region (Washington, Oregon, and Idaho) of the United States for the first time in the spring of 1989. Benzimidazole-resistant isolates were found in nine of 62 fields sampled in 1989 and in 17 of 167 fields sampled in 1990, which represents 24 and 19% of those fields yielding the pathogen, respectively. In 1989 and 1990, respectively, 96 and 70% of all isolates collected from fields where fungicide resistance was detected were resistant to the benzimidazole fungicides. All fields where fungicide-resistant strains of the eyespot fungus were found had at least four previous applications of a benzimidazole fungicide. In 1989 and 1990, respectively, 24 and 15% of the P. herpotrichoides cultures collected had a slow growth rate with feathery colony margins on potato-dextrose agar and corresponded to rye-type isolates. However, benzimidazole-resistant rye-type isolates represented only 7 and 4% of the total resistant isolates collected in 1989 and 1990, respectively. [References: 29].

1781 Ortelli, S.; Glezendanner, U.; Nosberger, J.; Winzeler, H.; Keller, B.; Winzeler, M. (1996) **EFFECT OF THE LR9 RESISTANCE GENE ON PATHOGENESIS OF THE WHEAT LEAF RUST FUNGUS.** *Plant Disease. 80(1):14-18.* English. [ETH ZENTRUM INST PFLANZENWISSENSCH CH-8092 ZURICH SWITZERLAND].

The pathogenesis of two leaf rust fungus isolates on seedlings of the susceptible cultivar Arina and two of its resistant near-isogenic lines (NILs) carrying Lr9 was studied by means of epifluorescence microscopy. The orientation of urediniospore germ tubes and differentiation of appressoria over stomata were similar on susceptible and resistant plants. The development of the fungus in the susceptible host was not stopped by any detectable host resistance reaction, and the number of haustorial mother cells increased exponentially. Fungal sporulation took place 7 to 8 days after inoculation. Host cells of the resistant Lr9 lines close to the haustorial mother cells died 24 to 44 h after inoculation due to a hypersensitive reaction. Before ceasing its growth, the fungus succeeded in forming generally only 1 to 3 haustorial mother cells. The necrotic area around an infection site reached an average area of 10, 000 mu m(2). The potential influence of this defense reaction on yield is discussed. [References: 26].

1782 Pandey, R.N.; Dange, S.R.S.; Jadon, B.S.; Desai, B.G. (Gujarat Agricultural University, Sardar Krushinagar (India). Department of Plant Pathology) (1994) **Occurrence of karnal bunt of wheat in north Gujarat.** *Indian Journal of Mycology and Plant Pathology (India) v. 24(3) p. 234.* 3 ref. English. (AGRIS 96-005571).

1783 Park, RF.; Burdon, JJ.; Mcintosh, RA. (1995) **STUDIES ON THE ORIGIN, SPREAD, AND EVOLUTION OF AN IMPORTANT GROUP OF PUCCINIA RECONDITA F SP TRITICI PATHOTYPES IN AUSTRALASIA.** *European Journal of Plant Pathology. 101(6):613-622.* English. [UNIV SYDNEY PLANT BREEDING INST COBBITTY PRIVATE BAG 11 CAMDEN NSW 2570 AUSTRALIA].

Wheat brown rust pathotype (pt) 104-2, 3, (6), (7), 11 was first detected in Australasia in Victoria during 1984. Although it appeared similar to a pre-existing pathotype, 104-2, 3, 6, (7), detailed greenhouse tests revealed nine pathogenic differences between the two rusts. Six differences involved contrasting virulence/avirulence for the resistance genes/specificities Lr12, Lr27 + Lr31 and Lr16, and three uncharacterised genes, present in the wheat cultivars Gaza and Harrier, and in triticale cultivar Lasko. Differences in partial virulence between the pathotypes were found for the genes Lr2a, Lr13 and Lr26. A comparison of the phenotypes for 13 isozyme systems in the two pathotypes revealed two differences, including a Pgm2 allele in pt 104-2, 3, (6), (7), 11 not found in other contemporary Australasian Puccinia recondita f. sp. tritici pathotypes. On the basis of these differences, it was concluded that pt 104-2, 3, (6), (7), 11 was introduced into the Australasian region before or during 1984. Seven variants of pt 104-2, 3, (6), (7), 11, that differed by single virulences, were detected during 1984-1992. Pt 104-2, 3, (6), (7), 11 and a derivative pathotype with virulence for Lr20 underwent rapid increases in frequency, largely displacing pathotypes which predominated before 1984. Although first detected in eastern Australia, both pathotypes spread to New Zealand, and the derivative pathotype appeared in Western Australia. The rapid spread and increase of these pathotypes could not be explained by host selection. Pt 104-2, 3, (6), (7), 11 and derivatives may therefore be more aggressive than other contemporary Australasian pathotypes. [References: 28].

1784 Perkowski, J.; Kiecana, I.; Chetkowski, J. (1995) **SUSCEPTIBILITY OF BARLEY CULTIVARS AND LINES TO FUSARIUM INFECTION AND MYCOTOXIN ACCUMULATION IN KERNELS.** *Journal of*

Phytopathology-Phytopathologische Zeitschrift. 143(9):547-551. English. [ACAD AGR POZNAN DEPT CHEM PL-60625 POZNAN POLAND].

Heads of 12 barley genotypes (8 cultivars and 4 lines) were inoculated with conidial suspension of the following single isolates: F. culmorum no. 3, F. graminearum no. 122 and F. sporotrichioides no. ATCC 62 360. The number of kernels per head, 1000 kernel weight and yield have been calculated for each genotype. Seed samples collected at harvest were analysed for several trichothecene mycotoxins and zearalenone. The mycotoxin concentrations (mg/kg) in barley kernels inoculated with F. graminearum were as follows: deoxynivalenol (DON) 0.1 to 5.4 (av. 2.3), 3-acetyldeoxy-nivalenol (3-AcDON) 0.0-0.2 (av. 0.1), 15-acetyldeoxynivalenol (15-AcDON) 0.0-0.7 (av. 0.2), nivalenol (NIV) 0.0-0.8 (av. 0.3), zearalenone (ZEA) 0.0-0.1 (av. 0.0); F. culmorum: DON 0.6 to 12.0 (av. 5.3), 3-AcDON 0.1 to 1.0 (av. 0.6), 15-AcDON nd, NIV 0.1-0.7 (av. 0.3), ZEA 0.1-0.5 (av. 0.2). F. sporotrichioides T-2 toxin 2.4-13.9 (av. 6.0), HT-2-toxin 0.1-0.8 (av. 0.3) and neosolaniol 0.2-1.5 (av. 0.7). [References: 25].

1785 Pocsai, E. (Fejer megyei Novenyegeszsegugyi es Talajved. All. (Hungary)) (1995) **[Results of study on barley yellow dwarf virus in Hungary]. Az arpa sarga torpeseg virus kutatas eredmenyei Magyarorszagon.** *Novenyvedelem (Hungary) v. 31(1) p. 5-10.* 3 tables; 24 ref. Hungarian. (AGRIS 96-005470).

The epidemy of 1982 and the resulting damage have directed the attention of virologists and plant breeders to the barley yellow dwarf virus. The author summarized all research results and informations on BYDV in Hungary, by beginning from the description of the virus until present days.

1786 Pocsai, E.; Kovacs, G.; Muranyi, I.; Orosz, A.; Papp, M.; Szunics, L. (1995) **DIFFERENTIATION OF BARLEY YELLOW DWARF LUTEOVIRUS SEROTYPES INFECTING CEREALS AND MAIZE IN HUNGARY.** *Agronomie. 15(7-8):401-408.* English. [PLANT HLTH & SOIL CONSERVAT STN CTY FEJER H-2481 VELENCE HUNGARY].

In 1994, a survey was carried out at 4 different locations in Hungary (Kiszombor, Kompolt, Martonvasar and Taplanszentkereszt) for the presence of barley yellow dwarf luteovirus (BYDV) serotypes in barley, wheat, triticale and maize. Leaf samples exhibiting symptoms of barley yellow dwarf virus were collected from cereal and maize plants. The number of samples collected was 119 from barley, 297 from wheat, 92 from triticale and 274 from maize. Diagnosis was done by double antibody sandwich enzyme-linked immunosorbent assay (DAS-ELISA), using RPV, RMV, MAV, PAV and SGV diagnostics (Agdia). We determined that, among the barley yellow dwarf luteovirus serotypes, the PAV serotype was dominant in cereals at all locations. In maize both the RPV and RMV serotypes were present at high rates. [References: 35].

1787 Rambach, O. (Ciba Geigy S.A., Rueil Malmaison (France)); Speich, J. (1994) **[Cyprodinil, a new fungicide to control cereal diseases [Septoria nodorum, Drechslera teres]]. Le cyprodinil, un nouveau fongicide pour lutter contre les maladies des cereales [Septoria nodorum, Drechslera teres].** Annales ANPP (France) v. 1 p. 209-215. ANPP. 7 ref. v. 1 p. 209-215. French. (AGRIS 96-017974).

1788 Rashid, AQMB. (1995) **DETECTION OF SEED-BORNE PSEUDOMONAS SYRINGAE PV SYRINGAE IN WHEAT.** *Plant Varieties & Seeds. 8(1):47-54.* English. [BANGLADESH AGR UNIV DEPT PLANT PATHOL MYMENSINGH BANGLADESH].

Certified seeds of the widely cultivated wheat variety Sonalika collected from different wheat growing areas of Bangladesh were used in the detection of the wheat bacterial leaf blight pathogen, Pseudomonas syringae pv. syringae. Different techniques and diagnostic strategies were employed. The pathogen seemed to be internally located in the seed and was easily detected by the ground-up liquid assay method. The results indicated the Meed for screening wheat seed samples in the certification programme for presence of this pathogen because it causes losses in wheat in the field. [References: 32].

1789 Richard, J.P. (BASF France, Saint Laurent Blangy (France)); Lipatoff, V. (1994) **[Use of PRESEPT to supervise the control of Septoria tritici [epoxiconazole]]. Utilisation du modele PRESEPT pour raisonner la lutte contre Septoria tritici [epoxiconazole].** Annales ANPP (France) v. 1 p. 273-278. ANPP. v. 1 p. 273-278. French. (AGRIS 96-005427).

1790 Riley, IT.; Reardon, TB. (1995) **ISOLATION AND CHARACTERIZATION OF CLAVIBACTER TRITICI ASSOCIATED WITH ANGUINA TRITICI IN WHEAT FROM WESTERN AUSTRALIA.** *Plant Pathology. 44(5):805-810.* English. [DEPT AGR S PERTH WA 6151 AUSTRALIA].

Two infestations of Anguina tritici in Western Australia were investigated for the presence of Clavibacter tritici. Five strains of C. tritici were isolated from each site and compared with strains from Egypt, India, Iran and Iraq by allozyme electrophoresis. The Australian strains were genetically homogeneous but distinct from the non-Australian strains. A. tritici galls were found to be colonized by C. tritici, a feature of C. tritici infection not previously reported. C. tritici strains from Australia adhered to A. tritici but not to Anguina funesta. No corynetoxins were detected in C. tritici-infected galls. The potential of non-toxigenic Clavibacter species, such as C. tritici, for biocontrol of Clavibacter toxicus, the species , responsible for poisoning livestock, is discussed. [References: 19].

1791 Rokibah, AA.; Eldin, TMS.; Elmeleigi, MA. (1995) **EFFECT OF FUSARIUM GRAMINEARUM, N-LEVEL AND THEIR INTERACTION ON WHEAT PRODUCTIVITY.** *Arab Gulf Journal of Scientific Research. 13(3):499-510.* English. [KING SAUD UNIV COLL AGR & VET MED DEPT PLANT PROTECT POB 1482 BURAYDAH SAUDI ARABIA].

An experiment was conducted in 1990/91 and repeated in 1991/92 to study the effects of Fusarium graminearum the causal agent of foot and root rot and N-level on wheat grain yield, yield components, plant height and heading date. Four nitrogen levels; 0, 138, 276 and 414 kg N/ha were applied to soils noninfested or infested with the fungus. The presence of F. graminearum caused a remarkable root rot and significantly reduced wheat grain yield, yield components and plant height. On the other hand, heading date was not influenced by the fungal infection. N-level had significant effects on all studied characteristics in both seasons. The third level of N (276 kg/ha) maximized the grain yield. Concerning the interaction between the fungus and N-level, the highest grain yield losses were found when either higher N-level or no nitrogen were applied to wheat plants in the infested soil. The third and second N-levels were optimum in the noninfested and infested soils, respectively. Based on the these results the common assumption that application of high N-level to overcome wheat grain yield losses caused by foot and root rot disease is not justified. [References: 17].

1792 Rouzet, J. (Ministere de l'Agriculture, Montpellier (France). Service Regional de la Protection des Vegetaux Languedoc Roussillon) (1994) **[Study of predicting model, PREGI, concerning the yellow rust of wheat]. Etude d'un modele de prevision, PREGI, concernant la rouille jaune du ble.** Annales ANPP (France) v. 1 p. 173-179. ANPP. v. 1 p. 173-179. French. (AGRIS 96-005529).

1793 Rouzet, J. (Ministere de l'Agriculture, Montpellier (France). Service Regional de la Protection des Vegetaux Languedoc Roussillon); Murer, F. (1994) **[Validation of model PRESEPT, prevision of septoriose risk on winter wheat]. Validation du modele PRESEPT, prevision du risque septoriose sur ble d'hiver.** Annales ANPP (France) v. 1 p. 165-172. ANPP. v. 1 p. 165-172. French. (AGRIS 96-005528).

1794 Saur, L.; Cavelier, N. (1995) **CHARACTERISTICS OF PSEUDOCERCOSPORELLA HERPOTRICHOIDES ISOLATES FROM VARIETIES OF WHEAT WITH THE PCH1 RESISTANCE GENE.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 102(5):472-477.* French. [INRA SRIV CTR RECH RENNES F-35650 LE RHEU FRANCE].

1795 Schilder, A.M.C.; Bergstrom, G.C. (1994) **Infection of wheat seed by Pyrenophora tritici-repentis.** *Canadian journal of botany = Journal canadien de botanique (Canada) v. 72(4) p. 510-519.* references. English. (AGRIS 96-005565).

1796 Seguin, B. (Institut Technique des Cereales et des Fourrages, Paris (France)); Maumene, C. (1994) **[Risks of seed borne diseases on cereals [Fusarium roseum, Fusarium nivale, Septoria nodorum, Helminthosporium gramineum, Ustilago nuda]]. Les risques dus aux maladies transmises par les semences de cereales a paille [Fusarium roseum, Fusarium nivale, Septoria nodorum, Helminthosporium gramineum, Ustilago nuda].** Annales ANPP (France) v. 2 p. 557-565. ANPP. v. 2 p. 557-565. French. (AGRIS 96-005535).

1797 Seifers, DL.; Harvey, TL.; Kofoid, KD.; Stegmeier, WD. (1996) **NATURAL INFECTION OF PEARL MILLET AND SORGHUM BY WHEAT STREAK MOSAIC VIRUS IN KANSAS.** *Plant Disease. 80(2):179-185.* English. [KANSAS STATE UNIV AGR RES CTR HAYS, KS 67601 USA].

Pearl miller (Pennisetum glaucum) and sorghum (Sorghum bicolor) plants at Hays, Kansas, were observed to have viruslike symptoms. Symptomatic plants were tested by enzyme-linked immunosorbent assay (ELISA) against wheat streak mosaic virus (WSMV), maize dwarf mosaic, sugarcane mosaic virus strain MDMV-B, and johnsongrass mosaic virus. Positive reactions were obtained only with WSMV antisera. Pearl millet and sorghum plants (of genotypes naturally infected in the field) mechanically inoculated in the greenhouse developed symptoms and were positive in ELISA for WSMV. The virus was vectored by wheat curl mites (Aceria tosichella) from pearl millet and sorghum to the host from which it was obtained and to wheat. Mechanical inoculation of several sorghum lines showed that the WSMV isolates differed in ability to infect sorghum, and the type specimen could not infect any of the sorghum lines. These results indicated that WSMV occurring at Hays can infect sorghum and pearl miller, crop plants not reported previously as susceptible to WSMV. [References: 29].

1798 Signoret, P.A. (Institut National de la Recherche Agronomique, Montpellier (France). Centre de Montpellier, Biologie et Pathologie Vegetale); Alliot, B. (1994) **[Maize virus disease problems in France [MDMV: Maize Dwarf Mosaic Virus, MRDV: Maize Rough Dwarf Virus, BYDV: Barley Yellow Dwarf Virus, MWLMV: Maize White Line Mosaic Virus]]. Les problemes poses par les maladies a virus du mais en France [MDMV: Maize Dwarf Mosaic Virus, MRDV: Maize Rough Dwarf Virus, BYDV: Barley Yellow Dwarf Virus, MWLMV: Maize White Line Mosaic Virus].** Annales ANPP (France) v. 2 p. 541-548. ANPP. 12 ref. v. 2 p. 541-548. French. (AGRIS 96-005483).

1799 Smart, DR.; Ferro, A.; Ritchie, K.; Bugbee, BG. (1995) **ON THE USE OF ANTIBIOTICS TO REDUCE RHIZOPLANE MICROBIAL POPULATIONS IN ROOT PHYSIOLOGY AND ECOLOGY INVESTIGATIONS.** *Physiologia Plantarum. 95(4):533-540.* English. [UNIV AUTONOMA BARCELONA CTR ECOL & APPLICAC FORESTAL E-08193 BARCELONA SPAIN].

No straightforward method exists for separating the proportion of ion exchange and respiration due to rhizoplane microbial organisms from that of root ion exchange and respiration. We examined several antibiotics that might be used for the temporary elimination of rhizoplane bacteria from hydroponically grown wheat roots (Triticum aestivum cv. Veery 10). Each antibiotic was tested for herbicidal activity and plate counts were used to enumerate bacteria and evaluate antibiotic kinetics. Only -lactam antibiotics (penicillins and cephalosporins) did not reduce wheat growth rates. Aminoglycosides, the pyrimidine trimethoprim, colistin and rifampicin reduced growth rates substantially. Antibiotics acted slowly, with maximum reductions in rhizoplane bacteria occurring after more than 48 h of exposure. Combinations of non-phytotoxic antibiotics reduced platable rhizoplane bacteria by as much as 98%; however, this was generally a reduction from about 10(9) to 10(6) colony forming units per gram of dry root mass, so that many viable bacteria remained on root surfaces. We present evidence which suggests that insufficient bacterial biomass exists on root surfaces of nonstressed plants grown under well-aerated conditions to quantitatively interfere with root nitrogen absorption measurements. [References: 33].

1800 Smidansky, ED.; Carroll, TW. (1996) **FACTORS INFLUENCING THE OUTCOME OF BARLEY YELLOW STREAK MOSAIC VIRUS-BROWN WHEAT MITE-BARLEY INTERACTIONS.** *Plant Disease. 80(2):186-193.* English. [MONTANA STATE UNIV DEPT PLANT PATHOL BOZEMAN, MT 59717 USA].

Barley yellow streak mosaic virus (BaYSMV), the cause of disease in barley, is transmitted in nature only by the brown wheat mite (Petrobia latens). Greenhouse and growth chamber experiments were conducted to gain insight into what underlies the reported association between severe BaYSMV-induced disease outbreaks and large mite populations with warm and dry conditions. Experiments were also done to determine the efficiency of the mite as a vector for BaYSMV. The presence of BaYSIMV antigen in diseased plants and viruliferous mites was confirmed by enzyme-linked immunosorbent assay (ELISA). Evidence was found for a critical temperature threshold between 21 and 26 degrees C for efficient expression of BaYSMV-induced symptoms in barley. The influence of barley host plants stressed by drought on disease incidence was neutral, positive, and negative at 21, 26, and 30 degrees C, respectively. Applying water periodically to mite egg deposition substrates on the soil surface appeared to reduce the number of eggs deposited. Mite counts were generally higher on BaYSMV-infected barley than on healthy barley. Preadult nonviruliferous mites readily acquired BaYSMV from infected host plants. Adult mites efficiently inoculated the virus into barley plants, and preadults were also able to inoculate the virus. Mite populations were able to expand at temperatures too low to support all but very low incidences of BaYSMV-induced disease in barley. There was also indirect evidence for transovarial passage of BaYSMV to red nondiapausal eggs within the mite vector. [References: 36].

1801 Smith, OP.; Peterson, GL.; Beck, RJ.; Schaad, NW.; Bonde, MR. (1996) **DEVELOPMENT OF A PCR-BASED METHOD FOR IDENTIFICATION OF TILLETIA INDICA, CAUSAL AGENT OF KARNAL BUNT OF WHEAT.** *Phytopathology. 86(1):115-122.* English. [USDA ARS FREDERICK, MD 21702 USA].

The polymerase chain reaction (PCR) was used to identify Tilletia indica, the causal agent of Karnal bunt of wheat. The method used two sets of oligonucleotide primers developed by sequence analysis of cloned DraI fragments of mitochondrial DNA of I: indica. The primer pair TI17M1 (5'-TCCCCTTGGATCAGAACGTA-3') and TI17M2 (5'-AGAAGTCTAACTCCCCCCTCT-3'), derived from clone pTI-MD17, amplified a single 825-bp product from all isolates of T. indica and no products for other Tilletia spp. In addition, the primer pair TI57M1 (5'-TTTTCCCTCTCTCCTTTTTTCA-3') and TI57M2 (5'-AGCAAAGACAAAGTAGGCTTCC-3'), derived from clone pTI-MD57, produced a product of 118 bp which was unique to I indica. Specificity of the primers was evaluated using 78 isolates of T.: indica and 79 isolates of five other Tilletia spp., including 69 isolates of T. barclayana, from geographically diverse locations. The specificity of amplification products for I: indica was confirmed by Southern-blot hybridization using pTI-MD17 or pTI-MD57 as P-32-labeled probes. The method also employed a control PCR assay that used primers to conserved binding sites that amplified an internal transcribed spacer (ITS) region of ribosomal DNA reported in the literature for several groups of fungi. All Tilletia spp. produced a 420-bp product using the primers ITS3 and ITS4 in the control assay. These results demonstrated that the negative PCR results obtained with T. barclayana and other Tilletia spp. using I: indica-specific primers were not associated with mycelial DNA degradation or the presence of PCR inhibitors. Using teliospores germinated from a seed wash extraction method of infested grain, we demonstrated that ?: indica can be reliably detected at an infestation level of five teliospores per 50-g grain sample. [References: 21].

1802 Sohn, A.; Schenk, P.; Hamacher, J.; Signoret, PA.; Steinbiss, HH. (1995) **COMPARISON OF WHEAT SPINDLE STREAK MOSAIC VIRUS (WSSMV) AND BARLEY YELLOW MOSAIC VIRUS (BAYMV) - 2 CLOSELY RELATED BYMOVIRUSES.** *Agronomie. 15(7-8):427-431.* English. [MAX PLANCK INST ZUCHTUNGSFORSCH CARL VON LINNE WEG 10 D-50829 COLOGNE GERMANY].

In order to better understand the evolutionary development that leads to different host ranges, we made a comparison of the closely related barley yellow mosaic bymovirus (BaYMV) and wheat spindle streak mosaic bymovirus (WSSMV). Using different methods both viruses were

found to be closely related. Leaves of BaYMV-infected winter barley and WSSMV-infected wheat typically showed similar symptoms. Electron microscopy studies revealed that both viruses lead to formation of 2 types of cytoplasmic inclusions bodies (CI, 'pinwheel' structures; crystal-like respectively membranous) in infected cells that showed structural differences. This close relationship is also reflected by the high degree of amino acid sequence homology (74% in CP-, 83% in Nlb-, 68% in Nla-region). In spite of the remarkably high similarities both viruses have separate hosts. We demonsttated that, independently of the host range, a reliable distinction between WSSMV and BaYMV is possible using Northern blot hybridisation, reverse transcriptase-polymerase chain reaction (RT-PCR) and Western blot analysis. Antisera raised against BaYMV proteins also detected WSSMV proteins in Western blot analyses. Even though corresponding proteins of both viruses were usually similar in size, the BaYMV-CI antiserum cross-reacted with an additional protein about 8 kDa larger in wheat extracts and the BaYMV 28 kDa antiserum detected a protein of about 30 kDa in wheat extracts. [References: 21].

1803 Steyer, S.; Kummert, J.; Froidmont, F. (1995) **CHARACTERIZATION OF A RESISTANCE-BREAKING BAYMV ISOLATE FROM BELGIUM.** *Agronomie. 15(7-8):433-438.* English. [CRA STN PHYTOPATHOL CHEMIN LIVOUX B-5030 GEMBLOUX BELGIUM].

A field near Huccorgne, in the province of Liege, Belgium, sown with the winter barley cultivar Express, has been showing slight mosaic symptoms since 1990. As the symptoms were attributed to an infection by barley yellow mosaic virus, experimental plots for an evaluation of the resistance of barley breeding material were established there from 1991 onwards. Symptoms were scored by visual assessment on a range of cultivars including old French varieties, some resistant Japanese material and breeding material from the Plant Breeding Station, Gembloux. The results were compared with those obtained for the same material sown in a field infected with the common BaYMV and BaMMV isolates. The differences in the behavior of some cultivars or lines in the 2 fields were due to the emergence of a virus strain, which, at present, is limited to this particular field. The use of molecular-based detection techniques and partial sequencing have shown that the new viral agent characterized at Huccorgne is a strain of BaYMV. [References: 11].

1804 Sun, P.; Zeng, SM. (1995) **THE APPLICATION OF FITNESS MATRIX IN THE STUDY OF RACE-CULTIVAR INTERACTION OF WHEAT STRIPE RUST.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 102(6):663-668.* English. [BEIJING AGR UNIV DEPT PLANT PROTECT BEIJING 100094 PEOPLES REPUBLIC OF CHINA].

In this paper, the fitness matrix was used to study the race-cultivar interactions. The data were obtained from field inoculum experiments of wheat stripe rust on four races of wheat stripe rust to six wheat cultivars. This experiments were conducted in Beijing Agricultural University Science Park in Sept. of 1993 to June of 1994. The following information in the race-cultivar system can be exploited by using the fitness matrix: 1. The parasitic fitness of each race on each cultivar relative to the fittest race-cultivar combination. 2. The relative parasitic fitness of two races on any of the cultivars. 3. The relative susceptibilities of two cultivars for any of the races. In this paper, the fitness matrix was also used as a way for the quantitative measurement of the concepts of horizontal resistance and vertical resistance. [References: 21].

1805 Tahvonen, R.; Hannukkala, A.; Avikainen, H. (1995) **EFFECT OF SEED DRESSING TREATMENT OF STREPTOMYCES GRISEOVIRIDIS ON BARLEY AND SPRING WHEAT IN FIELD EXPERIMENTS.** *Agricultural Science in Finland. 4(4):419-427.* English. [AGR RES CTR INST PLANT PROTECT SF-31600 JOKIOINEN FINLAND].

The effect of seed dressing with the antagonist Streptomyces griseoviridis on root rots and yields of wheat and barley was studied in field experiments. In long-term field experiments, where different levels of soil-borne inoculum of root rots were maintained with different crop sequences, seed treatment with the antagonist increased yields slightly on average over all experimental years. However, variations between years, crops and crop sequences were considerable. The highest yield increases were in excess of 600 kg/ha, whilst treatment occasionally resulted in slight yield losses. In experiments in which seed naturally infested with Fusarium spp. was used, seed treatment with S. griseoviridis increased yields of wheat but not those of barley. Seed dressing with an organomercurial fungicide resulted in higher yield increases than the biopreparate.

1806 Thienpont, E. (Cyanamid Agro, Tassin la Demi Lune (France)); Navarro, D.; Pollet, N.; Rime, P. (1994) **[Use of metconazole for the control of cereal diseases]. Utilisation du metconazole pour lutter contre les maladies des cereales.** Annales ANPP (France) v. 1 p. 217-222. ANPP. 6 tableaux. v. 1 p. 217-222. French. (AGRIS 96-017975).

1807 Tillman, BL.; Harrison, SA.; Russin, JS.; Clark, CA. (1996) **RELATIONSHIP BETWEEN BACTERIAL STREAK AND BLACK CHAFF SYMPTOMS IN WINTER WHEAT.** *Crop Science. 36(1):74-78.* English. [TEXAS AGRIC RES & EXT CTR RT 7 BOX 999 BEAUMONT, TX 77713 USA].

Disease symptoms caused hy Xanthomonas campestris pv. translucens (J.J.R.) Dye occur on leaves (bacterial streak), spikes (black chaff), and peduncles of wheat (Triticum aestivum L. em. Thell.). Bacterial streak-black chaff has become prevalent in semi-tropical regions and cultivar resistance is the best control method. The objective of this work was to determine the relationship between bacterial streak and black chaff symptoms on wheat. In field tests during 1991 to 1994, black chaff severity and bacterial streak severity were not correlated among 15 soft red winter wheat cultivars and advanced Lines or 387 wheat cultivars and germplasm accessions. Greenhouse tests during 1993 to 1994 showed that 'Florida 304' was susceptible to bacterial streak, but resistant to black chaff. In contrast, 'Coker 9877' was susceptible to black chaff, but moderately resistant to bacterial streak. The cultivar Terral 101 was resistant to both black chaff and bacterial streak, whereas LA85426 was susceptible to both diseases. Wheat genotypes may be resistant to black chaff but susceptible to bacterial streak or vice-versa. This may have caused the lack of correlation between black chaff and bacterial streak in the field. The results indicate that breeders cannot select indirectly for resistance to bacterial streak by selecting for resistance to black chaff. Since yield loss is related to bacterial streak but not to black chaff, wheat should be evaluated for resistance to bacterial streak and not black chaff. [References: 28].

1808 Trevathan, L.E. (Mississippi State University); Khan, M.A.; Robbins, J.T. (1993) **Effect of protectant and eradicant fungicides on area under the leaf rust progress curve, yield, and kernel weight of Mississippi winter wheat.** *Bulletin (Mississippi Agricultural and Forestry Experiment Station) (USA); no. 1004 7 p.* references. English. (AGRIS 96-005553).

1809 Troup, J.M. (Ministere de l'Agriculture, Nancy (France). Service Regional de la Protection des Vegetaux Lorraine); Fotre Muller, M.J. (1994) **[To a strategy of one fungicide spray on wheat culture in Lorraine (France) [Septoria tritici; triazoles]]. Vers une strategie fongicide a un seul traitement sur ble en Lorraine (France) [Septoria tritici; triazoles].** Annales ANPP (France) v. 3 p. 1077-1083. ANPP. v. 3 p. 1077-1083. French. (AGRIS 96-005544).

1810 Vacher, D.; Hebrard, J.P. (eds.) (1995) **[Main cereal virus diseases [cereal yellows, mosaic, dwarf problems, BYDV, WDV, BaYMV, BaMMV, WSBMV, WYMV]]. Les viroses: ne pas se laisser surprendre [jaunisse, mosaique, nanisme, JNO, VMJO, VMMO, VMB, VMJB, VSDA, VMA].** Institut Technique des Cereales et des Fourrages, Paris (France). *Perspectives Agricoles (France) (no.205) p. 2-20.* French. (AGRIS 96-017959).

1811 Wallwork, H.; Potter, TD.; Lichon, A. (1995) **OCCURRENCE OF WIRREGA BLOTCH IN BARLEY AND OTHER GRASS SPECIES IN AUSTRALIA.** *Australasian Plant Pathology. 24(1):22-25.* English. [S AUSTRALIAN RES & DEV INST WAITE CAMPUS GLEN OSMOND SA 5064 AUSTRALIA].

Wirrega blotch caused by Drechslera wirreganensis has been found in barley, wheat, barley grass, brome grass, ryegrass and annual veldtgrass at several sites in South Australia and Western Australia. Variation in barley

cultivars for resistance to the pathogen was identified in two field trials and yield losses of 13-36% were estimated in the susceptible cultivar Skiff. [References: 2].

1812 Wellings, CR. (1995) **SPECIALISATION OF THE WHEAT STRIPE RUST PATHOGEN (PUCCINIA STRIIFORMIS F SP TRITICI) IN AUSTRALIA AND NEW ZEALAND IN 1990 AND 1991.** *Australasian Plant Pathology. 24(3):202-208.* English. [UNIV SYDNEY PLANT BREEDING INST COBBITTY PRIVATE BAG 11 CAMDEN NSW 2570 AUSTRALIA].

Eleven pathotypes of Puccinia striiformis f.sp. tritici were detected in surveys. Two of these were recorded for the first time. The appearance of the new pathotypes, which showed close pathogenic similarity to currently prevalent pathotypes, provided further evidence for the role of single gene mutation in pathogenic evolution in the pathogen population. Seasonal differences in stripe rust incidence and severity throughout the wheat growing areas of eastern Australia and New Zealand were attributed to environmental conditions. The survey data are discussed in relation to host resistance genes currently deployed in eastern Australia. [References: 18].

1813 Wiik, L.; Olofsson, B.; Johnsson, L.; Olvaang, H. (1995) **[Spraying with fungicides for control of cereal diseases in Sweden during 1976-1992]. Sprutning mot skadesvampar i straasaed med fungicider 1976-1992.** *Rapport - Sveriges Lantbruksuniversitet, Institutionen foer Vaextskyddsvetenskap (Sweden); no. 3 115 p.* SLU-VAeXT-R--3-SE. Swedish. (AGRIS 96-005523).

1814 Winter, W.; Krebs, H.; Baenziger, I. (Eidg. Forschungsanstalt fuer landwirtschaftlichen Pflanzenbau (FAP), Zuerich Reckenholz (Switzerland)) (1995) **[Smut diseases and barley stripe: susceptibility of [cereal] varieties]. Brandpilze und Streifenkrankheit: Sortenanfaelligkeit.** *Agrarforschung (Switzerland) v. 2(8) p. 325-328.* 3 graphs, 2 photos, 6 ref. German. (AGRIS 96-018008).

Fourteen winter and spring wheat varieties as well as five spelt wheat varieties were tested from 1990 to 1994 for their susceptibility to common bunt (Tilletia caries). In addition, studies on the susceptibility of six winter wheat varieties to loose smut (Ustilago tritici), and of seven winter and spring oat varieties to loose smut (Ustilago avenae) were carried out between 1992 and 1995. Finally, this paper informs on the susceptibility of five winter barley varieties to covered smut (Ustilago hordei), and of four varieties to the barley stripe disease (Drechslera graminea). For both conventional and organic farmers, the control of these diseases includes the use of certified seed, chemical or non chemical seed treatment, and the cultivation of less susceptible varieties.

1815 Wolf, PFJ.; Hoffmann, GM. (1995) **QUANTITATIVE RESISTANCE OF WHEAT CULTIVARS AGAINST DRECHSLERA TRITICI-REPENTIS AND PATHOGENICITY OF DIFFERENT ISOLATES OF THE FUNGUS.** *Zeitschrift fur Pflanzenkrankheiten und Pflanzenschutz-Journal of Plant Diseases & Protection. 102(5):478-492.* German. [TECH UNIV MUNCHEN WEIHENSTEPHAN LEHRSTUHL PHYTOPATHOL D-80350 FREISING GERMANY].

Fifty winter- and ten cultivars of spring wheat from the Federal Republic of Germany were examined for resistance against Drechslera tritici-repentis (Common names: Yellow spot, Tan spot). The artificial infection of 2-3-leaf seedlings was conducted with single-spore isolates of the causal agent in greenhouses. Symptom expression was optimal at 15 to 17 degrees C. Eight to 10 days after inoculation, necrosis of seedling leaves was visually assessed and wheat cultivars were classed in categories of can spot severity (percentage of necrosis: slight < 10 %, slight-moderate 10-20 %, moderate 20-40 %, severe > 40 %). The winter wheat cultivars 'Sperber', 'Herzog', 'Niklas' were found as highly resistant, 'Farmer', 'Bert' and 'Basalt' as susceptible Among the spring wheat cultivars, 'Star' was slight susceptible, the durum cultivar 'Grandur' was high susceptible. During 2 years, the epidemic progress of the disease was measured from growth stage 32 up to 85 in order to analyze the field resistance of 16 cultivars by given environmental conditions. The German wheat cultivars were separated by characteristic quantitative effects (reduced inoculum, delayed disease progress, reduced yield losses). Concerning the assessment of field resistance, it is considered that effects of reducing lesion number and lesion growth enhance the reduction of necrosis and, therefore, the growth of population is delayed distinctly. As a consequence, the differences between resistant and susceptible genotypes increase during the vegetation period. Under moderate disease pressure, the slightly susceptible cvs. 'Apollo', 'Sperber', 'Herzog', 'Albrecht' did not require fungicide sprays, but under high disease pressure the level of resistance is not sufficient to reduce damaging enough. In particular, monoculture of wheat and minimum tillage practices favour the causal agent. Field hygiene measures as crop rotation, the avoidance of minimum tillage including the use of resistant cultivars is considered to be very important for solving problems, even in regions with a high frequency of the fungus. Fifty-nine single-spore isolates of the fungus were investigated for variability. The isolates were samples from across the area of the old Federal *Republic of* Germany. In artificial culture (V-8 juice agar), most isolates appeared dark (93, 8 %) and only dark mycelial types sporulated profusely. An existence of races of the causal agent in a sense of isolate x genotype specificity was not evident. However, the isolates are separated by quantitative differences concerning the virulence. [References: 10].

1816 Yildirim, A.; Jones, SS.; Murray, TD.; Cox, TS.; Line, RF. (1995) **RESISTANCE TO STRIPE RUST AND EYESPOT DISEASES OF WHEAT IN TRITICUM TAUSCHII.** *Plant Disease. 79(12):1230-1236.* English. [WASHINGTON STATE UNIV DEPT CROP & SOIL SCI PULLMAN, WA 99164 USA].

A collection of 279 Triticum tauschii (syn. Aegilops squarrosa) accessions was evaluated for resistance to stripe rust (Puccinia striiformis) and eyespot (Pseudocercosporella herpotrichoides) diseases. Seedlings were inoculated with four different races of P. striiformis that represent all known virulences in the Pacific Northwest, and a genetically modified strain of P. herpotrichoides expressing beta-glucuronidase. Seventeen percent (44) of the T. tauschii accessions were resistant to all Pacific Northwest races of stripe rust, and 45% (115) were resistant to eyespot. Thirty-nine of the 279 accessions were resistant to the stripe rust races and the eyespot pathogen. Accessions resistant to stripe rust were mainly from the Caspian Sea region of Iran and Azerbaijan, with the majority belonging to T. rauschii subsp. strangulata and T. t. subsp. meyeri. There was no clear association between resistance to eyespot and geographical origin or taxonomic subgroup. [References: 39].

1817 Yurina, TP.; Yurina, EV.; Karavaev, VA.; Solntsev, MK.; Kukushkina, MA.; Ekobena, FAP. (1996) **PHYSIOLOGICAL CHARACTERISTICS OF WHEAT LEAVES IN CULTIVARS RESISTANT AND SUSCEPTIBLE TO POWDERY MILDEW.** *Russian Journal of Plant Physiology. 43(1):64-69.* English. [MOSCOW MV LOMONOSOV STATE UNIV FAC BIOL MOSCOW 119899 RUSSIA].

Peroxidase and polyphenol oxidase activities, the rate of photosynthesis, the content of chlorophyll, and the induction of fluorescence and thermoluminescence were monitored in the leaves of six wheat (Triticum aestivum L.) cultivars differing in their resistance to powdery mildew. The pathogens stimulated peroxidase activity in all six cultivars (to greater extent in the resistant ones). Seven to 13 days after inoculation, photosynthetic activity tended to rise, while, after 21 days, it slightly declined (to a greater degree in the susceptible cultivars). A positive correlation was found between photosynthetic activity and the parameters of leaf luminescence: the relative quenching of fluorescence during its slow induction ($r = 0.56$, $P > 0.999$) and the relative size of peak B in the curves of thermoluminescence ($r = 0.49$, $P > 0.99$). The conclusion was drawn that the observed changes in the physiological state and the fluorescence parameters result from nonspecific plant responses to infection and that the degree of stimulation of metabolic activities at the early infection stages characterizes the nonspecific resistance plant to the pathogen. [References: 19].

H50 MISCELLANEOUS PLANT DISORDERS

1818 Bocharova, M.A.; Astakhova, N.V.; Yushin, I.R.; Alieva, G.P. (1994) **[Effect of oxycarbam on frost hardiness in winter wheat]. Vliyanie oksikarbama na morozostojkost' ozimoj pshenitsy.** *Fiziologiya rastenij (Russian Federation) v. 41(4) p. 609-613.* 18 ref. Russian. (AGRIS 96-018426).

1819 Borghi, B.; Corbellini, M.; Ciaffi, M.; Lafiandra, D.; Destefanis, E.; Sgrulletta, D.; Boggini, G.; Difonzo, N. (1995) **EFFECT OF HEAT SHOCK DURING GRAIN FILLING ON GRAIN QUALITY OF BREAD AND DURUM WHEATS.** *Australian Journal of Agricultural Research. 46(7):1365-1380.* English. [IST SPERIMENTALE CEREALICOLTURA SEZ S ANGELO LODIGIANO VIA MULINO 3 I-20079 SAN ANGELO LODIGIANO ITALY].

In southern Europe the Mediterranean climate is responsible for the remarkable variability in both yield and quality from year to year and also from location to location, but it offers also a unique opportunity for the production of high-quality wheats which are deficient in the European Economic Community. This study was conducted to determine the role of the fluctuation of temperatures during grain filling on the theological properties of bread and durum wheats (Triticum aestivum and Triticum turgidum) as evaluated with a Chopin alveograph. During the 1991-92 season, four cultivars of bread and durum wheat were grown in several locations scattered along the Italian peninsula and the island of Sicily. In each location different temperature profiles were imposed during grain filling by anticipating or delaying sowing date or by covering the plots with plastic tunnels. Viscoelastic properties, evaluated by the variations in W, P and L alveograph parameters were significantly affected by the imposed treatments. In presence of a long period of temperature in the range of 30-35 degrees C a dough 'strengthening' effect was observed, while frequent episodes of daily maximum temperatures above 35 degrees C led to a dough 'weakening' effect. These results observed both in durum and bread wheat confirm those firstly detected on bread wheat in Australia in areas charcterized by a Mediterranean-like climate. The practical relevance of these effects differs in the two species: an increase of dough strength is considered detrimental in breadmaking quality, while it exerts a positive effect in pastamaking quality. [References: 27].

1820 Bredemeijer, GMM.; Esselink, G. (1995) **SUGAR METABOLISM IN COLD-HARDENED LOLIUM PERENNE VARIETIES.** *Plant Varieties & Seeds. 8(3):187-195.* English. [DLO CPRO CTR PLANT BREEDING & REPROD RES POB 16 6700 AA WAGENINGEN NETHERLANDS].

Seven varieties of Lolium perenne L., representing a wide range of winter hardiness, were used to investigate relationships between freezing tolerance of leaves and levels of non-structural carbohydrates and key enzymes of sugar metabolism in leaves. Relatively small differences were observed in freezing tolerance assessed by the electrolyte leakage method among six of the seven varieties; only the variety Yatsyn I was significantly less tolerant than the others. The differences in contents of sugars and the related enzymes phosphofructokinase (PFK), glucose 6-phosphate dehydrogenase (G6PDH), 6-phosphogluconate dehydrogenase (6PGDH) and fructose-3, 6-biphosphatase (FBPase) among the six varieties were also small and non-significant. in ca. Yatsyn I, the lower degree of freezing tolerance was associated with significantly lower levels of sugars, enzymes, and total protein. The lower activity of PFK was mainly due to reduced activity of the high molecular weight cytosolic form of the enzyme. A similar phenomenon was observed in cv. Baroldi of the frost sensitive species Westerwolds ryegrass (Lolium multiflorum Lam.). These results support the view that high levels of sugars promote the development of maximum hardiness only when associated with high metabolic activity. The consequence of the latter for the usefulness of the characters investigated for screening purposes is discussed. [References: 28].

1821 Bridger, GM.; Falk, DE.; Mckersie, BD.; Smith, DL. (1996) **CROWN *FREEZING* TOLERANCE AND FIELD WINTER SURVIVAL OF WINTER CEREALS IN EASTERN CANADA.** *Crop Science. 36(1):150-157.* English. [MCGILL UNIV MACDONALD CAMPUS 21222 LAKESHORE RD ST ANNE DE BELLEVUE PQ H9X 3V9 CANADA].

Winter cereal production in many areas of eastern Canada is limited by a lack of consistent winter survival. A cold acclimated crown freezing test has been adopted to *circumvent* high variability associated with field tests. Relationships between field survival and crown freezing tolerance (LT(50), lethal temperature for 50% of seedlings) of artificially acclimated wheat (Triticum aestivum L.) and barley (Hordeum vulgare L.) were investigated. Field survival was evaluated in 1989 and 1990 at several sites in southern Ontario with a held survival index (FSI). In separate experiments, the effect of rooting medium (calcined clay or soil), cold acclimation regime (constant at 2 degrees C and 12-h photoperiod or decreasing temperature and photoperiod), and developmental stage (two-leaf or five-leaf) on crown freezing tolerance were assessed with six genotypes of wheat and barley. The ability of the crown freezing test to differentiate 11 genotypes each of wheat and barley with from two to 20 replicates was investigated. The correlation between FSI and LT(50) was strong, ranging from -0.66 to -0.96 and was not affected by rooting media, developmental stage, or cold acclimation regime. Increasing the number of replicates did not affect the relationship between FSI and LT(50), but did increase precision. Eight replications were required to detect differences of 1 degrees C among genotypes. A 1 degrees C difference corresponded to a field survival difference of 7.1% for barley and 4.6% for wheat. The range in held survival was narrow at 19.2% for barley and 22.6% for wheat. This implies that, under eastern Canadian conditions, eight replicates of a crown freezing test could broadly categorize genotypes according to winterhardiness, but would not be sufficient to detect small differences. However, where freezing tests are used to assist in the identification of genotypes with higher levels of winterhardiness, a wide range of protocols can be used. [References: 33].

1822 Clement, JMAM.; Venema, JH.; Vanhasselt, PR. (1995) **SHORT-TERM EXPOSURE TO ATMOSPHERIC AMMONIA DOES NOT AFFECT LOW-TEMPERATURE HARDENING OF WINTER WHEAT.** *New Phytologist. 131(3):345-351.* English. [UNIV GRONINGEN CTR BIOL DEPT PLANT BIOL POB 14 9750 AA HAREN NETHERLANDS].

The effect of atmospheric NH3 on low-temperature hardening of winter wheat (Triticum aestivum L. cv. Urban) was investigated. Growth and photosynthesis were stimulated by ammonia exposure. After a 14 d exposure at moderate temperatures (day/night 18.5/16 degrees C) total nitrogen content was enhanced by 45% compared with the controls. During that period, water-soluble sugar content was not affected by NH3. After lowering the temperature to 4/3 degrees C, sugar content of the control plants doubled within 2 d, whereas in the plants exposed to NH3 it increased to a much lesser extent. Total nitrogen content further increased, leading to an 85% higher level in the NH3-exposed plants. Frost hardiness was not affected by atmospheric ammonia. It is concluded that winter wheat is tolerant to high ammonia concentrations, even under unfavourable growth conditions. [References: 45].

1823 Deffune, G.; Simunek, P.; Scofield, A.M.; Lee, H.C.; Lopez, L. (1995) **[Allelopathy in biological and biodynamic systems: research on wheat and potato quality and productivity]. Alelopatia en los sistemas biologicos y biodinamicos: investigacion sobre la calidad y productividad del trigo y la patata.** 1. Congreso de la Sociedad Espanola de Agricultura Ecologica; Toledo (Espana); 28-29 Sep 1994. *[Ecological practices for a quality agriculture: proceedings of 1st Congress of Ecological Agriculture Spanish Society, Toledo, 28-29 September of 1994]. Practicas ecologicas para una agricultura de calidad: actas del 1er Congreso de la Sociedad Espanola de Agricultura Ecologica, Toledo, 28-29 de septiembre de 1994. Junta de Comunidades de Castilla-La Mancha, Toledo (Espana). Consejeria de Agricultura y Medio Ambiente p. 213-219.* JCCM, CAMA. 8 fig.; 8 ref. Spanish. (AGRIS 96-006085).

1824 Demotes Mainard, S. (Institut National de la Recherche Agronomique, Le Rheu (France). Centre de Rennes, Amelioration des Plantes); Gate, P. (1995) **[Soft wheat sterility: influence of low intensity radiations]. Sterilite du ble tendre: comment agissent les rayonnements faibles.** *Perspectives Agricoles (France) (no.205) p. 78-86.* 7 ref. French. (AGRIS 96-018418).

1825 Dhawan, RS. (1995) **EFFECT OF ISOPROTURON ON HILL ACTIVITY AND MEMBRANE PERMEABILITY IN LEAVES OF WHEAT (TRITICUM AESTIVUM), SMALL CANARY GRASS (PHALARIS MINOR) AND WILD OAT (AVENA LUDOVICIANA).** *Indian Journal of Agricultural Sciences. 65(12):894-895.* English. [CHAUDHARY CHARAN SINGH HARYANA AGR UNIV REG RES STN DEPT AGRON KARNAL 132001 HARYANA INDIA].

1826 Heinz, GH.; Hoffman, DJ.; Lecaptain, LJ. (1996) **TOXICITY OF SELENO-L-METHIONINE, SELENO-DL-METHIONINE, HIGH SELENIUM WHEAT, AND SELENIZED YEAST TO MALLARD DUCKLINGS.** *Archives of Environmental Contamination & Toxicology. 30(1):93-99.* English. [US NATL BIOL SERV PATUXENT ENVIRONM SCI CTR LAUREL, MD 20708 USA].

The toxicity of four chemical forms of selenium (seleno-L-methionine, seleno-DL-methionine, selenized yeast, and high selenium wheat) was compared in day-old mallard ducklings (Anas platyrhynchos). In the first experiment, in which the basal diet was 75% wheat, survival after 2 weeks was lower for ducklings fed 30 mu g/g selenium as seleno-L-methionine (36%) than for ducklings fed 30 mu g/g selenium as seleno-DL-methionine (100%) or 30 mu g/g selenium from high selenium yeast (88%). The concentration of selenium at 2 weeks in the livers of survivors was similar for ducklings fed 15 mu g/g selenium as seleno-DL-methionine (12 mu g/g, wet weight), seleno-L-methionine (11 mu g/g), and high selenium wheat (11 mu g/g), but was lower when the selenium came from selenized yeast (6.2 mu g/g). When fed 30 mu g/g selenium from the various sources, the selenium concentrations in liver were 20 mu g/g for seleno-DL-methionine, 19 mu g/g for seleno-L-methionine, and 9.9 mu g/g for selenized yeast. In a second experiment, in which the basal diet was a commercial duck feed, survival after 2 weeks was 100% in ducklings fed 30 mu g/g selenium as seleno-DL-methionine, seleno-L-methionine, or selenized yeast. Selenium concentrations in liver were similar for ducklings fed the 30-mu g/g selenium diets as the DL or L forms of selenomethionine (27 and 25 mu g/g), but lower for ducklings fed selenized yeast (13 mu g/g). The greater toxicity of the L form of selenomethionine was probably related to the palatability or nutritional nature of the wheat-based diet used in experiment 1, but the exact reason for the difference between the DL and L forms is unknown. Biologically incorporated selenium, derived from high selenium wheat, was no more toxic than selenium derived from the two purified forms of selenomethionine, and the selenium in selenized yeast was not as toxic as that in the two forms of selenomethionine. [References: 24].

1827 Horst, WJ. (1995) **THE ROLE OF THE APOPLAST IN ALUMINIUM TOXICITY AND RESISTANCE OF HIGHER PLANTS - A REVIEW.** *Zeitschrift fur Pflanzenernahrung und Bodenkunde. 158(5):419-428.* English. [UNIV HANNOVER INST PLANT NUTR HERRENHAUSER STR 2 D-30419 HANNOVER GERMANY].

In acid mineral soils excess of aluminium ions (Al) is one of the most important factors determining plant species and ecotype distribution, and limiting growth and yield of crops. Aluminium preferentially accumulates in the root tips as sites of cell division and cell elongation. Whether inhibition of cell-division rate is due to direct interaction of Al with the chromatin in the nuclei is rather questionable because of the low radial mobility of Al in the root and the rapidity of cessation of root elongation after Al addition to the growth medium. Externally applied Al instantaneously binds to binding sites in the apoplast. Cross binding of pectates by Al may affect extensibility and water permeability of the cell wall. Interaction of Al with other cell-wall constituents is most likely but needs clarification. Aluminium also affects plasma-membrane characteristics. Ca2+ influx and K+ efflux are inhibited, and synthesis of callose is induced. Induction of callose suggests an increase rather than a decrease in cytosolic Ca2+ as initial response to Al. there is little evidence suggesting major disruption of plasma membrane and cytoplasmic functions by Al K+ uptake, H+ extrusion, Fe(III) reducing capacity and lipid peroxidation are hardly affected even in roots severely inhibited in elongation by Al. Al uptake and physiological/bio-chemical effects of Al on intact plant roots can be mimicked even more sensitivity using cell suspension cultures which, therefore, represent a powerful tool for the study of Al toxicity. Large differences in Al resistance exist between plant species and cultivars of a species. Root elongation-rate and callose formation can be used as indicators for al injury. Since short term Al injury in mainly expressed in the apoplast, Al resistance requires exclusion of Al from or/and inactivation of Al in the apoplast. Generally, Al-resistant genotypes are characterized by lower Al accumulation of the root apical meristems. This is achieved by a lower cation-exchange capacity/surface negativity or complexation of Al through root exudates (mucilage, organic acids). Long term exposure of plants to Al also inhibits shoot growth via induction of nutrient (Mg, Ca, P) deficiencies, drought stress and phyto-hormone imbalances. Such longer term effects have to be taken into consideration when selecting genotypes for high yielding capacity on acid oils high in available Al. [References: 88].

1828 Ibijbijen, J.; Ismaili, M. (1995) **EFFECT OF WATER STRESS ON COMPETITION BETWEEN MEDICAGO TRUNCATULA AND WHEAT IN N-15 LABELED SOIL.** *Arid Soil Research & Rehabilitation. 9(4):399-408.* English. [MOULAY ISMAIL UNIV DEPT BIOL POB 4010 MEKNES MOROCCO].

Crop mixtures that include legumes increase yield and restore soil fertility. These mixtures are limited by drought, which is frequent in Morocco due to lack of and poor distribution of rain. However, annual Medicago species are very important to forage production, and they have a tolerance to water stress. The effect of water stress on N-2 fixation and N transfer by Medicago truncatula cv. Jemalong (medic), when mixed with wheat (Triticum durum cv. Karim), was investigated in three greenhouse experiments. Annual medic and wheat were seeded in 20-L pots in pure and mixed stands. Three watering treatments were used: -0.9, -1.5, and -2.5 MPa in the first experiment; and -0.9, -2.5, and -3.5 MPa in the second and third experiments. Competition between medic and wheat was affected by hydric treatments; the medic was more competitive for soil water than the wheat, especially under severe water stress. Shoot dry weight of wheat grown with medic was higher than that of wheat grown in pure stands. Medic alone took up more soil N than wheat alone, while in the mixture, medic took up less soil N than wheat, indicating that the mixed medic was not competing for soil mineral N. Using the N-15 dilution technique, it was found that medic N-15 concentration was lower than that of the wheat in all treatments, suggesting active N-2 fixation. Apparently, the medic obtained from 20% to 73% of its N from the atmosphere, depending on the water regime. The atoms-percent excess N-15 in medic decreased significantly in the mixture, showing higher N-2 fixation (N-15 dilution method) than in pure medic. Mixed medic derived 82% of its N from fixation at severe water stress (T-2) and 92% at the control (T-0), showing that N-2 fixation by medic was less affected by water stress in the mixed stand than in the pure stand. In the first experiment, N transfer was detected only in the control treatment, but in the second and third experiments, transfer of N was significant ($p = 0.05$).

1829 Jones, DL.; Kochian, LV. (1995) **ALUMINUM INHIBITION OF THE INOSITOL 1, 4, 5-TRISPHOSPHATE SIGNAL TRANSDUCTION PATHWAY IN WHEAT ROOTS - A ROLE IN ALUMINUM TOXICITY.** *Plant Cell. 7(11):1913-1922.* English. [CORNELL UNIV USDA ARS US PLANT SOIL & NUTR LAB TOWER RD ITHACA, NY 14853 USA].

In crop plants, aluminum (Al) rhizotoxicity is a major problem worldwide; however, the cause of Al toxicity remains elusive. The effects of Al on the inositol 1, 4, 5-trisphosphate (Ins[1, 4, 5]P-3)-mediated signal transduction pathway were investigated in wheat roots. Exogenously applied Al (50 mu M) rapidly inhibited root growth (<2 hr) but did not affect general root metabolism. An Ins(1, 4, 5)P-3 transient was generated in root tips, either before or after exposure to Al for 1 hr, by treating the roots with H2O2 (10 mM). Background (unstimulated) levels of Ins(1, 4, 5)P-3 were similar in both Al-treated and Al-untreated root apices, However, H2O2-stimulated levels of Ins(1, 4, 5)P-3 in root apices showed a significant (>50%) reduction after Al exposure in comparison with untreated controls, indicating that Al may be interfering with the phosphoinositide signaling pathway, When phospholipase C (PLC) was assayed directly in the presence of Al or other metal cations in microsomal membranes, AlCl3 and Al-citrate specifically inhibited PLC action in a dose-dependent manner and at physiologically relevant Al levels. Al exposure had no effect on inositol trisphosphate dephosphorylation or on a range of enzymes isolated from wheat roots, suggesting that Al exposure may specifically target PLC. Possible mechanisms of PLC inhibition by Al and the role of Ins(1, 4, 5)P-3 in Al toxicity and growth are discussed. This study provides compelling evidence that the phytotoxic metal cation Al has an intracellular target site that may be integrally involved in root growth. [References: 47].

1830 Krishnaraj, S.; Thorpe, TA. (1996) **SALINITY STRESS EFFECTS ON [C-14-1]- AND [C-14-6]-GLUCOSE METABOLISM OF A SALT-**

TOLERANT AND SALT-SUSCEPTIBLE VARIETY OF WHEAT. *International Journal of Plant Sciences. 157(1):110-117.* English. [UNIV CALGARY DEPT BIOL SCI PLANT PHYSIOL RES GRP CALGARY AB T2N 1N4 CANADA].

The effect of salt (sodium sulfate) on carbohydrate metabolism was studied in a salt-tolerant (Kharchia-65) variety and a salt-susceptible (Fielder) variety of wheat (Triticum aestivum L.) by comparing their responses under control and stress conditions. Leaf segments of Kharchia-65 showed increased activity through both the pentose phosphate pathway (PPP) and the glycolytic pathway of glucose oxidation, with the former being comparatively more active in response to salt. In Fielder, there was an increase in PPP activity at the expense of glycolytic pathway activity. Label from glucose was found in the lipid, neutral sugar, amino acid, organic acid, and phosphate ester fractions in all treatments. On the basis of the label distribution patterns, it appears that Fielder leaves incubated with [C-14-6]-glucose were not able to utilize glucose efficiently under saline conditions. This finding was further supported by decreased label incorporation into all the fractions, especially the amino acid and organic acid fractions. Adenosine phosphate and reduced pyridine nucleotide concentrations were consistent with these observations. We conclude therefore that the salt-tolerant variety had an enhanced metabolic activity compared with the salt-susceptible variety, which contributed to its ability to overcome the adverse effects of salt. [References: 32].

1831 Lambers, H.; Vandenboogaard, R.; Veneklaas, EJ.; Villar, R. (1995) EFFECTS OF GLOBAL ENVIRONMENTAL CHANGE ON CARBON PARTITIONING IN VEGETATIVE PLANTS OF TRITICUM AESTIVUM AND CLOSELY RELATED AEGILOPS SPECIES. *Global Change Biology. 1(6):397-406.* English. [UNIV UTRECHT DEPT PLANT ECOL & EVOLUTIONARY BIOL SORBONNELAAN 16 3584 CA UTRECHT NETHERLANDS].

The use of fossil fuel is predicted to cause an increase of the atmospheric CO2 concentration, which will affect the global pattern of temperature and precipitation. It is therefore essential to incorporate effects of temperature and water supply on carbon partitioning of plants to predict effects of elevated [CO2] on growth and yield of Triticum aestivum. Although earlier papers have emphasized that elevated [CO2] favours investment of biomass in roots relative to that in leaves, it has now become clear that these are indirect effects, due to the more rapid depletion of nutrients in the root environment as a consequence of enhanced growth. Broadly generalized, the effect of temperature on biomass allocation in the vegetative stage is that the relative investment of biomass in roots is lowest at a certain optimum temperature and increases at both higher and lower temperatures. This is found not only when the temperature of the entire plant is varied, but also when only root temperature is changed whilst shoot temperature is kept constant. Effects of temperature on the allocation pattern can be explained largely by the effect of root temperature on the roots' capacity to transport water. Effects of a shortage in water supply on carbon partitioning are unambiguous: roots receive relatively more carbon. The pattern of biomass allocation in the vegetative stage and variation in water-use efficiency are prime factors determining a plant's potential for early growth and yield in different environments. In a comparison of a range of T. aestivum cultivars, a high water-use efficiency at the plant level correlates positively with a large investment in both leaf and root biomass, a low stomatal conductance and a large investment in photosynthetic capacity. We also present evidence that a lower investment of biomass in roots is not only associated with lower respiratory costs for root growth, but also with lower specific costs for ion uptake. We suggest the combination of a number of traits in future wheat cultivars, i.e. a high *investment of* biomass in leaves, which have a low stomatal conductance and a high photosynthetic capacity, and a low investment of biomass in roots, which have low respiratory costs. Such cultivars are considered highly appropriate in a future world, especially in the dryer regions. Although variation for the desired traits already exists among wheat cultivars, it is much larger among wild Aegilops species, which can readily be crossed with T. aestivum. Such wild relatives may be exploited to develop new wheat cultivars well-adapted to changed climatic conditions. [References: 64].

1832 Leshem, YY.; Kuiper, PJC. (1996) IS THERE A GAS (GENERAL ADAPTATION SYNDROME) RESPONSE TO VARIOUS TYPES OF ENVIRONMENTAL STRESS [Review]. *Biologia Plantarum. 38(1):1-18.* English. [BAR ILAN UNIV DEPT LIFE SCI IL-52900 RAMAT GAN ISRAEL].

A hypothesis of existence of a general adaptation syndrome (GAS), in which different types of stress evoke similar coping mechanisms, resulting in adaptations, is tested for plants. As stress coping mechanisms, oxy-free radical scavengers and antioxidants, osmoregulation, the role of abscisic acid, jasmonates, nitric oxide, synthesis of heat shock proteins and phytochelatins as heavy metal detoxifiers are discussed. [References: 105].

1833 Mahan, JR.; Mcmichael, BL.; Wanjura, DF. (1995) METHODS FOR REDUCING THE ADVERSE EFFECTS OF TEMPERATURE STRESS ON PLANTS - A REVIEW [Review]. *Environmental & Experimental Botany. 35(3):251-258.* English. [USDA ARS PLANT STRESS & WATER CONSERVAT RES UNIT ROUTE 3 BOX 215 LUBBOCK, TX 79401 USA].

Thermal stresses adversely affect plant growth and development worldwide and the resultant reductions in yield limit profitability of agricultural production. The identification of an optimal thermal range provides a means for quantifying thermal stress experienced by a plant. The thermal dependence of apparent K-m and variable fluorescence are two procedures for estimating optimal thermal ranges. The ability of a plant to resist thermal stress can be increased through alteration of plant temperature and/or alteration of the optimal thermal range. Optimization of temperature can be accomplished through alteration of canopy architecture, optimization of plant root systems, and irrigation management based on plant temperature. Alteration of optimal thermal range of a species may be accomplished through breeding or molecular engineering methodologies. [References: 38].

1834 Manderscheid, R.; Weigel, HJ. (1995) DO INCREASING ATMOSPHERIC CO2 CONCENTRATIONS CONTRIBUTE TO YIELD INCREASES OF GERMAN CROPS. *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(2):73-82.* English. [BUNDESFORSCH ANSTALT LANDWIRTSCHAFT INST PROD & OKOTOXIKOL BUNDESALLEE 50 D-38116 BRAUNSCHWEIG GERMANY].

The global atmospheric CO2-concentration is increasing and there has been an increase in Germany of about 30 ppm from 340 ppm to 370 ppm CO2 during the last two decades. The hectare yield of many crops has also increased during this time period. The objective of the present study was to estimate whether the past and future change in the atmospheric composition significantly contributes to the increase in hectare yield. Different crop species (beans, Phaseolus vulgaris, cv Pfalzer Juni; spring barley, Hordeum vulgare L., cvs. Alexis and Arena; spring wheat, Triticum aestivum L., cvs. Star and Turbo; maize, Zea mays L., cvs. Bonny and Boss) were grown at ambient (372 ppm) and at slightly elevated CO2-concentrations (459 ppm and 539 ppm) in open-top chambers and the effect of the different CO2-concentrations on the growth and yield of the plants was measured. The past and future CO2-effect was estimated from the slope of a linear CO2-yield curve (percentage increase in yield per ppm CO2, 100 % at 370 ppm) fitted to the data and those from previous studies on wheat and maize. The percentage increase in yield per ppm CO2 is insignificant for beans, of borderline significance for silage maize (0.06 % per ppm), and 0.35 % per ppm and 0.26 % per ppm for barley and wheat, respectively. The CO2-elevation primarily decreases the tiller dieback of the cereals. Considering the increase in CO2 of 30 ppm and in the hectare yield of 25 % (barley) and 28 % (wheat) from 1970 to 1990, the contribution of CO2 to the increase in the agricultural production is estimated to be one fourth up to one half of the increase in hectare yield of spring cereals. Given a recent yearly increase of 2 ppm the future CO2-related increase in hectare yield is estimated to be about 0.5-0.7 % per year. [References: 32].

1835 Miglietta, F.; Tanasescu, M.; Marica, A. (1995) THE EXPECTED EFFECTS OF CLIMATE CHANGE ON WHEAT DEVELOPMENT. *Global Change Biology. 1(6):407-415.* English. [CNR INST AGROMETEOROL & ENVIRONM ANAL IATA P CASCINE 18 I-50144 FLORENCE ITALY].

Air temperature and the atmospheric concentrations of carbon dioxide are expected to rise. These two factor have a great potential to affect development, growth and yield of crops, including wheat. Rising ait temperature may affect wheat development more than rising atmospheric CO2 as there is not yet evidence that elevated CO:! concentrations can directly induce changes in wheat development. In winter wheat, temperature has a complex effect on development due to its strong interaction with vernalization and photoperiod. In this paper, potential effects of rising temperature on the development of winter wheat from sowing to heading are considered in the light of this complex controlling mechanism. Data from a large series of field trials made in Romania is analysed at first and, subsequently, the IATA-Wheat Phenology model is used to calculate the impact of air warming on wheat development under different climate change scenarios. Data from the field trials showed very clearly the occurrence of a complex temperature/photoperiod/vernalization interaction for field sown crops and demostrated that the photoperiodic and vernalization responses have a key role in controlling the duration of the emergence-heading period. Temperature plays, instead, a central role in controlling seed germination and crop emergence as well as leaf inititiation and leaf appearance rate. The results of model analysis showed very well that the impact of an even or uneven distribution of warming effects may be very different. In the first case, the model predicted that the duration of the vegetative period was at least partly reduced in some years. In the second case, the model suggested that if warming will be more pronounced in winter than in spring, as predicted for some areas of the world by General Circulation Models, we may expect an increase in the duration of the vegetative phase of growth. On the contrary, in case of a spring warming but unchanged winter temperatures, we may expect a substantial decrease in the duration of the vegetative period. [References: 26].

1836 Novozhilova, O.A.; Arefeva, L.P.; Kirichenko, E.B.; Prusakov, A.N.; Semikhov, V.F. (1994) **[Polipeptide composition change of wheat bushing out knot proteins during the wintering]. Izmenenie polipeptidnogo sostava belkov uzla kushcheniya pshenitsy v protsesse zimovki.** *Byulleten' Glavnogo botanicheskogo sada (Russian Federation) (no.169) p. 36-40.* 12 ref. Russian. (AGRIS 96-018427).

Proteins of tillering out knot of four winter wheat varieties of different tolerance for winter conditions were investigated by SDS-electrophoresis. Wheat plants were grown *in field* experiment conditions. Essential changes of SDS-electrophoretic spectra of albumins and globulins were observed during the wintering particularly at the latest wintering period. The changes depended upon the winter tolerance of a variety.

1837 Porter, JR.; Leigh, RA.; Semenov, MA.; Miglietta, F. (1995) **MODELLING THE EFFECTS OF CLIMATIC CHANGE AND GENETIC MODIFICATION ON NITROGEN USE BY WHEAT.** *European Journal of Agronomy. 4(4):419-429.* English. [ROYAL VET & AGR UNIV DEPT AGR SCI AGROVEJ 10 DK-2630 TASTRUP DENMARK].

This paper considers how and the extent to which climate change and the balance of nitrogen between crops and soils may interact and how the ability to modify genetically specific crop attributes might affect the overall nitrogen balance of the crop-soil system. The possible effects of each change have been assessed using the AFRCWHEAT2 crop model for wheat. Model output pointed to a decrease in harvest index as a result of coincidental increases in CO2 level and temperature, and the importance of considering not only changes to average but also to the variability of environmental driving variables is illustrated. When mean temperatures were raised the model predicted that more nitrate would be left in the soil at the end of the season but that raising CO2 level could counter this effect. Doubling the variability of temperature had a more complicated effect on the soil N balance with the mean amount of residual soil nitrate predicted to be at about the same level as for the baseline and with only a comparatively small change in its coefficient of variation. These results are interpreted in terms of a bell-shaped response of mineralisation rate to temperature. Raising the value of the maximum N concentration (N-max) in the shoots increased the amount of NO3-N extracted from the soil. However, the overall effects were not simply proportional to the increase in N-max because the crop could also become limited by the supply of N from the soil. [References: 52].

1838 Pridvorev, N.I.; Kosilova, A.N.; Lukin, L.Yu. (1994) **[On winter hardiness of water wheat in the Central Chernozem Zone of Russian Federation]. O zimostojkosti ozimoj pshenitsy v TsChZ.** *Zemledelie (Russian Federation) (no.6) p. 19-21.* Russian. (AGRIS 96-018399).

1839 Singh, A.; Agrawal, M. (1996) **RESPONSE OF TWO CULTIVARS OF TRITICUM AESTIVUM L TO SIMULATED ACID RAIN.** *Environmental Pollution. 91(2):161-167.* English. [BANARAS HINDU UNIV DEPT BOT VARANASI 221005 UTTAR PRADESH INDIA].

The present experiment was aimed at assessing the impact of simulated acidic precipitation (SAR) on growth, biomass accumulation and yield of two cultivars of wheat (Triticum aestivum *L.), Malviya* 206 and 234, varying in cuticular thickness and leaf area. Wheat cultivars were exposed to simulated rain acidified to pH 5.6 (control), 5.0, 4.5, 4.0 and 3.0 from 30 days of age, twice a week for five weeks. The plants received ambient precipitation of unknown acidity, as well as the acid rain treatments. Growth parameters such as shoot height, roof length, and leaf area were reduced significantly in treated plants at different growth stages. Above and below-ground biomass also decreased significantly in the plants treated with acidic precipitation. Relative to control, the number of grains per plant and yield per m(2) declined significantly, at all SAR treatments. The hypothesis that the variety with thinner cuticle and greater leaf area would be more susceptible to acidic precipitation was not supported by the present study. [References: 28].

1840 Sun, R.; Lawther, JM.; Banks, WB. (1995) **THE EFFECT OF ALKALINE NITROBENZENE OXIDATION CONDITIONS ON THE YIELD AND COMPONENTS OF PHENOLIC MONOMERS IN WHEAT STRAW LIGNIN AND COMPARED TO CUPRIC(II) OXIDATION.** *Industrial Crops & Products. 4(4):241-254.* English. [UNIV WALES BIOCOMPOSITES CTR BANGOR LL57 2UW GWYNEDD WALES].

A comparative study of degradation of wheat straw lignin by alkaline nitrobenzene and cupric compound (CuO, Cu(OH)(2), CuSO4 5H2(O)) oxidation was carried out at 170 degrees C for 2.5 h in 2 N NaOH (7 mi) and 6.8% nitrobenzene. The major products of such a degradation were the phenolic aldehydes of vanillin and syringaldehyde in both of the reactions. A relative high guaiacyl/syringyl ratio value was obtained by nitrobenzene oxidation, whereas a slightly high syringy/guaiacyl ratio appeared in the cupric(II) oxidation. A suite of up to 13 phenols was detected in the oxidation mixtures except that no acetosyringone appeared in the nitrobenzene oxidation. Gallic acid, protocatechuic acid and acetovanillone were firstly identified in both of the oxidation products from wheat straw lignin. The main difference between the two oxidant reagents was twice yield of nitrobenzene oxidation than that of cupric(II) oxidation. The effects reaction time, temperature, concentration of sodium hydroxide and nitrobenzene, and the amounts of sample used on the reaction yield and components of oxidation products from wheat straw were performed at 38 various conditions and the nature of the aldehyde and acid products determined by high-performance liquid chromatography (HPLC). The results obtained showed that the percentages of various products were dependent on the conditions of alkaline nitrobenzene oxidation. The reaction condition (0.10 g straw in 2 N NaOH (7 mi) with 6.8% nitrobenzene at 170 degrees C for 4 h in a steel autoclaves) optimised for maximum recovery of products from wheat straw. Meanwhile, ferulic and p-coumaric acid released in amounts during the nitrobenzene oxidation, especially, at 170 degrees C for 2.5 h in 2 N NaOH without nitrobenzene, which suggested that more than 50% of ferulic acid was in the etherified form while p-coumaric acid was predominant in the esterified bond with lignin in wheat straw. [References: 21].

1841 Udovenko, G.V. (1993) **[Productivity, photosynthetic activity and assimilate utilization in grain crops under salinity conditions]. Produktivnost', fotosinteticheskaya deyatel'nost' i utilizatsiya assimilyatov u zernovykh kul'tur pri zasolenii pochvy.** *[Collection of scientific works in applied botany, genetics and breeding - All-Russia Research Institute of Plant Science [VIR]] v. 149 p. 132-137.* 7 ref. Russian. (AGRIS 96-018408).

1842 Warrag, MOA. (1995) **AUTOTOXIC POTENTIAL OF FOLIAGE ON SEED GERMINATION AND EARLY GROWTH OF MESQUITE (PROSOPIS JULIFLORA).** *Journal of Arid Environments. 31(4):415-421.* English. [KING SAUD UNIV COLL AGR & VET MED BURAYDAH SAUDI ARABIA].

Aqueous extracts of 10, 20, 40 and 60 g dry leaves of mesquite (Prosopis juliflora), in a line of distilled water, were tested for their autotoxic effects on seed germination and early seedling growth. With the exception of the effect of the least concentrated extract on the final seed germination, all extracts reduced seed germination percentage, and radicle and hypocotyl lengths considerably, in comparison with the distilled water control. This reduction increased with the increase of extract concentration throughout the germination period. The radicles, which did not elongate at all in the highest concentrated extract, were more affected than the hypocotyls. Using ground leaves mixed with sand in the ratios of 1:15, 1:10 and 1:5, (leaves: sand, by volume) compared to sand as a control, resulted in similar findings. The pH and the osmotic potentials of the extracts were not low enough to bring about such effects, so it could be concluded that the mesquite foliage contains water-soluble allelochemicals which could inhibit seed germination and seedling growth of the same species. (C)1995 *Academic Press* Limited [References: 19].

1843 Yasin, M. (National Agricultural Research Centre, Islamabad (Pakistan)); Sarwar, M. (Pakistan Agricultural Research Council, Islamabad (Pakistan)); Nabi, G. (1993) **Growth and some important mineral concentration of wheat varieties in relation to soil moisture stress.** *Pakistan Journal of Agricultural Research (Pakistan) v. 14(2 and 3) p. 136-142.* 6 tables, 14 ref. English. (AGRIS 96-018425).

H60 WEEDS

1844 Caux, PY.; Kent, RA.; Bergeron, V.; Fan, GT.; Macdonald, DD. (1995) **ENVIRONMENTAL FATE AND EFFECTS OF MCPA - A CANADIAN PERSPECTIVE [Review].** *Critical Reviews in Environmental Science & Technology. 25(4):313-376.* English. [ENVIRONM CANADA EVALUAT & INTERPRETAT BRANCH ECOSYST CONSERVAT DIRECTORATE OTTAWA ON K1A 0H3 CANADA].

A review of the environmental chemistry, fate, and toxicology of the herbicide MCPA was conducted. MCPA is used worldwide and is among the top ten herbicides sold in Canada. It has a systemic effect and is used to control a large range of broadleaf weeds in agricultural and noncrop lands. MCPA is highly water soluble and has a low affinity for most soil types, which gives it the potential to leach and contaminate groundwaters. It can undergo microbial degradation in aerobic conditions; therefore, it is only slightly persistent in soil and water. In Canada, MCPA has been detected in surface waters at levels varying between 0.00003 and 0.013 mg/l, and at relatively high levels in some groundwater (1.0 mg/l). It has also been reported to affect organisms such as the diatom Navicula pelliculosa at levels as low as of 0.026 mg/l, and the beagle dog at concentrations of 0.75 mg/kg/d. This review includes the development of the Canadian Water Quality Guidelines for MCPA, which are numerical concentrations of MCPA designed to protect freshwater and marine water life, livestock, and crops. [References: 202].

1845 Chiverton, P.A. (Department of Plant and Forest Protection, Swedish University of Agricultural Sciences, Box 7044, 750 07 Uppsala (Sweden)) (1993) **Large-scale field trials with conservation headlands in Sweden.** *Proceedings of a conference on crop protection in Northern Britain, Dundee, UK, 23-25 March 1993 [compiled by Williams, G. H.]. p. 207-215.* Scottish Crop Research Institute. 17 ref. English. (AGRIS 96-006264).

1846 Conn, JS.; Deck, RE. (1995) **SEED VIABILITY AND DORMANCY OF 17 WEED SPECIES AFTER 9.7 YEARS OF BURIAL IN ALASKA.** *Weed Science. 43(4):583-585.* English. [UNIV ALASKA USDA ARS SUBARCTIC AGRIC RES UNIT POB 757200 FAIRBANKS, AK 99775 USA].

A 50-year study at Fairbanks, AK, was started in 1984 to determine soil seed longevity of 17 weed species. Seed were buried in mesh bags 2 and 15 cm deep and were exhumed 0.7, 1.7, 2.7, 3.7, 4.7, 6.7, and 9.7 yr later. Viability was determined by germination and tetrazolium tests. All common hempnettle and quackgrass seed were dead after 2.7 and 3.7 yr, respectively. Less than 1% of wild oats and foxtaill barley seed were viable after 3.7 yr, but > 6.7 yr were required for loss of all viability. By 9.7 yr, < 1% seed viability remained for: bluejoint reedgrass, corn spurry, pineappleweed, prostrate knotweed, and wild buckwheat. From 2 to 5% of seed from common chickweed, common lambsquarters, flixweed, Pennsylvania smartweed, rough cinquefoil, marsh yellow-cress and shepherd's-purse were viable, while 62% of American dragonhead seed was still alive. Seed longevity in agricultural fields is not greater under subarctic conditions than under warmer conditions. [References: 10].

1847 D'Souza, D.S.M.; Hewson, R.T.; Whytock, G.P.; Davies, D.H.K. (Hoechst UK Limited, Agriculture Division, East Winch Hall, East Winch, Kings Lynn, Norfolk PE32 1HN (United Kingdom)) (1993) **HOE 1825 - a new graminicide for the control of Avena spp. (wild oats) in barley.** *Proceedings of a conference on crop protection in Northern Britain, Dundee, UK, 23-25 March 1993 [compiled by Williams, G. H.]. p. 49-54.* Scottish Crop Research Institute. 9 ref. English. (AGRIS 96-006251).

1848 Duering, R.A.; Hummel, H.E. (Justus Liebig Univ., Giessen (Germany). Inst. of Phytopathology and Applied Zoology. Biological and Biotechnical Plant Protection) (1993) **Soil tillage as a parameter influencing the fate of three selected soil herbicides [isoproturon, terbuthylazine, metamitron].** 45th International Symposium on Crop Protection; Gent (Belgium); 4 May 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 58(3a) p. 827-835.* 7 ill.; 13 ref. English. (AGRIS 96-018530).

1849 Endres, GJ.; Ahrens, WH. (1995) **FALL-APPLIED TRIFLURALIN GRANULES IN CONSERVATION-TILL SPRING WHEAT (TRITICUM AESTIVUM).** *Weed Technology. 9(4):703-709.* English. [N DAKOTA STATE UNIV RES EXTENS CTR BOX 219 CARRINGTON, ND 58421 USA].

Field experiments were conducted to evaluate postplant crop residue, green and yellow foxtail control, and wheat grain yield after fall application of trifluralin granules in undisturbed small grain stubble. Levels of postplant residue were at least 48% cover (line transect method) and 2750 kg/ha of aboveground dry matter where herbicide granules were left unincorporated or were incorporated with conservation-till methods, including an undercutter, rotary hoe, or undercutter followed by a rotary hoe, Trifluralin at 0.56 kg/ha applied as granules in mid October in untilled stubble and incorporated with conservation-till methods controlled foxtail 81 to 88%, with control appearing slightly lower when granules were not incorporated. The 81 to 88% foxtail control in conservation-till treatments was comparable to control achieved with trifluralin at 0.56 kg/ha applied in mid October on conventionally-tilled soil and incorporated by a field cultivator. Foxtail control improved somewhat as trifluralin rate was increased to 0.84 and 1.12 kg/ha in conservation-till treatments, Slight wheat stand reductions at 1.12 kg/ha of trifluralin did not appear to reduce wheat yield. Fall application of trifluralin granules in these high-residue conditions apparently minimizes herbicide losses by photodecomposition and volatility, thereby facilitating good trifluralin efficacy the following season. [References: 26].

1850 Ghersa, CM.; Holt, JS. (1995) **USING PHENOLOGY PREDICTION IN WEED MANAGEMENT - A REVIEW [Review].** *Weed Research. 35(6):461-470.* English. [UNIV BUENOS AIRES FAC AGRON DEPT ECOL AVE SAN MARTIN 4453 RA-1417 BUENOS AIRES DF ARGENTINA].

The success of weed management based on ecological principles and weed biology will depend on a better understanding of the effect of environment on life history strategies, growth, and competition of weeds and crops, and particularly upon the ability to predict weed and crop phenology. This paper reviews the importance of phenotypic plasticity to weed and crop competition and other biological interactions. We also discuss the utility of phenological predictions in weed management and review current weed phenology models that are based on thermal time. By understanding the variables that drive plant phenotypic responses, new approaches and more long-term solutions for weed problems can be developed. [References: 104].

1851 Gutierrez Sosa, M. (1995) **[How to control wheat regrowths]. Como controlar los rebrotes de trigo.** *AIMCRA (Asociacion de Investigacion para la Mejora del Cultivo de la Remolacha Azucarera) (Espana) (no.47) p. 20-24.* Spanish. (AGRIS 96-006307).

1852 Kwon, TJ.; Young, DL.; Young, FL.; Boerboom, CM. (1995) **PALWEED-WHEAT - A BIOECONOMIC DECISION MODEL FOR POSTEMERGENCE WEED MANAGEMENT IN WINTER WHEAT (TRITICUM AESTIVUM).** *Weed Science. 43(4):595-603.* English. [KOREA RURAL ECON INST SEOUL SOUTH KOREA].

Based on six years of data from a field experiment near Pullman, WA, a bioeconomic decision model was developed to annually estimate the optimal post-emergence herbicide types and rates to control multiple weed species in winter wheat under various tillage systems and crop rotations, The model name, PALWEED:WHEAT, signifies a Washington-Idaho Palouse region weed management model for winter wheat. The model consists of linear preharvest weed density functions, a nonlinear yield response function, and a profit function, Preharvest weed density functions were estimated for four weed groups: summer annual grasses, winter annual grasses, summer annual broadleaves, and winter annual broadleaves, A single aggregated weed competition index was developed from the four density functions for use functions for use in the yield model, A yield model containing a logistic damage function performed better than a model containing a rectangular hyperbolic damage function, Herbicides were grouped into three categories: preplant nonselective, postemergence broadleaf, and postemergence grass, PALWEED: WHEAT was applied to average conditions of the 6-yr experiment to predict herbicide treatments that maximized profit, In comparison to average treatment rates in the 6-yr experiment, the bioeconomic decision model recommended less postemergence herbicide, The weed management recommendations of PALWEED:WHEAT behaved as expected by agronomic and economic theory in response to changes in assumed weed populations, herbicide costs, crop prices, and possible restrictions on herbicide application rates. [References: 24].

1853 Lemerle, D.; Verbeek, B.; Coombes, N. (1995) **LOSSES IN GRAIN YIELD OF WINTER CROPS FROM LOLIUM RIGIDUM COMPETITION DEPEND ON CROP SPECIES, CULTIVAR AND SEASON.** *Weed Research. 35(6):503-509.* English. [NEW S WALES AGR & FISHERIES AGR RES INST WAGGA WAGGA NSW 2650 AUSTRALIA].

The competitive abilities of eight winter crops were compared against Lolium rigidum Gaud. (annual ryegrass), an important weed of southern Australia, as a potential strategy to suppress weeds and reduce dependence on herbicides. Two cultivars of each species were chosen to represent the range of competitive ability within each crop and grown in field experiments in 1992 and 1993. The order of decreasing competitive ability (with the ranges of percentage yield reduction from L. rigidum at 300 plants m(-2) in parenthesis) was as follows: oats (Avena sativa L.), 2-14%; cereal rye (Secale cereale L.), 14-20%; and triticale (x: Triticosecale), 5-24%; followed by oilseed rape, (Brassica napus L.), 9-30%; spring wheat (Triticum aestivum L.), 22-40%; spring barley (Hordeum vulgare L.), 10-55%; and, lastly, field pea (Pisum sativum L.), 100%, and lupin (Lupinus angustifolius L.), 100%. Differences in competitive ability of cultivars within each species were identified, but competition was strongly influenced by seasonal conditions. Competition for nutrients (N, P and K) and light was demonstrated. L. rigidum dry matter and seed production were negatively correlated with grain yield of the weedy crops. More competitive crops offer the potential to suppress grass weeds while maintaining acceptable grain yields. Ways of improving the competitive abilities of grain legume crops are discussed. [References: 32].

1854 Omar, S.A.; Hemida, S.K.; Abd El Mallek, A.Y. (Assiut Univ. (Egypt). Faculty of Science) (1994) **In vitro effects of alachlor and haloxyfop herbicides on wheat straw degradation by some fungal species.** *Bulletin of the Faculty of Science, Assiut Univ. (Egypt) v. 23(2) p. 13-23.* 1 ill. 1 table; 26 ref. English. (AGRIS 96-006187).

1855 Rajput, M.J. (Sindh Agriculture Univ., Tandojam (Pakistan)); Alam, S.M. (Atomic Energy Agricultural Research Centre, Tandojam (Pakistan)); Rajput, M.S. (1993) **Effect of weed control and N application on the growth of wheat.** *Pakistan Journal of Agricultural Research (Pakistan) v. 14(2 and 3) p. 131-135.* 5 tables, 7 ref. English. (AGRIS 96-018635).

1856 Razzaq, A.; Khan, B.M.; Khan, B.R.; Hashmi, N.I. (National Agricultural Research Centre, Islamabad (Pakistan). Wheat Programme); Hobbs, P.R. (1993) **Chemical control of Phalaris minor and Avena fatua in wheat.** *Pakistan Journal of Agricultural Research (Pakistan) v. 14(2 and 3) p. 192-197.* 2 ills., 4 tables, 10 ref. English. (AGRIS 96-018636).

1857 Rouchaud, J.; Gustin, F. (Universite Catholique de Louvain, Louvain la Neuve (Belgium). Lab. of Phytopharmacy); Callens, D.; Himme, M. van; Bulcke, R.; Cappellen, O.; Mouraux, D. (1993) **Effects of the recent organic fertilizer treatments onto the herbicides isoxaben, atrazine and metolachlor soil metabolisms in winter wheat and maize crops.** 45th International Symposium on crop protection; Gent (Belgium); 4 May 1993. *Mededelingen - Faculteit Landbouwkundige en Toegepaste Biologische Wetenschappen. Universiteit Gent (Belgium) v. 58(2a) p. 197-202.* 1 ill.; 3 tables; 2 ref. English. (AGRIS 96-006267).

During the six months first crop period, the soil biodegradation of the herbicide isoxaben was slower in the winter wheat field plots which had been recently treated with one of the organic fertilizers cow manure, pig slurry or green manure, relative to the control plots not treated with organic fertilizers. The isoxaben soil metabolites were identified; their formations also were slowed down by the organic fertilizers treatment. At the end of the crop, the isoxaben and its metabolites soil concentrations became very low, and similar in the organic fertilizers treated and untreated plots. These recent organic fertilizers treatments had similar effects onto the herbicides atrazine and metolachlor soil biodegradations in maize crops. These effects however were lower with atrazine than with metolachlor.

1858 Shaner, DL. (1995) **HERBICIDE RESISTANCE - WHERE ARE WE - HOW DID WE GET HERE - WHERE ARE WE GOING.** *Weed Technology. 9(4):850-856.* English. [AMER CYANAMID CO PRINCETON, NJ 08543 USA].

The first significant cases of herbicide-resistant weed populations were to the triazines in the 1970s. In the last 10 years there has been an increase in the number of weed populations that have become resistant to an array of herbicides. In some of these cases, like rigid ryegrass in Australia, a multitude of resistant biotypes has evolved with different mechanisms of resistance. If the present trend continues, the number of herbicides effective on certain weed species may diminish rapidly. To counteract this trend, industry has organized a number of intercompany working groups to specifically address the development of resistance and to implement plans to manage resistance. University and extension along with industry personnel across the world have begun educating growers on resistance management. However, this effort needs to be intensified to find new solutions for controlling weeds through the use of integrated weed management practices that incorporate new and established herbicides with cultural, mechanical, and biological control methods. The challenge is to develop cost effective, environmentally sustainable programs for weed control while maintaining the present efficiency in food and fiber production so that needs of an ever expanding human population can be met. [References: 40].

1859 SINGH.; SAMUNDER.; Malik, RK.; Panwar, RS.; Balyan, RS. (1995) **INFLUENCE OF SOWING TIME ON WINTER WILD OAT (AVENA LUDOVICIANA) CONTROL IN WHEAT (TRITICUM AESTIVUM) WITH ISOPROTURON (VOL 43, PG 370, 1995).** *Weed Science. 43(4):719.* English.

1860 Soliman, FS. (1995) **ASSESSMENT OF SOME HERBICIDAL COMBINATIONS IN WHEAT FIELDS OF DIERAB, SAUDI ARABIA.** *Arab Gulf Journal of Scientific Research. 13(3):521-534.* English. [KING SAUD UNIV COLL AGR DEPT PLANT PROTECT POB 2460 RIYADH 11451 SAUDI ARABIA].

The efficiency of four herbicides, viz., isoproturon (arelone), methabenzthiazuron (tribunil), fenoxaprop-ethyl (puma) and a ready mix formulation of mecoprop/dichlorprop/MCPA (duplosane super) and

some of their combinations in controlling weeds in wheat fields as well as their effect on grain yield and its components were studied at the Agricultural Research and Experimental Station of Dierab in seasons 1991 and 1992 in two different sites. The experimental sites were of loamy sand soil and were under sprinkler and central pivot irrigation system. The results of the study revealed that, Malva spp (common mallow) and Lolium rigidum (ryegrass) were the predominant weeds in the experimental area. Treatments of duplosane super at 3.5 and 2.5 L/ha; combinations of duplosane super (2.5 L/ha) with either tribunil (0.75 kg/ha), arelone (0.75 L/ha) or puma (2.5 L/ha); and tribunil (1.5 kg/ha) showed to be most efficient in controlling broad-leaved weeds. Arelone (1.5 and 0.75 L/ha) and puma (3.5 and 2.5 L/ha), on the other hand, gave slight control of the grassy weed Lolium rigidum. The results also showed that duplosane super and its combinations as well as tribunil had significantly increased grain yield in wheat in the first site. On the other hand, duplosane super 2.5 L+puma 2.5 L/ha was the only treatment that significantly increased grain yield in wheat in the second season in the second site. [References: 21].

1861 Vouzounis, N.A.; Americanos, P.G. (Agricultural Research Inst., Nicosia (Cyprus)) (1995) **Post-emergence control of weeds in cereals [wheat, barley] with non-hormone type herbicides.** *Technical Bulletin (Cyprus); no. 168 6 p.* 2 tables; 10 ref. English. (AGRIS 96-018579).

A number of non-hormone type herbicides controlled broad-leaved weeds but did not increase grain yield of wheat and barley.

1862 Wallace, A.; Evans, PM.; Bowran, D. (1995) **EFFECTIVE BARLEY GRASS (HORDEUM SPP) CONTROL IN ANNUAL MEDICS WITH 2, 2-DPA HERBICIDE.** *Australian Journal of Experimental Agriculture. 35(6):725-730.* English. [WESTERN AUSTRALIA DEPT AGR GREAT SO AGR RES INST KATANNING WA 6317 AUSTRALIA].

The ability of 2, 2-dichloropropionic acid (2, 2-DPA) to control annual grasses was examined in a 4-year-old medic (Medicago polymorpha var. brevispina cv. Circle Valley) pasture. Six rates of 2, 2-DPA with and without spray adjuvants (1% spray oil + 0.25% wetting agent) were used: 0.37, 0.56, 0.74, 1.11, 1.48, 2.22 kg a.i./ha. The pasture was sprayed in July at the 4-true-leaf stage of the medic, after identifying and counting grasses and medics. Plants were counted again after spraying and grass seed heads were counted in spring. At the end of the season, medic seed yields were obtained. Nine annual pasture legumes were later evaluated for their tolerance to 2.22 kg 2, 2-DPA/ha at 3 growth stages [post plant, pre-emergence (PPPE); 3-5-true-leaf stage; flowering] under weed-free conditions. A rate of 1.11 kg 2, 2-DPA/ha was found to reduce barley grass density by 85%. Efficacy was improved, however, with higher rates and/or the addition of spray adjuvants. Because of low silvergrass (Vulpia spp.) and ryegrass (Lolium rigidum) plant numbers, it was not possible to assess whether 2, 2-DPA controlled these species effectively. There was no effect of herbicide on medic seed yields, seed weight, seed number per pod, or seed germination. Medic seed yields were well correlated with plant density of medic but not with herbicide rates. There was a wide variation in biomass production of the 9 pasture legumes in the evaluation of tolerance, when assessed by visual rating and seed yield, with significant biomass and yield reductions at all timings of application of 2, 2-DPA. Subterranean clover (Trifolium subterraneum L.) was the most severely affected..Generally, medic species tolerated 2, 2-DPA well. Serena was the most susceptible medic cultivar at any treatment time, with seed yield reductions at the first 2 times of application. The results suggest that 2, 2-DPA could be used safely on annual medics for the control of barley grass, and possibly other annual grasses. [References: 17].

1863 Wicks, GA.; Hanson, GE. (1995) **EFFECT OF RAINFALL ON GLYPHOSATE PLUS 2, 4-D PERFORMANCE ON ECHINOCHLOA CRUS-GALLI.** *Weed Science. 43(4):666-670.* English. [UNIV NEBRASKA W CENT RES & EXT CTR DEPT AGRON N PLATTE, NE 69101 USA].

Barnyardgrass is a problem in winter wheat fields in the central Great Plains following harvest, Glyphosate plus 2, 4-D efficacy on barnyardgrass with or without atrazine was investigated under various watering events at three sites in west central Nebraska, Two experiments were initiated at each site, One experiment dealt with rainfall and the other rainfall plus irrigation, Main plots in stubble fields infested with barnyardgrass were sprayed with glyphosate plus 2, 4-D at 0.4 plus 0.7, 0.5 plus 0.8, and 0.6 plus 1.0 kg ae ha(-1) alone and with 2.2 kg al ha(-1) atrazine. Barnyardgrass was under drought stress in unwatered areas in 1991 at two sites, but the 1993 site was waterlogged, Glyphosate plus 2, 4-D at 0.6 plus 1.0 kg ha(-1) controlled 62, 99, and 100% of the barnyardgrass at the three sites 30 DAT, Nevertheless, control was reduced to 48, 88, and 35% when atrazine was combined with glyphosate plus 2, 4-D. Poorest control came when plants were under stress from drought or waterlogging and atrazine was included in the spray solution, In subplots barnyardgrass plants in a 0.8 m(2) area were watered 6, 3, or 1 d before spraying and 1, 4, 7, or 11 d after spraying, By watering drought-stressed barnyardgrass 6 d before spraying, control generally was similar or better than with later watering dates, Watering 6 d before spraying with glyphosate plus 2, 4-D plus atrazine at 0.6 plus 1.0 plus 2.2 kg ha(-1) reduced but did not eliminate antagonism from atrazine. [References: 10].

J11 HANDLING, TRANSPORT, STORAGE AND PROTECTION OF PLANT PRODUCT

1864 Almeida, A.A. de; Poy, L. de F.A. (1994) **[The reproduction of Rhizopertha dominica (F., 1792) (Coleoptera, Bostrychidae), in whole and broken grains and on hard and soft varieties of wheat]. Reproducao de Rhizopertha dominica (F., 1792)(Coleoptera, Bostrychidae) em graos inteiros e partidos, de cultivares de trigo, de textura vitrea e suave.** *Revista Brasileira de Entomologia (Brazil) v. 38(3-4) p. 599-604.* 9 ref. Portuguese. (AGRIS 96-006376).

1865 Arthur, FH. (1995) **AERATION ALONE VERSUS CHLORPYRIFOS-METHYL TREATMENT FOLLOWED BY AERATION FOR WHEAT STORED IN GEORGIA - SIMULATED FIELD TEST.** *Journal of Economic Entomology. 88(6):1764-1770.* English. [USDA ARS N CENT REG US GRAIN MKT RES LAB 1515 COLL AVE MANHATTAN, KS 66502 USA].

Wheat treated on 7 July with 6 ppm chlorpyrifos-methyl was artificially infested with lesser grain borer, Rhyzopertha dominica (F.), and rice weevil, Sitophilus oryzae (L), and subsequently aerated when temperatures cooled, was compared with untreated wheat infested and aerated at the same conditions. Temperatures were monitored from 7 July to 5 April inside the bins and populations of the introduced species and a natural infestation of red Hour beetle, Tribolium castaneum (Herbst), were assessed using probe tl aps and a grain trier. Average daily temperatures at 7 sample positions in untreated wheat were from 17.01 +/- 0.53 to 21.46 +/- 0.52 degrees C, and were not significantly different from average temperatures at corresponding positions in treated wheat, which were from 16.00 +/- 0.63 to 18.98 +/- 0.60 degrees C. Initial chlorpyrifos-methyl residue on treated wheat was 5.75 +/- 0.51 ppm, but after 6 wk residues declined by 67.2 - 52.7%. Lesser grain borers collected from probe traps and trier samples were significantly more numerous in untreated wheat than in treated wheat on the Ist sample date (20 August); however, populations were larger in treated wheat on 2 later sample dates (12 November and 29 March). Few rice weevils or red flour beetles were collected from treated wheat. There was significantly more dockage (ground flour and insect frass) in untreated wheat than in treated wheat on 4 of 6 sample dates, while the percentage of insect-damaged kernels was significantly greater in untreated wheat than in treated wheat on all sample dates. [References: 14].

1866 Cofieagblor, R.; Muir, WE.; Sinicio, R.; Cenkowski, S.; Jayas, DS. (1995) **CHARACTERISTICS OF CARBON DIOXIDE SORPTION BY STORED WHEAT.** *Journal of Stored Products Research. 31(4):317-324.* English. [UNIV MANITOBA DEPT AGR ENGN WINNIPEG MB R3T 5V6 CANADA].

The sorption of carbon dioxide gas (CO2) by wheat was determined in glass flasks at four temperatures (0, 10, 20, and 30 degrees C) and four moisture contents (m.c.) (12, 14, 16, and 18% wet basis). The gaseous concentrations were analyzed by gas chromatography and the vacuum developed from the sorption of CO2 by wheat was measured with a mercury manometer. The calculated amount of CO2 sorbed at equilibrium was a non-linear function of both temperature and moisture content. Sorption of CO2 by wheat decreased with increasing temperature from 0 to 30 degrees C at 14% m.c., and the initial rate of sorption increased with

increasing m.c. from 12 to 18% at a temperature of 20 degrees C. Sorption was modelled using non-linear regression at two conditions (0-30 degrees C at 14% moisture content and 12-18% moisture content at 20 degrees C). The maximum mass of CO2 sorbed in 60 h was 0.510 g/kg of wheat at 18% m.c. and 0 degrees C and the lowest was 0.224 g/kg at 18% m.c. and 30 degrees C. A linear relationship existed between the initial CO2 concentration and the concentration after 60 h when 250 g of wheat of 14% m.c. at 20 degrees C was exposed in 500 ml flasks. [References: 11].

1867 Horabik, J.; Molenda, M.; Ross, IJ. (1995) **COMPARISON OF LOAD DISTRIBUTION IN TWO SIMILAR GRAIN BINS.** *Transactions of the ASAE. 38(6):1875-1879.* English. [UNIV KENTUCKY DEPT AGR & BIOSYST ENGN LEXINGTON, KY 40546 USA].

Wall and bottom loads and the resultant moment of force have been compared for two similar model bins. Corrugated wall bins of 0.6 and 1.2 m in diameter with height-to-diameter ratios of 4 were used in the experiments. The wall and flat bottom of the bins were each supported independently on three load cells to isolate wall and bottom loads. Center and off-center discharge of the bins was tested. The vertical wall load to total grain load and the dimensionless moment found during eccentric discharge were strongly influenced by the difference in the wall friction coefficient resulting from different size corrugations and different kinds of grain. The maximum moment was found for an orifice eccentricity ratio of 0.67 for both bins. [References: 12].

1868 Kaneko, S.; Oyanagi, A. (1995) **VARIETAL DIFFERENCES IN THE RATE OF ESTERIFICATION OF ENDOSPERM LUTEIN DURING THE STORAGE OF WHEAT SEEDS.** *Bioscience Biotechnology & Biochemistry. 59(12):2312-2313.* English. [NATL FOOD RES INST 2-1-2 KANNONDAI TSUKUBA IBARAKI 305 JAPAN].

The varietal differences in the rate of esterification of endosperm lutein by fatty acids during the storage of wheat seeds were determined for 138 wheat cultivars. Nine cultivars were found in which esterification did not proceed. The increase in free linoleic acid during storage was no different between the non-esterified and esterified cultivars. This suggests that the esterification of lutein is not caused by lipase, but rather by an unknown acylhydrolase which has a high substrate specificity to lutein. [References: 5].

1869 Muenzing, K. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Klemm, H.; Xie, X. (1995) **[Quality changes of corn quality by heat treatment for pest control]. Veraenderungen der Getreidequalitaet durch Waermebehandlung als Vorratsschutzmassnahme.** *Getreide Mehl und Brot (Germany) v. 49(2) p. 80-84.* 5 graphs, 2 tables; 12 ref. German. (AGRIS 96-018768).

1870 Opoku, G.; Gamble, EE. (1995) **STORABILITY OF SEEDS OF NORMAL AND NAKED TYPES OF OAC KIPPEN BARLEY.** *Plant Varieties & Seeds. 8(3):197-205.* English. [UNIV GUELPH DEPT CROP SCI GUELPH ON N1G 2W1 CANADA].

Seeds are seldom harvested and sown without undergoing a storage period of varying duration. A study to evaluate the storage potential of normal and naked OAC Kippen barley (Hordeum vulgare L.) was initiated at the flora Research Station, flora, in 1992 and 1993. Seeds of the two barley types were harvested from the field at three different times and at three different combine cylinder speeds (1000, 1300, 1600 rpm). The three different times of harvest consisted of swathing al physiological maturity and then combining later (swathing), direct combining at harvest maturity i.e. when seed moisture content was around 14% (normal harvest), and delayed harvest (late harvest). The seeds were stored in the laboratory at room temperature and viability and vigour were evaluated using the warm and cold germination tests at 0, 2, 4, 6 and 8 months after storage. During the spring of 1993, the seeds from 1992 harvest (after 8 months of storage) were sown in the Field at two sites to determine emergence and grain yield potential. If was observed that as seeds deteriorated in storage, warm germination decreased (3%) whereas cold germination decreased more (6%) after eight months. Viability and vigour of the seeds harvested at the highest cylinder speed, at delayed harvest and seeds combined after swathing deteriorated faster in storage. Seeds from the highest cylinder speed had reduced emergence and grain yield when planted in the field after 8 months of storage. Emergence and grain yield of the two barley types were similarly affected by cylinder speed at the two sites. Combine cylinder speed and time of harvest were very important in maintaining seed viability and vigour. [References: 19].

1871 Tembo, E.; Murfitt, RFA.; Credland, PF. (1995) **EFFECT OF COMBINING VEGETABLE OIL WITH PIRIMIPHOS-METHYL FOR PROTEIN OF STORED WHEAT AGAINST SITOPHILUS GRANARIUS (L) (VOL 31, PG 77, 1995).** *Journal of Stored Products Research. 31(4):355.* English.

1872 White, NDG.; Demianyk, CJ.; Kawamoto, H.; Sinha, RN. (1995) **POPULATION GROWTH OF CRYPTOLESTES FERRUGINEUS AND C-PUSILLUS (COLEOPTERA, CUCUJIDAE) ALONE, OR IN COMPETITION IN STORED WHEAT OR MAIZE AT DIFFERENT TEMPERATURES.** *Bulletin of Entomological Research. 85(3):425-429.* English. [AGR & AGRI FOOD CANADA RES CTR 193 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

Cryptolestes ferrugineus (Stephens) and C. pusillus (Schonherr) were reared separately at initial densities of 20 or 40 adults each and together at an initial density of 20 adults/100 g cracked wheat or cracked maize at 35, 30, 25, and 20 degrees C and 70% r.h, for developmental periods of 10, 11, 16, or 40 weeks, respectively. Intraspecific competition in the 40-adult treatments restricted population growth to levels similar to 20-adult treatments for each species; impact was greatest for C. pusillus on maize at 30 degrees C, where the population of the 40-adult treatment was less than half that of the 20-adult treatment. Both species produced larger populations on wheat than on maize, except for C. pusillus at 35 degrees C; mortality for both species was high on wheat at 35 degrees C. Interspecific competition resulted in significantly reduced populations relative to single species populations for both C. ferrugineus at 30, 25, and 20 degrees C and C. pusillus at 35, 30, and 25 degrees C on wheat and for C. ferrugineus at 25 and 20 degrees C and C. pusillus at 35, 30, and 25 degrees C on maize. During interspecific competition, C. ferrugineus was more successful in multiplying at 35 and 30 degrees C on wheat and 35 degrees C on maize; both species multiplied equally well at 25 degrees C on wheat or 30 and 25 degrees C on maize; C. pusillus multiplied best at 20 degrees C on both wheat and maize. Cryptolestes pusillus reproduces more effectively alone or in interspecific competition under cool conditions, although C. ferrugineus occurs with much greater frequency in cool Canadian stored grain, probably because of cold-hardiness and winter survival. [References: 24].

L01 ANIMAL HUSBANDRY

1873 Economides, S.; Georghiades, E.; Kyprianou, G.; Antoniou, I.; Photiou, A. (Agricultural Res. Inst., Nicosia (Cyprus)) (1995) **The effect of partial replacement of barley hay by barley silage on the performance of lactating cows in early lactation.** *Technical Bulletin (Cyprus); no. 174 12 p.* 5 tables; 34 ref. English. (AGRIS 96-019338).

Hay and silage made from barley, variety Morocco 628, were used in three feeding trials to investigate the effect of replacing part of barley hay and other roughages by barley silage on the milk yield, milk composition and body weight changes of lactating Friesian cows in early lactation. The digestibility coefficients of barley silage and barley hay (fed alone or with concentrates) were measured with Chios wether sheep. It was concluded that the nutritive value of silage and hay made from barley cut at the same stage of maturity was similar and milk yield of lactating cows and milk composition were not affected by the partial replacement of the roughage component by barley silage.

L02 ANIMAL FEEDING

1874 Andrae, J.G.; Horn, G.W.; Lowrey, G. (1994) **Effect of alternate-day feeding of a monensin-containing energy supplement on weight gains and variation in supplement intake by wheat pasture stocker cattle.** *Research report P (USA) (no. 939) p. 158-161.* references. English. (AGRIS 96-007355).

1875 Bernardo, D.J. (Oklahoma State University); Coulibaly, N.; Cravey, M.D.; Horn, G.W. (1994) **Use of production isoquants in evaluating the response of wheat pasture stocker cattle to increasing levels of energy supplementation.** *Research report P (USA) (no. 939) p. 144-150.* references. English. (AGRIS 96-007426).

1876 Boersting, C.F.; Bach Knudsen, K.E. (1994) **The nutritive value for mink of decorticated mill fractions of wheat exposed to different treatments.** 253. NJF-Seminar; Rebild (Denmark); 28-30 Sep 1994. *NJF-utredning/rapport (Finland) (no. 98) p. 205-215.* 16 ref. English. (AGRIS 96-019655).

1877 Colinschoellen, O.; Jurjanz, S.; Gardeur, JN.; Laurent, F. (1995) **INFLUENCE OF THE NATURE OF THE CONCENTRATE ON ZOOTECHNICAL PERFORMANCES OF DAIRY COWS RECEIVING A COMPLETE DIET.** *Annales de Zootechnie. 44(4):359-372.* French. [INRA ENSAIA SCI ANIM LAB 2 AVE FORET HAYE BP 172 F-54505 VANDOEUVRE LES NANCY FRANCE].

The influence of concentrate (wheat or sugar beet pulp + corn gluten feed) on milk yield and composition, rumen volatile fatty acids and some blood parameters was studied with a crossover design using 36 dairy cows (22 primiparous) during 2 experimental periods of 6 weeks each. The cows were fed ad libitum with a complete diet consisting, in large part, of maize silage. The 2 diets had the same energy concentration (1.57 Mcal/kg dry matter [DM]) and crude protein (14.20%). The nature of the supplement had no significant effect on mean daily total DM intake (18.0 kg) and mean daily milk production (22.2 kg/d). The most affected was the fat content of the milk, fat-corrected milk and fat yield which increased with the fibrous concentrate (+3.2 g/kg milk, $P < 0.05$, +1.1 kg, $P < 0.10$ and +73 g/d, $P < 0.01$, respecfively) (table II); the true protein content of the milk and the body weight were significantly higher with the starchy concentrate (+0.7 g/kg, $P < 0.05$ and +580 g/d, $P < 0.01$, respectively). The proportion of acetic acid in the rumen fluid was significantly lower (-3%, $P < 0.05$) and the proportion of propionic acid higher (+2%, $P < 0, 05$) with the starchy concentrate (table III). The nature of the concentrate had neither a significant effect on the non-esterified fatty acids and beta OH-butyrate contents, nor on the uremia (table IV and fig I). The glycemia was significantly increased for the diet with the starchy concentrate (+0.02 g/l, $P < 0.05$) (fig 2). [References: 26].

1878 Damgaard, Birthe M. (1994) **[The effect of Cerone treated barley on the reproduction conditions of mink]. Effekten af ceronebehandlet byg paa reproduktionsforholdene hos mink.** 253. NJF-Seminar; Rebild (Denmark); 28-30 Sep 1994. *NJF-utredning/rapport (Finland) (no. 98) p. 242-246.* 4 ref. Danish. (AGRIS 96-019656).

1879 Edwards, J.F. (Texas AandM University, College Station, TX.); Fossum, T.W.; Willard, M.D.; Cohen, N.D.; Patterson, W.B.; Carey, D.P. (1995) **Changes in the intestinal mucosal cell populations of German Shepherd dogs fed diets containing different protein sources.** *American journal of veterinary research (USA) v. 56(3) p. 340-348.* references. English. (AGRIS 96-007553).

Sixteen German Shepherd Dogs from 4 litters were IgA-deficient on the basis of at least 1 of 2 serum IgA determinations, and all had small intestinal bacterial overgrowth, as documented by quantitated small intestinal bacterial culture in another study. These dogs were fed 2 diets that differed principally in their protein source (chicken vs beef, milk, and wheat). All dogs were fed each diet for 2 weeks before the study began. Next, all dogs were fed the chicken-based diet for 2 months. Then, half the dogs (group 1) were randomly assigned to continue eating the chicken-based diet, while the other half (group 2) ate a diet containing beef, milk, and wheat proteins. The small intestine was biopsied at the beginning of the study and after dogs had eaten the assigned diet for 2 and 4 months. At 2 months, group-2 dogs had more colonic mucosal mast cells, but this difference did not persist at 4 months. At the end of the study (ie, 4 months), although all dogs were clinically normal, group-2 dogs had significantly ($P = 0.010$) decreased numbers of jejunal villus plasma cells. However, these histologic changes were not considered clinically important. There were no significant differences in blood eosinophil counts, serum trypsin-like immunoreactivity, or cobalamin, folate, or IgA concentration. Clinical differences were not detected between the 2 groups, before or after the study. Changes were seen in serum IgM and IgG concentrations. Although results of this study suggest that dietary protein may influence intestinal mucosal cell populations, there was no evidence that the protein sources in these 2 diets caused intestinal disease in these dogs under the conditions of this study.

1880 Ernst, R.A. (University of California, Davis, CA.); Vohra, P.; Kratzer, F.H.; Ibanga, O. (1994) **A comparison of feeding corn, oats, and barley on the growth of White Leghorn chickens, gastrointestinal weights of males, and sexual maturity of females.** *The journal of applied poultry research (USA) v. 3(3) p. 253-260.* references. English. (AGRIS 96-019670).

1881 Fuente, JM.; Deayala, PP.; Villamide, MJ. (1995) **EFFECT OF DIETARY ENZYME ON THE METABOLIZABLE ENERGY OF DIETS WITH INCREASING LEVELS OF BARLEY FED TO BROILERS AT DIFFERENT AGES.** *Animal Feed Science & Technology. 56(1-2):45-53.* English. [UNIV POLITECN MADRID ETS ETS INGN AGRON DEPT ANIM PROD E-28040 MADRID SPAIN].

The effect of enzyme addition on the AMen of a two-row barley for broiler chickens was determined with increasing levels of barley at 10 and 30 days of age in a 4 X 3 factorial design. Four levels of barley (30, 40, 50 and 60%) and two commercial enzyme complexes were used, the first obtained from Trichoderma reesei and Aspergillus niger and the second from Bacillus subtilis and Humicola insolens. At both 10 and 30 days of age, the AMEn of diets decreased significantly with increasing barley level (218 kJ for each 10% barley included). The enzyme response magnitude (1.4% on average) was affected by barley level; the response was only significant at 40 and 50% barley inclusion (AMEn improved 2.6% on average). There was no difference between enzyme complexes or ages in the AMEn of the diets or the barley (AMEn 12.71 and 13.10 MJ kg(-1) for unsupplemented and enzyme supplemented barley respectively). Gut viscosity alone accounted for 97% of AMEn variation among unsupplemented diets, Increasing gut viscosity by 1 cps corresponded to a decrease in AMEn of 59 kJ. However, gut viscosity was not highly related to AMEn in enzyme supplemented diets because of the virtual complete elimination of the viscosity effect. [References: 24].

1882 Guertin, G.; Lachance, B.; Pelletier, G.; Stlaurent, GJ.; Roy, GL.; Petitclerc, D. (1995) **EFFECTS OF PHOTOPERIOD AND FEEDING WHOLE MAIZE, WHOLE BARLEY, OR ROLLED BARLEY ON GROWTH PERFORMANCE AND DIET DIGESTIBILITY IN VEAL CALVES.** *Livestock Production Science. 44(1):27-36.* English. [AGR & AGRI FOOD CANADA LENNOXVILLE PQ J1M 1Z3 CANADA].

Fifty-seven black and white male dairy calves, reared from 48 to 222 kg liveweight, were used to study the effects of photoperiod and feeding whole maize (75%; WM), whole barley (80%; WE) or rolled barley (80%; RE) based diet after weaning. Photoperiod treatments were 10 h of light (L):14 h of dark (D), 16L:8D, 10L:14D for 6 weeks then followed by 16L:8D, or 16L:8D for 6 weeks then followed by 10L:14D. During weeks 17 and 20, 30 calves of uniform weight, ten per feeding treatment, underwent two digestibility trials. Exposure to 16L:8D photoperiod or a change from 16L:8D to 10L:14D increased similarly weight gain by 5.6% and feed intake by 9.5% without affecting feed efficiency. Calves fed WM consumed less feed ($P < 0.05$), had similar average daily gain (ADG) and were 25% more efficient than calves fed WE but calves fed RE had a lower average daily feed intake ($P < 0.05$), had similar ADG and were 10% more efficient than WE-fed calves. Calves fed RE had a tendency to have higher ($P=0.07$) carcass weight and dressing percentage (118.8 kg and 53.6%, respectively) than calves fed WE (115.4 kg and 52.0%, respectively). Body and meat composition, meat color, and haematocrit and haemoglobin levels were not significantly affected by feeding or photoperiod treatments, Digestibility of dry matter (DM), energy (E), nitrogen, starch (S), phosphorus (P) and copper (Cu) were higher ($P < 0.05$) for calves fed WM compared to those fed WE. Furthermore, digestibility of DM, E, S, P and Cu were reduced ($P < 0.05$) in the diet containing WE compared to the diet containing RE. Diet did not affect energy intake even though, when expressed as a percentage of energy intake, calves fed WM retained more E ($P < 0.05$) than those fed WE (77.2 vs 64.7%) and calves fed RE had a higher E retention (69.8%) than those fed WE. Nitrogen intake and excretion were

higher ($P < 0.05$) for the calves fed WE compared to those fed WM; there was no significant difference between both barley diets. Nitrogen retention was not affected by the diets. Blood urea level of calves fed WE was also 28.8% higher than blood urea level of calves fed WM. There was no significant effect of photoperiod treatments on diet digestibility, E and N retentions, and blood urea levels nor was there any significant interaction with diet treatments except on body weight changes. In conclusion, our results indicated positive effects of long-day photoperiod on growth performance but also showed evidence of photorefractoriness to subsequent photoperiod exposure. There was no effect of photoperiod on feed digestibility and feed efficiency. Digestibility and energy retention were lower with whole barley as compared with whole maize diet but were improved by rolling barley thus improving feed efficiency. [References: 41].

1883 Havrevoll, Oe.; Ekern, A.; Kjoes, N.P.; Haug, A. (1995) **The effect of feeding on milk fat content and fatty acid composition: new research experiences and feeding practice in Norway.** NJF-utredning/rapport (Finland); no. 102 p. 100-109 327 p. University Printing House. 18 ref. 327 p. English. (AGRIS 96-019520).

1884 Heldt, J.S. (South Dakota State University.); Pruitt, R.J.; Haigh, R.H.; Young, D.B. (1994) **Evaluation of wheat middlings as a supplement for beef cows grazing native winter range.** *South Dakota beef report (USA) (no. 94-B) p. 23-27.* English. (AGRIS 96-019580).

1885 Horn, G. (Oklahoma State University); Krenzer, G.; Bernardo, D.; McDaniel, B. (1994) **Preliminary evaluation of wheat varieties in the wheat grain/stocker cattle enterprise.** *Research report P (USA) (no. 939) p. 151-157.* references. English. (AGRIS 96-007427).

1886 Jeroch, H.; Danicke, S. (1995) **BARLEY IN POULTRY FEEDING - A REVIEW.** *Worlds Poultry Science Journal. 51(3):271-291.* English. [UNIV HALLE WITTENBERG FAC AGR INST ANIM NUTR EMIL ABDERHALDEN STR 25B D-06108 HALLE GERMANY].

In most European countries barley (Hourdeum vulgare L.) is an important feedstuff for poultry, and its use could increase with changes in economic circumstances. Compared with wheat, barley contains more fibre and less energy. The nutritive value and suitability of this grain as a feedstuff for growing poultry are more or less affected by varying beta-glucan concentrations. The anti-nutritive effects of beta-glucan in the gastrointestinal tract of young chicks can be avoided by adding beta-glucanase of microbial origin to barley-containing or barley-based diets, thus making this grain crop acceptable for broiler fattening diets. Feed mixtures for layers may contain a higher proportion of barley without negative effects on egg production. When formulating diets, the low content of linoleic acid has to be considered. [References: 115].

1887 Jost, M.; Bracher Jakob, A. (Eidg. Forschungsanstalt fuer viehwirtschaftliche Produktion (FAG), Posieux (Switzerland)) (1995) **[Oat flakes or enzymes in the diet of piglets]. Haferflocken oder Enzyme im Ferkelfutter.** *Agrarforschung (Switzerland) v. 2(7) p. 283-286.* 5 tables, 2 graphs, 1 photo, 10 ref. German. (AGRIS 96-019623).

For economic reasons, the relatively expensive oat flakes used in weaner diets are more and more being replaced by barley supplemented with enzyme blends. In a feeding trial with 128 piglets two diets containing 15 and 30 % oat flakes respectively were compared with two barley-based diets (55 and 30 % respectively), one supplemented with the multi-enzyme product Porzyme SP. Enzyme supplementation did not show any effect on neither the performance nor the digestibility. Neither did the diet containing 15 % oat flakes. By contrast, the 30 % oat flake diet improved digestibility of gross energy significantly. Compared to the barley-based diets, the 15 % oat flake diet improved feed conversion and the 30 % oat flake diet had a positive effect on growth rates and feed intake.

1888 Leaver, JD.; Hill, J. (1995) **THE PERFORMANCE OF DAIRY COWS OFFERED ENSILED WHOLE-CROP WHEAT, UREA-TREATED WHOLE-CROP WHEAT OR SODIUM HYDROXIDE-TREATED WHEAT GRAIN AND WHEAT STRAW IN A MIXTURE WITH GRASS SILAGE.** *Animal Production. 61(Part 3):481-489.* English. [UNIV LONDON WYE COLL ASHFORD TN25 5AH KENT ENGLAND].

Twenty-four Holstein Friesian cows in experiment 1 and 40 cows in experiment 2 were used over 12 weeks in continuous designs, to evaluate winter wheat as a forage for daily cows. In experiment 2, whole-crop wheat was ensiled at 350 g dry mattter (DM) per kg (EW) or harvested later and stored at 550 g DM per kg following treatment with 40 g urea per kg DM (40W). In addition to these treatments in experiment 2, whole-crop wheat of 550 g DM per kg treated with 20 g urea per kg DM (20W), and combine harvested wheat grain plus wheat straw (40:60 ratio) treated with sodium hydroxide (SG) were also included. These whole-crop wheat forages were incorporated into the diet at a level of 400 g/kg of the forage DM in experiment 1, and 330 g/kg in experiment 2, with the remainder of the forage being grass silage. A control treatment of grass silage (GS) offered as the sole forage teas also included. The forages were mixed in a mixer wagon and offered ad libitum. A fixed level of 8 kg/day of concentrates was offered in experiment 1 and 7 kg/day in experiment 2. Total DM intake was significantly greater for EW and 40W than for GS in experiment 7, but not in experiment 2. Milk yield was not significant ly affected by diets (mean 28.8 kg/day in experiment 1 and 29.6 kg/day in experiment 2). Milk fat, protein and lactose contents and yields were also not significantly affected by diets. The additional fetal metabolizable energy (ME) intake of the whole-crop diets compared with GS was partitioned to live weight. There was no evidence of ME intakes being substantially greater than ME requirements as found in previous studies. A 5 X 5 Latin square digestibility experiment was carried out with Holstein-Friesian heifers offered the individual forages used in experiment 2. In take was significantly greater for the urea-treated whole-crop wheat forages than for grass silage and for sodium hydroxide-treated grain and straw. The digestible organic matter in the dry matter (DOMD) of grass silage was 692 g/kg and the whole-crop wheat diets ranged from 626 g/kg for ensiled whole-crop wheat to 682 g/kg for the sodium hydroxide-treated grain plus straw (40:60 ratio), with the DOMD of urea-treated whole-crop being intermediate. The results indicated that whole-crop wheat had higher intake characteristics than grass silage in spite of its lower digestibility. [References: 14].

1889 Lehman, KB.; Okine, EK.; Mathison, GW.; Helm, J. (1995) **IN SITU DEGRADABILITIES OF BARLEY GRAIN CULTIVARS.** *Canadian Journal of Animal Science. 75(3):485-487.* English. [UNIV ALBERTA DEPT AGR FOOD & NUTR SCI EDMONTON AB T6G 2P5 CANADA].

Differences in in situ dry matter degradabilities occurred at all incubation times when 22 cultivars of barley grain grown at three locations were examined. Rapidly and slowly degradable fractions ranged from 25 to 40% and from 49 to 65%, respectively. Rates of degradation ranged from 23 to 35% h(-1) ($P = 0.03$). [References: 9].

1890 Muirhead, S. (1995) **Dehydrated potato byproducts are substitute for barley, corn.** *Feedstuffs (USA) v. 67(17) p. 14, 71.* English. (AGRIS 96-019650).

1891 Nasi, JM.; Helander, EH.; Partanen, KH. (1995) **AVAILABILITY FOR GROWING PIGS OF MINERALS AND PROTEIN OF A HIGH PHYTATE BARLEY-RAPESEED MEAL DIET TREATED WITH ASPERGILLUS NIGER PHYTASE OR SOAKED WITH WHEY.** *Animal Feed Science & Technology. 56(1-2):83-98.* English. [HELSINKI UNIV DEPT ANIM SCI POB 28 SF-00014 HELSINKI FINLAND].

The improvement of phytin-phosphorus utilization in barley-rapeseed meal (800 and 200 g kg(-1)) diet due to Aspergillus niger phytase (EC 3.1.3.8) supplement was assayed in a 8 X 6 cyclic change over designed digestibility and balance trial with eight growing pigs of 28-70 kg live weight. The 2 X 2 X 2 factorially arranged diets were either fortified with dicalcium phosphate to supply total phosphorus (P) 6.7 and available P (aP) 2.8 g kg(-1) or without inorganic P supplement, P 5.3, aP 1.4 g kg(-1); were fed either as soaked with whey at 40 degrees C for 3 h or without soaking; and half the diets were supplemented with phytase 1000 PU g(-1) (Finase(R)FP500). Each diet contained calcium (Ca) 8.0 g kg(-1). Other nutrients were at similar levels in each diet. Soaking of the meal with whey significantly improved ash and organic matter digestibilities ($P < 0.001$). The digestibilities of ash ($P < 0.001$) and ether extract ($P < 0.05$) were

enhanced (2 and 3% units) by phytase treatment, No effect on nitrogen (N) utilization was found due to phytase addition, but soaking significantly improved N retention in relation to N intake. Both the soaking of the diet and addition of microbial phytase significantly improved ($P < 0.01$, $P < 0.001$) the apparent absorption of P (3 and 9% units), The retained P in diets with supplementary phytase was significantly higher ($P < 0.01$) than that without, 3.8 vs. 2.8 g day(-1). The soaking had an enhancing effect on P retention, P retention in relation to intake was greater ($P < 0.001$) in diets with added phytase than without (36 vs, 31%). From the diet with inorganic P supplementation a significantly lower retention value, 29% ($P < 0.001$), was achieved compared with the P-unsupplemented diets. Phytase supplementation did not affect Ca absorption but significantly increased Ca retention due to lower urinary excretion. The soaking had no effect on Ca absorption or retention. Utilization of magnesium and zinc was not affected by the treatments. The results indicate that microbial phytase and soaking with whey improved the utilization of phytate P in barley-rapeseed meal diet and reduced the amount of P excretion in faces. [References: 43].

1892 Ng'ambi, J.W.; Ngosa, M. (1995) **Palatibility as a constraint to voluntary intake of wheat straw and star grass hay by growing goats.** *UNISWA Research Journal (Swaziland) v. 9 p. 64-69.* 5 tables. English. (AGRIS 96-019616).

Two experiments were conducted to evaluate the effect of palitibility on voluntary intake of roughage by growing goats. In the first experiment there was an increase in daily organic matter of wheat straw when molasses was sprayed (0.41kg per goat) as compared to when molasses and straw were offered separately (0.30kg per goat) or when no molasses were offered (0.3kg). Daily digestible organic matter intake increased from 0.31kg to 0.38kg. This represented a 23 per cent increase overall ($P<0.01$). In the second experiment the responses in intake when molasses was sprayed on star grass hay were not considered significant.

1893 Niu, ZY.; Campbell, GL.; Bhatty, RS.; Rossnagel, BG. (1995) **COMPARISON OF CONDOR AND CDC RICHARD HULLESS BARLEYS FOR BROILER CHICKS.** *Canadian Journal of Animal Science. 75(3):489-491.* English. [UNIV SASKATCHEWAN DEPT ANIM SCI & POULTRY SCI 72 CAMPUS DR SASKATOON SK S7N 5B5 CANADA].

Five Condor and five CDC Richard hulless barley samples, representing a range in crude protein (12.4-15.3%), were fed to broiler chicks in D-glucanase-supplemented diets formulated to be moderately limiting in crude protein (18% CP). The barley varieties had comparable mean CP (Condor, 13.8%; CDC Richard, 14.1%) and starch (Condor, 56.4%; CDC Richard, 57.5%), although Condor was somewhat higher in beta-glucan content (3.5 vs. 2.8%; $P < 0.10$). There were no differences ($P > 0.05$) in body weight or feed conversion among chicks fed the two barleys, indicating that protein utilization was similar in broiler chicks fed Condor and those fed CDC Richard hulless barleys. [References: 8].

L51 ANIMAL PHYSIOLOGY-NUTRITION

1894 Boukila, B.; Seoane, JR.; Bernier, JF. (1995) **EFFECTS OF DIETARY HYDROXIDES ON INTAKE, DIGESTION, RUMEN FERMENTATION AND ACID-BASE BALANCE IN SHEEP FED A HIGH-BARLEY DIET.** *Canadian Journal of Animal Science. 75(3):359-369.* English. [UNIV LAVAL FSAA DEPT SCI ANIM CITE UNIV LAVAL PQ G1K 7P4 CANADA].

Eight mature wethers fitted with rumen cannulae were used in a double 4 x 4 Latin square feeding trial to study the effect of dietary alkalis on digestive physiology of sheep fed a high-barley diet. The treatments were: C = control diet composed of 17% alfalfa meal and 83% concentrate, on as-fed basis; CA = control plus 1% Ca(OH)(2); MG = control plus 0.79% Mg(OH)(2); CAMG = control plus 0.5% Ca(OH)(2) and 0.39% Mg(OH)(2). Dry matter intake averaged 1.91, 2.54, 2.79, and 2.72% of BW for diets C, CA, MO and CAMG, respectively ($P < 0.01$). Digestible DM intake was also affected by the treatments and averaged 0.97, 1.26, 1.35 and 1.37 kg d(-1) for C, CA, MG, and CAMG diets, respectively ($P < 0.01$). Apparent DM digestibility was higher in sheep fed the C diet than in those fed the other diets ($P < 0.03$) and it was inversely related to intake ($P < 0.01$). Total VFA concentration was lower in sheep fed C than in those fed the hydroxides ($P < 0.01$). Proportions of individual VFA were not altered by the diet except for isobutyrate which was higher in sheep fed the C diet ($P < 0.01$). Rumen NH3-N concentration was lower in sheep fed the hydroxide-containing diets than in animals fed the control diet ($P < 0.01$). Plasma urea nitrogen was lower for the C diet ($P < 0.01$). Plasma glucose tended to be lower for the C diet than for the other diets ($P < 0.06$). The control diet induced a mild form of systemic acidosis as indicated by the decrease in blood pH, HCO3- and base excess ($P < 0.01$). Addition of Ca(OH)(2) and Mg(OH)(2) to the diet, alone or in combination, improved the systemic acid-base status of sheep and was associated with increased DM intake. [References: 43].

1895 Brancopardal, P.; Lalles, JP.; Formal, M.; Guilloteau, P.; Toullec, R. (1995) **DIGESTION OF WHEAT GLUTEN AND POTATO PROTEIN BY THE PRERUMINANT CALF - DIGESTIBILITY, AMINO ACID COMPOSITION AND IMMUNOREACTIVE PROTEINS IN ILEAL DIGESTA.** *Reproduction, Nutrition, Development. 35(6):639-654.* English. [INRA JEUNE RUMINANT LAB 65 RUE ST BRIEUC F-35042 RENNES FRANCE].

Three milk substitute diets, in which the protein was either provided exclusively by skim milk powder or partially (52%) substituted by a native wheat gluten or a potato protein concentrate, were given to intact or ileo-c ae cal cannulated preruminant calves. The apparent faecal nitrogen digestibility was lower ($P < 0.05$) with the potato than with the gluten and control diets (0.90, 0.93 and 0.95, respectively). The same trend was observed at the ileal level (0.83, 0.87 and 0.91, respectively). Apparent digestibilities of most amino acids were lower with the potato than with the control diet ($P < 0.05$ for glutamic acid, proline, cystine, methionine, isoleucine, leucine, tyrosine and lysine). The same trend was observed with the gluten diet. Apparent digestibilities of glutamic acid and cystine were also lower ($P < 0.05$) with the potato than with the gluten diet. Protein fractions of Mr 43 000 and below 14 000 were detected immunochemically in ileal digesta corresponding to the potato diet, but no immunoreactivity was found in digesta with the gluten diet. However, the considerable enrichment of digesta in glutamic acid and proline with gluten indicates that dietary protein fractions rich in these 2 amino acids escaped digestion in the small intestine. With the potato diet, the undigested fractions contained high levels of aspartic acid, glutamic acid and cystine. [References: 47].

1896 Davis, D.A. (Texas Univ., Port Aransas, TX (USA). Marine Science Inst.); Arnold, C.R. (1995) **Effects of two extrusion processing conditions on the digestibility of four cereal grains for Penaeus vannamei.** *Aquaculture (Netherlands) v. 133(3-4) p. 287-294.* 25 ref. English. (AGRIS 96-020169).

1897 Feng, P.; Hunt, CW.; Pritchard, GT.; Parish, SM. (1995) **EFFECT OF BARLEY VARIETY AND DIETARY BARLEY CONTENT ON DIGESTIVE FUNCTION IN BEEF STEERS FED GRASS HAY-BASED DIETS.** *Journal of Animal Science. 73(11):3476-3484.* English. [UNIV IDAHO DEPT ANIM & VET SCI MOSCOW, ID 83844 USA].

Five ruminally and duodenally cannulated steers were used in a 5 x 5 Latin square design with a 2 x 2 + 1 arrangement of treatments to study the effects of barley variety and dietary barley content on digestive function in steers fed grass hay-based diets. Barley varities evaluated were Russell and Steptoe, which had bulk densities of 67.7 and 64.5 kg/hL, respectively. Supplemental treatments were as follows: corn, low Russell(Ru-lo), low Steptoe (St-lo), high Russell (Ru-hi), and high Steptoe (St-hi). Corn, Ru-lo, and St-lo were provided at 30% (DM basis) of grass hay-based diets, whereas Ru-hi and St-hi were provided at 35.5% of diet DM (equal starch content as the corn treatment). No treatment differences ($P > .10$) were observed for DMI, ruminal particulate passage rate, and NDF total tract digestibility. Ruminal DM and starch digestibility were greater ($P <.01$) for barley-containing diets than for the corn diet. Similarly, total tract DM($P <.10$) and starch($P <.01$) digestibility was greater for barley than for corn diets. Microbial protein and non-NH3 N flow to the small intestine were greater ($P <.01$) for the barley diets than for the corn diet. Starch intake ($P <.01$) and DM digestibility ($P <.10$) were greater for high-than for low-barley diets; however, differences due to barley variety were not observed ($P >.10$). In situ disappearance of grass hay NDF at 8 and 96 h of incubation was greater ($P <.05$) for barley than for corn diets. Rate of in situ disappearance of grain DM was greater ($P <.01$) for barley than for corn

and for Russell than for Steptoe barley. Responses suggest that-ruminal and total tract digestibility and protein flow to the small intestine can be increased with barley compared with corn as an energy supplement to grass hay-based diets. [References: 32].

1898 Lindberg, JE.; Cortova, Z. (1995) **THE EFFECT OF INCREASING INCLUSION OF LUCERNE LEAF MEAL IN A BARLEY-BASED DIET ON THE PARTITION OF DIGESTION AND ON NUTRIENT UTILIZATION IN PIGS.** *Animal Feed Science & Technology. 56(1-2):11-20.* English. [SWEDISH UNIV AGR SCI DEPT ANIM NUTR & MANAGEMENT BOX 7024 S-75007 UPPSALA SWEDEN].

The partition of apparent preileal and postileal digestion of a barley-based diet with increasing inclusion of lucerne leaf meal (LLM; 0, 5, 10 and 20%) was studied in a 4 x 4 change-over experiment with ileal cannulated growing pigs. There was a significant increase in the ileal flow and total tract excretion of nutrients and energy when the inclusion level of LLM was increased. This was more pronounced on the ileal now of dry matter (DM), organic matter (OM) and dietary fibre (DF) than on the total tract flow. With increasing inclusion of LLM in the diet, the ileal and total tract digestibility of DM and OM and energy were significantly reduced while, in contrast, the digestibilities of crude protein and DF were non-significantly affected. The proportion (% of total tract digestibility) of preileal digestibility of LLM was 35, 43, 25 and 41 for DM, OM, DF and energy respectively, while the digestion of CP and crude fat was almost completed at the terminal ileum. There was a significant reduction in the dietary content of digestible and metabolizable energy with increasing inclusion of LLM in the diet. [References: 31].

1899 Mcallister, TA.; Selinger, LB.; Mcmahon, LR.; Bae, HD.; Lysyk, TJ.; Oosting, SJ.; Cheng, KJ. (1995) **INTAKE, DIGESTIBILITY AND AEROBIC STABILITY OF BARLEY SILAGE INOCULATED WITH MIXTURES OF LACTOBACILLUS PLANTARUM AND ENTEROCOCCUS FAECIUM.** *Canadian Journal of Animal Science. 75(3):425-432.* English. [AGR & AGRI FOOD CANADA RES CTR POB 3000 LETHBRIDGE AB T1J 4B1 CANADA].

The effect of ensiling barley treated with two bacterial inoculants containing mixtures of Lactobacillus plantarum and Enterococcus faecium (1.0 x 10(5) cfu g(-1) as fed silage) on the nutritional value and aerobic stability of barley silage was examined. Inoculants differed in the strains they contained and were originally selected by Pioneer Hi-Bred International for use with corn or alfalfa silage, SILA-BAC(R) (1174), or with grass silage (X2637). Concentrations of water-soluble carbohydrates were higher ($P < 0.05$) in inoculated than in control silages. Although inoculants appeared to increase the numbers of lactic acid producing bacteria (LAB) at ensiling, post-ensiling numbers (cfu g(-1)) of yeasts and molds were lower ($P < 0.05$) in inoculated than in control silages. Lactic acid concentrations and pH were similar among the silages and variations in the growth of yeast and mold populations could not be explained by differences in the production of volatile fatty acids (VFA) among silages. Inoculation of barley silage with either inoculant increased ($P < 0.01$) the average daily gain of lambs. A digestibility experiment with 12 growing ram lambs showed that inoculants did not alter ($P > 0.05$) DM intake, feed efficiency or the digestion of DM, organic matter, acid detergent fiber (ADF) and neutral detergent fiber (NDF). Nitrogen intake and retention were greater ($P < 0.05$) in lambs fed silage inoculated with 1174 as compared with control silage. Yeast populations were increased ($P < 0.05$) in control and 1174 after 2 d of exposure to air but it required 13 d for a similar yeast population to be established in X2637 silage. Increases in the mold populations within the silages were noted after 2, 5 and 13 d of exposure to air for control, 1174 and X2637, respectively. The temperature of control silage increased ($P < 0.05$) 2 d after exposure to air, whereas increases in temperature were delayed for 4 d in 1174 and 8 d in X2637. Temperatures rose as high as 30 degrees C in control silage, but did not exceed 24 degrees C in inoculated silages during the 13 d period. [References: 45].

1900 Miron, J.; Solomon, R.; Bruckental, I.; Benghedalia, D. (1996) **EFFECT OF CHANGING THE PROPORTION, WHEAT SORGHUM IN DAIRY COW RATIONS ON CARBOHYDRATE DIGESTIBILITY AND NAN FLOW TO THE INTESTINE.** *Animal Feed Science & Technology. 57(1-2):75-86.* English. [AGR RES ORG VOLCANI CTR INST ANIM SCI POB 6 IL-50250 BET DAGAN ISRAEL].

Five rumen- and abomasum-cannulated cows in mid-lactation were fed ad libitum, for two periods of 21 d each, two isonitrogenous (17% crude protein) total mixed rations (TMR) composed of 45% sorghum-wheat combination, 38% corn silage, 12% soybean meal, urea, buffers and minerals. The two TMRs differed in their sorghum (S): wheat (W) ratio, which was 70/30 in S and 30/70 in W treatments. Dry matter intake was 17.2 and 16.6 kg d(-1) in S and W, respectively. Effect of treatments on the digestibility df carbohydrate constituents and N metabolism was examined. Neutral detergent fiber (NDF)-polysaccharides digestibility in stomachs and the entire gastrointestinal tract (GIT) was significantly higher in S than in W. The digestibility of neutral detergent soluble (NDS)-alpha-glucans was significantly higher in W than in S. More of NDS-alpha-glucans escaping ruminal fermentation was digested in the intestine of the S cows as compared with the W cows. The digestibility in entire GIT of total NDS-monosaccharide residues was 93% in W and 86% in S. Digestibility values of total carbohydrates in stomachs (49% and 52%) and entire GIT (79% and 80%) of S and W cows were similar. S and W cows were similar in rumen pH (6.15 and 6.13), rumen volatile fatty acids concentrations (133 and 136 mM) and rumen NH, concentration (21 and 23 mg per 100 mi). Non-ammonia-N flow through the abomasum (410 and 403 g d(-1)) and N absorption in the intestine (67%) were also similar in S and W. [References: 30].

1901 Tani, H.; Ohishi, H.; Watanabe, K. (1995) **WHEAT FLOUR LIPASE INHIBITOR DECREASES SERUM LIPID LEVELS IN MALE RATS.** *Journal of Nutritional Science & Vitaminology. 41(6):699-706.* English. [KYODO MILK IND CO LTD FUNDAMENTAL RES LAB NISHITAMA TOKYO 19001 JAPAN].

Triacylglycerol is digested and absorbed primarily through the action of lipase in the lingual and pancreatic juices. We used a wheat flour-derived lipase inhibitor to inhibit triacylglycerol absorption from the intestinal tract, and studied the effect on serum lipid concentration. Rats were given free access to high fat diets containing the lipase inhibitor at 0 (control), 0.05, 0.1 and 0.2% levels for 3 weeks, and their serum triacylglycerol, total cholesterol, and HDL-cholesterol concentrations were measured at weeks 1, 2 and 3. The measured values were significantly lower in the groups receiving the lipase inhibitor than in the control group. The degree of decrease in these respects was roughly dose-dependent. Additionally, the inhibitor intake raised the fecal lipid excretion and lowered the hepatic cholesterol level. It was, therefore, assumed that the inhibition of lipase in the digestive tract interfered with lipolysis and thereby with cholesterol absorption. [References: 21].

N20 AGRICULTURAL MACHINERY AND EQUIPMENT

1902 Neale, M.; Williams, P. (Silsoe Research Institute, Wrest Park, Silsoe MK45 4HS (United Kingdom)) (1993) **A survey of wheat straw swaths and the implications for in-field straw processing equipment.** *Agricultural Engineer (United Kingdom) v. 48(3) p. 72-74.* 4 ref. English. (AGRIS 96-010151).

P01 NATURE CONSERVATION AND LAND RESOURCES

1903 Zaman, A.; Choudhuri, SK. (1995) **WATER USE AND YIELD OF WHEAT UNDER UNMULCHED AND MULCHED CONDITIONS IN LATERITE SOIL OF THE INDIAN SUB-CONTINENT.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(5):349-353.* English. [BIDHAN CHANDRA KRISHI VISWAVIDYALAYA FAC AGR DEPT AGRON B-4-220 KALYAN 741235 W BENGAL INDIA].

A field experiment was conducted during three winter seasons on West Bengal laterite soil to study the effect of irrigation and paddy straw mulch on water consumption. Water use efficiency and yield of wheat are reported. Both irrigation and mulch increased wheat yield significantly; there was also significant interaction between irrigation and straw mulch application: three irrigations combined with mulch resulted in 21.6 q ha(-1)

wheat grain yield compared with 17.5 q ha(-1) for three irrigations without mulch. Mulch consistently increased irrigation response. Both irrigation and mulch increased water consumption and water use efficiency of the wheat crop. To compare the two irrigation treatments, irrigation at crown root initiation followed up by at flowering stage gave higher values of water use efficiency as well as higher grain yield than that of irrigation applied at panicle stage followed by at crown root initiation. [References: 6].

P10 WATER RESOURCES AND MANAGEMENT

1904 Everall, NC.; Lees, DR. (1996) **THE USE OF BARLEY-STRAW TO CONTROL GENERAL AND BLUE-GREEN ALGAL GROWTH IN A DERBYSHIRE RESERVOIR.** *Water Research. 30(2):269-276.* English. [SEVERN TRENT WATER LTD QUAL & ENVIRONM SERV 43 DIMPLE RD MATLOCK DE4 3LQ DERBY ENGLAND].

The presence of rotting barley-straw al approximately 50 g m(-3) in a disused water supply reservoir appeared to significantly reduce both the general phytoplankton productivity and the cyanobacterial dominance. Algal control mechanisms were not implemented via nutrient removal but appeared in part biological by encouraging phytoplankton grazing organisms and mainly chemical by releasing relevant levels of known phytotoxic compounds near to the decomposing straw. No short term deleterious environmental impact was recorded in the receiving watercourses. Preliminary chemical characterisation of straw leachate is discussed with respect to known phytotoxic agents from the limited toxicological literature. [References: 34].

P30 SOIL SCIENCE AND MANAGEMENT

1905 Elliott, LF.; Saxton, KE.; Papendick, RI. (1995) **THE EFFECT OF RESIDUE MANAGEMENT AND PARATILLAGE ON SOIL WATER CONSERVATION AND SPYING BARLEY YIELDS.** *Journal of Soil & Water Conservation. 50(6):656-658.* English. [NATL FORAGE SEED PROD RES CTR CORVALLIS, OR 97331 USA].

Summer fallowing wastes water, energy, and soil. Summer fallowing is practiced because it often increases or stabilizes cereal grain yield in low-rainfall climates. The effect of crop reside management and paratillage (Paraplow tillage) on water storage was determined in a summer fallow 35 cm (13.8 in) precipitation zone to assess feasibility for annual cropping. Paratillage and crop residues significantly increased overwinter water storage. Averaged over the three residue treatments, four replications, and 3 years, paratillage increased the overwinter soil water storage by 8.2 +/- 4.3 cm (3.2 +/- 1.9 in) over that not paratilled. Similarly, averaged over the two tillages, the standing residue increased the overwinter soil water storage 1.0 +/- 3.7 cm (0.4 +/- 1.4 in) over the chopped stubble and 6.3 +/- 3.0 nn (2.5 +/- 1.2 in) over the burned stubble. The increased water storage did not result in significant increases in barley yields in these study plots. The increased water storage of these practices over an entire field may allow economic annual cropping in some cares. [References: 12].

1906 Johansen, A.; Jensen, ES. (1996) **TRANSFER OF N AND P FROM INTACT OR DECOMPOSING ROOTS OF PEA TO BARLEY INTERCONNECTED BY AN ARBUSCULAR MYCORRHIZAL FUNGUS.** *Soil Biology & Biochemistry. 28(1):73-81.* English. [RISO NATL LAB DEPT ENVIRONM SCI & TECHNOL POB 49 DK-4000 ROSKILDE DENMARK].

The role of arbuscular mycorrhizas in the transfer of N and P between pea (Pisum sativum L.) and barley (Hordeum vulgare L.) plants was studied in a controlled environment. The plants were grown together in PVC containers, either in symbiosis with Glomus intraradices Schenck and Smith or as non-mycorrhizal controls, and with their root systems separated by an intermediate buffer zone (2 cm), confined by fine nylon mesh. The pea donor plants were supplied simultaneously with N-15 and P-32, using a split-root labelling technique, in order to follow the flow of N and P to the barley receiver plants during 60 d of growth. In half of the containers, the donor-plant shoot was removed 42 d after the start of labelling and the roots were left in the soil to decompose. The reverse transfer of N and P, from barley donor to pea receiver plants was also measured to allow calculation of the net transfer through hyphae between mycorrhizal donor and receiver plants. No significant transfer of N was detected from intact pea donor plants to the barley receiver plants in the non-mycorrhizal controls. Mycorrhizal colonization slightly increased the transfer of N. However, the net transfer of N was almost insignificant since N was also transferred in the reverse direction, from barley to pea. Removal of the pea donor-plant shoots increased the N transfer to 4% of the donor-root N in the non-mycorrhizal controls. Contrastingly, 15% of the donor-root N was transferred to the receiver plants, when plants were colonized by G, intraradices. The results for P transfer followed the same patterns as was observed for N, although in smaller proportions. The results indicate that arbuscular mycorrhizas may play a significant role in the flow of N and P between two plants interconnected by hyphae, when the root system of one of the plants is decomposing. [References: 37].

1907 Khan, MJ.; Glenn, EP. (1996) **YIELD AND EVAPOTRANSPIRATION OF TWO BARLEY VARIETIES AS AFFECTED BY SODIUM CHLORIDE SALINITY AND LEACHING FRACTION IN LYSIMETER TANKS.** *Communications in Soil Science & Plant Analysis. 27(1-2):157-177.* English. [ENVIRONM RES LAB 2601 E AIRPORT DR TUCSON, AZ 85706 USA].

Two barley varieties (California Mariout and Gustoe), differing in putative salt tolerance, were grown in lysimeter tanks containing 1 m(3) of sandy loam soil in a greenhouse experiment in Tucson, Arizona. The varieties were subjected to three salinity treatments (0, 150, and 250 mol/m(3) NaCl) and two leaching fractions (LF) (0.2 and 0.4). Mariout, a reportedly salt-tolerant, high straw variety, yielded more grain and biomass than the semi-dwarf variety, Gustoe, across salinity treatments, but slopes of growth responses to salinity were similar. Mariout grain yields on control solution were the equivalent of 4.8-5.3 t/ha, similar to good open field yields of this variety. Gustoe yields were lower, 3.5-4.1 t/ha. Salinity reduced Mariout yields to 4 t/ha on 150 mol/m(3) and this was judged to be the highest irrigation salinity which will produce economic yields of this variety. The saturated soil extract (ECe) in the loot zone at this salinity was 11.8 dS/m. For both varieties, biomass and grain yields were reduced by 2.4-3.1% for each 1 dS/m increase in ECe, and ECe's producing 50% yield reduction of biomass or grain ranged from 17-21 dS/m. Increasing the LF increased biomass and grain production by both varieties, especially on 150 mol/m(3) treatment, but did not reduce ECe as much as expected. Adding additional water as a LF increased the amount of evapotranspiration rather than reducing ECe. [References: 25].

P33 SOIL CHEMISTRY AND PHYSICS

1908 Alakukku, L.; Elonen, P. (1995) **LONG-TERM EFFECTS OF A SINGLE COMPACTION BY HEAVY FIELD TRAFFIC ON YIELD AND NITROGEN UPTAKE OF ANNUAL CROPS.** *Soil & Tillage Research. 36(3-4):141-152.* English. [AGR RES CTR INST CROP & SOIL SCI SF-31600 JOKIOINEN FINLAND].

The long-term effects of soil compaction by heavy traffic on crop growth were examined in field experiments on a heavy clay (Vertic Cambisol) and an organic soil (Mollic Gleysol). There were three treatments: one pass and four repeated passes with a tandem axle load of 16 Mg, with wheel tracks completely covering the plot area, and a control without experimental traffic. Both loadings compacted the soils to a depth of 0.4-0.5 m. For 9 years after the loading, spring cereals (oats, wheat and barley) were the main crops grown. Yield, moisture content at harvest, thousand-kernel and bulk weight and nitrogen uptake of crops were determined each year. Although lodging of crops in the control and sometimes also in the treatment with one pass complicated the interpretation of results, especially for the organic soil, compaction clearly did affect crop production, For several years after the loading, it decreased yields and nitrogen uptake of crops and lowered seed moisture contents at harvest. Effects of the compaction were especially marked on the clay soil in the first 3 years and the rainy sixth year. Taken as a mean of the first 8 years, compaction of the clay soil with four passes reduced the yields by 4% and nitrogen uptake of annual crops by 9%. Compaction of the organic soil with four passes decreased the yield by 1% and nitrogen yield by 4%, as a mean of the first 5 and the last 3 years, The bulk weight or the thousand-kernel weight of yields was not notably affected by the compaction. [References: 37].

1909 Barakah, FN.; Salem, SH.; Heggo, AM.; Binshiha, MA. (1995) **ACTIVITIES OF RHIZOSPHERE MICROORGANISMS AS AFFECTED BY APPLICATION OF ORGANIC AMENDMENTS IN A CALCAREOUS LOAMY SOIL .2. NITROGEN TRANSFORMATIONS.** *Arid Soil Research & Rehabilitation. 9(4):467-480.* English. [KING SAUD UNIV COLL AGR DEPT SOIL SCI POB 2460 RIYADH 11451 SAUDI ARABIA].

The activities of some nitrogen transforming microorganisms in the rhizosphere of both alfalfa and wheat growing in a calcareous loamy soil of Saudi Arabia as affected by organic amendments have been studied in a greenhouse experiment. The organic amendments were sludge (narrow C/N ratio) and wheat straw (wide C/N ratio), applied at 2% w/w to the soil. The asymbiotic nitrogen fixers, either aerobic or anaerobic, as well as the nitrifying bacteria, were determined in the rhizosphere and nonrhizosphere soils periodically for 7 weeks. Total nitrogen, organic carbon, ammonium, and nitrate nitrogen were determined in the same samples. Results showed that treatment of the calcareous loamy soil with organic amendments significantly enhanced the microbial population transforming nitrogen (asymbiotic N-2 fixers and nitrifying bacteria) in the rhizosphere and nonrhizosphere soils of both plants with high values for the former during most of the experimental periods. However, the rhizosphere effect was not obvious in the case of Azotobacter densities. The highest stimulative effect for the asymbiotic N-2 fixers and nitrifying bacteria was observed in the soil amended with sludge, especially in the early periods of plant growth. Also, the microbial numbers were more influenced by their proximity to the alfalfa roots than to wheat roots. Total nitrogen in the rhizosphere and nonrhizosphere soils of alfalfa and wheat significantly increased with application of organic amendments. The increase was especially evident in the rhizosphere region. Ammonium nitrogen values in the soils amended with organic matter were higher in the root regions of both plants than in unamended soil, indicating a high ammonification rate for the former by heterotrophic microorganisms. Amendment of soil with 2% sludge (narrow C/N ratio) enhanced the mineralization of organic nitrogen and nitrification processes. Amendment of soil with straw (wide C/N ratio) increased immobilization of mineral nitrogen. Using the sewage sludge (2% w/w) as an organic amendment to the loamy soil did not retard the proliferation and activities of the asymbiotic N-2 fixers and nitrifying bacteria in the soil but enhanced the processes.

1910 Dao, TH. (1995) **SUBSURFACE MOBILITY OF METRIBUZIN AS AFFECTED BY CROP RESIDUE PLACEMENT AND TILLAGE METHOD.** *Journal of Environmental Quality. 24(6):1193-1198.* English. [USDA ARS POB 1199 EL RENO, OK 73036 USA].

The role of crop residues as a sorptive layer for herbicides applied in conservation tillage systems is not well understood. The organic mulch may retain herbicides and decrease chemical mobility and off-site transport. Field and laboratory experiments were conducted to determine the effects of surface placement of crop residues on herbicide mobility in Norge silt loam (fine-silty, mixed, mesic Udic Paleustoll). In the field, four treatments were established that included no-till plots with all crop residues removed (NTRR), residues left standing (NTRS), residues cut and laid Bat on ground (NTRF), and plots that were moldboard plowed to incorporate residues (MT). An application of 1.15 kg ha(-1) of metribuzin [4-amino-6-(1, 1-dimethylethyl)-3-(methylthio)-1, 2, 4-triazine-5(4H)-one] and 50 kg ha(-1) of potassium bromide was made. Soil cores were taken to 1-m depth following an initial sprinkler irrigation and natural rainfalls. Wheat residues intercepted metribuzin and attenuated subsurface movement in NT soils. Standing crop residues or residues placed Bat on the soil surface resulted in more metribuzin in the near-surface zone; centers of mass of concentration distributions in NTRS and NTRF soils showed that metribuzin moved only 47 to 62% of the distance observed in MT soil after 45 and 175 mm of precipitation, respectively. Addition of straw matter to soil and elevated organic C concentrations in the near-surface zone of no-till soils resulted in two- to fivefold increase in metribuzin retention. Therefore, placement geometry of crop residues and the retention capacity of the near-surface zone could be managed to attenuate metribuzin mobility in the field to achieve optimal herbicidal functions and dissipation. [References: 28].

1911 Hojberg, O.; Binnerup, SJ.; Sorensen, J. (1996) **POTENTIAL RATES OF AMMONIUM OXIDATION, NITRITE OXIDATION, NITRATE REDUCTION AND DENITRIFICATION IN THE YOUNG BARLEY RHIZOSPHERE.** *Soil Biology & Biochemistry. 28(1):47-54.* English. [ROYAL VET & AGR UNIV DEPT ECOL & MOLEC BIOL MICROBIOL SECT ROLIGHEDSVEJ 21 DK-1958 FREDERIKSBERG C DENMARK].

Potential activities (enzyme contents) of ammonium (NH4+) oxidizing, nitrite (NO2-) oxidizing, nitrate (NO3-) reducing and denitrifying bacteria were measured in bulk and rhizosphere soil obtained from young barley plants in the field. The activities as well as pools of inorganic N (NH4+, NO2- and NO3-) were followed for 3 weeks in the beginning of the growth season (May-June). During the 3 weeks two separate periods of rain gave dramatic changes in soil water content. A rainfall in the beginning of the sampling period, resulting in a short-term wetting of the soil, stimulated the potential nitrification in the rhizosphere. On the other hand, potential denitrification only responded positively to the second, longer wetting of the soil. The potential activities were not affected by changes in the pools of inorganic N. As judged from the potential activities (enzyme contents), both groups of nitrifiers, NO3- reducer, and denitrifiers seemed most abundant in the rhizosphere, where the activities were from 1.5 to 2.5 times higher than in the bulk soil. NH4+ oxidizers and NO2- oxidizers showed a distinct and similar trend throughout the sampling period, which was also the case for NO3- reducers and denitrifiers. The results indicate that potential activities (enzyme contents) in the four bacterial groups were less dependent on their inorganic N substrates in the bulk and rhizosphere soils, but showed distinct and different responses to duration of soil wetting after rainfall. [References: 32].

1912 Hountin, JA.; Karam, A.; Parent, LE.; Isfan, D. (1995) **EFFECT OF PEAT MOSS-SHRIMP WASTES COMPOST ON THE GROWTH OF BARLEY (HORDEUM VULGARE L) ON A LOAMY SAND SOIL.** *Communications in Soil Science & Plant Analysis. 26(19-20):3275-3289.* English. [UNIV LAVAL DEPT SOIL SCI EQUIPE RECH SOLS AGRICOLES & MINIERS PAVILLON PAUL COMTOIS QUEBEC CITY PQ G1K 7P4 CANADA].

A greenhouse experiment was conducted to determine the effect of peat moss-shrimp wastes compost on barley (Hordeum vulgare L.) grown on a limed loamy sand soil. A control, four rates of compost applied alone and in combination with three rates of nitrogen, phosphorus, and potassium (NPK) chemical fertilizer were evaluated. Applications of compost to limed soil substantially enhanced the growth of barley over the control. When considering all treatments, the main effect of compost rates on straw yield, numbers of tillers, plant height, and number of ears was more important than that of fertilizer. A significant interaction on barley growth parameter values was obtained with compost and fertilizer rates. A combination of moderate application of compost and fertilizer gave in some instances, more yield than compost or fertilizer applied alone. Nutrient content of barley increased with rate of compost applied to soil over the control. A significant relationship was found between soil organic carbon (C) and straw yield, number of tillers, plant height and number of ears whereas grain yield was correlated with soil total N. Results from this study indicate that peat moss-shrimp wastes compost could represent a potential means of renovating low fertility sand soils. [References: 25].

1913 Lee, H.S.; Ku, J.H. (Seoul National University, Suwon (Korea Republic). College of Agriculture and Life Science) (1995) **Effect of water table depth in different soil texture on quality of barley and wheat grain.** *Korean Journal of Crop Science (Korea Republic) v. 40(3) p. 278-284.* 2 ill.; 2 tables; 16 ref. Korean. (AGRIS 96-022440).

1914 Park, M.E. (Rural Development Administration, Suwon (Korea Republic). Agricultural Science and Technology Institute) (1995) **The effect of soil moisture stress on the growth of barley and grain quality.** *Journal of Korean Society of Soil Science and Fertilizer (Korea Republic) v. 28(2) p. 165-175.* 3 illus.; 8 tables; 15 ref. Korean. (AGRIS 96-010656).

1915 Sharma, PK.; Verma, TS.; Bhagat, RM. (1995) **SOIL STRUCTURAL IMPROVEMENTS WITH THE ADDITION OF LANTANA CAMARA BIOMASS IN RICE-WHEAT CROPPING.** *Soil Use & Management.*

11(4):199-203. English. [HIMACHAL PRADESH AGR UNIV DEPT SOIL SCI PALAMPUR 176062 HIMACHAL PRADES INDIA].

A long-term field experiment was initiated in June 1988 in a silty clay loam soil to investigate the potential of Lantana camara, an obnoxious weed, for improving structural properties and productivity of soil in rice-wheat cropping. Lantana was incorporated into the soil 10-15 days before puddling at 10, 20 and 30 t/ha (fresh weight). At the end of the sixth cropping season, Lantana additions increased the organic carbon (OC) of the 0-15 cm soil layer by 11-24%, and of water-stable aggregates (WSA, 0.50-8.0 mm diameter) by 10-21%; OC of WSA < 0.50 mm diameter remained unaffected. About 17-25% of the applied OC was retained in the soil. The OC increase resulted in a decrease in bulk density of the plough layer (0-15 cm) by 7%, a decrease in aggregates of 2-8 mm diameter and of clods by 4% and 6%, respectively. There was an increase in water-stable aggregates and aggregate porosity, and a decrease in clod-breaking strength from 420 to 216 kPa. Soil cracking at the surface changed from wide, deep cracks in hexagonal pattern to a close-spaced network of fine cracks. Lantana additions increased < 5 mm wide cracks at the expense of 10-20 mm wide cracks; 5-10 mm wide cracks remained unchanged. Total volume of cracks decreased by 36% and surface area of cracks by 55% compared with the control plots. [References: 16].

P34 SOIL BIOLOGY

1916 Abdel Wahab, S.M.; Hassan, M.E. (Soils and Water Research Institute, Minia (Egypt)); Elwarraky, K. (Field Crop Research Institute, Minia (Egypt)); Safwat, M.S.A. (Minia University, Minia (Egypt). Faculty of Agriculture) (1994) **Evaluation of symbiotic N fixation of Faba bean, Chickpea and Lentil as affected by phosphorus fertilization.** African Crop Science Conference; Kampala (Uganda); 14-18 Jun 1993. *African Crop Science Conference Proceedings (Uganda) v. 1(1) p. 71-73.* 12 ref. English. (AGRIS 96-010772).

1917 Bostrom, U. (1995) **EARTHWORM POPULATIONS (LUMBRICIDAE) IN PLOUGHED AND UNDISTURBED LEYS.** *Soil & Tillage Research. 35(3):125-133.* English. [SWEDISH UNIV AGR SCI DEPT CROP PROTECT SCI BOX 7043 S-75007 UPPSALA SWEDEN].

The extent of earthworm injury caused by rotary cultivation followed by ploughing of a meadow fescue and a lucerne ley was estimated. For comparison, parts of the leys were left undisturbed. One year later, earthworm biomasses in the ploughed leys and the undisturbed leys were estimated, The ploughed plots were under barley at the time. Rotary cultivation killed 61-68% of the earthworm biomass. The ploughing that followed increased the mortality by a further estimated 12% and 9% of the original biomass in the meadow fescue and lucerne leys, respectively. One year later, earthworm abundance in the ploughed treatments was similar to that in the undisturbed lucerne ley, while it was lower in the undisturbed meadow fescue ley. The difference in earthworm biomass between the leys was probably due to inferior food quality and drier soil conditions in the grass ley. More large adults of Aporrectodea caliginosa Sav. were found in the ploughed treatments than in the undisturbed leys, and this species also constituted a greater part of the earthworm biomass in the former compared with the latter (i.e. 85% and 60%, respectively). The biomasses of Lumbricus rubellus Hoffm. and juvenile Lumbricus terrestris L. were significantly greater ($P < 0.05$) in undisturbed lucerne than in meadow fescue. [References: 31].

1918 Elshanshoury, AR. (1995) **INTERACTIONS OF AZOTOBACTER CHROOCOCCUM, AZOSPIRILLUM BRASILENSE AND STREPTOMYCES *MUTABILIS*, IN RELATION TO THEIR EFFECT ON WHEAT DEVELOPMENT.** *Journal of Agronomy & Crop Science-Zeitschrift fur Acker und Pflanzenbau. 175(2):119-127.* English. [TANTA UNIV FAC SCI DEPT BOT TANTA EGYPT].

Single or dual inoculation of wheat seedlings (Triticum aestivum L. cv. Sakha 69) with Azotobacter chroococcum, Azospirillum brasilense or Streptomyces mutabilis in sterilized soil resulted in significant stimulation of their populations in the rhizosphere, compared with the initial values. Viable counts of Azospirillum and Azotobacter decreased in dual inoculations with Azotobacter or Streptomyces, and contrasted with those of Streptomyces, compared with the results of single inoculation. Single and dual inoculations stimulated plant growth, significantly increased the concentrations of indole-3-acetic acid (IAA), P, Mg, N and total soluble sugars (TSS) in wheat shoots. Soil content of N increased by single inoculation with Azotobacter and all dual inoculations. Soil-IAA significantly increased by all inoculations. Growth of A. brasilense significantly inhibited by filtrates from 7-day-old cultures of S. mutabilis than from A. chroococcum, in vitro. The biosynthesis of antibacterial substance(s) by Azotobacter significantly decreased by supplementing their cultures with metabolic products from A. brasilense, bur were stimulated by metabolic products from Streptomyces cultures. All metabolic products significantly decreased the growth of A. chroococcum, A. brasilense and S. mutabilis, nitrogen-fixation and biosynthesis of IAA in A. chroococcum, whereas biosynthesis of IAA stimulated in S. mutabilis. Most of the measured parameters after exposure to the tested bacteria or their metabolites were significantly correlated. The significance of IAA, nitrogen fixation and antibacterial substances, produced by such agronomically beneficial bacteria in early wheat growth is discussed. [References: 45].

1919 Hetrick, BAD.; Wilson, GWT.; Todd, TC. (1996) **MYCORRHIZAL RESPONSE IN WHEAT CULTIVARS - RELATIONSHIP TO PHOSPHORUS.** *Canadian Journal of Botany-Revue Canadienne de Botanique. 74(1):19-25.* English. [KANSAS STATE UNIV DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

The effect of five mycorrhizal fungi on the growth of 10 wheat cultivars under three phosphorus regimes was assessed in a greenhouse study. Six of the cultivars responded positively, while four responded negatively or were nonresponsive to mycorrhizal inoculation. The responses of the individual cultivars were consistent regardless of inoculum source, suggesting that mycorrhizal responsiveness is an inherited trait rather than a response to individual fungi. Mycorrhizal responsiveness decreased with P fertilization for cultivars that were dependent on the symbiosis, but it was unaffected by P fertilization in cultivars that were negatively impacted by the mycorrhizae. Mycorrhizal and P responsiveness of each cultivar were highly correlated ($r = 0.94$), suggesting that P responsiveness may be a good predictor of the mycorrhizal dependence of selected wheat cultivars. The relationship between wheat biomass production and percentage root colonization was positive for cultivars, which responded favorably to the symbiosis, and negative for cultivars, which responded negatively or were nonresponsive to mycorrhizal inoculation. Amendment with P did not significantly affect these relationships. To determine whether differences in mycorrhizal responsiveness are related to nutrient uptake by the fungus, P-32 uptake of Turkey (responsive cultivar) and Newton (nonresponsive cultivar) was controlled by severing the mycorrhizal hyphae in a split-pot experiment. Plants with intact hyphae absorbed more P-32 than those with severed hyphae for both cultivars, and significantly more counts per minute of P-32 were evident in Newton than in Turkey, suggesting that mycorrhizal function is not impaired even in cultivars that do not display a biomass increase in response to mycorrhizal symbiosis. [References: 22].

1920 Hoffman, CA.; Carroll, CR. (1995) **CAN WE SUSTAIN THE BIOLOGICAL BASIS OF AGRICULTURE [Review].** *Annual Review of Ecology & Systematics. 26:69-92.* English. [UNIV GEORGIA INST ECOL ATHENS, GA 30602 USA].

Large areas of the tropics are inherently marginal for general agriculture, and inappropriate management is decreasing productivity on even high-quality soils. For improving the biological basis of long-term agriculture sustainability, especially on marginal lands with low fertility and depleted soil organic matter, we must improve management practices. These practices include increasing soil organic matter and water-stable aggregates by using cover crops during fallow, finding better matches between crops and local environment, enhancing microbial activities in the rhizosphere, and selecting for more beneficial VA mycorrhizal species and better crop-VAM matches. New crop varieties, including transgenic crops, with improved pest and disease resistances and improved root characteristics to increase the beneficial interactions in the rhizosphere could increase productivity with low environmental cost. Analysis of environmental risks associated with release of transgenic plant, including

possible risks from hybridization with wild relatives, must be considered as part of any implementation plan. [References: 128].

1921 Howard, PJA.; Robinson, CH. (1995) **THE USE OF CORRESPONDENCE ANALYSIS IN STUDIES OF SUCCESSIONS OF SOIL ORGANISMS.** *Pedobiologia. 39(6):518-527.* English. [INST TERR ECOL MERLEWOOD RES STN GRANGE OVER SANDS LA11 6JU CUMBRIA ENGLAND].

Classical correspondence analysis is a valuable method for analysing interrelationships between counts of organisms and habitats or substrata. We illustrate the method with an analysis of counts of 21 species of litter-decomposing fungi recorded from washed particles of straw (Triticum aestivum L. cv. Slejpner) internodes and leaves plated in modified Czapek-Dox agar. In addition to providing graphical displays of the relationships between species, between substrates, and the interrelationships between species and substrates, the method also provides decompositions of inertia which are necessary for the interpretation of the graphical displays. Here, the data matrix is sufficiently small to allow the results of the analysis to be understood in relation to the original counts, so that larger matrices may be analysed with confidence. The results showed that only 9 of the 21 species isolated from particles of straw plated into modified Czapek-Dox medium and, in a parallel but undocumented study, 8 out of 23 species from particles plated into lignin agar medium, made major contributions to the two fungal communities. The ordination charts illustrate well the relationships between species and substrata, and the decompositions of inertia enable the 'casual' species and those which make major contributions to be identified. For example, for the modified Czapek-Dox medium, axis 2 separates the initial (March) leaves with Cladosporium sp. and Epicoccum nigrum from March internodes with Fusarium sp. and Cladorhinum foecundissimum. Axis 1 separates these two substrata/species groups from the rest. Axis 3 separates the decomposition systems March, May, and July internodes from the sequence March, May, July leaves. Only Phoma sp. seems to be associated strongly with May internodes, and no species is associated strongly with July internodes or with May or July leaves on this axis. Axis 4 separates May leaves with Trichoderma sp., Humicola grisea, and Geomyces pannorum? from Phoma sp. and Chaetomium murorum. [References: 22].

1922 Jensen, ES. (1996) **RHIZODEPOSITION OF N BY PEA AND BARLEY AND ITS EFFECT ON SOIL N DYNAMICS.** *Soil Biology & Biochemistry. 28(1):65-71.* English. [RISO NATL LAB DEPT ENVIRONM SCI & TECHNOL POB 49 DK-4000 ROSKILDE DENMARK].

Rhizodeposition of N during plant growth influences the microbial activity in the rhizosphere and constitutes a source of labile organic N, but has not been quantified to the same degree as the rhizodeposition of C. The rhizodeposition of N, defined as root-derived N present in the soil after removal of visible roots and root fragments, was determined during field pea (Pisum sativum L.) and spring barley (Hordeum vulgare L.) growth in a sandy soil at a low concentration of mineral N using a continuous split-root N-15-labelling technique. The N rhizodeposition constituted 15 and 48% of the below-ground N in pea when determined 7 and 14 (maturity) wk after planting (WAP), respectively. In barley 32 and 71% of the below-ground N were present in rhizodeposits at the two samplings. At maturity the rhizodeposition of N amounted to 19 mg N plant(-1) (7% of total plant N) for pea and 17 mg N plant(-1) (20% of total plant N) for barley. Incubation of soils, after removal of roots, showed that the N rhizodeposits were labile; 79% of the pea and 48% of the barley root-derived N present in soil at 7 WAP were mineralizable. The root-derived N present in soil at maturity was less labile, since only 30 and 23% of the N rhizodeposition from pea and barley, respectively, were mineralized upon incubation. The mineralization of N in soils was studied during 3 months after harvest of plants at maturity with roots in situ and was found to be greater after pea than after barley. This was due to differences in the net mineralization of N from roots and rhizodeposits, which was greater after pea than after barley. Rhizodeposits and roots contributed 35% of the N mineralized after pea and 12% of the N mineralized after barley. After removing roots and root fragments from the soil the total net mineralization of N was similar in soil previously grown to pea and barley. [References: 34].

1923 Lopezfando, C.; Bello, A. (1995) **VARIABILITY IN SOIL NEMATODE POPULATIONS DUE TO TILLAGE AND CROP ROTATION IN SEMI-ARID MEDITERRANEAN AGROSYSTEMS.** *Soil & Tillage Research. 36(1-2):59-72.* English. [CSIC CTR CIENCIAS MEDIOAMBIENTALES SERRANO 115 DPDO E-28006 MADRID SPAIN].

The soil nematode fauna was assessed as a potential ecological index for the progressive stages of degradation, as well as the possibilities of restoration of a Calcic Haploxeralf in a semi-arid environment in Spain. With this aim in mind, soil characteristics and nematode populations were compared in a virgin ecosystem (evergreen oak forest) and in a closely associated area subjected to intensive cereal cultivation. In addition, in the latter area, the effects of different tillage systems, local soil compaction and crop rotations were evaluated over a 3 year period. Nematode populations were compared in experimental plots subjected to three contrasted situations: (i) no-tillage versus conventional tillage, (ii) soil compacted by tractor traffic versus undisturbed by traffic, and (iii) barley monoculture versus barley-vetch or barley-sunflower rotations. The soil with a virgin ecosystem had the greatest number and diversity of fungivorous (Tylenchus) and omnivorous predator (mononchids and dorilaimids) nematodes, whereas the values for endoparasites (Heterodera avenae and Pratylenchus) nematodes increased in tilled soil. The population of bacterial-feeding nematodes (rhabditids) was the same in virgin and cultivated areas. The greatest density and diversity in the no-tillage system occurred in the bacterial-feeding, fungivorous and omnivorous predator groups. A favorable effect of crop rotation was that the population of plant parasites (pathogenic) remained below crop damage concentrations. The effect of traffic on soil compaction was reflected conspicuously by the vertical distribution of soil nematodes within the soil profile. The population of plant parasites increased with depth, whereas the opposite occurred with the bacterial-feeding and omnivorous predator groups. [References: 32].

1924 Nieder, R.; Neugebauer, E.; Willenbockel, A.; Richter, J. (1995) **SIGNIFICANCE OF MICROBIAL BIOMASS AND NONEXCHANGEABLE AMMONIUM WITH RESPECT TO THE NITROGEN TRANSFORMATIONS IN LOESS SOILS OF NIEDERSACHSEN DURING THE GROWING SEASON OF WINTER WHEAT .1. CHANGE OF POOL SIZES.** *Zeitschrift fur Pflanzenernahrung und Bodenkunde. 158(5):469-475.* German. [INST GEOG & GEOOKOL LANGER KAMP 19 C D-38106 BRAUNSCHWEIG GERMANY].

Nitrogen transformations in loess soils have been examined by laboratorry and field experiments. After straw application ((Delta) 8 t . ha(-1)), N in microbial biomass (N-mic)increased by about 20 mg . kg(-1) soil ((Delta) 90 kg N . ha(-1). 30 cm(-1)) after 9 days of incubation (20 degrees C). Another laboratory experiment yielded an increase of about 400 mg of NH4+-N . kg(-1) fixed by minerals within 1 h after addition of 1 M NH4+-acetate. Defixation of the recently fixed NH4+ after addition of 1 M KCl amounted to only 60 mg . kg(-1) within 50 days. In a field experiment with winter wheat 1991, an increase in N-mic of about 80 kg N . ha(-1). 30 cm(-1) was observed from March to June. After July, growth of the microbes was limited by decreased soluble carbon concentrations in the rhizosphere. Different levels of mineral N-fertilizer (0, 177 and 213 kg N . ha(-1)) did not affect significantly the microbial biomass. The same field experiment yielded a decrease of non-exchangeable ammonium on the "zero"-fertilized plot in spring by 200 kg N . ha(-1). 30 cm(-1). The pool of fixed ammonium increased significantly after harvest. After conventional mineral N-fertilizer application (213 kg N . ha(-1)), NH4+-defixation was only about 120 kg N . ha(-1). 30 cm(-1) until July. [References: 22].

1925 Nieder, R.; Willenbockel, A.; Neugebauer, E.; Widmer, P.; Richter, J. (1995) **SIGNIFICANCE OF MICROBIAL BIOMASS AND MINERAL FIXED AMMONIUM WITH RESPECT TO THE NITROGEN TRANSFORMATIONS IN LOESS SOILS OF NIEDERSACHSEN DURING THE GROWING SEASON OF WINTER WHEAT .2. N-15-TURNOVER.** *Zeitschrift fur Pflanzenernahrung und Bodenkunde. 158(5):477-484.* German. [INST GEOG & GEOOKOL LANGER KAMP 19 C D-38106 BRAUNSCHWEIG GERMANY].

Field experiments 1988/89 on a fallow plot of the southern Niedersachsen loess area with straw application ((L)ambda 10 t . ha(-1), homogeneously incorporated by hand) yielded an increase in microbial

biomass-N (N-mic) by 60 kg N . ha(-1). 30 cm(-1) until March 1989 and further 40 kg N . ha(-1), till May which was almost completely remobilized until han est. For a cropped plot (with winter wheat and 10 t . ha(-1) straw incorporation), N immobilization was of similar magnitude. Up to 18% of the applied N-15- fertilizer (185 kg N . ha(-1)) were microbially immobilized. In contrast to 1988/89, no significant mass change of N-mic occurred in 1991 due to straw application ((=) over cap 10 t . ha(-1)). Variations in the amount of : N-mic were nearly independent on the treatment (crop, with 140 kg fertilizer -N . ha(-1) or without N-fertilirer, respectively; fallow plot without fertilizer-N) within a range of 225-400 kg N . ha(-1). 30 cm(-1), Directly after N:application (each 70 kg N . ha(-1) in March and in May), up to 100% of the fertilizer-N were assimilated by the microbes. Subsequently, remobilization of the immobilized nitrogen occurred within 2, (in March), or 6 weeks (in May), respectively. Simultaneously. organic soil-N was mineralized after each N-application and minerally fixed for its biggest, part. Between March and June, the fixed NH4+ decreased by about 112 kg N . ha(-1) 30 cm(-1). [References: 21].

1926 Pfender, WF.; Fieland, VP.; Ganio, LM.; Seidler, RJ. (1996) **MICROBIAL COMMUNITY STRUCTURE AND ACTIVITY IN WHEAT STRAW AFTER INOCULATION WITH BIOLOGICAL CONTROL ORGANISMS.** *Applied Soil Ecology. 3(1):69-78.* English. [KANSAS STATE UNIV DEPT PLANT PATHOL THROCKMORTON HALL MANHATTAN, KS 66506 USA].

Wheat straw on pans of soil in a greenhouse was inoculated with either the fungus Limonomyces roseipellis or the bacterium Pseudomonas fluorescens strain Pf-5, biocontrol agents for Pyrenophora tritici-repentis, a straw-borne phytopathogen. The inoculated straw was exposed to alternate wetting and drying for 7 weeks to assess the effects of intentionally applied microorganisms on selected ecological parameters of the plant litter microflora. Pseudomonas fluorescens had little effect, but L. roseipellis had measurable effects on some aspects of microbial community structure and function. The frequency distribution of fungal taxa on straw was altered by L. roseipellis, with a large increase in yeasts and a decrease in several filamentous fungi. Compared with non-treated straw, respiration (CO2 evolution) under conditions of adequate moisture (- 0.1 MPa) was increased in straw colonized by L. roseipellis, but respiration at - 7 MPa was unaffected. The spectrum of sole carbon sources utilized by the straw microflora was altered slightly in Limonomyces-treated straw. These observations provide a basis for further studies concerning inoculant-induced ecological effects under field conditions. [References: 34].

1927 Sharratt, BS. (1996) **SOIL TEMPERATURE, WATER CONTENT, AND BARLEY DEVELOPMENT OF LEVEL VS RIDGED SUBARCTIC SEEDBEDS.** *Soil Science Society of America Journal. 60(1):258-263.* English. [USDA ARS N CENT SOIL CONSERVAT RES LAB N IOWA AVE MORRIS, MN 56267 USA].

Ridge tillage may promote early-season warming of soils in subarctic regions and thereby optimize the plant growing environment. This study was conducted to assess soil temperature and water content, along with barley (Hordeum vulgare L.) development, on a level vs. ridged Pergelic Cryaquept at Fairbanks, AK. Ridges were oriented north-south, east-west, northeast-southwest, and northwest-southeast. Seed zone soil temperature and water content were measured, the former by thermocouples, at the ridge peak and furrow as well as on ridge slopes where barley was grown during the 1989 through 1991 growing seasons. Barley grown on the level surface and on southerly ridge aspects produced at least 25 g m(-1) more grain and 20 g m(-1) more straw than barley grown on northerly aspects. The vegetative developmental rate was 0.03 leaves d(-1) faster on southern ridge aspects or the level surface than on northern aspects, owing to 2 degrees C higher temperatures of soil with a southerly or level exposure. Soil water content on northern ridge aspects was occasionally 0.05 m(3) m(-3) higher than on southern aspects in the early growing season (<60 d after planting), but 0.04 m(3) m(-3) lower than on the level soil surface in the late growing season (>60 d after planting). In the subarctic, the plant growing environment is as favorable on a level soil surface as on a south-facing ridge aspect, owing to nearly equal early-season soil temperatures and higher soil water content in the late season. [References: 20].

1928 Stepanenko, IL.; Goncharov, NP. (1995) **ASSOCIATIVE NITROGEN FIXATION IN THE RHIZOSPHERE OF DIFFERENT WHEAT SPECIES.** *Russian Journal of Plant Physiology. 42(6):741-745.* English. [RUSSIAN ACAD SCI INST CYTOL & GENET SIBERIAN DIV PR AKAD LAVRENT EVA 10 NOVOSIBIRSK 630090 RUSSIA].

The activity of associative nitrogen fixation and its variability was compared for one diploid and eight tetraploid wheat species by the method of acetylene reduction. Polymorphism was revealed in the ability of plants to support nitrogen fixation. The tetraploid species Triticum timopheevii was found to be the most active. The species T. turanicum, T. polonicum, and T. turgidum had low activities, and the soft wheat T. aestivum was medium-active. Single samples with a high significance of the trait were detected among the tetraploid species T. aethiopicum, T. cartlicum, and T. durum. Apparently, genotypes with high associative nitrogen fixation are most common among ancient cultivated wheat species from Asia Minor. [References: 6].

1929 Tarafdar, J.C. (Universitat Hohenheim, Stuttgart (Germany). Institute fur Pflanzenernahrung) (1995) **Role of a VA mycorrhizal fungus on growth and water relations in wheat in presence of organic and inorganic phosphates.** *Journal of The Indian Society of Soil Science (India) v. 43(2) p. 200-204.* 5 tables; 1 ill., 19 ref. English. (AGRIS 96-010760).

P35 SOIL FERTILITY

1930 Breland, TA. (1995) **GREEN MANURING WITH CLOVER AND RYEGRASS CATCH CROPS UNDERSOWN IN SPRING WHEAT - EFFECTS ON SOIL STRUCTURE.** *Soil Use & Management. 11(4):163-167.* English. [AGR UNIV NORWAY DEPT BIOTECHNOL SCI POB 5040 N-1432 AS NORWAY].

The objective of the present study was to investigate the potential of undersown catch crops to counteract soil degradation after autumn ploughing. Italian ryegrass (Lolium multiflorum Lam.) and white clover (Trifolium repens L.) were undersown in spring wheat on a loam soil in southern Norway, allowed to grow as cover crops after grain harvest and ploughed in to 20 cm depth as green manure in late October. Ryegrass prevented a collapse of the ridged plough furrow profile during winter, which occurred on gain monoculture and white-clover plots. Also, it tended to improve the water stability of aggregates, aggregate size distribution, bulk density, and pore volume in soil sampled in May. The preservation of the plough furrow profile was mainly attributed to enmeshment by an extensive system of fine roots and less to rhizosphere and microbial effects on aggregate stability. The results showed that ryegrass catch crops may give rapid structure improvements that are likely to contribute appreciably to easier seedbed preparation and less soil degradation in arable farming systems, even if the soil is ploughed in autumn. [References: 36].

1931 Elabbadi, K.; Ismaili, M.; Materon, LA. (1996) **COMPETITION BETWEEN MEDICAGO TRUNCATULA AND WHEAT FOR N-15 LABELED SOIL NITROGEN AND INFLUENCE OF PHOSPHORUS.** *Soil Biology & Biochemistry. 28(1):83-88.* English. [UNIV MOULAY ISMAIL FAC SCI POB 4010 MEKNES MOROCCO].

To determine competition for nitrogen uptake, a greenhouse experiment was conducted using annual Medicago truncatula cf. Jemalong (medic) and Triticum turgidum spp. durum cv. Karim (wheat) grown alone or in mixture, over five successive crop cycles. Pots were supplied with P equivalent to 0, 50, 100 and 150 kg P2O5 ha(-1) at the beginning of each crop cycle. The soil was labeled by growing wheat plants on soil fertilized with N enriched with 10.43 atom % N-15 excess and by incorporating the labeled wheat as organic matter (2.08 atom % N-15 excess) back into the soil. This method allowed estimation of N, fixed by medic and N transfer to wheat. Compared to the sole medic crop, dry herbage yield and total N of medic grown in mixture, were reduced. Medic plants alone (unmixed) assimilated 80% more soil N that wheat alone at the higher rate of P. When in mixture, wheat plants took up more soil N than medic plants. The percentage N derived from synbiosis (%Ndfa), by the sole medic, averaged 60%. In mixture, %Ndfa of the medic was 80%. The total N difference method gave higher values for %Ndfa (6-22%) than the isotope dilution technique, depending on the P rate. This was because P rates affected the

N absorption of medic and wheat differently. Dry herbage yield and total N of medic and wheat grown alone and in mixture were improved by P supply. Competition between medic and wheat was affected by P fertilization, favoring wheat which became more competitive for uptake of soil N at the higher P rates. When no P was added to the soil, mixed medic took up 60% of the soil N absorbed by sole medic; at the higher P rate, this was reduced to 34%. Transfer of N fixed by medic to wheat was detected only after the second crop cycle. [References: 42].

1932 Hylander, LD. (1995) **EFFECTS OF LIME, PHOSPHORUS, MANGANESE, COPPER, AND ZINC ON PLANT MINERAL COMPOSITION, YIELD OF BARLEY, AND LEVEL OF EXTRACTABLE NUTRIENTS FOR AN ACID SWEDISH MINERAL SOIL.** *Communications in Soil Science & Plant Analysis. 26(17-18):2913-2928.* English. [SWEDISH UNIV AGR SCI DEPT SOIL SCI DIV PLANT NUTR & SOIL FERTIL POB 7014 S-75007 UPPSALA SWEDEN].

A pot experiment was performed during the 1992 growing season on an acid, sandy topsoil taken from a Swedish liming experiment. A central composite experimental design was used in order to study the effects of supply of phosphorus (P) and micronutrients at different liming levels on yield of barley (Hordeum vulgare L. c.v. Golf), mineral content in plant, straw, and grain, and level of soil extractable nutrients. The results showed no increase of yield due to liming despite the fact that lime increased the yield significantly in the field experiment. The soil appeared initially to have a good balance between the nutrients included in the experimental design with the exception of P. An excessive supply of manganese (Mn) decreased the yield. The contents of calcium (Ca) and aluminum (Al) in the plant were hardly affected by the treatments, while the contents of P, Mn, copper (Cu), and zinc (Zn) more than doubled compared to no supply. The contents of P, Cu, and Zn were mainly influenced by the supply of the actual element, while the content of Mn was more closely related to the supply of lime. Soil pH(H2O) and CaCl2-extractable P, Mn, Cu, and Zn were highly related to the supplies of lime, P, Mn, Cu and Zn, respectively. Only a few interactions were observed. [References: 35].

1933 Maag, M. (1995) **DENITRIFICATION LOSSES FROM SANDY AND SANDY LOAM SOILS UNDER SPRING BARLEY FERTILIZED WITH SLURRY AND AMMONIUM NITRATE.** *Acta Agriculturae Scandinavica Section B-Soil & Plant Science. 45(4):234-241.* English. [DANISH INST PLANT & SOIL SCI RES CTR FOULUM DEPT SOIL SCI BOX 23 DK-8830 TJELE DENMARK].

The interaction between soil factors and denitrification loss from soil is not well understood. This study was conducted to determine whether soil air-filled porosity (AFP), nitrate concentration and N management could explain some of the large variation found in denitrification studies. Denitrification losses from a coarse sandy soil and a sandy loam soil under spring barley were measured during a three-year period using the acetylene-based static soil core method. The sandy loam soil received 100 and 133 kg inorganic N ha(-1) yr(-1) in pig slurry and inorganic fertilizer, respectively, while the coarse sandy soil received 100 and 120 kg inorganic N ha(-1) yr(-1) in pig slurry and inorganic fertilizer, respectively. In the coarse sandy soil no interaction between soil AFP and soil nitrate concentration in relation to denitrification existed-during the three years investigated, and annual losses arising from denitrification were low (<1 kg N ha(-1)). In this soil type the low denitrification loss from the plot treated with slurry is explained by the inability of the slurry to create hot spots owing to the slurry incorporation technique (harrowing) and to the amount of slurry used (30 Mg). Annual losses arising from denitrification in the sandy loam soil were in the order inorganic fertilized > slurry fertilized > control. In this soil type a linear relationship between log(10) denitrification activity and air-filled porosity could explain 50% of the variation in denitrification activity, but no influence of soil nitrate concentration was found. The regression parameters for the AFP regression varied between unamended and amended soil, with the highest slope in the amended soil regression. [References: 34].

1934 Maas, EV.; Lesch, SM.; Francois, LE.; Grieve, CM. (1996) **CONTRIBUTION OF INDIVIDUAL CULMS TO YIELD OF SALT-STRESSED WHEAT.** *Crop Science. 36(1):142-149.* English. [USDA ARS US SALIN LAB 450 W BIG SPRINGS RD RIVERSIDE, CA 92507 USA].

Grain yield in wheat (Triticum aestivum L. emend. Thell.) is highly dependent upon the number of spike-bearing tilters produced by each plant. Soil salinity can greatly decrease their number and productivity. Knowing the contribution of specific tillers is essential for breeding salt-tolerant genotypes and for developing wheat growth simulation models. Our objective was to determine the effects of soil salinity on the contribution of individual culms to total grain and dry matter yields of two spring wheat cultivars, Anza and Yecora Rojo. Plants were grown in Pachappa fine sandy loam soil (mixed, thermic, Mollic Haploxeralf) in outdoor lysimeters for 2 yr. Three salinity treatments were imposed by irrigating with waters containing equal weights of NaCl and CaCl2 (electrical conductivities congruent to 1, 12, or 18 dS m(-1)). Despite substantial losses in the number of tillers at moderate levels of salt stress, grain yields of the main stem (MS) and tillers T1 and T2 were as great of greater than those on nonstressed plants of both cultivars. The contribution of the MS to yield on a land area basis increased from about 25 to 35% in nonsaline treatments to over 80% with increasing salinity. The contribution of primary tillers (congruent to 58-65% in nonsaline conditions) decreased substantially only at the highest salinity levels. Salinity stress significantly decreased the number of spikelets per spike but the number of kernels per spike either increased or was unaffected except at the highest level of stress. Increasing salinity decreased total straw yields primarily because of fewer tillers, but dry weights of the MSs and remaining tillers were also smaller. Results show that loss of spike-bearing tillers accounts for most of the yield reduction in salt-stressed wheat. [References: 25].

1935 Recous, S.; Robin, D.; Darwis, D.; Mary, B. (1995) **SOIL INORGANIC N AVAILABILITY - EFFECT ON MAIZE RESIDUE DECOMPOSITION.** *Soil Biology & Biochemistry. 27(12):1529-1538.* English. [INRA UNITE AGRON RUE F CHRIST F-02007 LAON FRANCE].

The effect of soil inorganic N availability on the decomposition of maize residues was tested under aerobic conditions in soil samples incubated for 125 days at 15 degrees C. Carbon residue were ground maize shoots applied at 4 g dry matter kg(-1) soil. The C-amended soils contained five initial inorganic N concentrations (10, 30, 60, 80 and 100 mg N kg(-1) soil). Gross N immobilization was calculated with a N-15 tracer, using changes in both the inorganic and organic N-15 pools. Inorganic N remained available in those soils having the three highest initial N concentrations. In this case the rates of C mineralization and N immobilization were similar. Soil inorganic N completely disappeared at the beginning of C decomposition in the soil samples with the two lowest N contents, resulting in a marked decrease of C mineralization rate compared to the three highest N contents. Gross N immobilization amounted to 39 mg N g(-1) added C after 40 days (end of the net immobilization period) for the three highest N concentrations, indicating that there was no luxury N consumption by the soil microflora. N immobilization was much lower in the two lowest-N treatments because decomposition was slow and microbial N immobilization per unit of mineralized C was reduced. The ratio N immobilized:C mineralized also decreased in all treatments during decomposition due to changes in microbial N demand with time or increasing contributions from other sources of N, such as biomass-N recycling, to microbial N assimilation. [References: 24].

1936 Turtola, E.; Jaakkola, A. (1995) **LOSS OF PHOSPHORUS BY SURFACE RUNOFF AND LEACHING FROM A HEAVY CLAY SOIL UNDER BARLEY AND GRASS LEY IN FINLAND.** *Acta Agriculturae Scandinavica Section B-Soil & Plant Science. 45(3):159-165.* English. [AGR RES CTR SF-31600 JOKIOINEN FINLAND].

Phosphorus losses by surface runoff and leaching were studied for three years in a 16-plot field on a heavy clay soil in south-west Finland to compare losses of total phosphorus (TP), particulate phosphorus (PP) and dissolved orthophosphate phosphorus (DP) from barley and grass ley plots. Barley was fertilized with 21 and 42 kg *ha(-1) y(-1) P* by placement technique. Ley was given P 42 and 84 kg ha(-1) y(-1), but split into two equal portions, by broadcasting. The mean losses of TP from the barley and ley were 1.2 and 1.6 kg ha(-1) y(-1), respectively. The PP losses (calculated as the difference between TP and DP) constituted 69% of the TP loss from barley, but only 35% of that from ley. In the case of barley, a considerable amount of PP was carried by drainage water. The mean DP losses were 0.4 kg ha(-1) y(-1) from barley and 1.0 kg ha(-1) y(-1) from ley. The higher DP

loss from ley was due to both the higher fertilizer rate and the fertilizer broadcasting technique. During the second and third years of the experiment, fertilizer broadcasting on the ley plots was followed by high DP concentrations in surface runoff and drainage water. The peak DP concentrations in drainage water occurred soon after fertilizer broadcasting followed by only 7-15 mm of flow, indicating fast preferential movement of orthophosphate from the surface through the soil. [References: 24].

1937 Yamulki, S.; Harrison, RM.; Goulding, KWT. (1996) **AMMONIA SURFACE-EXCHANGE ABOVE AN AGRICULTURAL FIELD IN SOUTHEAST ENGLAND.** *Atmospheric Environment. 30(1):109-118.* English. [UNIV BIRMINGHAM INST PUBL & ENVIRONM HLTH BIRMINGHAM B15 2TT W MIDLANDS ENGLAND].

A micrometeorological method and a chamber method were used to measure ammonia exchange over a mineral-fertilised wheat crop and to monitor the seasonal variation of NH3 under a variety of environmental and soil conditions. Ammonia emission was favoured regardless of fertilisation in dry and warm conditions in summer with an average NH3 flux of about 0.03 mu g N m(-2) s(-1). In contrast, a consistent NH3 deposition was observed during wet conditions in winter with an average flux of - 0.068 mu g N m(-2) s(-1) and an average apparent deposition velocity of about 1.6 cm s(-1). The effect of temperature was clearly observed through a diurnal variation in the rate of NH3 emission with the maximum occurring at midday. The results also showed that, whilst negligible NH3 was emitted from the soil, much higher fluxes (emission or deposition) were observed above the crop. Ammonia exchange patterns throughout the whole experimental study showed a dependence on the ambient NH3 concentration with a compensation point of 3-4 mu g m(-3). Loss of NH3 to the atmosphere accounted for approximately 1% of the NH4NO3 fertiliser applied to the soil. [References: 52].

Q01 FOOD SCIENCE AND TECHNOLOGY

1938 Baldwin, EA.; Nisperoscarriedo, MO.; Baker, RA. (1995) **USE OF EDIBLE COATINGS TO PRESERVE QUALITY OF LIGHTLY (AND SLIGHTLY) PROCESSED PRODUCTS [Review].** *Critical Reviews in Food Science & Nutrition. 35(6):509-524.* English. [USDA ARS CITRUS & SUBTROP PROD LAB WINTER HAVEN, FL USA].

Lightly processed agricultural products present a special problem to the food industry and to scientists involved in postharvest and food technology research. Light or minimal processing includes cutting, slicing, coring, peeling, trimming, or sectioning of agricultural produce. These products have an active metabolism that can result in deteriorative changes, such as increased respiration and ethylene production. If not controlled, these changes can lead to rapid senescence and general deterioration of the product. In addition, the surface water activity of cut fruits and vegetables is generally quite high, inviting microbial attack, which further reduces product Stability. Methods for control of these changes are numerous and can include the use of edible coatings. Also mentioned in this review are coating of nut products, and dried, dehydrated, and freeze-dried fruits. Technically, these are not considered to be *minimally* processed, but many of the problems and benefits of coating these products are similar to coating lightly processed products. Generally, the potential benefits of edible coatings for processed or lightly processed produce is to stabilize the product and thereby extend product shelf life. More specifically, coatings have the potential to reduce moisture loss, restrict oxygen entrance, lower respiration, retard ethylene production, seal in flavor volatiles, and carry additives that retard discoloration and microbial growth. [References: 129].

1939 Bhatty, RS. (1995) **HULL-LESS BARLEY BRAN - A POTENTIAL NEW PRODUCT FROM AN OLD GRAIN [Review].** *Cereal Foods World. 40(11):819-824.* English. [UNIV SASKATCHEWAN CTR CROP DEV SASKATOON SK S7N 0W0 CANADA].

1940 Seguchi, M. (1995) **SURFACE STAINING OF WHEAT STARCH GRANULES WITH REMAZOLBRILLIANT BLUE R DYE AND THEIR EXTRACTION WITH AQUEOUS SODIUM DODECYL SULFATE AND MERCAPTOETHANOL.** *Cereal Chemistry. 72(6):602-608.* English. [KOBE WOMENS UNIV FAC HOME ECONOM KOBE HYOGO 614 JAPAN].

Wheat starch granules were strained with Remazolbrilliant blue R (RBB) dye. The RBB-stained starch granules (RBB-starch) were successively extracted with 1% sodium dodecyl sulfate (SDS) solution containing 1% 2-mercaptoethanol-(2-ME) at room temperature for 1 day (extraction 1), 5 days (extraction 2), and 15 days (extraction 3). The stained molecules were solubilized first, an indication that the RBB dye was bound to the granule surface. After each extraction with 1% SDS solution containing 1% 2:ME, granules were examined by scanning electron microscopy. The appearance of the residual starch structure changed greatly between extraction 2 and 3. After extraction 3, only a shell-like structure was present. X-ray diffraction analysis of this sample indicated an absence of crystallinity. The SDS extracts were subjected to Sepharose CL-2B gel-filtration chromatography. Two blue peaks were observed for extraction 1: one high and one low molecular size. The low molecular weight peak decreased for extraction 2 and was absent for extraction 3. The high molecular weight blue peak did not disappear, although the ratio of unstained carbohydrate to RBB-stained carbohydrate increased with time. The low molecular weight blue peak was further subjected to the Sephadex G-50 gel-filtration chromatography, and the resulting single peak was analyzed for sugars, proteins and peptides, and lipids. Only lipids were found. The main TLC spot was RBB stained and indicated lysophosphatidylglycerol by Dittmer and periodate spray reagents. [References: 35].

1941 Tamura, A.; Nagano, H.; Omori, M.; Shoji, Z.; Iibushi, S.; Arai, M. (1995) **IMPROVEMENT IN HYDROGEN PRODUCTIVITY BY A LEAVENING BACTERIUM, ENTEROBACTER CLOACAE GAG, AND ITS APPLICATION TO MANTOU.** *Bioscience Biotechnology & Biochemistry. 59(11):2137-2139.* English. [OTSUMA WOMENS UNIV DEPT FOOD SCI CHIYODA KU TOKYO 102 JAPAN].

Enterobacter cloacae GAG, a bacterium isolated from water in which apples have been steeped, is also found in traditional fermented wheat foods, One important characteristic of this bacterium is that it produces hydrogen gas during inflation as these foods are being prepared, The effects of various nutrient sources and culture conditions on the production of hydrogen gas by the bacterium were examined for the improvement of these traditional foods, Glucose was found to be an effective carbon source and casamino acids were found to be effective nitrogen sources, E. cloacae GAO was used to make mantou. When wheat flour with casamino acids was used to make mantou, a better internal structure and taste were obtained. [References: 9].

1942 Tani, H.; Ohishi, H.; Watanabe, K. (1995) **KINETICS STUDIES OF A WHEAT-DERIVED LIPASE INHIBITOR.** *Journal of Agricultural & Food Chemistry. 43(11):2796-2797.* English. [GIFU UNIV UNITED GRAD SCH AGR SCI GIFU 50111 JAPAN].

Q02 FOOD PROCESSING AND PRESERVATION

1943 Alagusundaram, K. (University of Manitoba, Winnipeg, Manitoba, Canada); Jayas, D.S.; Friesen, O.H.; White, N.D.G. (1994) **Airflow patterns through wheat, barley, and canola in bins wth partially perforated floors: and experimental investigation.** *Applied engineering in agriculture (USA) v. 10(6) p. 791-796.* references. English. (AGRIS 96-011057).

Experiments were conducted to study the airflow patterns during drying through wheat, barley, and canola stored in a 4.2-m diameter (13.6 ft) cylindrical steel bin with a fully perforated floor that was modified to give three different partially perforated floors (straight, cross, and square floor openings). To show the airflow patterns through the grains, iso-pressure and iso-traverse time lines were drawn across two different cross-sections of the bulk for each floor type. The zones of poor ventilation were the portions of the grain near the lower corners of the bin farthest from the floor opening in all three cases. The shapes of the ventilation fronts through wheat, barley, and Canola were almost the same across any given cross-section of the bulk and floor type. Based on the traverse time, calculated using the airflow resistance data from the literature, drying or cooling rates through barley were faster than through wheat and the drying or cooling rates through wheat were faster than canola.

1944 Collar, C.; Martinez, CS. (1995) **EFFECTS OF FORMULATION AND PROCESSING CONDITIONS ON EASILY EXTRACTABLE LIPID AND NITROGEN COMPONENTS OF WHEAT SOURDOUGHS.** *International Journal of Food Science & Technology. 30(4):493-504.* English. [CSIC INST AGROQUIM & TECNOL ALIMENTOS DEPT CIENCIA ALIMENTOS LAB CEREALES POLIGONO LA COMA S-N PATERNA VALENCIA SPAIN].

The changes in free lipid (neutral lipids, glycolipids, and phospholipids) and extractable nitrogen (amino acids, peptides, and proteins) components of unyeasted and yeasted wheat sourdoughs started with Lactobacillus plantarum B-39 were investigated in samples under different processing conditions. A central composite surface response design was used with factor analysis to investigate the effect of flour extraction rate lash content), added water, presence or absence of yeast, and fermentation temperature on readily extractable lipid and nitrogen components. Absolute values for extractable protein and non-protein components were highly correlated with ash content of flour (factor 1); whereas phospholipids and neutral lipids were closely connected with added water (factor 2). Sixty sourdoughs were classified into three groups: 1) high-ash fermented sourdoughs produced high (>350 mg kg(-1)) total nonprotein amino nitrogen and medium (<3 mg g(-1)) lipid levels; mid-ash flour doughs had lower levels of both components; 2) low-ash fermented sourdoughs produced low (<300 mg kg(-1)) levels of amino acids and peptides and medium lipids levels, and 3) unfermented sourdoughs had low (<250 mg kg(-1)) levels of non-protein nitrogen components and most made with low-ash flour had medium lipid levels; most made with medium and high-ash flours had high (>4 mg g(-1)) neutral lipid levels and were largely separated from the low-ash group. The most promising sourdoughs for bread were those with low added water, fermented from higher ash flour with maximum levels of extractable amino acids, peptides and proteins and medium to high polar and neutral lipid levels. [References: 40].

1945 Contamine, AS.; Abecassis, J.; Morel, MH.; Vergnes, B.; Verel, A. (1995) **EFFECT OF MIXING CONDITIONS ON THE QUALITY OF DOUGH AND BISCUITS.** *Cereal Chemistry. 72(6):516-522.* English. [INRA TECHNOL CEREALES LAB 2 PL VIALA F-34060 MONTPELLIER FRANCE].

The effect of energy input during mixing on the standard French biscuit petit beurre was observed by means of an experimental mixer fitted out with monitoring devices. Results showed an energy threshold of approximate to 60 kJ/kg, beyond which the biscuits retracted and grew thicker. This phenomenon was accurately studied by a theological and physicochemical characterization of the dough. The viscoelastic properties of the biscuit dough were determined by dynamic measurements on a parallel plate rheometer The parameter tg delta (G "/G') decreased proportionally to the mixing energy, indicating an increase in the elasticity of the material. Consequently, doughs characterized by tg delta values >0.48 are of poor quality, producing short and thick biscuits that are unsuitable for packaging. For low strains, G' is higher than G ", whereas for high strains, the theological behavior is modified (G " > G'), indicating a change in the structure of the material. The value of the limit deformation D corresponding to the point of intersection of the curves G' and G " depends on the energy input during mixing. The development of the gluten network was indirectly characterized by continuous measurements of the extractability of lipids by hexane, The more energy is absorbed by the dough and the more gluten network develops, the smaller the amount of extractable lipids. Doughs that retain <80% of their lipids produce biscuits of poor dimensional stability. [References: 21].

1946 Eynard, L.; Guerrieri, N.; Cerletti, P. (1995) **MODIFICATIONS OF STARCH DURING BAKING - STUDIED THROUGH REACTIVITY WITH AMYLOGLUCOSIDASE.** *Cereal Chemistry. 72(6):594-597.* English. [UNIV MILAN DIPARTIMENTO SCI MOLEC AGROALIMENT VIA CELORIA 2 I-20133 MILAN ITALY].

Conditions that ensure starch hydrolysis by amyloglucosidase in a limited substrate system were worked out. Using these conditions, we evaluated the degree of access of the enzyme to starch molecules in different starchy materials. Raw starches of different botanical origins are hydrolyzed at different rates, but starches with limited branching hydrolyze more rapidly. A good example of this is a limit dextrin, which is more susceptible than its parent amylopectin. We also studied the effect of gelatinization on the enzymatic availability of starch. It was observed that damaged granules undergo amylolysis much more rapidly than do undamaged ones. Therefore, the extent of amylolysis in a given starch is governed by the degree of granule damage. Starch in bread is hydrolyzed more rapidly and extensively than is that in flour and dough, but no significant differences were found in conventional yeast fermentation between soft and durum wheat. On the other hand, bread obtained by acid fermentation initially undergoes slow amylolysis, although the final level reached is the same as in bread made from the same flour by conventional yeast fermentation. [References: 16].

1947 Gobbetti, M.; Simonetti, MS.; Corsetti, A.; Santinelli, F.; Rossi, J.; Damiani, P. (1995) **VOLATILE COMPOUND AND ORGANIC ACID PRODUCTIONS BY MIXED WHEAT SOUR DOUGH STARTERS - INFLUENCE OF FERMENTATION PARAMETERS AND DYNAMICS DURING BAKING.** *Food Microbiology. 12(6):497-507.* English. [INST DAIRY MICROBIOL I-06100 PERUGIA ITALY].

Lactobacillus brevis subsp. lindneri CB1, Lactobacillus plantarum DC400 and Saccharomyces cerevisiae 141 or Saccharomyces exiguus M14 were used as starters to produce wheat sour dough breads. Sour doughs with higher relative percentage of yeast fermentation products (1-propanol, 2-methyl-1-propanol, 3-methyl-1-butanol and ethanol) and with higher total peak area of volatile compounds, or with a more complete profile (higher amounts of ethylacetate and lactic and acetic acids, and the presence of carbonyl compounds) were produced by the associations between lactic acid bacteria (LAB) and S. cerevisiae 141 or S. exiguus M14, respectively. Low temperature (25 degrees C) and sour dough firmness (dough yield 135) were appropriate for LAB souring activities but limited yeast metabolism. Raising the temperature to 30 degrees C and semi-fluid sour doughs gave more complete volatile profiles. Flour ash content from 0.55-1% positively influenced the total amount of volatiles and lactic and acetic acid productions. While at 3 h the sour dough was mainly characterized by iso-alcohols, an increase of leavening time up to 9 h gave a total amount of volatiles about three times higher than that at 5 h and strengthened the LAB contribution. The additions of fructose and citrate to the dough enhanced the acetic acid and volatile synthesis by LAB, respectively. After baking, the ethanol disappeared, 2-methyl-1-propanal was synthetized, lactic and acetic acids remained constant, the total amount of volatiles was reduced to a level < 12.5% of the initial and an increase in the relative percentage of iso-alcohols and aldehydes was detected. The differences attributed to the two mixed starters were maintained after baking. A comparison between amino acid and volatile profiles before and after baking showed the influence of amino acids on the formation of volatiles during baking. (C) 1995 Academic Press Limited [References: 41].

1948 Janssen, AM.; Vanvliet, T.; Vereijken, JM. (1996) **FUNDAMENTAL AND EMPIRICAL RHEOLOGICAL BEHAVIOUR OF WHEAT FLOUR DOUGHS AND COMPARISON WITH BREAD MAKING PERFORMANCE.** *Journal of Cereal Science. 23(1):43-54.* English. [AVEBE BA RES & DEV AVEBE WEG 1 9607 PT FOXHOL NETHERLANDS].

The rheological characteristics of wheat flour doughs from the cultivars Obelisk and Katepwa and of biscuit flour doughs, and also of biscuit flour doughs containing glutens isolated from cv. Obelisk and cv. Katepwa flour, were compared and discussed in relation to bread making performance. Four different rheological methods were employed: two fundamental methods, i.e. dynamic (oscillatory) and uniaxial compression tests, and two empirical methods, i.e. tests using a Brabender Extensograph and a Chopin Alveograph. The fundamental methods showed that a dough of cv. Katepwa flour had a higher resistance to deformation and was more elastic than a dough of cv. Obelisk flour. Doughs of biscuit flour exhibited an intermediate behaviour, except that loss tangent values were close to those of a cv. Obelisk flour dough. Addition of cv. Obelisk gluten to biscuit flour hardly affected the rheological behaviour, whereas addition of cv. Katepwa gluten resulted in a higher resolution resistance to deformation and a higher elasticity. Uniaxial compression tests clearly showed the strain hardening and strain rate thinning characteristics of the flour doughs, which were most pronounced for a dough of cv. Katepwa flour. The rheological

characteristics of cv. Obelisk and cv. Katepwa flour doughs and of biscuit flour doughs containing the glutens corresponded with those of the isolated hydrated glutens. The information about the rheological behaviour of the flour doughs obtained by the four methods was complementary and in good agreement, despite differences in applied strains, deformation rates and modes of deformation. The empirical tests showed that the extensibility of the biscuit flour dough was less compared to that of the other doughs. This study suggests that in order to obtain a high loaf volume and a fine-crumb structure, wheat flour dough has to exhibit biaxial strain hardening and extensibility exceeding a minimum level; it is likely that the resistance to deformation may vary within a certain range. (C) 1996 Academic Press Limited [References: 22].

1949 Janssen, AM.; Vanvliet, T.; Vereijken, JM. (1996) **RHEOLOGICAL BEHAVIOUR OF WHEAT GLUTENS AT SMALL AND LARGE DEFORMATIONS - COMPARISON OF TWO GLUTENS DIFFERING IN BREAD MAKING POTENTIAL.** *Journal of Cereal Science. 23(1):19-31.* English. [AVEBE BA RES & DEV AVEBE-WEG 1 9607 PT FOXHOL NETHERLANDS].

The rheological characteristics of hydrated cv. Obelisk and Katepwa glutens, with poor and good baking potential, respectively, were studied at small and large deformations. Dynamic (oscillatory) measurements at small deformations over a frequency range of 0.03 to 3 rad/s showed that cv. Katepwa gluten had a higher dynamic modulus and a lower loss tangent than cv. Obelisk gluten. Overmixing resulted in increases in the dynamic moduli of both glutens. Measurements at different water contents indicated that the lower dynamic moduli at higher water contents resulted mainly from a concentration effect and were not due to water acting as a plasticiser. The apparent biaxial extensional viscosities of the glutens were determined by uniaxial compression of cylindrically shaped test pieces at various cross-head speeds. This proved to be a very useful method of providing information about the rheological behaviour of glutens at large deformations as a function of different strain rates. At every biaxial strain rate tested, the apparent biaxial extensional viscosity of cv. Katepwa gluten was higher than that of cv. Obelisk gluten. A thin layer of biaxially extended gluten showed a higher resistance to further biaxial extension than a less biaxially extended, thicker laver. Cv. Katepwa gluten exhibited this strain hardening behaviour to a greater extent than cv. Obelisk gluten. Possible consequences for baking performance are discussed. (C) 1996 Academic Press Limited [References: 32].

1950 Janssen, AM.; Vanvliet, T.; Vereijken, JM. (1996) **RHEOLOGICAL BEHAVIOUR OF WHEAT GLUTENS AT SMALL AND LARGE DEFORMATIONS - EFFECT OF GLUTEN COMPOSITION.** *Journal of Cereal Science. 23(1):33-42.* English. [AVEBE BA RES & DEV AVEBE WEG 1 9607 PT FOXHOL NETHERLANDS].

Glutens derived from two wheal cultivars with a known difference in bread making quality, i.e. cv. Katepwa (good) and cv. Obelisk (poor), were fractionated into gliadin and glutenin. Cultivar Katepwa gluten contained more glutenin than cv. Obelisk gluten. Reconstituted glutens were prepared by mixing, in different ratios, gliadin and glutenin fractions that originated from one gluten type or from both glutens. The rheological properties of these mixtures, when hydrated, were studied at small deformations in shear and at large deformations in biaxial extension. The reconstitution of gluten in its original glutenin/gliadin ratio produced a composite that had a somewhat higher resistance to deformation and was more elastic than the unfractionated gluten. This was true for both gluten types. However, the difference between the theological behaviour of both reconstituted gluten types was comparable with that found between the native glutens. From measurements with glutens reconstituted at various glutenin/gliadin ratios, it appeared that the main factor determining the theological behaviour of hydrated gluten is the glutenin/gliadin ratio. By interchanging thee gliadin and glutenin fractions of the two glutens, it was shown that the source from which the fractions originated, particularly that of the glutenin fraction, was also important. (C) 1996 Academic Press Limited [References: 21].

1951 Jones, AM.; Thomas, KC.; Ingledew, WM. (1995) **VERY HIGH GRAVITY FERMENTATION FOR FUEL ALCOHOL PRODUCTION - THE USE OF WHEAT MASHES FORTIFIED WITH SUGAR ADJUNCTS.** *International Sugar Journal. 97(1163):606-610.* English. [UNIV SASKATCHEWAN DEPT APPL MICROBIOL & FOOD SCI SASKATOON SK S7N 0W0 CANADA].

Very high gravity (VHG) fermentation is potentially important in ethanol production as it is one way to reduce processing costs without major alterations to plant. In this work the fermentation of VHG wheat mashes prepared using soluble sugar adjuncts was assessed, with and without nutrient supplements. In the presence of nutrients, similar rates of fermentation and high ethanol yields were achieved from VHG wheat mashes and from mashes made with a basal wheat mash and various sugar adjuncts or freeze-dried wheat hydrolysate. These data suggest that the use of sugar adjuncts could alleviate some of the practical difficulties encountered during preparation and fermentation of high carbohydrate grain mashes.

1952 Kim, H.G.; Cheigh, H.S. (Pusan National University, Pusan (Korea Republic). Department of Food Science and Nutrition) (1995) **Oxidative stability of wheat germ lipid and changes in the concentration of carotenoid and tocopherol during oxidation.** *Korean Journal of Food Science and Technology (Korea Republic) v. 27(4) p. 478-482.* 2 ill.; 5 tables; 20 ref. Korean. (AGRIS 96-022994).

1953 Kong, D.; Choo, TM.; Jui, P.; Ferguson, T.; Therrien, MC.; Ho, KM.; May, KW.; Narasimhalu, P. (1995) **VARIATION IN STARCH, PROTEIN, AND FIBRE OF CANADIAN BARLEY CULTIVARS.** *Canadian Journal of Plant Science. 75(4):865-870.* English. [PEI GRAIN ELEVATORS CORP POB 250 KENSINGTON PE C0B 1M0 CANADA].

Barley (Hordeum vulgare L.) is a major feed in the Maritime region of Canada, but information on the chemical composition of barley cultivars grown in the Maritimes is lacking. Therefore, a study was undertaken to determine if starch, protein, neutral-detergent fibre (NDF), and acid-detergent fibre (ADF) of barley vary from region to region in Canada and to determine if barley cultivars that originated from Eastern Canada exhibit different chemical composition than those that originated from Western Canada The chemical composition of two-row and six-row, covered and hulless, and feed and malting cultivars were also compared. Seventy-five cultivars were tested in eight environments (i.e. Charlottetown, Ottawa, Brandon, and Bentley in 1991 and 1992). These cultivars were classified into eight classes in four comparisons: eastern vs. western, two-row vs. six-row, hulless vs. covered, and feed vs. malting. Charlottetown grains were relatively low in protein, high in starch, and intermediate in NDF and ADF in comparison with grains produced at the other three locations. This suggests that more research in cultivar development and crop management is needed to increase the protein concentration of barley in the Maritimes. On average, two-row cultivars contained more starch and less fibre than six-row cultivars. Eastern two-row cultivars contained more protein than western two-row cultivars. As expected, hulless barleys contained more starch and protein, but less fibre than covered barleys. Canadian barley cultivars exhibited considerable variation in chemical composition. The cultivar x environment interaction was much smaller than the cultivar effect. Therefore, it is important to identify barley cultivars with high nutritional quality for use in commercial production. [References: 26].

1954 Kunz, K. (Univ. Bonn (Germany). Inst. fuer Lebensmitteltechnologie); Weidenboerner, M.; Kunz, B. (1995) **[Controlling of the food-relevant fungi Cladosporium herbarum, Eurotium repens, Penicillium expansum und Rhizopus stolonifer by use of spices in wheat bread]. Die Nutzung von Gewuerzen in Weizenbrot zur Kontrolle der lebensmittelrelevanten Schimmelpilze Cladosporium herbarum, Eurotium repens, Penicillium expansum und Rhizopus stolonifer.** *Chemie, Mikrobiologie, Technologie der Lebensmittel (Germany) v. 17(1-2) p. 1-5.* 1 graph, 1 table; 12 ref. German. (AGRIS 96-023009).

1955 Lukow, OM.; White, NDG.; Sinha, RN. (1995) **INFLUENCE OF AMBIENT STORAGE CONDITIONS ON THE BREADMAKING QUALITY OF TWO HARD RED SPRING WHEATS.** *Journal of Stored Products Research. 31(4):279-289.* English. [AGR & AGRI FOOD CANADA RES CTR 195 DAFOE RD WINNIPEG MB R3T 2M9 CANADA].

The effect of ambient storage conditions (weekly mean temperature ranged from -4 to 25 degrees C, relative humidity from 28 to 73%) on the quality of two hard red spring wheats, Katepwa and Roblin, was studied for 15 months (November-January). Only 4 of 19 breadmaking quality parameters changed during storage. There was a slight decrease in flour yield and an increase in farinograph stability for Katepwa. Sedimentation values decreased at similar rates for the two cultivars. The common response of Katepwa and Roblin in falling number values may make this variable a useful tool to monitor long-term storage of wheat. Changes in these quality parameters could limit their use in screening wheat breeders) lines since comparison of samples tested at different dates may not be valid. These problems can be overcome by using internal controls, which are grown, harvested and analyzed with the test lines. [References: 34].

1956 Neumann, H. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1995) **[Production of whole wheat bread with coarse whole wheat meal]. Herstellung von Weizenvollkornbroten mit Weizenvollkorngrobschrot.** *Getreide Mehl und Brot (Germany) v. 49(2) p. 99-103.* 10 ill., 4 tables; 12 ref. German. (AGRIS 96-023005).

1957 Omori, T.; Iwata, T.; Umemoto, Y.; Shimoda, M. (1995) **IMPROVEMENT OF BARLEY SHOCHU FLAVOR BY CONTROLLING THE GLYCEROL CONCENTRATION IN THE MASH.** *Seibutsu-Kogaku Kaishi-Journal of the Society for Fermentation & Bioengineering. 73(6):481-487.* English. [SANWA SHURUI CO LTD RES LAB 2231-1 YAMAMOTO USA OITA 87904 JAPAN].

The effect of the glycerol concentration in the mash on the taste of shochu was examined. The glycerol concentration was varied by glycerol addition. Although the alcohol concentrations in the shochu were not influenced, the ester concentrations were affected by the glycerol concentration in the mash. The isoamyl acetate concentration in shochu was highest at 10 g/l of the glycerol in the mash, and the beta-phenylethyl acetate concentration at 14 g/l. Barley shochu was produced using three strains of shochu yeast (Saccharomyces cerevisiae). The glycerol concentration in the mash was 6-14 g/l, and it was influenced by the glucoamylase activity in the mash and the yeast strain. When shochu was distilled from mashes under vacuum conditions, the ester concentrations were influenced not only by the concentrations in the mash but also by the glycerol concentration. By contrast, the alcohol concentrations were not influenced by the glycerol concentration. The distillation ratio of isoamyl acetate was highest at 10 g/l of glycerol, while that of beta-phenylethyl acetate increased gradually. These results suggest that glycerol influences the distillation of flavor components, and that its concentration in barley shochu mash is a factor that can affect the quality of barley shochu. [References: 5].

1958 Omori, T.; Ogawa, K.; Yuki, K.; Shimoda, M. (1995) **INFLUENCES OF HIGHER FATTY ACIDS ON GLYCEROL PRODUCTION BY SHOCHU YEAST (SACCHAROMYCES CEREVISIAE) IN BARLEY SHOCHU MASH [Japanese].** *Seibutsu-Kogaku Kaishi-Journal of the Society for Fermentation & Bioengineering. 73(6):473-480.* Japanese. [SANWA SHURUI CO LTD RES LAB 2231-1 YAMAMOTO USA OITA 87904 JAPAN].

The influences of higher fatty acids on glycerol production by shochu yeast (Saccharomyces cerevisiae) were investigated to clarify the factors necessary for higher glycerol production by yeast (GPY) in all-koji shochu mash. Glycerol production by shochu yeast strains increased in oleic- or linoleic acid-supplemented media, but decreased in the medium supplemented with palmitic acid. The influences of unsaturated fatty acids on glycerol production in this experiment were the same for beer and whisky yeasts. There was a high correlation between the amount of intracellular triglyceride in shochu yeast (TGY) and the amount of GPY. Glycerophosphatase activity in shochu yeast was the highest in the medium containing linoleic acid. The amount of koji influenced the linoleic acid concentration in shochu mash and the linoleic acid composition of intracellular higher fatty acids. When linoleic acid was added to mash with a koji ratio of 33%, the amount of GPY increased from 5.1 to 5.6 g/l. These results suggest that linoleic acid might be a stimulating factor for glycerol production by shochu yeast in all-koji mash. [References: 8].

1959 Rasanen, J.; Harkonen, H.; Autio, K. (1995) **FREEZE-THAW STABILITY OF PREFERMENTED FROZEN LEAN WHEAT DOUGHS - EFFECT OF FLOUR QUALITY AND FERMENTATION TIME.** *Cereal Chemistry. 72(6):637-642.* English.

The effects of fermentation time and flour quality on the baking quality of prefermented frozen wheat doughs were studied. The doughs were baked from six different flours and fermented optimally (40 min) and less than optimally (25 min) before freezing. After frozen storage (1-14 days), the baking quality was evaluated and the structure of the doughs was studied by microscopic and theological methods. Fermentation time had a dramatic effect on the freezing and thawing stability of the doughs. With one-day storage, the loaf volumes were, on average, 20% greater after shorter than after longer fermentation time. Moreover, with interrupted fermentation the change in loaf volume due to freezing was almost independent of flour quality. Microstructural and theological studies showed that the reason for these improvements was a thicker gluten network and greater amount of small gas bubbles. However, the interrupted fermentation did not reduce the deterioration of loaf volumes during longer storage times. The most significant decrease (11% of the fresh volume) occurred during the first week but continued during the second week of frozen storage (up to 15% of the fresh volume). [References: 23].

1960 Reinkemeier, M. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Roecken, W.; Leitzmann, C. (1995) **[Use of defined bacterial starter cultures in sour doughs for wheat bread production. - 1. Part: A rapid method for routine analysis (enzymatical and mechanical lysis) of plasmids from starter cultures of the genus Lactobaccilus]. Einsatz definierter Starterkulturen zur Herstellung von Weizensauerteigbrot. - 1. Mitt.: Schnellmethode zur Isolierung von Plasmiden aus Starterkulturen der Gattung Lactobacillus.** *Getreide Mehl und Brot (Germany) v. 49(2) p. 93-98.* 2 graphs, 5 tables; 39 ref. German. (AGRIS 96-023004).

1961 Renard, C. (Agro Industrie Recherches et Developpements, Pomacle (France)); Belloy, C.; Pauwels, O.; de Baynast, R. (1995) **[Dimensioning of a crossflow filtration unit: treatment of wheat and chicory hydrolysates]. Dimensionnement d'une unite de filtration tangentielle: cas du traitement des hydrolysats de ble et de chicoree.** *Industries Alimentaires et Agricoles (France) v. 112(7-8) p. 491-498.* 7 ref., 7 graph. French. (AGRIS 96-011197).

1962 Roach, RR.; Hoseney, RC. (1995) **EFFECT OF CERTAIN SURFACTANTS ON THE STARCH IN BREAD.** *Cereal Chemistry. 72(6):578-582.* English. [KEEBLER CO ELMHURST, IL USA].

Addition of Tristearin (C(18)TG) improved loaf volume in a manner similar to that of shortening. Triolein (C(18)TG), when used to replace shortening in the breadmaking formula, improved volume only slightly, probably because less solid fat was present. Using the hydrated form of monoglycerides (MG) was more effective than blending the MG with the flour in a high-speed mixer or adding them as is. Light micrographs of starch isolated from bread showed that MG or sodium stearoyl lactylate (SSL) added to the formula reduced the swelling of starch, whereas shortening did not. If the effect of MG on crumb firmness relates to their effect on starch swelling, then the mechanism of softening for MG is different than that for shortening. The SSL had a somewhat different effect in this limited water system than it had in an excess water system. The effect appeared to be similar to that in the excess water system heated to a lower temperature. Studies with bread made from defatted flour showed that MG reduced crumb firmness, whereas shortening did not. This supports the idea that the mechanisms by which these two lipids reduce crumb firmness are different. [References: 21].

1963 Rochagarza, AE.; Zayas, JF. (1995) **EFFECT OF WHEAT GERM PROTEIN FLOUR ON THE QUALITY CHARACTERISTICS OF BEEF PATTIES COOKED ON A GRIDDLE.** *Journal of Food Processing & Preservation. 19(5):341-360.* English. [KANSAS STATE UNIV DEPT FOODS & NUTR JUSTIN HALL MANHATTAN, KS 66506 USA].

Patties with ground beef alone or extended with wheat gem protein flour (WGPF) at levels of 2.0, 3.5, and 5.0% were fabricated. WGPF was added as a slurry. Beef patties were. cooked on a griddle to a temperature of 69+/-1C. With the addition of WGPF, water holding capacity decreased and pH increased. No difference was found in a(W). Yield increased and cooking losses decreased as extension level increased. Beef patties with WGPF added shrank less than all Beef patties. Protein and fat contents decreased, but moisture increased with the addition of WGPF. Extension with WGPF did not cause significant changes in amino acid content. Wheat-like aroma and flavor as well as juiciness and tenderness increased as extension level increased. No difference in lightness was found; however, redness decreased and yellowness increased with increasing WGPF. WGPF showed a potential use as a meat extender.

1964 Saulnier, L.; Peneau, N.; Thibault, JF. (1995) **VARIABILITY IN GRAIN EXTRACT VISCOSITY AND WATER-SOLUBLE ARABINOXYLAN CONTENT IN WHEAT.** *Journal of Cereal Science. 22(3):259-264.* English. [INRA BIOCHIM & TECHNOL GLUCIDES LAB BP 527 F-44026 NANTES FRANCE].

Twenty-two varieties of wheat grown in France were analysed for their content of water-soluble arabinoxylans and the viscosity of their aqueous extracts. A high natural variation was observed in these two parameters [range 0.36-0.83% (w/w) dry matter and 1.24-2.28, for arabinoxylan content and relative viscosity, respectively]. The water-soluble arabinoxylans also exhibited a large variation in weight-average molecular weight as shown by size-exclusion chromatography and their intrinsic viscosities. The content of water-soluble arabinoxylans was only poorly correlated with the viscosity of the aqueous extracts. (C) 1995 Academic Press Limited [References: 19].

1965 Shomer, I.; Lookhart, G.; Salomon, R.; Vasiliver, R.; Bean, S. (1995) **HEAT COAGULATION OF WHEAT FLOUR ALBUMINS AND GLOBULINS, THEIR STRUCTURE AND TEMPERATURE FRACTIONATION.** *Journal of Cereal Science. 22(3):237-249.* English. [AGR RES ORG VOLCANI CTR DEPT FOOD SCI POB 6 IL-50250 BET DAGAN ISRAEL].

Albumins and globulins were fractionated by coagulation at 70, 100, and 120 degrees C and were studied by microscopic and electrophoretic methods. The coagulated albumins of a U.S. commercial hard red winter (HRW) wheat blend sample included larger aggregates than those of an Israeli spring wheat (SW). Dialyzed globulins appeared as finger-like patterns with embedded oil droplets and heat-coagulated globulins appeared as aggregates with fibril-like patterns. An increase in size of coagulated aggregates was observed as temperatures increased (70, 100, and 120 degrees C). Differences in capillary zone electrophoresis (CZE) and sodium dodecyl sulfate (SDS)- polyacrylamide gel electrophoresis (PAGE) patterns between coagulates from samples of an Israeli SW and a U.S. commercial HRW wheat were seen at all the coagulation temperatures. SDS-PAGE patterns of coagulates obtained at lower temperatures exhibited relatively more intense bands of higher molecular weight components, and those obtained at higher temperatures exhibited relatively more intense bands of lower molecular weights. (C) 1995 Academic Press Limited [References: 22].

1966 Sumathi, A.; Vishwanatha, S.; Malleshi, NG.; Rao, SV. (1995) **EFFECT OF PROCESSING DIFFERENCES IN CARBOHYDRATES OF CEREAL LEGUME BLENDS ON BLOOD GLUCOSE RESPONSES IN AN INDIVIDUAL WITH IMPAIRED GLUCOSE TOLERANCE.** *Journal of Food Science & Technology-Mysore. 32(5):413-415.* English. [CENT FOOD TECHNOL RES INST DEPT GRAIN SCI & TECHNOL MYSORE 570013 KARNATAKA INDIA].

Among cereal-legume blends of malted, popped and roller dried wheat, chickpea, greengram and moth bean, the malted cereal-legume blend showed the highest glycemic response in a normal as well as in an individual with impaired glucose tolerance, as compared to popped and roller dried cereal-legume blends. [References: 13].

1967 Swanston, JS.; Ellis, RP.; Stark, JR. (1995) **EFFECTS ON GRAIN AND MALTING QUALITY OF GENES ALTERING BARLEY STARCH COMPOSITION.** *Journal of Cereal Science. 22(3):265-273.* English. [SCOTTISH CROP RES INST DUNDEE DD2 5DA SCOTLAND].

In this study inbred barley lines carrying waxy and/or high amylose genes were obtained from a cross between Waxy Hector and a breeders' line BE285 (high amylose Glacier x Midas) and assessed for malting quality. Inbred lines were assayed and classified as having none, one or both genes. After malting, waxy lines had a slightly lower hot water extract than normal starch lines. Large effects were demonstrated for both grain nitrogen content and hot water extract in high amylose lines and, particularly, in lines with both genes. Endosperm modification during malting was reduced by both starch mutations. Electron microscopy showed that the phenotype with both genes was characterised by a highly compacted endosperm. During malting, this structure was extremely resistant to modification. (C) 1995 Academic Press Limited [References: 37].

1968 Symons, SJ.; Dexter, JE. (1996) **ALEURONE AND PERICARP FLUORESCENCE AS ESTIMATORS OF MILL STREAM REFINEMENT FOR VARIOUS CANADIAN WHEAT CLASSES.** *Journal of Cereal Science. 23(1):73-83.* English. [CANADIAN GRAIN COMMISS GRAIN RES LAB 1404-303 MAIN ST WINNIPEG MB CANADA].

Mill streams from laboratory-scale and pilot-scale millings of seven Canadian wheat classes were used to extend previous evaluations of fluorescence imaging as a flour refinement estimator. Flour streams and diverse mill streams derived from throughout the Grain Research Laboratory (GRL) Pilot Mill during the milling of Canada Western Red Spring (CWRS) wheat were subjected to fluorescence measurement of pericarp and aleurone tissue. Both techniques showed clear differentiation among the mill streams. Strong linear relationships of pericarp fluorescence to ash content, grade colour and L^* (brightness) were found. Relationships of aleurone fluorescence to the same refinement indices, although still statistically significant ($P<0.05$), were weaker because of the previously established tendency for break flours to exhibit lower aleurone fluorescence than reduction flours of comparable refinement. Extending the GRL Pilot Mill break system to broaden the refinement range within CWRS break flours confirmed a strong linear relationship between break flour refinement and aleurone fluorescence. The robustness of fluorescence as a hour refinement indicator under different milling conditions was examined for commercially grown wheats from seven Canadian wheat classes using three different mills. For every wheat class and every milling process both fluorescence techniques showed clear differentiation among flour streams. Pericarp fluorescence was strongly related to flour refinement for all wheat classes, aleurone fluorescence was less strongly related because of anomalous low fluorescence of break flours. The relationships of pericarp fluorescence to the flour refinement indices were heterogeneous among wheat classes. It is well established that flour ash content and flour colour have limitations for estimating the refinement of flours from wheats of diverse origin. Therefore, the heterogeneity of pericarp flourescence relations among wheats provides evidence that pericarp fluorescence is a more objective flour refinement estimator. The regression equations of pericarp fluorescence to flour refinement indices when a single wheat was milled by different mills were clustered closely, although heterogeneity was evident for several wheats. (C) 1996 Academic Press Limited [References: 42].

1969 Tuomi, T.; Rosenqvist, H. (1995) **ANNUAL VARIATIONS IN THE MICROFLORA OF SOME VARIETIES OF FINNISH MALTING BARLEY.** *Agricultural Science in Finland. 4(4):407-418.* English. [HELSINKI UNIV TECHNOL DEPT CHEM ENGN BIOCHEM & MICROBIOL LAB SF-02150 ESPOO FINLAND].

Three major Finnish malting barley varieties were studied for annual variations in the incidence of seed-derived fungi, bacteria and actinomycetes. In 1990-1992, 114 characterized fungal, 59 uncharacterized bacterial and 12 uncharacterized actinomycetal isolates were extracted from samples of seed intended for use in malting. When the yield of the plant hormone, indole-3-acetic acid (IAA), from enriched microbial cultures was weighed against the microbial biomass and the endogenous IAA concentration of the barley harvests, it was concluded that potential exists for bacterial IAA production in biologically significant amounts, given some minor annual variations. As expected from the average rainfall

and temperature during the growing season, microbial counts in all cultivars were highest in 1992. Most of the fungal species found were of saphrophytic character, and field fungi were dominant in the samples. On the whole, microbial counts and spectra in all samples confirmed that each harvest of all cultivars was of good vigour and well suited for malting purposes. Strains of plant pathogenic character included species of Septoria nodorum (Berk) Berk, Drechlera teres (Sacc) Subraim & Jain, D. sorokiniana (Sacc) Subram & Jain and D. graminea (Rab.) Shoem. A consistent difference was noted in the microbial infection severities of the cultivars.

1970 Warchalewski, JR.; Stasinska, B.; Madaj, D. (1995) **CHANGES IN PH AND SOME BIOLOGICAL ACTIVITIES OF EXTRACTABLE PROTEINS DURING MALTING PROCESS OF WHEAT GRAIN.** *Nahrung. 39(5-6):419-431.* English. [AGR UNIV DEPT FOOD BIOCHEM & ANAL 48 MAZOWIECKA ST PL-60623 POZNAN POLAND].

The dynamics of changes in extractable protein content, total alpha- and beta-amylolytic activity, alpha-amylolytic activity, anti-alpha-amylolytic and antitryptic activities as well as of pH values during malting process of selected wheat grain variety were studied. The effect of the microflora on the native amylases and their inhibitors were accounted for by microbiological evaluation of wheat grain and malted wheat. After steeping at 72 h the pH of water extracts of wheat grain decreased from 6.4 to 6.0 in samples germinated with gibberellic acid (GA(3)), and to 6.1 in samples germinated without GA(3) added. Further decrease of pH up to 5.8 was noted during germination in the case of GA(3) added. On the other hand the increase of native alpha-amylolytic activity and activities of endogenous inhibitors within the first 72 h (steeping) of malting process of wheat grain with and without GA(3) added were hightly correlated. Rapid increase of wheat grain extractable proteins were started 24 h later. Physiological importance of these findings was discussed. [References: 42].

1971 Weegels, PL.; Hamer, RJ.; Schofield, JD. (1996) **FUNCTIONAL PROPERTIES OF WHEAT GLUTENIN [Review].** *Journal of Cereal Science. 23(1):1-18.* English. [TNO NUTR & FOOD RES BIOCHEM & GENE TECHNOL DIV POB 360 3700 AJ ZEIST NETHERLANDS].

The importance of glutenin in bread-making quality has led to a substantial research effort. Studies on glutenin can be grouped into four categories: studies that determine the statistical relationships between the quantity of fractions and quality, studies of reconstitution and fortification, breeding and genetic modification, and those that assess structure-function relationships during processing. Statistical relationships between glutenin, glutenin fractions and glutenin polypeptides and quality have been established. The SDS or acetic acid unextractable glutenin correlated strongly with quality parameters. For high M(r) glutenin subunits the relationships with quality are less strong. In some studies it was demonstrated that the presence of some high M(r) glutenin subunits is correlated with the quantity of unextractable glutenin. Therefore, subunits are probably indirectly linked with breadmaking quality via the quantity of unextractable glutenin. Recombination and fortification studies are hampered by changes in functionality of proteins after their separation. Recently, small scale tests have been developed in which small amounts of glutenin fractions can be studied. Controlled breeding studies have demonstrated the importance of high M(r) glutenin subunits 5 + 10 and, to a lesser extent, 1 or 2* for quality. In most of these studies the quantity of unextractable glutenin is not reported. This hampers adequate conclusions on cause-effect relationships. During dough processing large changes occur in the extractability of glutenin. The significance of these changes for dough properties and bread quality still requires investigation. (C) 1996 Academic Press Limited [References: 140].

1972 Zwingelberg, H. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1995) **[Possibilities and limitations with simplified flour production technics]. Moeglichkeiten und Grenzen beim Einsatz vereinfachter Mehlherstellungsverfahren.** *Getreide Mehl und Brot (Germany) v. 49(2) p. 85-89.* 11 graphs; 11 ref. German. (AGRIS 96-022998).

Q03 FOOD CONTAMINATION AND TOXICOLOGY

1973 Beck, R. (1995) **[Infestation and significance of mycotoxins in grain and in milling products]. Vorkommen und Bedeutung von Mykotoxinen im Getreide und in Mahlprodukten.** *Muehle + Mischfuttertechnik (Germany) v. 132(9) p. 130-131.* 6 graphs. German. (AGRIS 96-023188).

1974 Chaudri, AM.; Zhao, FJ.; Mcgrath, SP.; Crosland, AR. (1996) **THE CADMIUM CONTENT OF BRITISH WHEAT GRAIN (VOL 24, PG 850, 1995).** *Journal of Environmental Quality. 25(1):202.* English.

1975 Ocker, H. D. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Eich, E.; Tietz, U.; Mrowietz, E. (1995) **[Pesticides and heavy metal residues in the German bread grain crop 1991 - 1993. - Part I: Residues of pesticides]. Rueckstaende von Pflanzenschutzmitteln und Schwermetallgehalte in den gesamtdeutschen Brotgetreideernten (BEE) der Jahre 1991 - 1993. - Teil I: Pflanzenschutzmittelrueckstaende.** *Getreide Mehl und Brot (Germany) v. 49(2) p. 118-123.* 2 graphs, 7 tables; 4 ref. German. (AGRIS 96-023187).

1976 Srivastava, A.; Gupta, K.C.; Singh, G. (Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (India). Department of Chemistry) (1994) **Residue analysis of tralkoxydim herbicide in soil, wheat grain and straw by reversed phase HPLC.** *Pesticide Research Journal (India) v. 6(2) p. 175-179.* 1 table; 5 ill., 6 ref. English. (AGRIS 96-011389).

1977 Wolff, J. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1995) **[On the occurence of mycotoxins in cereals]. Zum Vorkommen von Mykotoxinen in Getreide.** *Getreide Mehl und Brot (Germany) v. 49(3) p. 139-147.* 17 graphs, 2 tables; 62 ref. German. (AGRIS 96-023256).

1978 Yeung, JM.; Mortimer, RD.; Collins, PG. (1996) **DEVELOPMENT AND APPLICATION OF A RAPID IMMUNOASSAY FOR DIFENZOQUAT IN WHEAT AND BARLEY PRODUCTS.** *Journal of Agricultural & Food Chemistry. 44(1):376-380.* English. [HLTH CANADA HLTH PROTECT BRANCH BUR CHEM SAFETY FOOD DIRECTORATE FOOD RES DIV PL 2203D OTTAWA ON K1A 0L2 CANADA].

A sensitive and simple enzyme-linked immunosorbent assay (ELISA) is described for the quantification of difenzoquat (DFQ) in foods using polyclonal antibodies. Two hapten analogues of DFQ with five-carbon spacer arms attached to one of the aromatic rings were synthesized. The resulting antiserum was specific to DFQ. The minimum detection limit was 0.8 ng/mL for beer and 16 ng/g for cereals with an IC50 (50% inhibition of binding) of 0.28 ng/mL in this assay. The recoveries of DFQ spiked at three levels into beer, cereal, and bread ranged from 72% to 101%. The mean intraassay and inter-assay coefficients of variation in this procedure were 4.68 and 6.9% for five commodities spiked at 100 ng/g or ng/mL DFQ, respectively. The ELISA procedure was applied to a limited survey of 13 beers and 12 breads, but no detectable DFQ residue was found. [References: 17].

Q04 FOOD COMPOSITION

1979 Abdelaal, ESM.; Hucl, P.; Sosulski, FW. (1995) **COMPOSITIONAL AND NUTRITIONAL CHARACTERISTICS OF SPRING EINKORN AND SPELT WHEATS.** *Cereal Chemistry. 72(6):621-624.* English. [UNIV SASKATCHEWAN DEPT CROP SCI & PLANT ECOL 51 CAMPUS DR SASKATOON SK S7N 5A8 CANADA].

One einkorn and five spring spelt accessions were grown at five and four locations in 1992 and 1993, respectively, and evaluated for their compositional and nutritional properties compared to common hard red spring (HRS) and durum wheats. Einkorn and two spelt accessions, SK0021 and PGR8801, were higher in soluble sugars, protein, and ash, whereas spelt accessions SK0505, SK0263, and RL5407 were higher in starch and fat. The accessions contained less total and insoluble dietary

fiber than did common HRS, while soluble fiber was similar among the wheat species. Einkorn was significantly higher in phosphorus level, and all accessions exceeded the HRS wheat in potassium level. Einkorn tended to be high in riboflavin and pyridoxine compared with other wheats, whereas einkorn and spelt SK0263 and RL5407 were richer in beta-carotene and retinol equivalent than was common HRS wheat. Einkorn and spelt SK0021 and PGR8801 flours had higher protein contents than did common HRS flour. The gluten content of all wheat species was similar and constituted about 77% of total flour protein. The gliadin to glutenin ratios were 2:1 for einkorn; 1:1 for spelt SK0021 and PGR8801 and common HRS; and 0.8:1 for durum and spelt SK0505, SK0263, and RL5407 wheat flour proteins. [References: 22].

1980 Biliaderis, CG.; Prokopowich, DJ.; Jacobson, MR.; Bemiller, JN. (1996) **EFFECT OF N-ALKYL GLUCOSIDES ON WAXY MAIZE AND WHEAT STARCH RETROGRADATION.** *Carbohydrate Research. 280(1):157-169.* English. [PURDUE UNIV WHISTLER CTR CARBOHYDRATE RES W LAFAYETTE, IN 46907 USA].

1981 Brueggemann, J. (Bundesanstalt fuer Getreide , Kartoffel und *Fettforschung in* Detmold und Muenster, Detmold (Germany)); Kumpulainen, J. (1995) **[The status of trace elements in German cereal based staple foods]. Spurenelementgehalte in deutschen Grundnahrungsmitteln aus Brotgetreide.** *Getreide Mehl und Brot (Germany) v. 49(3) p. 171-177.* 9 graphs, 5 tables; 26 ref. German. (AGRIS 96-023362).

1982 Corke, H. (1995) **PROTEIN CONTENT AND COMPOSITION IN CROSSES BETWEEN WILD AND CULTIVATED BARLEY.** *Cereal Research Communications. 23(4):411-417.* English. [UNIV HONG KONG DEPT BOT POKFULAM RD HONG KONG HONG KONG].

Hordeum spontaneum Koch, the wild progenitor of cultivated barley (Hordeum vulgare L) is known to be high in grain protein concentration (GPC). Experiments were conducted to determine its potential usefulness in breeding for increased grain protein concentration and improved nutritional quality of barley grown for human and animal diets. A series of cross and backcross derived lines were obtained from five accessions of H. spontaneum crossed to Australian H. vulgare cv. 'Clipper', using 'Clipper' as the recurrent parent. There were significant effects of level of backcrossing and of H. spontaneum parental source on GPC and on seed weight. However, the mean GPC of 14% in F-2 plants (compared to 10% in the 'Clipper' parent), was reduced to a mean of about 12% after only one backcross, although variation was observed. Mean seed weight was generally maintained near the level of the 'Clipper' parent. Further studies were made on lines derived from H. spontaneum line HS-5, grown at two levels of nitrogen, to determine the distribution of protein into hordein, salt soluble, and glutelin components. In most of the 'Clipper' x HS-5 derived lines the fractions were almost identical to those in 'Clipper' itself, an observation that has favorable implications for maintaining the relatively high lysine levels of the cultivated parent in selected lines. Higher nitrogen conditions favored increased GPC, decreased seed size, slightly increased hordein percent in protein, and reduced relative differences in GPC. [References: 16].

1983 Cserhalmi, Zs.; Czukor, B. (Kozp. Elelmiszerip. Kut. Int. (Hungary)) *(1994)* **[Effect of extrudation on some technofunctional properties of wheat meal]. Az extrudalas hatasa a buzadara egyes technofunkcios tulajdonsagaira.** *Elelmezesi Ipar (Hungary) v. 48(9) p. 263-266.* 4 tables; 3 ill. Hungarian. (AGRIS 96-011780).

The authors have examined, how the changes of the extrudational circumstances - temperature of the process, moisture content of the basis material - influence the expansion index (EI), the water and fat binding ability of wheat-meal using BRABENDER 20 DN laboratory extruder.

1984 Falk, JD.; Sokhansanj, S.; Besant, RW. (1996) **CONTINUOUS MEASUREMENT OF THE SIZE AND MASS OF WHEAT KERNELS USING MICHELSON INTERFEROMETRY.** *Computers & Electronics in Agriculture. 14(1):1-8.* English. [UNIV SASKATCHEWAN COLL ENGN SASKATOON SK S7N 5A9 CANADA].

In this paper, we describe an optical method for making continuous and simultaneous measurements of the change in size and mass of a kernel of grain during drying at room temperature. The instantaneous mass is measured by gravimetric method while the change in an overall dimension is measured by an optical method using the Michelson interferometry technique. The dimensional measurements were made to within 0.3 microns and the mass measurements were made to within of 0.0001 g. The system was sensitive to grain orientation and vibrations during measurements. [References: 8].

1985 Forssell, P.; Hamunen, A.; Autio, K.; Suortti, T.; Poutanen, K. (1995) **HYPOCHLORITE OXIDATION OF BARLEY AND POTATO STARCH.** *Starch-Starke. 47(10):371-377.* English. [VTT BIOTECHNOL & FOOD RES POB 1500 SF-02044 VTT FINLAND].

The oxidation of barley and potato starches was studied using sodium hypochlorite as oxidant. The degree of oxidation, depolymerization during oxidation and gel formation of barley starch was compared with the properties of potato starch. The effect of oxidation on gelatinization of starches as well as on amylose-lipid complex of barley starch was also analyzed. Barley starch was not as easily oxidized as potato starch. In both starches depolymerization of amylopectin and amylose occurred during oxidation. Based on the dissociation enthalpy of amylose-lipid complex, the lipid-bound amylose in barley starch was readily oxidized. Oxidation decreased the gelling ability of barley starch. At high level of oxidation gel formation by potato starch was much slower and weaker than by barley starch. [References: 28].

1986 Gennadios, A. (University of Nebraska Lincoln, Lincoln, NE.); Weller, C.L. (1992) **Tensile strength increase of wheat gluten films.** *American Society of Agricultural Engineers. Meeting (USA); no. 926517 10 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 96-011632).

1987 Gidley, MJ.; Cooke, D.; Darke, AH.; Hoffmann, RA.; Russell, AL.; Greenwell, P. (1995) **MOLECULAR ORDER AND STRUCTURE IN ENZYME-RESISTANT RETROGRADED STARCH.** *Carbohydrate Polymers. 28(1):23-31.* English. [UNILEVER RES LABS VLAARDINGEN COLWORTH HOUSE SHARNBROOK MK44 1LQ BEDS ENGLAND].

Molecular features underlying the resistance to amylolytic hydrolysis in cooked and cooled gels of wheat, amylomaize V and amylomaize VII starches have been investigated using a combination of physicochemical techniques. X-ray diffraction and C-13 CP/MAS NMR spectroscopy indicate levels of crystalline and double helical order to be 25-30% and 60-70%, respectively, in enzyme-resistant retrograded starches. The width of features in diffraction patterns and NMR spectra indicate smaller and/or less perfectly arranged B-type double helical aggregates than found in native potato or amylomaize VII starch. Differential scanning calorimetry in excess water shows a broad endothermic transition from below 100 to c. 170 degrees C which is interpreted in terms of double helix melting. Consistent with a broad melting endotherm, (linear) chain lengths present in enzyme-resistant starches cover a range of degree of polymerisation (DP) from less than 10 to c. 100 as determined by high performance anion exchange chromatography (HPAEC). This dispersion of chain lengths coincides with the range expected from previous studies for double helices (minimum required DP of 10) with no major intervening amorphous regions (maximum DP similar to 100). HPAEC analysis also shows a periodicity in chain length for DP multiples of 6 above DP18 for all three enzyme-resistant retrograded starches. A model is proposed to account for this observation based on restricted enzyme access to potential substrates arranged in double helical aggregates. In general, enzyme-resistant retrograded starch reflects features both of aggregated/gelled amylose (high double helix content; low crystallinity, DP range from junction zones of DP 10-100), and the consequence of enzyme action on such a structure (periodicity of six units from accessibility of enzyme to aggregated substrate). [References: 43].

1988 Han, S.H.; Kim, J.M.; Baek, S.H. (Wonkwang University, Iri (Korea Republic). College of Agriculture) (1995) **Aluminum contents in wheat**

flour foods. *Korean Journal of Food Science and Technology (Korea Republic) v. 27(3) p. 303-305.* 4 tables; 12 ref. Korean. (AGRIS 96-011781).

1989 Holdsworth, MJ.; Munozblanco, J.; Hammondkosack, M.; Colot, V.; Schuch, W.; Bevan, MW. (1995) **THE MAIZE TRANSCRIPTION FACTOR OPAQUE-2 ACTIVATES A WHEAT GLUTENIN PROMOTER IN PLANT AND YEAST CELLS.** *Plant Molecular Biology. 29(4):711-720.* English. [JOHN INNES CTR DEPT MOLEC GENET COLENY LANE NORWICH NR4 7UJ NORFOLK ENGLAND].

The promoter of the wheat low-molecular-weight glutenin (LMTYG1D1) gene contains a cis element called the GCN4 like motif (GLM) which has low homology to one class of binding site for the maize endosperm-specific b-ZIP transcription factor Opaque-2 (O2). Previous work has shown that the GLM element interacts with the nuclear factor ESBFII during wheat endosperm development at the time of maximum transcription of the LMWG1D1 gene. In this paper we demonstrate that O2 binds to the GLM element and can activate high levels of transcription from the wheat GLM in transient assays in plant protoplasts and in yeast cells. Lower levels of O2 activation through the GLM element in yeast containing a defective GCN4 gene showed that GCN4 was necessary for high levels of O2 transcriptional activation, indicating that O2 may need to heterodimerise with GCN4 to activate transcription in yeast. These observations provide evidence that the GLM represents a new type of O2 DNA-binding site, and support a postulate that an O2 homologue may activate endosperm-specific expression of wheat storage protein genes. [References: 33].

1990 Hong, B.H.; Baik, B.K. (Korea University, Seoul (Korea Republic). Department of Agronomy) (1995) **Studies on selection of dietary fiber resources-(3)-Relationship between endosperm pentosan content and grain hardness in different classes of wheat cultivars.** *Korean Journal of Breeding (Korea Republic) v. 27(3) p. 226-235.* 6 ill.; 6 tables; 17 ref. Korean. (AGRIS 96-023369).

1991 Hong, B.H.; Baik, B.K. (Korea University, Seoul (Korea Republic). Department of Agronomy) (1995) **Studies on selection of dietary fiber resources-(4)-Constitutional difference of flour fractions in wheat cultivars and its relationships with pentosan and grain hardness.** *Korean Journal of Breeding (Korea Republic) v. 27(3) p. 236-243.* 5 ill.; 6 tables; 16 ref. Korean. (AGRIS 96-023463).

1992 Hou, G.; Ng, PKW. (1995) **QUANTIFICATION OF GLUTENIN SUBUNITS BY SEQUENTIAL ACETONE PRECIPITATION AND BY SODIUM DODECYL SULFATE POLYACRYLAMIDE GEL ELECTROPHORESIS (SDS-PAGE) COUPLED WITH DENSITOMETRY USING A KNOWN QUANTITY OF GLUTENINS AS A STANDARD.** *Cereal Chemistry. 72(6):545-551.* English. [MICHIGAN STATE UNIV DEPT FOOD SCI & HUMAN NUTR E LANSING, MI 48824 USA].

Glutenin subunit groups (high molecular weight glutenin subunits, [HMW-GS]; low molecular weight glutenin subunits [LMW-GS]) were quantified by a sequential acetone precipitation method and by sodium dodecyl sulfate polyacrylamide, eel electrophoresis (SDS-PAGE) coupled with densitometry using a known quantity of extractable glutenin proteins as a quantitative standard. The average quantity of extractable HMW-GS analyzed in 17 soft wheat patent flours was 8.46 and 7.26% of flour protein by the sequential acetone precipitation and densitometric methods, respectively, whereas the average quantity of extractable LMW-GS was 15.29% of flour protein by the sequential acetone precipitation method and 17.07% of flour protein by the densitometric method. The mean total quantities of extractable glutenin subunits in the 17 flour samples determined by these two methods were 23.75 and 24.33%, respectively. There were no significant differences between the two methods ($P > 0.05$) in the quantities of the total glutenins determined. However, the quantities of HMW-GS, LMW-GS, and total glutenin subunits determined by each of the procedures were highly correlated. The densitometric quantification of glutenin subunit groups with the aid of a known quantity of glutenin proteins as a quantitative standard was shown to be an effective method because of its speed, small sample size, reliability, and simultaneous quantification and characterization of glutenin subunits. [References: 34].

1993 Huebner, F.R. (National Center for Agric. Util. Research, USDA, ARS, Peoria, IL.); Bietz, J.A. (1994) **RP-HPLC for assessment of quality in cereals and legumes. Breadmaking quality (wheat).** *High-performance liquid chromatography of cereal and legume proteins p. 206-234.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-023462).

1994 Im, H.; Henson, CA. (1995) **CHARACTERIZATION OF HIGH PI ALPHA-GLUCOSIDASE FROM GERMINATED BARLEY SEEDS - SUBSTRATE SPECIFICITY, SUBSITE AFFINITIES AND ACTIVE-SITE RESIDUES.** *Carbohydrate Research. 277(1):145-159.* English. [UNIV WISCONSIN DEPT AGRON MADISON, WI 53706 USA].

Substrate specificity and subsite affinities of high pI alpha-glucosidase from germinated barley (Hordeum vulgare L.) seeds were investigated by kinetics. The enzyme has only one maltose binding site per molecule and shows high activity on small maltooligosaccharides and nigerose, Hydrolysis of isomaltose and p-nitrophenyl alpha-glucoside is moderate. Trehalose is not hydrolyzed at detectable rates. The ratios of the maximum velocities for maltose, nigerose, isomaltose, p-nitrophenyl alpha-glucoside and malto-triose, -tetraose, -pentaose, -hexaose, -heptaose are 100:95:21:9:111:116:119:104:111. The K-m values for these substrates are 1.91, 1.29, 5.32, 1.04, 1.11, 2.37, 2.92, 5.44 and 7.89 mM, respectively. Based on the rate parameters for maltooligosaccharides, the subsite affinities (A(i)s) in the active site of the enzyme were evaluated according to subsite theory. Subsites 1, 2 and 3, having positive A(i) values (A(1), A(2) and A(3); 1.34, 5.37 and 0.27 kcal/mol, respectively), were considered to be effective for the binding of substrate to the active site. The different arrangement of subsite affinities among alpha-glucosidases, glucoamylases and amylases was used to explain their substrate specificities. Chemical modification with conduritol B epoxide and N-bromosuccinimide in the presence and absence of ligands revealed carboxylate and tryptophanyl groups, respectively, as essential functional groups in the active site of the enzyme. Chemical modification with phenylglyoxal and *pyridoxal 5'-phosphate* suggests that arginine and lysine, respectively, also have significant roles in enzyme function. [References: 37].

1995 Izydorczyk, MS.; Biliaderis, CG. (1995) **CEREAL ARABINOXYLANS - ADVANCES IN STRUCTURE AND PHYSICOCHEMICAL PROPERTIES.** *Carbohydrate Polymers. 28(1):33-48.* English. [GRAIN RES LAB 1404-303 MAIN ST WINNIPEG MB R3C 3G8 CANADA].

Arabinoxylans constitute a major fraction of cereal cell wall polysaccharides. They consist of a linear beta-(1→4) linked xylan backbone to which alpha-L-arabinofuranose units are attached as side residues via alpha-(1→3) and/or alpha-(1→2) linkages. Several structural models have been put forward based on enzymic degradation studies and structure elucidation of oligosaccharides by NMR, methylation, and periodate oxidation techniques. These tentative models present different substitution patterns of arabinoses along the xylan chain. Cereal arabinoxylans exhibit a great deal of structural heterogeneity with respect to ratio of Araf/Xylp, substitution pattern of arabinoses, content of feruloyl groups and molecular size. The conformation and physicochemical properties (viscosity, gelation potential, intermolecular association) of arabinoxylans in aqueous solutions are dependent on the molecular features of these polysaccharides; specific structure-property relationships have been established in model and actual food systems. Wheat and rye arabinoxylans are important functional ingredients in baked products affecting the mechanical properties of dough, as well as the texture and other end-product quality characteristics. [References: 94].

1996 Kelfkens, M. (TNO Nutrition and Food Research, Zeist (Netherlands)) (1995) **[Prediction and evaluation of wheat milling quality]. Vorausbestimmung der Mahlfaehigkeit von Weizen.** *Getreide Mehl und Brot (Germany) v. 49(3) p. 135-138.* 9 graphs; 4 ref. German. (AGRIS 96-023367).

1997 Kunde, K. H. (1995) **[Buck wheat. Cultivation, growth and harvesting, processing and significance in nutrition]. Buchweizen. Anbau, Aufwuchs und Ernte, Bearbeitung und Bedeutung in der Ernaehrung.** *Muehle + Mischfuttertechnik (Germany) v. 132(8) p. 119-121.* 5 ill., 2 graphs; 5 ref. German. (AGRIS 96-023374).

1998 Labuschagne, MT.; Vandeventer, CS. (1995) **VARIABILITY OF QUALITY CHARACTERISTICS IN SOFT WHEATS DIFFERING ON THE GLU-B1 LOCUS.** *Cereal Research Communications. 23(4):419-424.* English. [UNIV ORANGE FREE STATE DEPT PLANT BREEDING POB 339 BLOEMFONTEIN SOUTH AFRICA].

Two groups of F-2:4 derived soft wheat lines differing only on the Glu-B1 locus were used to compare the contribution of 12 measured traits to wheat quality in the presence of different Glu-B1 high molecular weight glutenin subunits (HMW-GS). A stepwise multiple regression analysis was used. Contributing factors for the two sets of material differed largely. In one group of material the presence of HMW-GS 17+18 was a large contributor to variability in wheat quality, especially to the alveograph and mixograph measurements. In the other set of material the contribution of these HMW-GS was very small, but AWRC was a major contributor to variability in wheat quality. This suggest that the expression of quality characteristics was largely influenced by genetic background. The Glu-B1 subunits will, however, have to be taken into account when parents for a soft wheat breeding programme are chosen. [References: 14].

1999 Liljeberg, HGM.; Granfeldt, YE.; Bjorck, IME. (1996) **PRODUCTS BASED ON A HIGH FIBER BARLEY GENOTYPE, BUT NOT ON COMMON BARLEY OR OATS, LOWER POSTPRANDIAL GLUCOSE AND INSULIN RESPONSES IN HEALTHY HUMANS.** *Journal of Nutrition. 126(2):458-466.* English. [LUND UNIV CTR CHEM DEPT APPL NUTR & FOOD CHEM S-22100 LUND SWEDEN].

Postprandial blood glucose and insulin responses to cereal products made from common barley, oats or a barley genotype containing elevated levels of beta-glucans were evaluated in nine healthy subjects, Porridges were made from commercial Swedish wholemeal barley or oat flours, and a mixed whole-meal porridge using the high fiber barley genotype and commercial Swedish common barley (50:50). Also studied were two types of flour-based bread products composed of high fiber barley and common barley in ratios of 50: 50 or 80:20, respectively. The common oat and barley porridges produced postprandial glucose and insulin responses similar to the white wheat bread reference, suggesting that the naturally occurring dietary fiber in these whole-meal flours has no impact on the glucose tolerance. In contrast, all high fiber barley products induced significantly lower responses than did the reference product, with the glycemic and insulin indices ranging from 57 to 72 or 42 to 72%, respectively. It is concluded that "lente" products of high sensory quality can be prepared from a barley genotype with an elevated content of soluble dietary fiber. The glycemic index of these products compares favorably with that of products made from common cereals, suggesting their use as a potential component of diets for patients with diabetes and hyperlipidemia, and for individuals predisposed to metabolic disease. [References: 34].

2000 Lookhart, G.; Bean, S. (1995) **SEPARATION AND CHARACTERIZATION OF WHEAT PROTEIN FRACTIONS BY HIGH-PERFORMANCE CAPILLARY ELECTROPHORESIS.** *Cereal Chemistry. 72(6):527-532.* English. [USDA ARS N CENT REG US GRAIN MKT RES LAB 1515 COLL AVE MANHATTAN, KS 66502 USA].

Wheat protein fractions, separated by the Osborne Solvent Fractionation Procedure, were characterized by high-performance capillary electrophoresis (HPCE). Each fraction was separated on a 27-cm fused-glass capillary (20 mu m, i.d.) using 0.1 M phosphate buffer (pH 2.5) containing hydroxypropylmethylcellulose, a polymer additive, at 45 degrees C and 22 kV constant voltage. Albumins and globulins migrated in the first 4 min, whereas gliadins and glutenins migrated after 4 min. Individual alpha, beta, gamma, and omega gliadin proteins, which were collected from reversed-phase highperformance liquid chromatography (RP-HPLC) separations, were also separated by HPCE. Combined results of this study and our previous studies provide a catalog of individual gliadin information from HPCE, HPLC, acid-polyacrylamide gel electrophoresis (A-PAGE) and sodium dodecyl sulfate (SDS)-PAGE, relating class, relative molecular size, hydrophobicity, relative charge, and separation times of each gliadin subclass by HPLC and HPCE. The main advantages of HPCE are: 1) the complementing of other electrophoretic and chromatographic protein separation methods, and 2) safety because no toxic acrylamides and only minute amounts of organic solvents and buffers are used. [References: 27].

2001 Lookhart, G.L. (USDA ARS, Grain Marketing Research Laboratory, Manhattan, KS.); Bietz, J.A. (1994) **Protein extraction and sample handling techniques.** *High-performance liquid chromatography of cereal and legume proteins p. 51-65.* American Association of Cereal Chemists, Inc. references. English. (AGRIS 96-023373).

2002 Marcin, A.; Belickova, E.; Siklenka, P. (Ustav Experimentalnej Veterinarnej Mediciny, Kosice (Slovak Republic)); Fencik, R. (1995) **[Dot-blot technique for the quantitative detection of the wheat protein in the sausages]. Dot-blot technika pre kvantitativne stanovenie psenicneho proteinu v salamach.** *Veterinarni Medicina - UZPI (Czech Republic) v. 40(7) p. 227-231.* 2 graphs, 1 table; 15 ref. Slovak. (AGRIS 96-011867).

2003 Mathew, J.M. (Washington State University, Pullman, WA.); Pitts, M.J.; Davis, D.C. (1992) **3D wheat kernel model simulating tempering effects on compressive loading.** *American Society of Agricultural Engineers. Meeting (USA); no. 926512 10 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 96-011634).

2004 Mills, ENC.; Brett, GM.; Holden, S.; Kauffman, JA.; Tatton, MJ.; Morgan, MRA. (1995) **PRODUCTION OF MONOCLONAL ANTIBODIES TO GLUTEN PROTEINS AND THEIR USE IN DEVELOPING TESTS FOR GLUTEN QUALITY.** *Food & Agricultural Immunology. 7(2):189-196.* English. [AFRC INST FOOD RES NORWICH LAB DEPT FOOD MOLEC BIOCHEM NORWICH RES PK NORWICH NR4 7UA NORFOLK ENGLAND].

There is a need for rapid, simple tests to give added assurance in gluten quality evaluation which address the needs of plant breeders and the milling and baking industry. As part of fundamental research into gluten protein structure-function relationships, a library of monoclonal antibodies (MAbs) has been developed to various gluten protein fractions, including both high and low molecular weight subunits of glutenin. The difficulties presented by wet-king with insoluble, heterogeneous gluten proteins in raising MAbs of the requisite specificity are discussed. Several of the MAbs have been used to develop rapid immunoassays which are capable of analyzing a single sample in 10 min, and these have been applied to the quantification of total glutenin proteins, and high and low molecular weight subunits of glutenin in flour samples, illustrating the potential of immunotechnology for monitoring flour quality. [References: 19].

2005 Navarro, A.; Manzanares, P.; Carbonell, JV.; Sendra, JM. (1995) **DETERMINATION OF (1-]3), (1-]4)-BETA-D-GLUCANASE ACTIVITY BY A CALCOFLUOR-FLOW INJECTION ANALYSIS METHOD.** *Journal of Cereal Science. 22(3):275-284.* English. [CSIC INST AGROQUIM & TECNOL ALIMENTOS JAIME ROIG 11 E-46010 VALENCIA SPAIN].

A new methodology for the determination of (1 --> 3), (1 --> 4)-beta-D-glucanase activity has been developed. The concentration decay curves corresponding to the depolymerisation of high molecular weight barley (1 -> 3), (1 --> 4)-beta-D-glucan by pure (1 --> 3), (1 --> 4)-beta-D-glucanase (E.C. 3.2.1.73) from Bacillus subtilis and by crude (1 --> 3), (1 --> 4)-beta-D-glucanase from different malts were monitored by the Calcofluor-FIA method. In all cases, the high molecular weight (1 --> 3), (1 --> 4)-beta-D-glucan decay curves fitted very well to an empirical formula describing the change in substrate concentration with time. The curves possess an inflexion point at which the depolymerisation rate of the substrate reaches a maximum. This maximum depolymerisation rate correlates with the initial concentrations of enzyme and substrate, E(0) and S-0, and the enzyme kinetic constants V-m and K-m through a hyperbola similar to that of Michaelis-Menten. The K-m determined for B. subtilis beta-glucanase was rather low, about 0.99 g beta-glucan/l, when compared with those corresponding to (1 --> 3), (1 --> 4)-beta-D-glucanase from different malts, which were, in turn, practically identical at about 2.92 g beta-glucan/l. Experiments with barley (1 --> 3), (1 --> 4)-beta-D-glucans of different high initial molecular weights showed that initial molecular weight had no influence on the kinetics. Thus, this new methodology permits the

determination of(1 --> 3), (1 --> 4)-beta-D-glucanase activity in a direct way, i.e. the amount of(1 --> 3), (1 --> 4)-beta-D-glucan degraded per amount of enzyme (or malt) per unit of time. Moreover, since it is insensitive to the initial molecular weight of the substrate, it seems to be well-suited for inter-laboratory comparisons of(1 --> 3), (1 --> 4)-beta-D-glucanase activities. (C) 1995 Academic Press Limited [References: 37].

2006 Palmer, GH.; Sattler, R. (1996) **DIFFERENT RATES OF DEVELOPMENT OF ALPHA-AMYLASE IN DISTAL ENDOSPERM ENDS OF GERMINATED (MALTED) CHARIOT AND TIPPER BARLEY VARIETIES.** *Journal of the Institute of Brewing. 102(1):11-17.* English. [HERIOT WATT UNIV INT CTR BREWING & DISTILLING DEPT BIOL SCI RICCARTON CAMPUS EDINBURGH EH14 4AS MIDLOTHIAN SCOTLAND].

Chariot Barley had a faster malting rate than Tipper. Even when the total levels of the aleurone-produced enzyme alpha-amylase were similar in both Chariot and Tipper, the distal ends of the grains of Chariot developed alpha-amylase at a faster rate than the corresponding endosperm ends of Tipper. The excised aleurone layers of Chariot and Tipper had similar potentials to produce alpha-amylase. Therefore the faster rate of development of alpha-amylase in the distal ends of the grains of Chariot may reflect faster transport of active gibberellic acid through the aleurone layer. Differences in the rates of transport of gibberellic acid through the plasmodesmata of the aleurone layer may determine the efficiency of production and distribution of endosperm-degrading enzymes during malting. The transport of gibberellic acid in the aleurone layer was facilitated by high moisture levels. [References: 12].

2007 Patel, MM.; Rao, GV. (1995) **EFFECT OF UNTREATED, ROASTED AND GERMINATED BLACK GRAM (PHASEOLUS MUNGO) FLOURS ON THE PHYSICOCHEMICAL AND BISCUIT (COOKIE) MAKING CHARACTERISTICS OF SOFT WHEAT FLOUR.** *Journal of Cereal Science. 22(3):285-291.* English. [GUJARAT AGR UNIV ASPEE COLL HOME SCI DEPT FOOD & NUTR SK NAGAR 385506 INDIA].

Determination of the physico-chemical characteristics of composite soft wheat flours in which 5-25% (w/w) Of the wheat flour was replaced with untreated, roasted and germinated black gram (Phaseolus mungo) flours (BGE) showed that when roasted BGF comprised 20% (w/w) of the blend, the increases in the ash and protein contents were 123% and 35%, respectively. The values for the gluten contents and the Zeleny and sodium dodecyl sulphate sedimentation test volumes for the composite flours indicated a weakening effect of BGF on the quality of soft wheal flour proteins, which could be beneficial for the preparation of biscuits (cookies). The alkaline water retention capacity values increased with the increasing addition of differently processed BGFs. Biscuit baking studies indicated that the diameter and spread ratio of biscuits were reduced. while the thickness increased, with increasing addition of all three BGFs, but the maximum reduction in diameter was observed with the addition of germinated BGF. The hardness value for biscuits increased with the addition of BGFs, but the effect was minimal with roasted BGF and maximal with germinated BGF. The surface grain score was reduced with increasing addition of BGF, but: in general, the roasted BGF showed the minimum adverse effect. From the overall biscuit making quality, addition of untreated BGF at the 15% level and of roasted and germinated BGFs at the 20% level were considered optimal for supplementing wheat flour. (C) 1995 Academic Press Limited [References: 17].

2008 Pietrzak, LN.; Collins, FW. (1996) **COMPARISON OF FLUOROMETRIC REAGENTS FOR MICROSPECTROFLUOROMETRIC DETERMINATION OF FLAVONOID GLYCOSIDES IN WHEAT GERM.** *Journal of Cereal Science. 23(1):85-91.* English. [AGR & AGRI FOOD CANADA CTR PLANT RES OTTAWA ON K1A 0C6 CANADA].

Measurement of flavonoids has been advocated for the physico-chemical determination of germ in flour milling fractions, primarily because flavonoids exist chiefly in the germ and are relatively immobile during milling. In these studies, four reagents which induce fluorescence in flavonoids in situ were evaluated for the direct determination of germ in flour. The determination of absorption, excitation and emission spectra of complexes formed for each reagent with germ, bran and flour were performed on a UMSP 80 microspectrophotometer. The highest selectivity and sensitivity were obtained using diphenylborinic acid ethanolamine ester and boron trifluoride. (C) 1996 Academic Press Limited [References: 21].

2009 Quaglia, GB.; Dilena, G. (1995) **BIOMASS AND HYDROLYTIC AND OXIDATIVE ENZYMES PRODUCTION BY FUNGAL GROWTH ON WHEAT MILLING BY-PRODUCTS.** *Nahrung. 39(5-6):483-489.* English. [IST NAZL NUTR UNITA TECNOL ALIMENTARI SPECIALI VIA ARDEATINA 546 I-00178 ROME ITALY].

Wheat bran and shorts, by-products of the milling process, were submitted to bioconversion by the white-rot Basidiomycete Lentinus endodes. The extracellular polyphenol oxidase, endo-cellulase and phytase productions by the mycelium growing in a solid-state condition on the two substrates were studied. The best results in terms of polyphenol oxidase and endo-cellulase activity yields were obtained in shorts cultures, while no relevant difference was noticed between the two substrates for phytase production. The in vitro dry matter enzyme digestibility (IVDMED) and total nitrogen gain of the substrates during biotransformation were also evaluated. Besides an increment in total nitrogen, the IVDMED of both substrates appeared to be reduced by the biotreatment. [References: 16].

2010 Roach, RR.; Hoseney, RC. (1995) **EFFECT OF CERTAIN SURFACTANTS ON THE SWELLING, SOLUBILITY AND AMYLOGRAPH CONSISTENCY OF STARCH.** *Cereal Chemistry. 72(6):571-577.* English. [KANSAS STATE UNIV DEPT GRAIN SCI & IND MANHATTAN, KS 66506 USA].

The effects of certain mono- and triglycerides and other surfactants on unmodified wheat and corn starch slurries were examined by the Viskograph E. All emulsifiers and surfactants tested caused a lower consistency than the control during the first stage of consistency increase and reduced consistency throughout most of the second stage of consistency increase. Certain monoglycerides went through apparent phase changes, which may have caused them to interact more fully with the starch and reduce consistency below that of the control. When carboxymethylcellulose (CMC) was used to create a background consistency, its consistency could not be deducted from the consistency of a starch plus CMC slurry to obtain the consistency of a starch-only slurry. All monoglycerides tested reduced starch swelling when compared to the control at temperatures of 60-80 degrees C. Monoglycerides with 18 carbons, both saturated and monounsaturated, reduced swelling at 90 degrees C. However, a 10 monoglyceride increased swelling at 90 and 95 degrees C. The increased swelling was also shown by light micrographs and consistency measurements. In general, triglycerides did not affect swelling. All monoglycerides reduced starch solubility compared to that of the control. No triglycerides had an effect on starch solubility. Swelling occurred in two stages, but solubility showed a relatively smooth increase as temperature increased. This suggests that swelling is related to the two stages of consistency increase found with such instruments as the amylograph or viskograph. [References: 27].

2011 Schipper, A.; Eizenhammer, H. (1995) **INVESTIGATIONS OF THE STARCH/AMYLASE-COMPLEX OF WHEAT IN DEPENDENCE ON THE STAGE OF GRAIN MATURITY.** *Angewandte Botanik. 69(5-6):177-182.* German. [UNIV GIESSEN INST PFLANZENBAU & PFLANZENZUCHTUNG 1 LUDWIGSTR 23 D-35390 GIESSEN GERMANY].

Grain samples of two winter wheat cultivars have been harvested in different stages of maturity. For characterizing the Starch/Amylase-Complex the meals from these grains have been tested in a BRABENDER-Amylograph for their viscose properties by carrying out three types of amylograms: Amylogram I (Normal amylogram). Amylogram II (amylase inactivated), Amylogram III (amylase inactivated and protein hydrolized enzymatically). The following results have been obtained: 1. If amylase is active (Normal amylogram respectively Amylogram I) the gelatinization maximum and the temperature maximum was found to be much lower in the earlier stages of grain development than in the full ripe grain. 2. If amylase is inactivated (Amylogram II) the gelatinization maxima were found - as expected - to be much higher and even show higher values in the earlier than in the later stages of grain development. 3. If amylase is

inactivated and in addition protein is hydrolized (Amylogram III) the gelatinization maxima were found to be distinctly lower than in Amylogram II; nevertheless the temperature maxima are higher than in Amylogram II. The tendency for higher gelatinization maxima in the earlier stages of grain development is always the same. 4. The beginning of the initial rise of viscosity shows differences in dependence on the ripening stage of the grain on the one hand and on amylase activity and protein hydrolize on the other hand. If protein is hydrolized the amylogram curve is another one and corresponds with the amylogram curve of pure wheat starch. [References: 22].

2012 Seibel, W. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)); Zwingelberg, H. (1995) **[Processing value of winter durum wheat varieties]. Verarbeitungsqualitaet von Winterdurumsorten.** *Getreide Mehl und Brot (Germany) v. 49(3) p. 131-134.* 9 tables; 11 ref. German. (AGRIS 96-023364).

2013 Shehata, M.A. (Univ. Hannover (Germany). Inst. fuer Lebensmittelchemie); Tawakkol, M.S.; Berger, R.G. (1995) **The browning of wheat germ preparations: I. Enzymatic processes.** *Chemie, Mikrobiologie, Technologie der Lebensmittel (Germany) v. 17(1-2) p. 33-36.* 4 graphs, 1 table; 16 ref. English. (AGRIS 96-023456).

2014 Vanloo, J.; Coussement, P.; Deleenheer, L.; Hoebregs, H.; Smits, G. (1995) **ON THE PRESENCE OF INULIN AND OLIGOFRUCTOSE AS NATURAL INGREDIENTS IN THE WESTERN DIET [Review].** *Critical Reviews in Food Science & Nutrition. 35(6):525-552.* English. [TIENSE SUIKERRAFFINADERIJ SERV AANDORENSTR 1 B-3300 TIENEN BELGIUM].

The classic definitions of inulin and oligofructose are constructively criticized. It is observed that inulin cannot unequivocally be described as a polydisperse 1-kestose-based (GF(n)) beta(2-->1) linear fructan chain, hut that inulin always contains small amounts of F-m and branched molecules. This review article describes the presence of inulin and oligofructose in common foodstuffs. Historical data on human consumption add an extra dimension. Modern analytical techniques (HPLC, LGC, HPAEC-PAD) are used to check the variety of data mentioned in the literature throughout the past century. Methods to determine inulin and oligofructose in natural foodstuffs (cereals, fruit, and vegetables) are optimized and used to determine the loss of inulin during storage and during preparation of the food. These findings allow quantification of the amount of inulin and oligofructose in the average daily western diet. The daily pet capita intake is estimated to range from 1 to 10 g, depending on geographic, demographic, and other related parameters (age, sex, season, etc.). Inulin and oligofructose are not measured by classic methods of dietary fiber analysis and consequently are often not mentioned in food tables. Their significant contribution (1 to 10 g/d/per capita) to the dietary fiber fraction (recommended at 25 g/d/per capita) is not taken into account in any nutritional recommendations. In view of this, inulin and oligofructose deserve more attention, both in food composition tables and in diet or nutrition studies. [References: 102].

2015 Weipert, D. (Bundesanstalt fuer Getreide , Kartoffel und Fettforschung in Detmold und Muenster, Detmold (Germany)) (1995) **[Alveograph results for assessment of wheat quality]. Alveogramme zur Beurteilung der Weizenqualitaet.** *Getreide Mehl und Brot (Germany) v. 49(3) p. 152-156.* 4 graphs, 4 tables; 8 ref. German. (AGRIS 96-023368).

2016 Yang, G.; Wehling, RL.; Zeece, MG.; Partridge, JE.; Shelton, DR. (1995) **CHARACTERIZATION OF HARD RED WINTER WHEAT STORAGE PROTEINS BY TWO-DIMENSIONAL ELECTROPHORESIS AND THEIR CORRELATIONS WITH SELECTED QUALITY PARAMETERS.** *Cereal Chemistry. 72(6):568-570.* English. [UNIV NEBRASKA DEPT FOOD SCI & TECHNOL 143 FILLEY HALL LINCOLN, NE 68583 USA].

Q05 FOOD ADDITIVES

2017 Adrians, R. (J. Rettenmaier und Soehne GmbH + Co., Ellwangen (Germany)) (1995) **[Freshness from fibres. Technological effect of dietary fibres in bread production and their influence on product quality]. Die Frische aus der Faser. Technologische Wirksamkeit von Ballaststoffen bei der Herstellung von Brot und ihr Einfluss auf die Produktqualitaet.** *Brot und Backwaren (Germany) v. 43(3) p. 22-25.* 3 ill., 5 tables. German. (AGRIS 96-023573).

2018 Moon, J.W. (Pusan Women's Junior College, Pusan (Korea Republic). Department of Home Economics); Suh, M.J. (Pusan National University, Pusan (Korea Republic). Department of Food Science and Nutrition) (1995) **The effect of potato lipoxygenase on the change of lipid distribution, fatty acid composition, carotenoids content and color value in wheat flour dough.** *Korean Journal of Food Science and Technology (Korea Republic) v. 27(3) p. 290-293.* 1 illus.; 3 tables; 26 ref. Korean. (AGRIS 96-011952).

Q51 FEED TECHNOLOGY

2019 Barrierguillot, B.; Casado, P.; Maupetit, P.; Jondreville, C.; Gatel, F.; Larbier, M. (1996) **WHEAT PHOSPHORUS AVAILABILITY .2. IN VIVO STUDY IN BROILERS AND PIGS - RELATIONSHIP WITH ENDOGENOUS PHYTASIC ACTIVITY AND PHYTIC PHOSPHORUS CONTENT IN WHEAT.** *Journal of the Science of Food & Agriculture. 70(1):69-74.* English. [INST TECH CEREALES & FOURRAGES F-91720 BOIGNEVILLE FRANCE].

In order to reduce the P concentration in manure, P availability in different plant feedstuffs should be determined. Wheat P availability has been studied by the digestive balance technique on broilers and pigs. Nineteen wheat samples were tested on broilers, giving a mean P retention of 57% (45-70%). P retention was observed to be linearly associated with the endogenous phytasic activity in wheats ($r = 0.58$; $P < 0.05$). This variability in P retention cannot be satisfactorily explained by the phytic P content of wheat. Four wheat samples were tested on pigs, giving a mean apparent P digestibility of 40%. [References: 22].

2020 Taiwo, AA.; Adebowale, EA.; Greenhalgh, JFD.; Akinsoyinu, AO. (1995) **TECHNIQUES FOR TRAPPING AMMONIA GENERATED FROM UREA TREATMENT OF BARLEY STRAW.** *Animal Feed Science & Technology. 56(1-2):133-141.* English. [OBAFEMI AWOLOWO UNIV INST AGR RES & TRAINING PMB 5029 IBADAN NIGERIA].

Three step-wise experiments were conducted to determine the ability of feeds in trapping excess ammonia from urea treated barley straw. In the first experiment, shredded barley straw was treated with urea (60 g kg(-1) DM) at 300 and 400 g moisture kg(-1) in laboratory silos. They were stored in incubator at 26 degrees C for 7, 14, 21 and 28 days. This was used to estimate the extent of urea hydrolysis and nitrogen retention. The second experiment measured the outflow rate of ammonia by blowing in air through treated straw into dilute H2SO4. The third experiment assessed the ability of grass and citrus pulp silages in holding ammonia. Urea hydrolysis was extensive (90-100%) but independent of moisture and treatment period ($P > 0.05$). About 74% of nitrogen added in the form of urea in treated straw was lost during aeration. Fermentation enhanced the ammonia holding capacity of citrus pulp. This was further improved with time and addition of molasses, It's nitrogen content was increased from 11.7 to 21.2 g kg(-1) DM. This decreased to 16.0 g kg(-1) DM about 5 h after gassing. Improvement in the nitrogen content of feeds with gassing suggest that dry matter and nitrogen intake by ruminants can be enhanced. [References: 12].

2021 Weinberg, ZG.; Ashbell, G.; Hen, Y.; Azrieli, A. (1995) **THE EFFECT OF A PROPIONIC ACID BACTERIAL INOCULANT APPLIED AT ENSILING ON THE AEROBIC STABILITY OF WHEAT AND SORGHUM SILAGES.** *Journal of Industrial Microbiology. 15(6):493-497.* English. [AGR RES ORG VOLCANI CTR FORAGE PRESERVAT & BY PROD RES UNIT IL-50250 BET DAGAN ISRAEL].

The effect of a new strain of Propionibacterium shermanii(PAB), applied at ensiling, on the aerobic stability of wheat and sorghum silages was studied in several experiments under laboratory conditions, In the one

experiment with wheat and in those with sorghum a lactic acid bacteria (LAB) inoculant (Lactobacillus plantarum and Pediococcus cerevisiae) was also included, After treatment, the chopped forages were ensiled in 1, 5-L anaerobic jars which were sampled in triplicate on predetermined dates to follow fermentation dynamics. At the end of the experiments, the silages were subjected to an aerobic stability test, The PAB inoculant improved the aerobic stability only in one experiment with wheat, in which the decrease in pH was very slow; the final pH remained relatively high (4.5). The PAB-treated silages contained 19.5 +/- 2.0 g of propionic acid per kg of dry matter, In the experiments with sorghum, the control and PAB-inoculated silages were stable, whereas LAB-inoculated silages deteriorated, The results suggest that PAB can survive in and improve the aerobic stability of only slow-fermenting silages which are prone to aerobic deterioration. [References: 16].

Q52 FEED PROCESSING AND PRESERVATION

2022 Chalaux, N.; Libmond, S.; Savoie, JM. (1995) **A PRACTICAL ENZYMATIC METHOD TO ESTIMATE WHEAT STRAW QUALITY AS RAW MATERIAL FOR MUSHROOM CULTIVATION.** *Bioresource Technology. 53(3):277-281.* English. [CTR TECH CHAMPIGNON F-37370 VILLENAVE DORNON FRANCE].

Wheat straw is the principal raw material for edible mushroom substrate preparation in Europe and America. The knowledge of its biodegradability by saprotrophic microorganisms is useful. By combining an enzymatic method with simple chemical analyses 29 samples of straw were distinguished in a principal component analysis. The effects of genetical variations, of cultivation practices and of sites of cultivation were observed. The measurement of the in vitro degradability of polysaccharides was the most discriminative variate with the two first principal components. Correlations between the measurements were determined with 52 straw samples and a practical simplified method was proposed. It includes ash content, water soluble compounds and the in vitro degradability of polysaccharides measured with a mixture of polysaccharidases. The significance of these measurements was investigated and discussed. [References: 20].

2023 Jacobs, JL.; Morris, RJ.; Zorrillarios, J. (1995) **EFFECT OF ENSILING WHOLE BARLEY GRAIN WITH PASTURE ON SILAGE QUALITY AND EFFLUENT PRODUCTION, AND THE PERFORMANCE OF GROWING CATTLE.** *Australian Journal of Experimental Agriculture. 35(6):731-738.* English. [DEPT AGR VICTORIA 78 HENNA ST WARRNAMBOOL VIC 3280 AUSTRALIA].

Pasture was ensiled with increasing amounts of whole barley in stacks [0, 75 (SLB), 150 (SMB) kg/t fresh pasture] or in 200-L drum silos [0, 75 (DLB), 150 (DMB), 225 (DHB) kg/t fresh pasture]. All silages were well fermented with low pH values and low ammonia concentrations. The addition of barley significantly (P<0.05) increased the dry matter content of the resultant stack silages by 29% (SLB) and 54% (SMB) and significantly (P<0.05) increased residual water-soluble carbohydrate levels in the SMB silage compared with untreated stack silage. Incorporation of barley with pasture in 200-L silos significantly (P<0.001) increased the dry matter of the resultant silages and significantly (P<0.02) reduced effluent production by 55, 93, and 100% for DLB, DMB, and DHB compared with the untreated silo silage. Dry matter, nitrogen, and lactic acid concentrations in effluent did not differ significantly, although total losses of these components were significantly (P<0.02) higher in the untreated silage. The stack silages were fed to beef steers (293 kg) and compared with silage diets containing equivalent levels of rolled barley mixed with untreated silage at feeding. Irrespective of method of feeding barley, animal performance improved compared with feeding a silage-only diet. At equivalent levels of barley inclusion, liveweight gains were higher and feed conversion ratios lower with the rolled barley diets. The results indicate that the addition of barley to low dry matter pasture during ensiling can reduce effluent production and the loss of soluble nutrients; however, it is likely that the grain will need to be processed to maximise subsequent animal production. [References: 36].

2024 Phipps, RH.; Sutton, JD.; Jones, BA. (1995) **FORAGE MIXTURES FOR DAIRY COWS - THE EFFECT ON DRY-MATTER INTAKE AND MILK PRODUCTION OF INCORPORATING EITHER FERMENTED OR UREA-TREATED WHEAT, BREWERS GRAINS, FODDER BEET OR MAIZE SILAGE INTO ON GRASS SILAGE.** *Animal Production. 61(Part 3):491-496.* English. [UNIV READING CTR DAIRY RES ARBORFIELD HALL FARM READING RG2 9HX BERKS ENGLAND].

One hundred and two multiparous Holstein/Fresian dairy cows were used to examine the effect on food intake and milk production of replacing 330 g/kg dry matter (DM) of first-cut perennial ryegrass silage (GS) with either fermented (FW) or urea (40 g/kg DM) treated (UW) whole-crop wheat, brewers' grains (BG), folder beet (FB) or maize silage (MS). A forage mixture containing GS and 750 g/kg DM of maize silage (MSH) was also offered. Dietary crude protein (CP) concentrations were equalized by offering all cows 6 kg DM per day of an appropriate concentrate supplement. DM intake and milk yield of cows offered GS (15.3, 23.0 kg/day) were increased (P<0.01) by the inclusion of BG (16.3, 26.7 kg.day), FB (17.6, 25.9 kg/day), MS (16.6, 26.4 kg/day) and MSH (18.5, 27.6 kg/day). BG, FB and MS all produced similar increased in milk yield. Although the inclusion of FW and UW increased (P<0.05) DM intake, milk yield was not significantly affected. The differences between the highest and lowest milk fat concentration, produced by FB (42.9 g/kg) and GS (29.9 g/kg) were increased (P<0.01) by BG (1.07, 0.82 kg/day). FB (1.11, 0.83 kg/day) or UW (1.00, 0.73 kg/day). Results show that farmers should consider replacing a major part of the grass silage component with an alternative forage or forage substitute. [References: 22].

2025 Svihus, B.; Selmerolsen, I.; Brathen, E. (1995) **EFFECT OF DIFFERENT PRESERVATION METHODS FOR HIGH-MOISTURE BARLEY ON FEEDING VALUE FOR BROILER CHICKENS.** *Acta Agriculturae Scandinavica Section A-Animal Science. 45(4):252-259.* English. [MONTANA STATE UNIV DEPT PLANT SOIL & ENVIRONM SCI BOZEMAN, MT 59717 USA].

High-moisture barley was preserved anaerobically by ensiling using different additives, aerobically with propionic acid, or by drying. Chemical composition, feeding value and effect on physiological parameters in broiler chickens were studied. The content of true protein, total amino acids, total beta-glucans and the viscosity were reduced when barley was stored in the moist stage. Anaerobic storage, which produced lactic acid and ethanol by fermentation, caused the strongest reduction. High-moisture barley reduced feed:grain ratio compared with dry barley, the difference being significant ($p < 0.05$) for the anaerobically stored barley in one experiment. Feeding high-moisture barley tended to reduce the relative weight of the digestive tract, and owing to less sticky droppings the cleanness of the cages and feathers was significantly improved ($p < 0.05$). [References: 30].

Q53 FEED CONTAMINATION AND TOXICOLOGY

2026 Kierekjaszczuk, D.; Marquardt, RR.; Frohlich, AA.; Clarke, J.; Xiao, H.; Abramson, D. (1995) **DETECTION AND QUANTIFICATION OF THE T-2 MYCOTOXIN BY ELISA UTILIZING TOXIN-SPECIFIC POLYCLONAL ANTIBODIES RAISED IN CHICKENS.** *Food & Agricultural Immunology. 7(3):243-252.* English. [UNIV MANITOBA FAC AGR & FOOD SCI DEPT ANIM SCI WINNIPEG MB R3T 2N2 CANADA].

Polyclonal antibodies against T-2 toxin (T-2) were raised in chickens immunized with a toxin-protein conjugate. A sensitive, indirect competitive ELISA was developed that allowed the detection of T-2 at concentrations higher than 0.04 ng ml(-1). The antibodies cross-reacted with other toxins/toxin derivatives having the same trichothecene nucleus as T-2, whereby the degree of cross-reactivity was modulated by the number of acetyl groups and site of their attachment to the trichothecene ring. The ELISA was used successfully for quantification of T-2 extracted from wheat samples that were spiked in vitro with toxin at a level of 5-500 ng g(-1) (ppb). These results show that for the first time, anti-T-2 antibodies have been developed in chickens and that they can be used for the quantification of T-2 in wheat grains. [References: 37].

Q54 FEED COMPOSITION

2027 Dudley Cash, W.A. (1994) **Enzymes improve metabolizable energy value of some barley varieties.** *Feedstuffs (USA) v. 66(50) p. 13.* references. English. (AGRIS 96-023609).

2028 Ng'ambi, J.W. (1995) **Effect of sodium hydroxide treatment of wheat straw on intake, digestion, rumen degradibility, passage rate and faecal particle size of goats.** *UNISWA Research Journal (Swaziland) v. 9 p. 70-74.* 3 tables; 15 ref. English. (AGRIS 96-023623).

A multiple latin square design experiment with 16 goats was used to determine the effects of NaOH treatment of wheat straw (4kg NaOH per 100kg straw). Two treatments: untreated and NaOH treated wheat straw (Mercia) with isonitrogenous and isoenergetic supplements were compared. Sodium hydroxide increased organic matter intake and digestibility by 21 and 20 per cent, respectively. Diet digestible organic matter intake also increased by 26 per cent.

2029 Ng'ambi, J.W.; Campling, R.C. (1995) **Effect of source and amount of protein supplement on voluntary intake and digestibility of sodium hydroxide treated wheat straw by cattle.** *UNISWA Research Journal (Swaziland) v. 9 p. 75-81.* 4 tables; 14 ref. English. (AGRIS 96-023622).

Two experiments on Friesian cattle are described. Diets of NaOH treated straw were fed (40kg per tonne). In the first experiment cows were fed ad lib treated straw supplemented by white fishmeal or soyabean meal. It was found that fishmeal supplying UDP was not superior as regards weight gain to concentrates supplying RDP. The second experiment evaluated the effect of the amount of protein supplement on intake and digestibility of NaOH treated wheat straw by cattle. In this experiment, a diet containing 95.6g CP/kg DM was sufficient to ensure high intake and digestibility of straw. .

Q55 FEED ADDITIVES

2030 Barrier Guillot, B. (Institut Technique des Cereales et des Fourrages, Boigneville (France)); Bedford, M.; Metayer, J.P.; Grosjean, F.; Gatel, F. (1995) **[Effect of Avizyme 1300 addition on feed value of wheat-based diets in broilers and laying hen [xylanases-based additive]]. Effet de l'addition de Avizyme 1300 sur la valeur alimentaire de regimes a base de ble chez le poulet de chair et la poule pondeuse [preparation enzymatique a base de xylanases].** *Sciences et Techniques Avicoles (France) (no 13) p. 4-12.* 9 ref., 10 tableaux. French. (AGRIS 96-023646).

Q70 PROCESSING OF AGRICULTURAL WASTES

2031 Hwang, J.K.; Kim, C.T.; Cho, S.J.; Kim, C.J. (Korea Food Research Institute, Sungnam (Korea Republic)) (1995) **Effects of various thermal treatments on physicochemical properties of wheat bran.** *Korean Journal of Food Science and Technology (Korea Republic) v. 27(3) p. 394-403.* 6 illus.; 3 tables; 57 ref. Korean. (AGRIS 96-012083).

2032 Kim, C.T.; Hwang, J.K.; Cho, S.J.; Kim, C.J. (Korea Food Research Institute, Sungnam (Korea Republic)); Kim, H.S. (Myongji University, Seoul (Korea Republic). Department of Chemical Engineering) (1995) **Modification of physico-chemical properties of wheat bran by twin-screw extrusion process-(1)-Effect of screw configuration and process parameters on system parameters.** *Korean Journal of Food Science and Technology (Korea Republic) v. 27(3) p. 404-413.* 6 illus.; 4 tables; 32 ref. Korean. (AGRIS 96-012084).

S01 HUMAN NUTRITION-GENERAL ASPECTS

2033 Barrera, G.; Gattas, V.; Uauy, R. (1995) **BIOLOGICAL QUALITY OF A MILK SUBSTITUTE FOR SCHOOL CHILDREN BASED ON REFINED WHEAT FLOUR SUBJECTED TO ENZYMATIC HYDROLYSIS.** *Archivos Latinoamericanos de Nutricion. 45(2):90-96.* Spanish. [UNIV CHILE INST NUTR & TECNOL ALIMENTOS UNIDAD NUTR CLIN SANTIAGO CHILE].

The biological quality of an experimental milk substitute based on raw wheat flour subjected to enzymatic hydrolysis in comparison to a control product based on extruded flours and milk protein was studied in 35 "healthy" female school age children. The girls were fed their customary diet during 2 consecutive 14 and 12 day periods, and randomized to the experimental and control products in a double blind crossover fashion. Apparent absorption of protein, energy, calcium and phosphorus was evaluated. Mean nitrogen intake from the experimental product was significantly lower (223 vs 244 mg/Kg/d p<0.0001). Absorbed nitrogen was also lower (187 vs 203 mg&kg/d p<0.0001). Energy intake and excretion were similar with both products; 96 and 95% of intake was absorbed for experimental and control products respectively. The mean calcium intake was significantly lower with the experimental product (39.7 vs 60.2 mg/kg/d p<0.0001). Absorbed calcium from the experimental product was 50% of control (20.7 vs. 39.5 mg/Kg/d p<0.0001). Phosphorus intake was also lower with the experimental product relative to control (22.0 vs 27.8 mg/Kg/d p<0.0001) and absorbed P was 13.1 vs 16.5 mg/Kg/d respectively. Both products were well tolerated. We conclude that the experimental product based on wheat flour does not differ significantly in protein and energy digestibility but calcium and phosphorus absorption and digestibility are significantly lower limiting its use in school feeding programs.

S20 PHYSIOLOGY OF HUMAN NUTRITION

2034 Weaver, CM.; Heaney, RP.; Teegarden, D.; Hinders, SM. (1996) **WHEAT BRAN ABOLISHES THE INVERSE RELATIONSHIP BETWEEN CALCIUM LOAD SIZE AND ABSORPTION FRACTION IN WOMEN.** *Journal of Nutrition. 126(1):303-307.* English. [PURDUE UNIV DEPT FOODS & NUTR W LAFAYETTE, IN 47907 USA].

Fractional calcium absorption from varying intakes of calcium carbonate co-ingested with wheat bran, as well as alone, was measured in a randomized crossover study in healthy adult women. The calcium carbonate was intrinsically labeled with Ca-45. Absorption from the carbonate, ingested without bran, showed the expected inverse relationship to the logarithm of ingested load size (slope = -0.1199; not substantially different from the value previously reported for milk). At 0.5 mmol calcium load, fractional absorption averaged 0.769 +/- 0.134, whereas at 12.5 mmol load it averaged 0.378 +/- 0.069. In contrast, fractional ahsorption from calcium carbonate co-ingested with 40 g of a cereal product containing 16 g wheat bran, across a calcium load range from 0.5 to 15.5 mmol, was essentially constant (mean for all loads: 0.230. +/- 0.069). Thus, the calcium-binding capacity of the bran cereal altered the usual inverse relationship between calcium load and fractional absorption. In vitro calcium binding to the bran cereal was linear over a wide range of calcium levels. This suggests that binding of calcium to one or more components of the bran cereal is sufficient to explain the reduced absorption demonstrated in vivo. [References: 10].

T01 POLLUTION

2035 Laurent, F. (Institut Technique des Cereales et des Fourrages, Paris (France)); Machet, J.M.; Pellot, P.; Trochard, R. (1995) **[Catch crops: a nitrate trap. Comparison between different species]. Cultures intermediaires pieges a nitrates: comparaison d'especes.** *Perspectives Agricoles (France) (no.206) p. 38-49.* 6 ill., 9 ref., 8 tableaux, 9 graph. French. (AGRIS 96-024129).

2036 Yagodin, B.A.; Govorina, V.V.; Vinogradova, S.B.; Zamaraev, A.G.; Sablina, S.M. (1994) **[Accumulation of nickel by some farm crops on training farm "Mikhailovskoye" in Moscow region]. Nakoplenie nikelya nekotorymi sel'skokhozyajstvennymi kul'turami v uchkhoze "Mikhajlovskoe" Moskovskoj oblasti.** *Izvestiya Timiryazevskoj sel'skokhozyajstvennoj akademii (Russian Federation) (no.2) p. 12-20.* 39 ref. Russian. (AGRIS 96-024068).

The data from different countries about accumulating nickel by agricultural plants, as well as the results of determining nickel concentration in winter wheat, barley, oats, potatoes, perennial and annual grasses grown in 1990 in field experiments carried out on "Mikhailovskoye" training farm in Moscow region are discussed in the

paper. Concentration of nickel in all crops used in these experiments was very high.

U10 MATHEMATICAL AND STATISTICAL METHODS

2037 Gusmao, L.; Baeta, J. (Estacao Agronomica Nacional, Oeiras, (Portugal)); Mexia, J.T.; Ferreira, T. (Nova de Lisboa Univ., Monte da Caparica (Portugal)); Bagulho, F.; Macas, B.; Coutinho, J. (Estacao Nacional de Melhoramento de Plantas, Elvas (Portugal)) (1994) **Increasing the accuracy in the statistical analysis of randomized complete block designs for cultivar yield trials.** Sociedade de Ciencias Agrarias de Portugal, Lisbon (Portugal). *Revista de Ciencias Agrarias (Portugal) v. 7(4) p. 59-65.* 5 tables; 10 ref. English. (AGRIS 96-012832).

2038 Kingwell, R. (1996) **PROGRAMMING MODELS OF FARM SUPPLY RESPONSE - THE IMPACT OF SPECIFICATION ERRORS.** *Agricultural Systems. 50(3):307-324.* English. [UNIV WESTERN AUSTRALIA DEPT AGR ECON NEDLANDS WA 6009 AUSTRALIA].

This paper explores the influence of specification errors in a programming model of farm wheat supply response. Specification errors are introduced by excluding various characteristics of production activities and other features of the farming system. Often model misspecification causes large changes in production response with wheat area and output elasticities changing by 40 per cent or more. In many cases the changes are due to the slope effect (dQ/dP) dominating the shift effect (P/Q). The main inference from results is that unless the farming system, with its array of production technologies, resources and enterprise alter natives, is described in some detail, it is highly likely that specification errors will noticeably bias estimates of supply response. Advances in spreadsheet, database and solving algorithm software enable farming systems to be described in greater detail, and with greater ease, than has hitherto been possible, so often model builders have fewer excuses for misspecifying models. [References: 62].

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[1] International Crops Research Institute for the Semi-Arid Tropics, Patancheru, Andhra Pradesh 502324, India

[2] International Association of Agricultural Information Specialists (IAALD)

[3] Technical Centre for Agricultural and Rural Cooperation, P.O. B. 380, 6700 AJ Wageningen, Netherlands

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