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OAT NEWSLETTER

VOLUME 41

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May 1991

Sponsored by the National Oat Conference

1990

OAT NEWSLETTER

VOLUME 41

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May 1991

Sponsored by the National Oat Conference

Michael S. McMullen, Editor

BYDV R p 70
GRIN BYDV - P 93

TABLE OF CONTENTS

Page

TITLE PAGE

TABLE OF CONTENTS

I. NOTES

Newsletter Announcements and Instructions.................... 1

Minutes of the American Oat Workers Conference business meeting.. 2

Minutes of the annual meeting of NCR-15 Oat Improvement...... 7

Award for Distinguished Service to Oat Improvement........... 9
Charles M. Brown.. 10
Howard F. Harrison.. 12

Fourth International Oat Conference Announcement............. 14

II. AMERICAN OAT WORKER'S CONFERENCE

Committees and sponsors...................................... 17

Photograph of participants................................... 18

Program.. 20

Abstracts.. 25

III. SPECIAL REPORTS

Utilization and Quality

Cereal Crops Research Unit, USDA, ARS. David M. Peterson, Cynthia A. Henson, Ronald W. Skadsen and Keith D. Gilchrist... 59

Acid-Extract Viscosity and B-Glucan Content of Oat. R. S. Bhatty and B. G. Rossnagel............................ 60

Variation in % Beta-glucan and Groat Protein Concentration of Oat Genotypes Grown at the Crop Development Centre in 1990. 61

Forage Quality of oats under different spacings of poplar (*Poplus deltoides*) plantation................................ 64

Pathology

Virulence of oat crown rust in the United States in 1990. K. J. Leonard and V. A. Brewster............................ 65

Iowa pathology notes. A. H. Epstein.......................... 69

Page

Evaluation of cultivated and wild oat species for tolerance to BYDV. Victor N. Soldatov, Valentina E. Merezhko, and Igor G. Loskutov.......... 70

Disease Report from Manitoba - 1990. J. Chong, D. E. Harder, and S. Haber.......... 71

Resistance of some oat cultivars against diseases. Srbobran Stojanovic and Dragoljub Maksimovic.......... 76

European oat disease nursery 1990. J. Sebesta, B. Zwatz, and L. Corazza.......... 77

Insect Resistance

Antibiosis of oat lines to three aphid species. C. I. Goellner and Elio Corseuil.......... 81

Herbicide Resistance

Herbicide resistance in oat. Solomon Kibite and K. N. Harker. 83

Germplasm collection, evaluation, and utilization

Guidelines for exporting and importing seed. Harold E. Bockelman and David Manning.......... 85

PI assignments in *Avena* since Vol. 40. Harold E. Bockleman... 86

Avena accessions in the National Small Grains Collection...... 87

Elite germplasm for the National Small Grains Collection. Harold E. Bockelman.......... 88

UK oat collection. M. J. Ambrose.......... 89

Wild avena germplasm. Mike Leggett.......... 89

Evaluation of National Small Grains Collection germplasm progress report - oat. H. E. Bockelman, D. M. Wesenberg, L. W. Briggle and M. A. Bohning.......... 90

A list of *Avena sterilis* accessions chosen to represent isozyme variation in the National Small Grains Collection. T. D. Phillips and J. P. Murphy.......... 96

Evaluation of some oat strains at Zabreb, Yugoslavia. R. Mlinar.......... 99

Evaluation of oat germplasm for different plant traits. R. N. Choubey.......... 101

Page

Characteristics of Avena sativa x A. moroccana in C_6 Amphiploid progenies. R. N. Choubey and S. N. Zadoo.......... 102

Utilization of Avena maroccana as a gene source for oat breeding. M. Kummer.................................... 104

Genetics

Proposed nomenclature for oat RFLP probes and loci. S. F. Kianian, R. L. Phillips, L. Szabo and H. W. Rines............. 105

The oat genome project at Iowa State University. Michael Lee and P. John Rayapati.................................. 106

IV. REPORTS FROM STATIONS OUTSIDE THE USA

CANADA

Agronomy of oats in Manitoba - 1990. P. D. Brown, S. Haber, J. Chong, D. E. Harder and P. Thomas......................... 107

Oat in Saskatchewan 1990. B. G. Rossnagel and R. S. Bhatty.... 108

GERMANY

Oat breeding in eastern Germany. Kurt Muller.................. 109

FINLAND

Development of Oat Cultivation in Finland. Marketta Saastamoinen.. 110

MEXICO

Oat performance in Chihuahua, Mexico - 1990. Philip Dyck and Jose J. Salmeron-Zamora..................................... 113

V. STATE REPORTS

ARKANSAS. R. K. Bacon....................................... 115

GEORGIA. P. L. Bruckner, J. W. Johnson, B. M. Cunfer, W. W. Hanna, and J. J. Roberts.............................. 116

IDAHO. Larry D. Robertson................................... 117

INDIANA. H. W. Ohm, G. E. Shaner, H. C. Sharma, R. M. Lister, G. C. Buechley, and K. M. Day............................... 118

IOWA. K. J. Frey, A. R. Campbell, A. H. Epstein, P. J. White, and R. K. Skrdla.. 120

Page

MARYLAND. D. J. Sammons and R. J. Kratochvil.................. 122

MARYLAND. Leon H. Slaughter.................................. 122

MICHIGAN. Russell Freed, Dale Harpstead, and Bryan Brunner.... 125

MINNESOTA. D. D. Stuthman, H. W. Rines, R. D. Wilcoxson, R. L. Phillips, D. A. Somers, S. R. Simmons, R. G. Fulcher, L. L. Hardman, L. Szabo, and K. J. Leonard.................... 126

NEBRASKA. L. Oberthur, T. Berke, and P. S. Baenziger.......... 128

NEW YORK. M. E. Sorrells, G. C. Bergstrom, and S. M. Gray..... 129

NORTH CAROLINA. Ron Jarrett, Steve Leath and Paul Murphy...... 131

NORTH DAKOTA. Michael S. McMullen and R. R. Baumann........... 133

OHIO. R. W. Gooding and H. N. Lafever........................ 135

OREGON. Russ Karow, Patrick Hayes, Randy Dovel................ 136

PENNSYLVANIA. David P. Livingston III, Joan C. Dietz and Gerald F. Elwinger.. 137

SOUTH DAKOTA. D. L. Reeves and Lon Hall...................... 138

TEXAS. M. E. McDaniel, David S. Marshall, L. R. Nelson, W. D. Worrall, Mark Lazar, John Sij, and E. C. Gilmore......... 139

UTAH. R. S. Albrechtsen...................................... 141

WISCONSIN. R. A. Forsberg, E. S. Oplinger, R. D. Duerst, J. B. Stevens, H. L. Shands, D. M. Peterson, C. A. Henson, R. W. Skadsen and K. D. Gilchrist and A. H. Ellingboe.......... 142

VI. CULTIVARS

Cultivar Name Clearance. Harold E. Bockelman, USDA-ARS........ 143

ARDO. J. Cervenka, J. Sebesta and F. Benes................... 144

LABUD. Dragoljub Maksimovic, Krstic Miodrag and Ponos Branka.. 146

GA-MITCHELL oat. P. L. Bruckner, D. D. Morey, B. M. Cunfer, and J. W. Johnson.. 147

VII. MAILING LIST.. 148

I. NOTES

NEWSLETTER ANNOUNCEMENTS AND INSTRUCTIONS

Persons interested in oat improvement, production, marketing, or utilization are invited to contribute to the Oat Newsletter. Previous issues may be used as a guide, but remember that the Newsletter is not a formal publication, and therefore that manuscripts suitable or planned for formal publication are not desired.

Specifically, but not exclusively, we would like to have:

1. Notes on acreage, production, varieties, diseases, etc. especially if they represent changing or unusual situations.

2. Information on new or tentative oat cultivars with descriptions. We want to include an adequate cultivar description, including disease reactions and full pedigree if possible.

3. Articles of sufficient interest to be used as feature articles.

4. Descriptions of new equipment and techniques you have found useful.

Material may be submitted at any time during the year. Please send all contributions and correspondence to:

Michael S. McMullen
Crop and Weed Sciences Dept., NDSU
Fargo, ND 58105, USA

Please Do Not Cite The Oat Newsletter in Published Bibliographies

Citation of articles or reports in the Newsletter is a cause for concern. The policy of the Newsletter, as laid down by the oat workers themselves, is that this letter is to serve as an informal means of communication and exchange of views and materials between those engaged in oat improvement and utilization. Material that fits a normal journal pattern is not wanted. Each year's call for material emphasizes this point. Oat workers do not want a newsletter that would in any way discourage informality, the expression of opinions, preliminary reports, and so forth.

Certain agencies require approval of material before it is published. Their criteria for approval of material that goes into the Newsletter are indifferent from criteria for published material. Abuse of this informal relationship by secondary citation could well choke off the submission of information. <u>One suggestion that may help</u>: If there is material in the Newsletter that is needed for an article, contact the author. If he is willing, cite him rather than the Newsletter. This can be handled by the phrase "personal communication".

Minutes of the American Oat Workers Conference Business Meeting
August 14 and 17, 1990. Jackson Hole, Wyoming

The meeting was called to order by chairman H. Ohm.

B. Rossnagel acted as recording secretary in the absence of D. Brown, AOWC secretary.

1. The minutes of the last meeting held in Ottawa, Canada in 1986 were accepted as circulated in the Oat Newsletter. MSC - Stuthman, Weaver.

2. New Business

(a) NOIC - B. Forsberg

The NOIC was established during the 1978 AOWC in Texas and has been involved in the coordination of National oat research activities since its first meeting in Minneapolis in 1978. Since then the NOIC has met annually, usually at the ASA meeting venue.

The question of the current purpose and function of the NOIC was raised in view of recent developments via the American Oat Assoc. and the assumption of the lobby role for oat by the AOA.

It was pointed out that the ASA-NOIC annual meeting is useful in providing guidance for priority setting etc. for the AOA legislative/research committee. After discussion it was generally agreed that the NOIC should continue as a resource to communicate information of national interest to US oat workers. The past-chairman of the AOWC should continue to become the chair of the NOIC.

(b) AOA Research Committee - D. Stuthman

- the 1990 delegation to Washington included Stuthman, Ohm, Murphy, Weaver and Henderson (AOA).

- activities have been reported in the most recent Oat Newsletter.

- the House sub-committee has marked-up 1/2 the oat request and passed the request to the Senate.

- the 1990 request was to full fund the NDSU grain quality position, to double the funding for oat germplasm research, to full fund an oat position at the National Seed Lab and to create a joint oat/barley grain quality position at the grain quality lab in Madison.

- the group acknowledged the AOA financial support for expenses for the trip to Washington.

(c) Chairman Ohm appointed G. Shaner, C. Brown, M. McMullen, B. Rossnagel and P. Murphy as the 1990 AOWC resolution committee to report back on Friday, 17/8/90.

(d) 4th International Oat Conference

R. Forsberg reported that the conference will be held in Adelaide, Australia, Oct. 19-23, 1992. A. Barr of the South Australian Dept. of Agriculture is the Conference Chairman.

(e) Oat CAC report - G. Shaner

- the Oat CAC meets annually in January just prior to the AOA legislative/research committee.
- minutes of the 1990 CAC meeting were circulated in the most recent Oat Newsletter and the group met again just prior to this AOWC business meeting.

Current Oat CAC concerns:

- Oat germplasm evaluations - activities re biological evaluation, species characterization and passport data for materials in the collection is well underway, but much remains to be done.
- Germplasm exchange with USSR - attempting to improve it.
- recently completed a revised germplasm enhancement plan, needs more funding.
- CAC membership is appointed by NOIC and has been stable for several years. The question of the need for more formal appointment and retirement procedures for the CAC is under discussion.
- APHIS is currently reviewing the National Noxious Weed Act, which offers the opportunity to have Avena sterilis removed from that list. The CAC will follow up on this.

(f) Removal of A. sterilis from noxious weed list.

- after considerable discussion, the AOWC Resolutions Committee was instructed to draft a resolution re this item for discussion at the Friday portion of the AOWC business meeting.

(g) Oat Monograph - H. Marshall

- as of now have all but one chapter in hand and reviewed.

(h) Oat Quality Lab report - D. Peterson

The Madison lab has been providing oat protein analysis service since 1970. For the last 15 years samples have been analyzed using NIR, however the instrument used is obsolete and difficult to repair.

- two planned chapters, Biotech Application and Management, are under consideration for elimination.
- the editing will be finished by the end of 1990.
- the ASA will require most of 1991 to complete the project.

Two new options were outlined:

(1) Technicon Infralyzer - 10 year old technology which for $15,000 could be upgraded to replace the Neotech currently used.

(2) Tecator Whole Grain Infra-red Analyzer

- whole oats or groats, therefore eliminates grinding
- could save dehulling for the breeder but requires a slightly larger sample size (5 g oat or 6.5 g groats).
- cost - $62,000

There was a general concensus that option #2 would be the best one to pursue.

(i) Chairman Ohm appointed Weaver, Freed, Ohm, Wesenberg and Harder as the 1994 AOWC site selection committee and asked them to report back on Friday, 17/8 if possible.

(j) Oat Workers' meeting during the ASA, San Antonio meeting will be held at the Marriott Rivercenter Hotel, in Conference Room 18 on Level 3, at 7:30 p.m., Oct. 23, 1990.

(k) Oat research position at Fargo, N.D. - D. Peterson

- the position was originally intended for research on oat fibre
- initial $100,000 funding was insufficient for a full SY and a committee was struck to advise as to how best to utilize the funds. That committee has recommended that a post-doctoral position be created to study detailed physical/chemical analysis of oat fibre including genetic and environmental effects.

(l) Strategic Plan for US Oat Research

It was agreed that the four-year-old document needs to be updated. H. Ohm agreed to meet with the original taskforce members over the next two days and to report back on Friday.

(m) H. Ohm appointed Burrows, Frey, Weaver and Wesenberg as the AOWC 1990 nominations committee.

(n) The meeting was adjourned until Friday, Aug. 17.
The meeting was re-convened at 7:30 a.m., 17/8/90.

(o) Report of the 1994 AOWC site selection committee - Weaver

It was MSC (Weaver, Shaner) that the AOWC accept the invitation from the Univ. of Minnesota to host the next meeting at St. Paul, Minnesota during the 3rd or 4th week of June, 1994.

(p) Update of Strategic Plans for US Oat Research - D. Schrickel

- the current document is four years old and needs revision.

- the current task force consists of Schrickel, Brown, Frey, Forsberg and Marshall.

- this group will meet at the ASA meeting in San Antonio this October with an agenda of items needing updating. Also at that time a new committee will be appointed by the NOIC and that new committee will have a new Strategic Plan developed and finalized by Dec. 31, 1991.

(q) Report of the 1990 AOWC Nominating Committee - Burrows

(1) Two candidates were nominated for the position of AOWC Secretary, D. Brown and B. Rossnagel.
It was MSC (Frey, Weaver) that nominations cease.
After voting, B. Rossnagel was declared elected.

(2) Two candidates were nominated for the position of AOWC chairman, M. McMullen and G. Shaner. It was MSC (Frey, Weaver) that nominations cease. After voting, G. Shaner was declared elected.

(3) Four candidates were nominated for the three positions of members at large, Weaver, Peterson, D. Brown and Barnett. It was MSC (Epstein, Frey) that nominations cease. After voting Weaver, Peterson and Barnett were declared elected.

(r) Chairman Ohm appointed a committee of Forsberg (Chair), Frey, Rossnagel, Kolb and C. Murphy to develop a proposal re an Oat Workers' Code of Ethics to be discussed at the NOIC meeting in San Antonio.

(s) Report of the Resolutions Committee - Shaner

The committee brought forward the following four resolutions.

Resolution #1

Whereas this has been a successful American Oat Worker's Conference, and whereas this success has been due largely to the excellent facilities, arrangements and coordination provided by our fine hosts:
Therefore, be it **RESOLVED** that the participants at this conference express their sincere appreciation to USDA, ARS, especially the National Small Grains Germplasm Research Facility, and the University of Idaho for being most gracious hosts.

Also, be it **RESOLVED** that the participants at this conference convey a special message of appreciation to Dr. Darrell Wesenberg, his wife

Janice, and other members of the Host Committee for selecting such a delightful location for this conference and the Companions Program, and for all the work they did to make these events a success.

MS (Stuthman, Weaver), Carried unanimously.

RESOLUTION #2

Whereas the Quaker Oats Company; Great Western Malting Company; General Mills, Inc.; Goldsmith Seeds, Inc.; Plant Science Research Inc.; Western Plant Breeders; the Idaho Barley Commission, and the U.S. Department of Agriculture, Agricultural Research Service provided generous financial support to the Conference,

Therefore, be it **RESOLVED** that the participants of the conference gratefully acknowledge the financial contributions of these organizations.

MS - (Stuthman, Weaver), Carried unanimously.

RESOLUTION #3

Whereas Dr. Herbert W. Ohm has faithfully served the American Oat Workers' Conference as Chairman, therefore, be it **RESOLVED** that the members of the American Oat Workers' Conference extend their sincere appreciation for his fine leadership, counsel, and guidance during the past four years.

MS (Stuthman, Weaver), carried unanimously.

RESOLUTION #4

Whereas it is often necessary to grow Avena sterilis in the field for purposes of oat research and breeding, and whereas Avena sterilis is a proven valuable genetic resource for improvement of cultivated oat, and whereas experience has shown that Avena sterilis has not become an established weed in any area of the United States where it has been grown in the field,

Therefore, be it **RESOLVED** that the American Oat Workers' Conference recommend to USDA, APHIS that Avena sterilis be removed from the federal list of noxious weeds.

MS (Peterson, Harder), Carried.

(t) Chairman Ohm thanked the AOWC for the opportunity to have been Chairman for the past four years and in particular thanked D. Wesenberg for his efforts re the 1990 AOWC.

(u) The meeting was adjourned, MSC (Falk, Kolb).

Reported by - Acting Secretary, B. Rossnagel

MINUTES OF THE ANNUAL MEETING
OF NCR-15 OAT IMPROVEMENT
JACKSON HOLE, WYOMING
AUGUST 15, 1990

The annual meeting of NCR-15 was called to order at the Snow King Resort in Jackson Hole, Wyoming by Herbert Ohm, Chairman of NCR-15. Experiment station representatives or their alternates in attendance were:

F. L. Kolb	Illinois AES
H. W. Ohm	Indiana AES
K. J. Frey	Iowa AES
R. Freed	Michigan AES
D. D. Stuthman	Minnesota AES
M. S. McMullen	North Dakota AES
R. W. Gooding	Ohio AES
D. L. Reeves	South Dakota AES
R. A. Forsberg	Wisconsin AES

Minutes. The minutes from the previous meeting in Lund, Sweden on July 5, 1988 were published in the Oat Newsletter. The minutes were approved as printed.

North Central Region Strategic Plan for Oat Research. The chairman, Herb Ohm, reported that the NCR Strategic Plan was submitted to directors of the State Ag. Expt. Stations in the North Central region, and Deon Stuthman visited with the directors about the plan in March, 1988. Herb asked if this report needs to be updated. Deon Stuthman suggested that since the national strategic plan for oat research is going to be updated, we should wait to update the North Central plan until the national plan has been revised. The consensus of the group was to wait to update the NCR Strategic Plan until the update on the national plan is completed.

NCR Oat Workers Field Day, 1991. The selection of a site for the 1991 field day was discussed. Herb Ohm listed the sites of field days since 1976 and then opened the floor for discussion. The possibility of a two day field day was discussed (possibly at Wooster, Ohio and East Lansing, Michigan), but after some discussion the consensus of the group was that due to the distance between the two sites and the time commitment required at a busy time of the season, a one day field day was more desirable for most people. Russ Freed indicated that Michigan State was willing to host the field day in 1991. He suggested that the last ten days of June would be the best time. The group approved holding the field day at Michigan State sometime close to June 25, 1991.

Uniform Early and Midseason Oat Performance Nurseries. Howard Rines updated the group on the Uniform Early and Midseason Oat Performance

Nurseries. Each cooperator will get a form letter regarding entering lines in the nurseries into the USDA germplasm collection. Howard reminded the group that cooperators are not permitted to carry out secondary distribution of seed. He also reported that Dave Peterson will conduct beta-glucan analysis on the uniform nursery entries when he gets the analysis up and running. The maximum number of entries in the UMOPN is set at 36. The UEOPN has been growing and it may be necessary to limit that nursery to 36 entries also.

1992 Meeting of NCR-15. The next meeting of NCR-15 is scheduled to be held in Adelaide, Australia in conjunction with the 4th International Oat Conference, Oct. 19-23, 1992.

State Reports. State reports were presented from Illinois, Indiana, Iowa, Michigan, Minnesota, North Dakota, Ohio, South Dakota, and Wisconsin. These reports included information on acreage, production, and production conditions in 1990, as well as, personnel changes, and variety and germplasm releases.

Election of Officers. Fred Kolb, secretary for the past two years, becomes chairman following this meeting. Rob Gooding was unanimously elected as secretary for the next two years after which he will become chairman for two years.

Meeting adjourned.

Respectfully submitted,

Herbert Ohm

Herbert W. Ohm
Chairman

Frederic L. Kolb

Frederic L. Kolb
Secretary

Warren W. Sahs

Warren W. Sahs
Administrative Advisor

AWARD FOR DISTINGUISHED SERVICE TO OAT IMPROVEMENT

At the 1966 meeting of the National Oat Conference in East Lansing, Michigan, a decision was made to honor selected persons for "recognition of their outstanding research contributions and /or meritorious service toward making oats a successful agricultural crop species." (See 1966 Oat Newsletter 17:1-2).

People who were awarded this honor in the past were I. M. Atkins, R. M. Caldwell, F. A. Coffman, H. K. Hayes, G. K. Middleton, D. E. Western, O. T. Bonnett, M. B. Moore, H. L. Shands, J. E. Grafius, N. F. Jensen, J. M. Poehlman, F. L. Patterson, T. Rajhathy, K. J. Frey, D. J. Schrickel, and M. D. Simons.

At the 1990 meeting of the American Oat Worker's Conference held at Jackson Hole, Wyoming, two people were chosen in accordance with Conference procedures. Photographs and biographies of those selected to receive the award for distinguished service to oat improvement at the 1990 meeting follow.

Charles M. Brown
Award for Distinguished Service to Oat Improvement

Dr. Charles M. Brown, Professor of Agronomy at the University of Illinois, has had a major impact on oat improvement. As a plant breeder and geneticist, Dr. Brown has made many significant contributions in oat breeding and research.

Dr. Brown was born in South Carolina where he was raised on a farm. He attended Clemson University and was awarded the B. S. degree in Agronomy in 1950. He then moved to the University of Wisconsin where he earned the M. S. and Ph. D. degrees in Agronomy under the direction of Hazel Shands. In 1954 he became the oat breeder at the University of Illinois where he has led an extraordinarily strong program in oat breeding and research for 35 years.

Dr. Brown has developed many improved oat varieties. These varieties have provided significant improvements over previously grown varieties in yield, oil and protein content, lodging resistance, barley yellow dwarf resistance (BYDV), and crown rust resistance. The widespread commercial production of these varieties demonstrates the significance and economic impact of Dr. Brown's contributions to oat improvement. In 1989, 49 % of the oat acreage planted in the United States to produce certified seed was planted to varieties developed by Dr. Brown. One of these varieties, Ogle, has been especially outstanding for high yield, BYDV resistance and very wide adaptation. Ogle has been grown commercially from New York to Nebraska and from the southern cornbelt to Canada. Ogle has been the highest yielding variety in many areas for over ten years. Another testimony to Dr. Brown's success as an oat breeder is the fact that one or more of his varieties have been included as checks in both the Uniform Early and the Uniform Midseason Oat Nurseries every year since 1970. Further, many varieties and germplasm lines from his program have been used extensively as parents by other oat breeders in the United States and around the world.

Dr. Brown has authored or co-authored numerous publications and several book chapters. In addition to variety and germplasm development, his major accomplishments include developing efficient, effective procedures for screening germplasm for resistance to BYDV; developing a modified system of single seed descent for rapid generation advancement; demonstrating maternal inheritance of oil content; and describing the pollen tube growth, fertilization, and early kernel development of Avena sativa and interspecific crosses with other Avena species. Dr. Brown and his colleague Dr. Henry Jedlinski also conducted research on the inheritance of BYDV and on cross protection in oat by different strains of BYDV.

In addition to his work on oat, Dr. Brown has conducted a research and breeding program on wheat. He has served as associate head of the University of Illinois Department of Agronomy for over 20 years and has been acting head of the Department of Agronomy on three separate occasions. His administrative ability has also been demonstrated in his service on numerous campus committees, such as chairman of the variety review committee. Dr. Brown has been involved in many committees and activities of the American Oat Workers and other professional organizations, served as chairman of the executive committee of the American Oat Workers, and has been a member of delegations informing members of the House and Senate about oat production and oat research priorities.

Dr. Brown has received a number of awards including; designation as a Fellow of the American Society of Agronomy and the Crop Science Society of America; recipient of the 1987 Paul A. Funk Recognition Award from the University of Illinois College of Agriculture; and recognition as an Honorary Life Member of the Illinois Crop Improvement Association and the Illinois Seed Dealers Association.

Howard F. Harrison
Award for Distinguished Service to Oat Improvement

Mr. Howard Harrison retired from his position as Senior Wheat and Oat Breeder, The New Northrup King Seed Co. (formerly, Coker's Pedigreed Seed Co. of Hartsville, South Carolina) in July, 1989. He had been a small grains breeder with Coker for over 30 years, and during this long period of service, he released over 30 improved wheat and oat varieties that substantially contributed to small grain and livestock production throughout the "southern" U. S. small grain production area.

Howard Harrison was born January 4, 1924, in Crawfordville, Georgia, and was raised on a farm there. He entered the U. S. Marines in 1941 at age 17, and served in the Pacific Theater in World War II as a radioman. After discharge from the Marines, he attended the University of Georgia, receiving the B. S. and M. S. degrees in Agronomy in 1952 and 1954, respectively. Following completion of his education at the University of Georgia, he was employed by the the Coker's Pedigreed Seed Company, and began his long and successful career as a small grains breeder at the company headquarters in Hartsville, South Carolina. With Mr. Sam Hadden, his predecessor and co-worker at Coker, he released 'Suregrain' in 1957 and 'Moregrain' in 1958. Suregrain continues to be the most popular oat variety in Argentina to the present time, and is used extensively for livestock forage, for grain production, and as a milling oat.

In 1958, Mr. Harrison was employed as Assistant Agronomist at the University of Georgia's Coastal Plains Experiment Station at Tifton. His responsibilities included maintaining peanut seedstocks; he hauled the Foundation Seed of experiment station varieties up to Plains, Georgia every year to be shelled by a young peanut processor named Jimmy Carter. Following the sudden death of Mr. Sam Hadden in 1961, Howard Harrison returned to the Coker's Pedigreed Seed Company, and assumed sole leadership of the small grains breeding program.

Howard Harrison's contributions to oat improvement include the release of 13 oat varieties that had a great impact on oat production in the U. S. "winter" oat area. He released the first two U. S. oat varieties with crown rust resistance derived from *Avena sterilis*, Coker 227 and Coker 234. Both of these varieties have remained in commercial production for over 20 years. He subsequently released at least nine additional oat varieties having rust resistance derived from *A. sterilis*. His varieties and germplasm lines have been used extensively as parents in other breeding programs, as sources of resistance to crown rust, stem rust, and barley yellow dwarf virus (BYDV). Therefore, his material has contributed to oat improvement throughout the U. S.; it also has been used extensively in developing germplasm and improved varieties for Latin American countries in Quaker Oats' International breeding effort.

Mr. Harrison also had an extremely successful career as a wheat breeder, releasing 19 improved varieties of soft red winter wheat. These wheat varieties did much to revitalize wheat production in the southeastern U. S. In 1982, he was named "Man of the Year in Southern Agriculture" by Progressive Farmer Magazine, in recognition of the contributions he had made toward improved agricultural production. He also was named "Distinguished Agronomist of the Year" by the Agronomy Society of South Carolina in 1982, and received the Gamma Sigma Delta Award of Merit for distinguished service to agriculture from the University of Georgia Chapter at his alma mater in 1983. He also received recognition from both the nation-wide organization and the Carolina-Virginia regional chapter of the National Agricultural Marketing Association in 1985. Other awards included the "Drug Science Foundation Award" for contributions to science in South Carolina, and a "Certificate of Appreciation" presented by the North Carolina Crop Improvement Association in 1989.

Those who know Howard Harrison best appreciate his plant breeding skill, his humor, and his common-sense approach to his work and to life. Howard is a modest individual who is likely to "poke fun" at his own accomplishments; his sense of humor does not tolerate much pomposity in anyone. His philosophy of plant breeding is perhaps best summed up in a bit of advice he once gave a young plant breeder: "Remember, it's hard to get *all* your coons up a single tree!" Although he recognized that *this* was true, he was successful in combining many desirable traits in his own varieties and germplasm lines, through his dedicated and untiring efforts to improve oats; the crop is better as a result of his work.

FOURTH INTERNATIONAL OAT CONFERENCE

OCTOBER 19 - 23, 1992

ADELAIDE

AUSTRALIA

Introduction

This conference will follow conferences held in the USA (1981), Wales (1985) and Sweden (1988) as the major international forum for interchange of research and information on all aspects of the oat crop.

First Circular

The first circular is in preparation (March, 1991) and will be mailed to each person on the mailing list of the (International) Oat Newsletter.

Potential delegates requiring additional information please write to:

Festival City Conventions
PO Box 986
NORWOOD SOUTH AUSTRALIA 5067

Your hosts and organisers

The hosts and organisers look forward to welcoming you to Adelaide and your participation in this conference. The conference is supervised by the International Oat Conference Committee (membership from eight nations), organised by the Fourth International Oat Conference, Inc. and Festival City Conventions located in South Australia.

Key contacts are:

- Dr Robert Forsberg, Chairman, International Oat Conference Committee
  C/- Department of Agronomy, 1575 Linden Drive
  Madison, Wisconsin USA 53706

- Mr Andrew Barr, Chairman, Fourth International Oat Conference Inc.
  GPO Box 1671
  Adelaide, South Australia 5001

- Festival City Conventions
  PO Box 986
  Norwood, South Australia 5067

Proceedings

A refereed proceedings of the conference will be published with papers from both oral presentations and posters eligible for inclusion. The proceedings will be distributed to delegates on registration.

Venue/Location

The conference will be held in Adelaide, capital of the state of South Australia. Adelaide is a city of one million people set on a coastal plain between the Mount Lofty Ranges and St. Vincent Gulf. It is close to the famous Barossa Valley wine areas and the scenic Flinders Rangers.

The conference sessions will be held at the Waite Agricultural Research Institute, one of Australia's leading centres for teaching and research in agricultural science.
South Australia has active research programmes in oat breeding, plant pathology, human and animal nutrition and weed science which will be on display during the conference.

Pre- and post- conference tours to other Australian destinations will be offered.

Program

This conference is the major forum for the interchange of information on all aspects of the oat crop including plant breeding, genetics, human and animal nutrition, weed science, plant pathology, economics and marketing.

It will feature invited, contributed papers and posters under the following topics.

Genetic Resource Development
Breeding Methodology
The Changing Role of Oats in Human Diets
Oats in Rangeland Animal Diets
The Changing Role of Oats in Intensively-Reared Animal Diets
Economics and Marketing of Oats
Developments in Crop Protection
Advances in Molecular Biology
Review of Technology for Oat Research
The Physiological Basis of Oat Yield
The Development and Commercialisation of Naked Oats
Oat Genetics, Cytogenetics and Inheritance

The program will probably run for five days and will include a one-day excursion into oat growing areas of South Australia.

Special Workshop

The conference organisers are interested in programming a special one-day workshop titled "Wild Oats in World Agriculture" to be presented as one full day in the conference week. The format would be invited papers and discussion under the following subject areas:-

The importance of Wild Oats in World Cropping Systems
Ecology of Wild Oats in Cropping Systems
Seed Dormancy in Wild Oats
Herbicide Resistance in Wild *Avena*
Interactions between Wild and Cultivated Oats in Cropping Systems
New Developments in the Control of Wild Oats

This workshop is a departure from the normal format of the Oat Conference but the local committee believes this is a very important subject area and worthy of inclusion. Potential delegates will be polled in the first circular to indicate their preference - the traditional format of a four day conference and one day or alternatively a 3 day conference, 1 day special workshop and 1 day field tour.

AMERICAN OAT WORKERS CONFERENCE - 1990

Snow King Resort
Jackson Hole, Wyoming
August 14-17, 1990

Executive Committee

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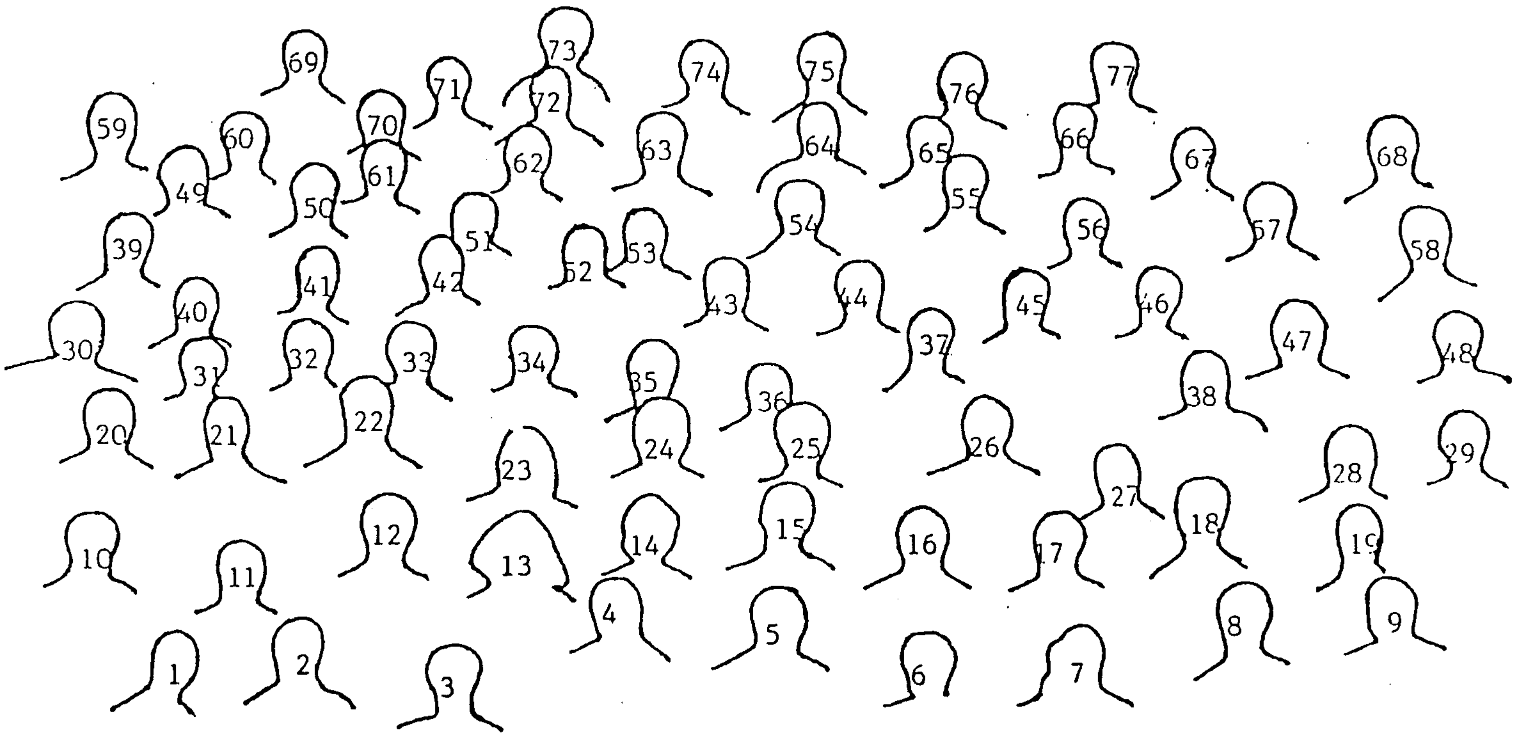
AGRICULTURAL RESEARCH SERVICE - Aberdeen, Idaho

Special Thanks to all of the staff of the National Small Grains Germplasm Research Facility, and especially, Fawn Buffi, University of Idaho Secretary; Glenda Rutger, ARS Secretary; and Kathy Burrup, ARS Administrative Technician.

AOWC Members Present for Group Photograph



1. Philip Dyck
2. Jose Marales
3. Marianne Plaus
4. David Peterson
5. Ron Barnett
6. Ann Soffes
7. Luci Polsoni
8. David Hoffman
9. Fred Kolb
10. Hector Rubio
11. Leslie Shugar
12. Ann McKendry
13. Pamela White
14. Adrianna Hewings
15. Tom Trevino
16. C. T. Liu
17. Joseph D. Mullen
18. Rob Gooding
19. Steven Leath
20. Darrell Wesenberg
21. Robert Forsberg
22. Ron Phillips
23. Delilah Irving
24. Juan Salmeron
25. Kenneth Frey
26. Jim B. Cretney
27. David Goslin
28. Steven Broich
29. David Marshall
30. Vernon Burrows
31. Len Seguin
32. Herbert Ohm
33. A. H. Epstein
34. Randy Dovel
35. Oly Cantu
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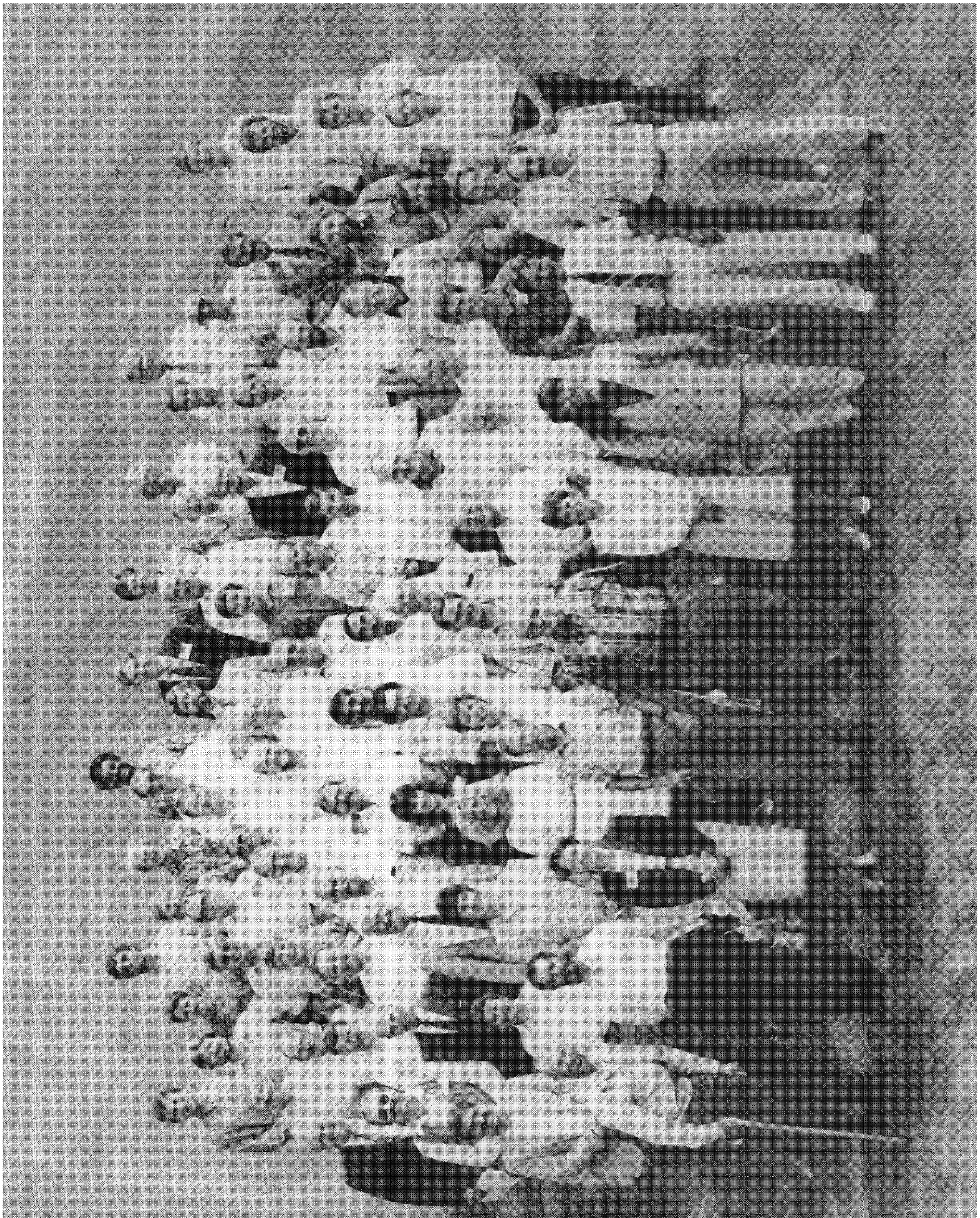
38. Charles Murphy
39. Howard N. Lafever
40. Russell Freed
41. Leslie Cregger
42. John Merboth
43. Gilbert Stallknecht
44. Dave Burrup
45. Harold Bockelman
46. Duane Falk
47. Brian Rossnagel
48. Paul Murphy
49. Bryan Brunner
50. Cal Qualset
51. Lee Briggle
52. Gary Bergstrom
53. Charles Brown
54. Gary Yarrow
55. Harold Marshall
56. Phillip Sisson
57. Fran Webster
58. Blair Goates
59. Jeff Johannesmeyer
60. David Livingston
61. Dale Reeves
62. Greg Shaner
63. J. Vincent
64. Milton McDaniel
65. Russell Moomaw
66. Don Harder
67. Lee Urie
68. Kurt Leonard
69. Pat Hensleigh
70. Phil Bregitzer
71. Mark Sorrells
72. Sam Weaver
73. S. Kibite
74. Howard Rines
75. Michael McMullen
76. Donald Schrickel
77. Deon Stuthman



AMERICAN OAT WORKERS' CONFERENCE
JACKSON HOLE, WYOMING AUGUST 14-17, 1990

Tuesday August 14, 1990

2:00 pm OAT CROP ADVISORY COMMITTEE MEETING
CAC CHAIRMAN: G. SHANER

3:30 pm AOWC BUSINESS MEETING
AOWC CHAIRMAN: H. OHM

Oat CAC Report
Oat Monograph Report
Research Committee Report
International Oat Conference Report
Resolutions Committee
Other Business

7:00 pm RECEPTION

Wednesday August 15, 1990

8:00 am BREEDING AND GENETICS I
SESSION CHAIRMAN: C. BROWN

A representation of genetic variation in the National Small Grains Collection of _Avena sterilis_ L. - T. PHILLIPS & P. MURPHY

Performance and grain quality of fifty-three foreign oat genotypes from nine non-north american countries as grown in Saskatoon, Canada in 1989 - B. ROSSNAGEL

Stability and performance of oat cultivars in environments of Chihuahua, Mexico - J. ZAMORA

Reserve carbohydrates in winter oat - D. LIVINGSTON

Resistance in oat to freeze damage and ice nucleating bacteria - D. MARSHALL

Reaction of oat cultivars to barley yellow dwarf virus at two Nebraska locations - J. WATKINS, R. KULM, T. GOMPERT & R. MOOMAW

10:00 am BREAK

10:30 am BREEDING AND GENETICS II
SESSION CHAIRMAN: D. STUTHMAN

A review of oat rust resistance breeding - G. SHANER

Gene deployment on the Puccinia pathway - D. HARDER, P. BROWN, & J. CHONG

Genetics of a reciprocal translocation involving the crown rust resistance gene Pc-38 - G. LEACH & M. McMULLEN

Fungicidal control of crown and stem rust of oat - M. McDANIEL

12:00 pm LUNCHEON

1:00 pm OAT QUALITY
SESSION CHAIRMAN: P. MURPHY

Analysis of Beta-glucan content in different oat genotypes - P. WHITE, K. CHANG & K. FREY

Genotype x environment interaction for oat beta-glucan concentrations - D. PETERSON

Concurrent selection for oil and hull percentage in spring oat using NMR - F. KOLB & C. BROWN

PANEL: Is there a naked-seeded oat in your future? - V. BURROWS, J. JOHANNESMEYER, H. MARSHALL, & G. YARROW

3:00 pm BREAK

3:30 pm CULTIVAR RELEASE POLICY, INTELLECTUAL PROPERTY PROTECTION, GERMPLASM EXCHANGE, AND RESEARCHERS' CODE OF ETHICS
SESSION CHAIRMAN: K. FREY

PANEL: Cultivar Release Policy, Intellectual Property Protection, Germplasm Exchange and Researchers' Code of Ethics - K. FREY, H. BOCKELMAN, R. FORSBERG, & C. MURPHY

5:00 pm BREAK AND DINNER ON YOUR OWN

8:00 pm AMERICAN OAT ASSOCIATION REPORT - P. HENDERSON

8:30 pm NCR-15 MEETING - Chairman: H. OHM
SOUTHERN SMALL GRAINS WORKERS MEETING - Chairman: R. BARNETT

Thursday, August 16, 1990

8:00 am APPLICATION OF BIOTECHNOLOGY IN OAT IMPROVEMENT I
SESSION CHAIRMAN: F. WEBSTER

PANEL: Applications of biotechnology in oat improvement - F. WEBSTER, I. ALTOSAAR, R. PHILLIPS, & J. VINCENT

9:45 am BREAK

10:15 am APPLICATION OF BIOTECHNOLOGY IN OAT IMPROVEMENT II
SESSION CHAIRMAN: D. HOFFMAN

Hypergene: graphics-based software for RFLP assisted plant breeding - N. YOUNG, M. SORRELLS, & S. TANKSLEY

Physical aspects of an embryogenic system in oat anther culture - L. POLSONI & D. FALK

Haploids from wide crosses - H. RINES, D. DAVIS, V. NUNEZ, G. CHEN, & L. DAHLEEN

11:15 am DISCUSSION

12:00 pm LUNCHEON

1:00 pm ROLE OF OAT IN SUSTAINABLE AGRICULTURE
SESSION CHAIRMAN: H. OHM

The role of plant breeders in sustainable agriculture - R. FREED

Economics of oats production - P. SISSON

Oats as a forage crop - R. FORSBERG & M. BRINKMAN

Dormoat - A possible role in sustainable agriculture - V. BURROWS

Oat as a companion crop for forage establishment - S. SIMMONS, D. STUTHMAN, T. HAUGEN, N. MARTIN, C. SHEAFFER & E. SCHIEFELBEIN

2:30 pm BREAK

3:00 pm COMPUTER DEMONSTRATIONS AND POSTER SESSION
COORDINATION: H. BOCKELMAN, D. HOFFMAN & S. KIBITE

Computer Demonstrations - 1) M. BOHNING
2) R. FREED

POSTERS -

Molecular and immunological evaluation of barley yellow dwarf virus resistance in a segregating wheat x wheatgrass population - L. GOULART, S. MACKENZIE, R. LISTER & H. OHM

MSTAT-C Microcomputer program for agricultural research - R. FREED

Heritability of oat mosaic virus resistance - D. UHR & P. MURPHY

Germplasm to cultivar - introgression of unadapted genotypes - D. STUTHMAN & G. POMERANKE

Reaction of winter oat cultivars to powdery mildew - S. LEATH, P. BRUCKNER & J. WILSON

Identification and characterization of oat mosaic and oat golden stripe viruses in winter oats in North Carolina - L. ELLIOT, S. LEATH & S. LOMMEL

Beta-glucan concentration and characteristics among Avena species - J. KOCH & D. PETERSON

Assessment of genetic relationship among Avena sterilis accessions - M. SORRELLS, J. GOFFREDA, B. BURNQUIST, S. TANKSLEY & J. MURPHY

Latent period of Puccinia coronata in oat - G. ALDRIDGE, H. OHM, & G. SHANER

Evaluation of Avena strigosa for reaction to BYDV by symptomatology, Elisa and dot blot assay - H. SHARMA, L. GOULART, R. LISTER, S. MACKENZIE & H. OHM

Characterization of oat haploids and their progeny - D.W. DAVIS, L.S. DAHLEEN & H.W. RINES

Computer-assisted identification of c-banded chromosomes in monosomic lines of the oat cultivar 'Kanota' - E.N. JELLEN, R.L. PHILLIPS, & H.W. RINES

Extraction and identification of antioxidants in oats - K. DUVE & P. WHITE

Plant regeneration from friable, embryogenic oat callus in response to exogenous cytokinins - P. BREGITZER & H. RINES

1989 survey for three serotypes of barley yellow dwarf virus in oat and wheat fields in Illinois - C. D'ARCY, A. HEWINGS, & C. EASTMAN

Plant regeneration in successive callus cultures of Avena - S. SAHA, J. GANA, V. AVIRINENI, G. SHARMA & D. WESENBERG

Lipid Distribution in oats varying in lipid concentration - D. IRVING, H. SCHIPPER, R. JOHNSTON & R. SAUNDERS

Newly identified isozyme polymorphisms among oat cultivars and Avena species - B. GOATES & D. HOFFMAN

The initiation of a molecular gene map for oats - D. HOFFMAN & M. GUTTIERI

Characterization of the barley yellow dwarf virus NY-MAV-PS1 and P-PAV genomes - P. UENG, J. VINCENT, E. KAWATA, H. LEI, R. LISTER & B. LARKINS

The genome of the NY-RPV isolate of barley yellow dwarf virus - J. VINCENT, R. LISTER & B. LARKINS

Inheritance and cytology of 'monster plant' traits in oat (Avena sativa L.) - S. KIBITE

5:00 pm BREAK

7:00 pm BANQUET

Friday, August 17, 1990

8:00 am AOWC BUSINESS MEETING

8:45 am BUS TOUR:
TETONIA RESEARCH AND EXTENSION CENTER
ABERDEEN RESEARCH AND EXTENSION CENTER
NATIONAL SMALL GRAINS GERMPLASM RESEARCH FACILITY

Noon: Sack Lunch Enroute

6:30 pm Return to Jackson Hole, Wyoming

Representation of Genetic Variation in the National Small Grains Collection of *Avena sterilis L.*

T.D. Phillips and J.P. Murphy
Dept. of Crop Science, North Carolina State University
Raleigh, NC

Nearly 6000 accessions of *Avena sterilis* L. are maintained in the National Small Grains Collection (NSGC). This wild hexaploid progenitor of cultivated oat (A. *sativa* L.) provides a readily available gene source for oat breeders. Information about variation in the wild oat collection would allow a breeder to more efficiently sample the gene pool. The objective of this study was to measure and categorize genetic variation among *A. sterilis* accessions contained in the NSGC. A sample of 1005 accessions was chosen to represent the geographical range of the collection. Starch gel electrophoresis was used to obtain data for 29 enzyme systems. Genetic distances between accessions were estimated using Jacquard's distance estimates based on banding patterns, and a dendrograph of the 1005 accessions was constructed. This resulted in the identification of 50 clusters of accessions based on genetic similarity. Additional clustering analyses of the dendrograph groups and countries revealed that the 50 groups could be further divided into six distinct groups. The dendrograph based on countries showed that Kenyan accessions were the most different. Israeli and Moroccan accessions clustered together, as did accessions from Turkey, Iraq and Iran. The accessions from Turkey were the most diverse within any of the countries. An oat breeder can more effectively sample the genetic variation in *A. sterilis* by choosing accessions from dendrograph groups rather than random sampling or sampling based solely on passport data.

Performance and Grain Quality of Fifty-Three Foreign Oat Genotypes From Nine Non-North American Countries as Grown at Saskatoon, Canada in 1989

B.G. Rossnagel
Crop Development Centre, University of Saskatchewan
Saskatoon, Saskatchewan

Via reciprocal exchanges of germplasm, several foreign genotypes were evaluated and compared with local checks in non-replicated trials at Saskatoon in 1989. Genotypes (number of lines in brackets from nine countries were tested, including: the U.S.S.R (9), Finland (4), Norway (5), Wales (5), Germany (4), Czechoslovakia (6), Sweden (5), Australia (13) and Argentina (2). Materials were evaluated for as many of the following traits as possible: grain yield, heading date, height, maturity, test weight, kernel weight, grain plumpness, oil content, protein content, beta-glucan content and general adaptation for Saskatchewan.

Of the 53 genotypes, A85012 and A4013 from Norway, Maldwyn and Melin from Wales, Flamingsnova and Flamingsregent from Germany, Zlatak from Czechoslovakia and Arne and Sanna from Sweden performed well for several traits of importance. Of the traits evaluated the greatest deficiencies relative to locally adapted check cultivars were noted for the physical grain quality traits test weight, kernel weight and grain plumpness.

Other potentially unique characteristics noted included the low % oil of Melin and Maldwyn (Wales) and Sang (Sweden), the low % beta-glucan of Martin (Norway) and higher beta-glucan of Envis (Wales), the high protein of Envis and Av2027/3/1/32 (Wales) and the tolerance to dicofop-methyl of I-83-37 x SW x CCN/11/20/5 (Australia).

Stability and Performance of Oat Cultivars in Environments of Chihuahua, Mexico

J.J. Salmeron-Zamora
Cereal Breeding, INIFAP-Cd. Cuauhtemoc, Mexico

Stability parameters for grain yield, plant height, days to heading and maturity were obtained from five advanced lines and six oat varieties. This study was carried out for five years in different locations of the High Mountain Valley region of Chihuahua. The objective was to evaluate the performance of new improved lines compared to the check varieties. Yield evaluations and morphological parameters were collected from a randomized complete block design experiment in five environments from 1986 to 1989. (In 1986 they were established in two locations.) The research was conducted under dry land conditions. The rainfall varied from 284 mm to 411 mm during the evaluations. The stability parameters were estimated according to the model proposed by Eberhart and Russel (1966). The analysis of variance across environments showed significance for the genotypes and for all the parameters considered. The genotype by environment interaction was not significant for any of the parameters. For grain yield the line Tu1/79AB-369-79GHG-133, was superior to all lines and varieties assessed, in plant height, days to flowering and maturity was statistically similar to Papigochi. Paramo was the variety which had a similar performance under low and high yielding environments and had the low yielding ability across environments. Cusi a new variety performed similar to Paramo but had higher yielding than Paramo across the environments. Both varieties were the earliest genotypes.

Reserve Carbohydrates in Winter Oat

D.P. Livingston III
USDA-ARS
University Park, PA

During cold hardening large amounts of a fructose polymer, called fructan, accumulate in storage organs of most cool-season grasses. Fructan is used as a reserve energy source and may be indirectly associated with freezing resistance. To compare carbohydrate accumulation in crowns of representative winter cereals, two oat, two barley, one wheat, and one rye cultivar were raised under controlled conditions for 5 weeks at 15C and 3 weeks at 2C. Starting at the end of week 4 and at weekly intervals carbohydrates were extracted from fresh crown tissue with ethanol and water. Carbohydrates were separated by High Pressure Liquid Chromatography and quantified with Refractive Index Detection. On a mg/g dry weight basis, oat accumulated significantly ($P<0.01$) less fructan of degree of polymerization greater than 9 ($DP>9$) than all other cultivars and significantly ($P<0.01$) more DP3 to DP7 fructan. The presence of large amounts of sucrose and DP3 to DP7 fructan suggested that substrate level was not limiting synthesis of $DP>9$ fructan in oat.

Resistance in Oat to Freeze Damage and Ice Nucleating Bacteria

David Marshall
Texas Agricultural Experiment Station, Texas A&M University
Research & Extension Center
Dallas, TX

Each year in the United States, millions of dollars are lost in crop production due to untimely freezes. Among the more severely affected crops are fall-sown small grains, particularly oat (Avena sativa). The Texas oat crop is dual-purpose in that the rapid and abundant production of green-matter makes excellent forage for beef and dairy cattle and the grain produced makes superior human and animal foods. However, the losses due to freeze damage have made oat cultivation a risky venture, particularly in the north-central portions of Texas. Oat production could be increased and be made less risky if methods could be found to protect the crop from freeze damage.

Research at TAES-Dallas has shown that (1) ice-nucleation-active (INA) bacteria were responsible (sometimes singly, sometimes partly) for freeze damage in oat; (2) control of INA bacteria by bacteriocides reduced freeze damage and increased forage and grain yields of oat; and (3) oat cultivars differed in their resistance to INA bacteria. Leaves of the moderately freeze-resistant cultivar 'H-833' supported growth of significantly fewer INA bacteria than leaves of 'Florida 501', a freeze-susceptible cultivar. The term "slow-freezing" was coined to describe the phenomenon of reduced freeze damage, as time spent at sub-freezing temperatures was increased.

Preliminary genetic studies in crosses involving Florida 501, H-833, and 'Nora' (moderately freeze-resistant) have indicated that two genes (possibly recessive) may be responsible for resistance to INA bacteria in H-833, and that genes for resistance from different sources may show additive effects. A diallel with six moderately freeze-resistant (slow-freezing) and three fast freezing oat lines has been made to assist in determining the number of genes and mode of inheritance of INA bacterial resistance in oat.

Reaction of Oat Cultivars to Barley Yellow Dwarf Virus at Two Nebraska Locations

John E. Watkins, Department of Plant Pathology, University of Nebraska-Lincoln, Lincoln, NE; Ralph E. Kulm, Holt County Extension Office, O'Neill, NE; Terry L. Gompert, Knox County Extension Office, Center, NE; and Russell S. Moomaw, University of Nebraska Northeast Research and Extension Center, Concord, NE

Ten oat cultivars were evaluated at field trials located in Boyd and Knox Counties in northeast Nebraska. Both trials were planted March 31, 1989 at a 65 lb/A seeding rate using a double disk opener drill with 8 in row spacings. Buctril was applied for postemergent broadleaf weed control. The Knox County trial was fertilized with a 70-60-20 (N-P-K) fertilizer and the Boyd County trial with 63-32-0. Both fields had been in corn in 1988. Fourteen x 30 ft plots were arranged in a randomized complete block design with four replications. Disease assessment of both trials was made June 7, 1989. Harvest dates were July 11 for Boyd County and July 12 for Knox

County. Precipitation was well below normal for the growing season with near normal temperatures.

Disease pressure in 1989 was moderate at both locations. Burnett showed the highest disease ratings at Boyd County and the second highest at Knox County; however, the severity was considered only moderate. 'Hazel', which is reported to be tolerant, showed a mixed severity at the two locations. It rated light at the Boyd County location but had the highest disease rating at Knox County. The yields and test weights for Hazel were below the experimental mean at both plot locations. 'Porter' showed the least BYDV severity at both locations. Light or light-moderate BYDV were recorded for 'Don', 'Hytest', 'Kelly', 'Nodaway 70', 'Ogle', 'Otee', and 'Starter'. Yield and test weight were probably more influenced by droughty conditions than by BYDV.

In 1990 eleven oat cultivars were evaluated for BYDV in field trials in Boyd and Knox Counties. The Boyd County trial was planted March 26, 1990 and the Knox County trial March 27, 1990. Plot size and seeding rate was the same as in 1989. The Boyd County trial was fertilized with a 0-70-0 fertilizer and the Knox County with 28-33-0. BYDV was severe on susceptible cultivars in 1990. Don, Hazel, and Ogle showed the lowest BYDV ratings at both locations; Bates, Otee, 'Settler', and Starter were intermediate; Kelly and 'HyTest' were high intermediate, and 'Burnett' and 'Trucker' had the highest ratings. The strain of BYDV present in both trials was PAV.

A Review of Oat Rust Resistance Breeding

Gregory Shaner
Department of Botany and Plant Pathology
Purdue University
West Lafayette, IN

The history of rust resistance breeding in oats provides a classical example of the consequences of the inappropriate use of monogenic resistance, and attempted remedies. For the past 60 years, resistance to crown rust and stem rusts has been an important objective of many oat breeding programs. Beginning with the Victoria resistance, and moving through a succession of three other sources of resistance to crown rust, oat breeders brought about "boom and bust" cycles of protection. Breeding for resistance to *Puccinia graminis avenae* followed a parallel course until the 1960s. Since then, many new genes for resistance to crown rust have been found in *Avena sterilis* from the Near East, but no comparably rich source of resistance to *P. graminis avenae* has been found, which has limited options for gene deploynent strategies. Ironically, for the past 25 years a single race of *P. graminis avenae* that overcomes the specific resistance genes in most oat cultivars has predominated in the Great Plains, but it has not caused widespread epidemics. Conversely, although there is a greater genetic diversity for crown rust resistance now than in the 1940s and 50s, and oat acreage has declined considerably, crown rust continues to cause significant losses, but not as devastating as losses in earlier decades. Because oat breeding in North America is almost entirely done at public institutions and breeders and pathologists are in close communication, oats is an ideal model crop for evaluating new strategies for the management of resistance genes.

Gene Deployment Along the *Puccinia* Pathway

D.E. Harder, P.D. Brown, J. Chong
Agriculture Canada Research Station
Winnipeg, Manitoba

Epidemiological studies showed a progressive south to north movement of rust epiphytotics, arising in Mexico and southern Texas, progressing through the central USA, and terminating in the northern prairies. This epidemiological zone became known as the "*Puccinia* pathway". The wide release of cultivars with uniform single-gene rust resistance resulted in quick demise of the resistance, and demonstrated the need to provide a broader and more varied base of resistance. Regional deployment of varying genes for crown rust resistance was proposed as a method for interrupting the movement of this rust along the *Puccinia* pathway. An agreement was made in the early 1970's, deploying 10 different genes in three regions along the *Puccinia* pathway. Additional genes subsequently isolated were to be distributed by agreement. Several factors have influenced the effectiveness of this scheme. One was a lack of precise identification of resistance genes involved. Another was that resources have generally declined, resulting in inadequate monitoring of the pathogen populations and isolation of new genes. A third, and perhaps the most important factor, has been the high variability of the *Puccinia coronata* population. The entire American and Canadian oat crop within the *Puccinia* pathway may be in jeopardy; U.S. and Canadian examples of the release of a crown rust resistant cultivar followed by the rapid increase of virulent crown rust isolates can be cited. Soon after the widespread release of Bond-derived cultivars in the 1940's, races virulent to the Bond resistance rapidly increased and caused continued crop losses. In the late 1980's, races with virulence to gene *Pc39* became predominant in Ontario due to the release of 'Woodstock', which has this gene. Also, races with virulence to the gene *Pc38* and *Pc39* combination, first identified from the north central U.S.A., have now become widespread here and in the eastern Canadian prairies. Due to widespread use of cultivars with these genes, the incidence of virulence to these genes is expected to continue to increase. The high variability in virulence of the crown rust population indicates a short-lived future for the remaining known resistance genes. Although there is available a relatively large pool of crown rust resistance genes, many of these genes are now becoming less effective or are inadequately tested against prevailing crown rust populations. The effectiveness of a gene deployment scheme depends on the availability of an adequate pool of resistance genes, resources for the identification and isolation of new genes, and cooperation in their use and distribution. Are these criteria realistic? Do we wish to reaffirm the gene deployment concept, or are there alternatives?

Genetics of a Reciprocal Translocation Involving the Crown Rust Resistance Gene *Pc-38*

Gene D. Leach and Michael S. McMullen
Department of Crop and Weed Sciences
North Dakota State University
Fargo, ND

Unexpected segregation of the oat crown rust resistance gene *Pc-38* was observed during routine rust testing of lines derived from 'Steele'/'Dumont' crosses. Ring quadrivalents were observed in cytological examinations of Steele/Dumont F_1

microsporocytes suggesting that the two cultivars differ by at least one reciprocal translocation. This study was conducted to determine the genetics of a reciprocal translocation in which unexpected segregation of *Pc-38* leads to the production of F_2 seedlings that are susceptible to crown rust even though both parents are homozygous for *Pc-38*. Ten homogeneous resistant Steele/Dumont $F_{2:3}$ (SD) lines were mated in a partial diallele with each other, and with Steele and Dumont to determine if the *Pc-38* locus occurs in the same chromosomal position in the 10 lines.

Microsporocytes were sampled from each F_1 plant to cytologically identify at meiosis the presence of a ring quadrivalent which would lead to the production of duplication-deficiency gametes. Approximately 100 F_2 seedlings from each F_1 hybrid were inoculated with crown rust isolate CR13 which is avirulent on *Pc-38*. The genetic data and cytological observations were used to determine the chromosomal constitution of Steele, Dumont, and the 10 SD lines. The SD lines possessed between 0 and 4 *Pc-38* genes which suggested that the duplication-deficiency gametes were viable and that manipulation of gene dosage was possible. Increased gene dosage apparently did not alter the expression of resistance by *Pc-38*.

Since *Pc-38* is either allelic or tightly linked with the crown rust resistance gene *Pc-63*, a line with *Pc-38* in an interchanged position crossed with a germplasm line homozygous for *Pc-63* was used to produce a homozygous allelic combination previously not obtainable. Segregation of resistance to CR13 (avirulent on *Pc-38* and *Pc-63*) in progeny of crosses of lines possessing *Pc-38* derived from Dumont with a line possessing *Pc-63* suggested the Dumont chromosome with *Pc-38* was interchanged relative to the chromosome with *Pc-63* while the chromosome derived from Steele possessed *Pc-38* in a position either allelic or tightly linked with *Pc-63*.

Fungicidal Control of Crown Rust and Stem Rust of Oat

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The systemic sterol-inhibitor fungicides such as Tilt (Ciba-Geigy) provide more effective control of rust pathogens than do older "contact" fungicide chemicals. We have been conducting oat disease-control research with this new "breed" of fungicides since the 1985-86 crop season. Although none of the sterol-inhibitor chemicals currently are approved for use on oats in Texas, Tilt and Bayleton (Mobay) are approved for use on wheat. Ciba-Geigy currently is pursuing registration of Tilt for use on oats.

Tilt is being used successfully to protect the commercial oat crop in the Entre Rios area (Parana state) of Brazil. Two applications of the high recommended rate of Tilt are used; this approach to oat disease control has certainly improved and stabilized oat production in this area, which is subject to heavy losses from both crown rust and stem rust.

Recently, we also have initiated research with the Baytan (Mobay) seed treatment chemical on oats. Since both fall-planted wheat and oats frequently become infected soon after emergence in Texas, heavy epidemics develop during winter and early spring months, particularly in seasons with mild winters. Since Baytan provides good systemic protection against rusts and mildew for several months, we believe that widespread use of Baytan would significantly reduce rust losses by delaying infection until much later in the season, and greatly reducing the number of uredial cycles in epidemics.

Results

1. Baytan seed treatment trials were conducted at three South Texas locations in 1990. Yield improvement of 5.0 to 8.3 bushels per acre was obtained on Nora (susceptible to both crown rust and stem rust); yield change of TAMO 386 (resistant to both rusts) ranged from -1.6 to +2.8 bushels per acre.

2. Yield increases as large as 60 bushels per acre have been obtained from timely application(s) of both single and multiple foliar spray treatment(s) of an effective experimental sterol-inhibitor chemical to susceptible oat genotypes.

3. Although yields and test weights of susceptible genotypes can be improved dramatically by fungicide treatment, our experience is that they still fall considerably short of those of resistant genotypes in most cases.

Since genetic resistance does appear to provide more effective protection against oat rusts than any chemical we have tested, it appears obvious that breeding for resistance should remain a high priority in areas having heavy disease epidemics. Both seed treatment and foliar fungicides can be used to provide an effective "second line of defense" when needed.

Analysis of Beta-glucan Content in Different Oat Genotypes

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The beta-glucan contents of 250 samples of genetically variable oats were measured by using a modified version of the enzymatic method by McCleary and Glennie-Holmes (1985) or by flow injection analysis. Each sample was well ground with a Retsch mill, and the beta-glucans were individually extracted and analyzed. The data among samples showed a normal distribution suggesting that the range of beta-glucan content for most samples was from 4.5 to 5.5%. Results showed significant differences among samples, indicating that genetic variability of oats affects the content of beta-glucan.

Genotype x Environment Interaction for Oat Beta-Glucan Concentrations

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Twelve commonly grown oat (Avena sativa L.) cultivars were grown in replicated plots at 12 locations, from New York to Idaho. Harvested grain was analyzed for Beta-glucan concentration by an automated fluorometric procedure based on the reaction of the solubilized polymer with calcofluor. The primary objective of the experiment was to determine whether there was a significant genotype x environment interaction. There were significant differences among genotypes at each location. Correlation coefficients between locations were generally, but not always, significant. A combined analysis of variance across all locations indicated that there was a significant ($P = 0.01$) genotype x environment interaction, but the F values for the main effects were much larger than that for the interaction term. We concluded that analysis of samples grown in one location would identify most, but not all high Beta-glucan genotypes.

Concurrent Selection for Oil and Hull Percentage in Spring Oat using NMR

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Nuclear magnetic resonance (NMR) has been used to select for oil percentage in oat groats. High groat percentage is also a desirable trait in oat. Our objective in this study was to determine if NMR could be used to concurrently select hulled oat samples for high oil and high groat percentage. Nine F_5 populations (approximately 100 lines per population) were evaluated using NMR on hulled oat samples. Based on NMR readings of hulled samples, the highest and lowest 10% of the plants were selected from each population and grown in the field in 1989. The parents were also grown. An NMR reading was determined on a hulled sample of each entry. Each sample was then dehulled, groat percentage was determined, and an NMR reading was determined for each groat sample.

In all nine crosses, groat oil percentage of the lines selected for high NMR value (based on hulled samples) was higher than those selected for low NMR value. Thus, selection based on NMR evaluation of hulled samples was effective in selecting for oil percentage. NMR values of hulled samples were highly correlated with those for dehulled samples ($r = 0.95$). Groat percentage of the lines selected for high NMR reading was higher in two of the nine crosses and not different in the remaining crosses. Breeders should be able to select for higher oil percentage by using NMR with hulled oat samples; groat percentage may also increase in some cases.

Naked Oat Improvement at Ottawa

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The Plant Research Centre is dedicated to the successful commercialization of the naked oat because we view this as a viable strategy to halt the progressive reduction in oat acreage. It will also help many countries reduce imports of energy and protein. Covered-seeded oats will continue to serve the milling and recreational horse markets but the oat hull covers up one of natures most nutritious cereal grains and virtually excludes the oat as a competitive grain for the pig and poultry industries. Naked oat groats contain the metabolizable energy of corn combined with enough protein of high quality to compete with corn and soybean meal in most pig and poultry diets.

Breeding strategies have been formulated to improve many of the deficiencies associated with present day naked varieties and progress in improving the naked oat ideotype has been substantial. Yield levels of advanced strains such as 0A826-3 and 0A820-3 are comparable in Eastern Canada to the groat yields of many of the currently grown covered seeded cultivars. Improvements have been made in straw strength, seed size, hectolitre weight, maturity, disease resistance and seed quality such as percent naked oat and groat hairiness. Processors such as Quaker Oats and Robin Hood Multifoods are actively evaluating naked oat strains as a raw material for food but the greatest impact that naked oats could have is in the specialized feed industry.

Production and Utilization of Naked-Seeded Oats

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Although improved cultivars of naked-seeded oats are available, acceptance by growers and industry may be limited because of unique growing, harvesting, storing, and marketing requirements. Some problems may go away with further cultivar improvement, production experience, and market development. In the meantime, growers should use practices that will increase the probability of success with naked-seeded oats.

GROWING PRACTICES. In general, management practices for hulled oats work with naked-seeded oats, but certain steps require careful attention. Obtaining consistently good stands may be more dependent on the use of high quality, treated seed and a firm, well-prepared seedbed than with hulled oats. In addition, embryos of naked seeds can be damaged in harvest, and the grower may need to adjust the seeding rate based on the percent germination.

Good weed control is especially important with naked oats, but 2,4-D (and possibly other herbicides) may interfere with the expression of the naked-seeded trait. This problem, along with small panicle size and multiple peduncle formation, has been observed in foundation seed production with Pennuda.

HARVESTING AND STORAGE. Timely harvest of naked oats seems especially important.

As with other oats, wet weather can cause head-sprouting, and this may result in poor threshing of naked-seeded grain. Naked oats may be more susceptible to shattering loss and bird damage than hulled oats, but more information is needed. Shattering may be especially likely in the more arid regions of oat production, and more information is needed about the feasibility of swathing the crop.

Moisture content of groats should be 12% or less for storage, and bins which facilitate aeration probably should be used. Proper combine cylinder speed and concave setting are essential to avoid groat damage during the harvest of naked oats. Damage to the embryo is especially critical if the grain is to be used for seed. Seed coat damage also results in accelerated loss of quality in storage and contributes to rapid development of rancidity.

Improved naked oats still have various degrees of fine hairs (trichomes) on the groat surface and especially at the brush end. Liberated hairs can cause discomfort and may cause poor grower acceptance. Workers should be protected by filtered air in a cab on machinery or they should wear a dust mask and possibly protective clothing.

UTILIZATION. There are numerous potential uses for naked-seeded grain, but markets and marketing standards are not developed in the USA. Growers will need to obtain a premium for naked oats to offset the loss of the hull and compensate for the extra care required to grow and harvest naked oats. Growers should be aware of the lack of markets, and in the absence of a known buyer, should be prepared to feed the grain to livestock. Demand at the marketplace must be developed if the crop is to become more than a feed for utilization on the growers farm. Variable expression of the naked-seeded trait is a major concern for the food processor but of less concern for the grower. More information is needed about the potential feed value of naked oats for various kinds of livestock and about processing requirements.

Hull-less Oat Potential: A Milling Company View

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Hull-less oats potentially offers the oat milling industry large benefits such as reducing milling costs by reducing electrical usage, capital expenditures and labor, and may potentially result in an increase in throughput, mill efficiency and reduced hull disposal costs. Currently, several issues must be addressed to make continuous milling of hull-less oats attractive: reduced percentage of hulled seeds, a groat size that allows the efficient separation of oats from groats and removal of contaminating barley, reduction of damage to the germ during processing, reduced seed trichomes and increasing field yields to be equal to hulled varieties, on a groat basis. In addition, protocols for the delivery of high grade milling oats to the mill must be developed, and most of all, hull-less oats must be accepted by oat growers as a viable crop.

Panel Discussion on Cultivar Release Policy, Intellectual Property Protection, Germplasm Exchange, and Researchers' Code of Ethics

Intellectual Property Protection

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The protection of intellectual property rights related to plants has been in evolution in the US for a period of 60 years. The Plant Patent Act (PPA), which permits granting plant patents to breeders of asexually reproduced plants, was enacted in 1930. The Plant Variety Protection Act (PVPA), which provides patent-like protection for seed plant species, was enacted in 1970. PVPA exempted six field crops and certain vegetables, but the act has since been amended to include these crop species. In 1985, the Board on Patent Appeals and Inferences held that utility patent protection would apply to new inventions (including varieties) from biotechnology and plant germplasm development.

The normal period of intellectual property protection under the PPA, PVPA, or utility patent is for 17 or 18 years. There are two primary differences between intellectual property protection under PVPA and utility patents:

a. PVPA provides for a "research exemption" which permits the use of PVPA protected varieties as parents in crosses without compensation to the inventor of the variety used as a parent, and

b. PVPA provides for a "farmers' exemption" which says that a farmer qualifies for exemption from paying royalty if his/her "primary farming occupation is the growing of crops for sale for other than reproductive purposes". This provides that a farmer can use his/her own seed or can sell it to neighbors without paying royalties.

Other forms of protection of plant intellectual properties are trade secrets and contracts. Trade secrets are governed by state law and the strength of the trade secret protection can vary from state to state. The trade secret must be held confidential with no public disclosure. Accidental disclosure can be a serious problem because a number of circumstances allow for public disclosure inadvertently, in which case the trade secret protection will be lost. Contracts can provide protection through licensing agreements, secrecy agreements, condition of sale agreements, and restricted use labels. Contract law is governed by the states.

Germplasm Exchange and Preservation of Elite Breeding Materials

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One aspect of germplasm exchange often overlooked is that of germplasm developed by domestic breeding programs. Breeders expend considerable effort throughout their careers in the production of breeding lines and genetic or cytogenetic stocks, many of which are never formally released. Even though a line is never released it may have considerable value as a source of unique agronomic traits, disease or insect resistance, etc. Often, this germplasm is eventually forgotten and then lost when a breeder retires or a program is terminated. Mechanisms need to be established to provide for "exchange" or preservation of such germplasm. Elite breeding lines, such as entries in Uniform Nurseries, may most appropriately be preserved in the National Small Grains Collection. However, genetic and cytogenetic stocks, which require special care and handling, need to be preserved in special collections. Ideally, a breeder should evaluate his/her materials and establish priorities for preservation before retiring or termination.

Cultivar Release Policies

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Plant breeders, agronomy/crop science departments, and State Agricultural Experiment Stations have trod some uncertain paths during the past 20 years in terms of cultivar release mechanisms and policies. While ESCOP (Experiment Station Committee on Policy) seed policy statements have provided guidelines widely accepted and followed for several decades, it has been only recently (October 1989) that this ESCOP statement was updated to address new and different methods and forms of cultivar release now in use. Changes in release policies and methods also have caused considerable confusion and antagonism among seed dealers, seed producers, and farmers. Variable modes of operation from state to state, from crop to crop, and even among cultivars within the same crop have added to the confusion that has existed, to the complexity of the issues, and to the difficulty of establishing national policy. The issues will undoubtedly become even more complex when cultivars genetically engineered through molecular technology enter the market place.

Cultivar release mechanisms employed by different universities, and which can be construed as institutional policy, include general release with ample foundation seed stocks; general release with restricted foundation seed stocks; release under plant variety protection specifying either three classes of seed beyond Breeders Seed (Foundation, Registered, Certified) or only two (Foundation and Certified); a restricted release to a relatively large company, to an individual seed producer (small company), or to a marketing group; and branding, a procedure which allows different companies to market the same genotype or selection under their respective "brand" names -- a practice strongly opposed by ESCOP. The relatively new technique of requiring producers of Certified Seed of a specific cultivar to be licensed for such production was devised to strengthen owner privileges afforded by plant variety protection. Two goals of plant variety protection and licensing as release policies are (i) to increase acreage seeded with high quality (Certified) seed, and (ii) to generate research/breeding fees for program support.

Biotechnology: Concepts of Future Challenges and Opportunities

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Biotechnology is moving forward at what seems to be an ever accelerating pace. Newspaper reports touting the benefits of recent discoveries are almost a daily occurrence. This presentation will consider the technologies currently under development and their implications on future research directions. Today's research is seen as emphasizing development of a new technology base. RFLP linkage maps, transformation protocols, and PCR systems are prime examples. As these technologies develop, the research focus will shift from development to application. Today's research objectives will become the tools of the future. In order for this transition to transpire efficiently, we must develop a vision of the future. What will be the objectives? What scientific disciplines will be required?

Additionally, as we consider the future we must also reflect upon the impact of our work and move forward responsibly. A number of the issues being raised must be seriously evaluated. One of these issues is food safety. Recently, the International Food Biotechnology Council released a detailed evaluation of the issues resulting from the development of genetically engineered organisms and proposed a series of "decision trees" which could be used to evaluate product safety. An overview will be presented on the food safety issues and consideration will be given to implications on future research.

Translational Control of Storage Protein Synthesis in Developing Oat Endosperm Tissue

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The Triticeae (wheat, barley, rye) preferentially accumulate alcohol-soluble proteins (prolamins) during grain development. Oats, along with rice, are genetically different, in that they accumulate the salt soluble globulins instead, therefore mimicing the dicots. We are searching to identify the DNA sequences which maintain the expression of the dicot globulins in a monocot genetic environment (1). Interestingly, oats at the same time do allow the expression of 10-15% prolamin protein during embryogenesis. Even more surprisingly, the prolamin mRNA is transcribed more abundantly than the globulin mRNA. The question arises, what factors cause globulin mRNA to be translated into the major oat protein so efficiently? The genetic elements which control the DNA transcription and mRNA translation for both globulin and prolamin genes in various cereals will prove to be invaluable information for the genetic engineering of specific grain properties.

We are studying the molecular nature of these two contrasting gene systems (globulins/prolamins) in cereal grain endosperm tissue. Our previous publications have shown that the differential expression of globulins and prolamins in oat may be effected at the level of translation (2,3). We are now studying in detail the mRNA sequences for prolamins and globulins, their 5'- and 3'- untranslated regions (UTRs or flanking sequences), to see whether these particular areas of the genes influence the translational efficiency during protein synthesis in the oat endosperm cells. The strategic goal is to construct new plasmids where the UTRs have been interchanged or altered. The new hybrid mRNAs can then be tested in homologous translation and expression systems, to identify the features of the oat globulin 5' UTR which favour the production and accumulation of globulin in oat to a level of 75-85%. Such translational enhancers, from viral mRNAs for example, are the object of active patents (4).

The structure and sequence of new globulin and prolamin clones will be analyzed and compared to see how ribosome binding sequences may influence translational efficiency of their respective mRNAs. (Supported by NSERC Strategic Grant 40659).

Molecular and Cellular Genetics Applications to Oats: Specific Ideas

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Wide cross hybridization results in the introduction of a large number of undesirable genes from the less adapted parent along with the specific gene(s) of interest. The probability of recovering a line with the trait(s) of interest and few of the undesirable traits is quite low. This accounts for the relatively little use of unadapted genetic materials in breeding programs. If only a single chromosome from the unadapted source could be added to the adapted source's chromosome complement, fewer undesirable genes would be introduced. In a normal hybridization of oats, 21 chromosomes come from each parent. The probability of recovering an F1 gamete with 20 chromosomes from the adapted parental source and 1 chromosome from the unadapted source is approximately $21\,(1/2)^{20}(1/2)$ or 1 in 68,657. On the other hand, the probability of recovering such a gamete if one added (via biotechnological methods) a single chromosome to the normal hexaploid complement of oats is approximately 1 out of 4. Normal recombination could be subsequently employed to reduce the contribution of the unadapted source while maintaining the trait of interest. The application of chromosome isolation and transfer techniques in oats seems to be particularly useful.

Restriction fragment length polymorphisms, RFLPs, offer many advantages for mapping genes controlling traits of interest. We recently made an interesting observation with plant breeding implications while mapping a gene controlling tryptophan levels in maize. Molecular Genetics Inc. (now Plant Science Research Inc.) selected a dominant gene governing high tryptophan levels from a tissue culture initiated from the hybrid of inbreds A188 and B73. The variant plants were backcrossed to a third inbred line for approximately 5 generations and then self-pollinated for 2 or 3 generations. These backcross derived lines were examined for the presence of donor parent RFLP alleles indicating linkage, depending on the frequency of lines with donor parent alleles. We found that the A188 and B73 inbreds had different alleles and, therefore, the hybrid tissue culture would have been heterozygous. The backcross derived lines with a donor parent allele always had the A188 allele, never the B73 allele (T.S. Kim, personal comm.). This implies that the high tryptophan gene was induced on the A188 chromosome in the hybrid tissue culture. Backcrossing the high tryptophan gene would have likely carried with it a large, flanking linkage block from A188. Because B73 is a superior inbred, a mutational event on the B73 homologue would have been more desirable. This information would have been very difficult to have determined without the use of RFLPs. In addition, the use of backcross derived lines allowed a determination of linkage by the analysis of only the three parental lines and a few backcross derived lines.

One of the questions frequently asked about tissue Culture-derived variation is the following : "Is the spectrum of mutations derived from tissue culture different from that generated by other forms of mutagenesis?". The empirical data indicate that the array of single gene mutations is quite similar to what has been observed with other methods. However, certain variants being derived from various plant tissue culture systems indicate that tissue culture may be producing some unusual changes. In both oats and Phaseolus, new endosperm proteins have been found among the regenerates (Dahleen and Rines for oats, Komatsuda for Phaseolus, personal comm.). In corn, lines derived from tissue culture of an inbred line sometimes gives a heterotic response when crossed back to the source inbred (Fincher, cited in Genome 1989, 31(2):1119-1220; Kaeppler, personal comm.). Such observations indicate that tissue culture might induce some unusual changes in the genome.

Application of Biotechnology in the Improvement of Disease Resistance in Oats

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Progress in plant molecular biology is increasing at a rapid rate such that efficient cereal transformation may be feasible in the near future. Until the time that host resistance genes can be incorporated into cereals, however, the tools of modern molecular biology are being utilized for cereal improvement. Regions of plant chromosomes associated with host resistance genes can be identified and their incorporation through plant breeding programs can be monitored with RFLP mapping. Resistance, or tolerance, to viral pathogens has been achieved in transgenic plants expressing viral coat protein genes. Other potential mechanisms for incorporating resistance to plant pathogenic viruses are the use of antisense RNA and ribozymes. Toward developing resistance to barley yellow dwarf virus (BYDV) in transgenic cereals, the genomes of different BYDV serotypes have been cloned, and characterized. As a model system for evaluating transgenic cross-protection-like resistance to BYDV, the BYDV coat protein gene has been transformed into potatoes.

Hypergene: Graphics-Based Software for RFLP Assisted Plant Breeding

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HyperGene™ is a graphics-based software package for carrying out restriction fragment length polymorphism (RFLP)-assisted breeding. The program accomplishes this goal in two ways. First, it converts numerical RFLP data into "Graphical Genotypes" in order to simplify data interpretation and management. Second, it allows the user to "paint" a desired genotypic configuration on a map template, which then acts as a basis for selecting and evaluating desirable individuals from the breeding population.

Given RFLP data for a segregating population, along with a genome map and knowledge of target regions of interest, HyperGene can: 1) Determine the proportion of the genome derived from each parent (genome ratio), 2) Generate graphical genotypes in full size, miniature, or spreadsheet formats, 3) Select individuals with a target genomic configuration, 4) Evaluate selected individuals on the basis of the probability of yielding a target genotype, and 5) Display phenotypic data for selected individuals in order to evaluate and compare the individuals.

HyperGene is also capable of simulating RFLP data for backcross and F2 populations. Using this feature, the effectiveness of RFLP-assisted breeding has been analyzed and compared to classical methods. These simulated experiments demonstrate that the use of RFLPs in backcross breeding can dramatically speed up introgression of multiple genomic segments into the genome of a recurrent parent.

One of the most important aspects of RFLP-assisted breeding is the ability to select against non-target regions of the genome. Results of HyperGene simulated backcrossing without selection, show that at least 6 generations are required to completely recover the recurrent parent genome. With RFLP markers, the recurrent parent genome can be recovered in 3 generations. The advantage to RFLP-assisted backcrossing is even more striking when used to incorporate a single allele into a recurrent parent genome. Using traditional backcrossing without RFLP markers, 100 generations are required to recover an individual with the locus and 2 centimorgans or less of the non-recurrent parent genome. In contrast, with a population of 300, only 2 generations are required using RFLP markers.

The most likely application of RFLP-assisted breeding in the near future will be transferring economically important genes into elite genotypes and cultivars using backcross and modified backcross methods. In the future, it may be possible to characterize and manipulate populations from sib-matings and multiple-crosses. HyperGene can facilitate these breeding strategies by providing a readily interpretable interface and statistical comparison of individuals.

Physical Aspects of an Embryogenic System in Oat Anther Culture

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Factors which affect anther culture response fall into three categories: genetic, physiological, and physical.

The genetics of pollen embryogenesis has been a topic of considerable research in cereal anther culture. Although the literature is not in agreement with respect to gene action, there is an overwhelming amount of information which implies that many differences in anther culture response are heritable. A survey of oat genotypes has demonstrated that genotypic differences exist in anther culture response.

Several physiological aspects of anther culture in cereals have been investigated.

The influence of donor plant growth conditions and inflorescence pretreatment feature prominently in the literature with a definite lack of consensus. Developmental stage of microspores at the time of culture has been determined to influence anther culture outcome and has been defined as the stage when the microspore nucleus is between the mid-uninucleate to early binucleate state. Physiological aspects of the oat anther culture system have not been formally investigated.

The most severe limitation in oat anther culture to date is the definition of the physical aspects of a readily repeatable system for the production of microspore-derived embryos and, ultimately the regeneration of haploid plants. Investigations to identify an appropriate physical protocol and media composition for the culture of oat anthers have been examined with some success. Information will be presented on the effect of specific carbon source, nitrogen source and exogenous hormone levels in the induction medium and their influence on anther response and embryo yield levels. Anther density and induction temperature were also investigated to set the physical parameters for the media studies.

Haploids From Wide Crosses

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Crosses between highly unrelated species represent an exciting new approach for obtaining haploid plants in small grains, including haploid oats (Avena sativa L.) from oat X maize (Zea maize L.) crosses. The wide cross method involves in vitro culture rescue of developing haploid embryos following spontaneous elimination of chromosomes from one of the parents during initial cell divisions of the hybrid embryos. The efficiency of the method is a function of the frequency of hybrid embryos formed and of the success rate in recovering haploid plants from the initiated embryos.

In initial efforts we recovered 14 haploid oat plants from 3300 emasculated oat florets to which maize pollen had been applied. Microscopic analysis of a sample of 3 to 6 day post-pollination oat florets revealed embryos initiated in 8 to 14% of florets pollinated; thus a percentage of initiated embryos were not being recovered as plants. Based on recent success in rescue of haploid wheat (Triticum aestivum L.) from wheat X maize crosses (Suenaga and Nakajima, Plant Cell Reports 8:263-266, 1989), we tried spraying florets one day post maize pollination with a solution of 2,4-dichlorophenoxyacetic acid (2,4-D) and gibberellic acid (GA). From wheat X maize crosses sprayed with a solution of 100 mg L^{-1} 2,4-D plus 75 mg L^{-1} GA, we isolated 91 embryos from 295 pollinated florets at 12 to 18 days post-pollination and from those recovered 33 plants. In recent oat X maize crosses we recovered 32 embryos from 647 florets sprayed with 6 to 400 mg L^{-1} 2,4-D plus GA versus no embryos from 91 unsprayed florets. Embryo initiation frequencies of 5,4,4, and 8% were obtained from treatments with 6,25,100, and 400 mg L^{-1}, respectively, of 2,4-D in this limited experiment.

An advantage of wide crosses versus anther culture as a source of haploid plants is that these wide crosses appear to be less genotype restricted. For example, the 33 wheat plants recovered after maize pollinations included at least one from each of 12 donor wheat genotypes used, and haploid oat plants have been obtained from all eight oat genotypes extensively tested with maize pollinations.

Additional experimentation should identify better pollen donor genotypes, hormone treatments, embryo rescue media, and other factors that will further improve the frequency of haploid production from the wide cross method. Haploid oat plants recovered from this method are being used to produce aneuploids for gene mapping, haploid tissue cultures for direct selection of recessive variants, and doubled haploids for agronomic evaluations.

The Role of Plant Breeders in Sustainable Agriculture

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Sustainable agriculture is the "buzz" word in agricultural research in the 1990s. However, plant breeders have not been included in many of the sustainable agriculture projects. Plant breeding programs can play a very important role in enhancing the sustainability of our agricultural systems. This can be done by developing new cultivars which help to protect and enhance our environment.

Plant breeders need to change their rhetoric to incorporate sustainability in the vocabulary of their breeding objectives. Some of the areas where new cultivar development can impact sustainability include:

1. disease and insect resistance, thus reducing the use of toxic chemicals
2. enhanced biological nitrogen fixation, thus reducing chemical nitrate use
3. enhanced production efficiency; higher yields with less inputs
4. increased stress tolerance, e.g. water, temperature, nutrient, salt, etc.
5. reduced soil erosion through better root systems
6. enhanced nutritive value, e.g. protein, water soluble fiber, etc.

Oat breeders need to reassess their breeding objectives to make sure sustainability is incorporated in our rhetoric. Of the above mentioned areas, only the BNF area is not appropriate at this time. Oat breeders can make a significant contribution to the sustainability of our agricultural systems by including some of these objectives in our programs.

Economics of Oats Production

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Oats acreage for harvest in the United States is expected to total 6.2 million acres in 1990. This is the second lowest of record, exceeded only by 1988, when drought damaged the crop. Harvest acres in 1990 will be less than 50% of the levels when Congress initially established target prices for corn and wheat in 1975. Pressure on Congress and USDA finally resulted in mandatory target prices for oats in 1982. The level established for the oats target price was not competitive with other grains in terms of cost of production, and merely escalated the down trend. The Acreage Reserve Program mandated in 1985 intensified the pressure by enrolling a high proportion of oats acreage. Congress finally recognized the uncompetitive structure of target prices with the Senate passing 1990 legislation that ratchets oats targets up $0.10 annually until the target reaches $1.85 in 1994 while the target prices of other grains remain unchanged. Despite these proposed increases in target prices, oats would still not compete favorably with other grains. For oats to be competitive in the United States with either current or proposed target prices requires a significant improvement in yields or a realignment of target prices for all grains.

Oats as a Forage Crop

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Renewed interest in oats as a forage crop surfaced in the early 1980s following positive farm experiences and observations dealing with (i) animal preference for oat/field pea silage (compared to corn silage) and (ii) animal nutrition (gain or maintenance). This interest has been enhanced by the frequent need for supplemental forage in northern dairy regions due to reduced alfalfa production caused by drought, pest damage, or winter injury.

Improved and more efficient forage quality assay techniques allow for accurate and meaningful forage quality evaluation of oat selections grown alone or as a component of oat/field pea mixtures. Crude protein, acid detergent fiber (ADF), and neutral detergent fiber (NDF) are the quality traits of concern. While adding peas to oats at recommended rates may not raise the harvested tonnage a significant amount, protein level and overall forage quality are improved.

Oat selections high in forage quality but low in tonnage, or high in tonnage but lower in quality comprise the extremes among oat selections being evaluated for use as forage. Use of a formula which converts forage yield and quality into pounds of milk per acre and dollars per acre allows evaluation of oat genotypes on both agronomic and forage-quality bases.

In the past, oat forage has been used mainly in rations for dry dairy cows or young stock where maintenance was the goal. The addition of field peas to an oat cultivar with relatively high forage quality results in a forage product suitable for an average-producing lactating dairy cow. Although oat/pea forage quality is below that of high quality alfalfa, advances in oat forage yield and quality through breeding and selection are expected.

Dormoat - A Possible Role in Sustainable Agriculture

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A dormoat is a cultivated spring oat (A. sativa L.) with seed dormancy genes derived from the wild oat (A. fatua L.). It was intended to breed a dormoat that could be sown in autumn, the seed would fail to germinate, but would germinate in early springtime. The early start in the season would enable dormoat to build a high yield potential as well as reduce the farmers spring workload. Failure to isolate ideal dormoat strains, and failure to develop seed management techniques to synchronize germination behavior to lower autumn emergence and increase spring emergence values has halted progress in developing this crop.

Recent emphasis on the development of sustainable agriculture systems has prompted a re-examination of the dormoat to see if it fits the demands of sustainable agriculture (ie. reduced use of fungicides, herbicides and pesticides; reduced use of petroleum because of fewer tractor hours; better use of land, labor and machinery; improved soil tilth and organic matter; reduced soil erosion, soil compaction, and equal or improved net returns per acre). Viewing dormoat as an improved wild oat rather than an improved conventional oat enables it to fit many of the requirements listed above. It is an annual but the new plan is to grow dormoat on the same site (probably marginal land) for 5-6 years or longer thus making the site a perennial oat production unit.

In the first year, non-dormant seed is sown in springtime on the chosen site, it germinates and produces a crop. During combining, a portion (combine losses and a metered amount) of the harvested seed is spread uniformly (special attachment on combine) over the site (simulates shattering). The amount of seed spread will have to be roughly 4-5 bu/ac. The increase cost of seed is offset by reduced fungicide and herbicide costs. Organic or slow release nitrogen fertilizer is spread after harvest and the seed, stubble, weeds and fertilizer are incorporated into soil in one operation. No seed treatment chemicals are used because the dormoat has been selected for persistence and diseases such as smut will not overwinter on seeds in soil. Some of the non-dormant seeds will germinate and grow in autumn and they prevent soil erosion and trap snow in winter and can be used as pasture. These plants will die during winter but in springtime a crop will emerge from the soil seed reserves. Spring tillage to prepare a seed bed is not required (save petroleum, time and machinery costs) thus saving soil moisture in arid soils and compaction on wet soils. A thick stand of dormoat plants will eliminate the need to spray for weed control. If wild oats are a problem, dwarf dormoats can be grown and the tall wild oat can be cut above the crop for forage. Some seeds from the original planting will not emerge until subsequent years and the remainder will die. Each year a crop is harvested, soil seed reserves are replenished and the cycle is repeated. When it is desired to rotate the crop, the land can be sown to perennial grass or forage legumes where volunteer oats are consumed by livestock or they are removed with herbicides. The crop will give versatility to producers who may use it for grain or forage. This change of role for dormoat may create a renewed interest in the crop.

Oat as a Companion Crop for Forage Establishment

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The current emphasis on "sustainable agriculture" encourages modification of cropping systems to reduce reliance on purchased chemical inputs and to conserve the soil resource. Companion or "nurse" cropping is a traditional practice that involves planting one crop (usually a small grain) along with a small-seeded forage (usually a legume) and permits them to grow together until the forage becomes established. The practice is old, dating at least to the 18th century. The conventional rationale for companion cropping has been to suppress weeds during the forage establishment period while producing additional forage, grain or straw during the seeding year. Companion cropping was discouraged by some agronomists during the 1950's, 60's and 70's in favor of direct forage seeding and use of herbicides for weed control.

Three hundred fifty forage producers throughout Minnesota responded in 1990 to a survey designed to assess their use of companion crops and reasons for using them. The survey also determined producer perceptions of current constraints and their response to the development of dwarf stature cultivars for use in companion crop systems.

Eighty-five percent of the survey respondents indicated that they seeded forages using companion crops while 15% used no companion crop. Seventy-three percent of the respondents used oats as a companion crop compared to 19% for barley and 8% for wheat. The most popular oat cultivar selected for companion cropping, identified by 31% of the respondents who used oats, was Starter. The cultivar Don was identified by 17%, Steele by 16% and Preston by 11%.

The most highly ranked reason for using companion crops was to protect the soil from erosion during small-seeded legume or grass establishment. Suppression of weeds was of intermediate importance. Production of additional forage, grain or straw was important for some producers but of lesser importance for a surprisingly large number.

Producers identified less lodging, less competition with the forage, and earlier maturity as desirable characteristics for future companion crop cultivars. Many producers (53%) favored development of dwarf cultivars for use in companion crop systems. Most of these perceived the dwarfs to be less prone to lodge and less competitive with the forage seedlings.

Field trials at St. Paul from 1987 though 1989 evaluated dwarf and conventional oat genotypes in a companion crop system. Dwarf oats provided good suppression of weeds and their forage dry matter yields were comparable to those of the conventional cultivars. Our survey and field studies indicate that dwarf stature oat genotypes show promise as effective components in companion crop systems and acceptable to producers.

Molecular and Immunological Evaluation of Barley Yellow Dwarf Virus Resistance in a Segregating Wheat X Wheatgrass Population

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Barley yellow dwarf virus (BYDV) is an important pathogen for which only tolerance and/or low levels of resistance have been identified in wheat (*Triticum aestivum*

L.). High levels of resistance to BYDV have been discovered in *Thinopyrum* spp., and this resistance can be transferred into wheat. Although reduced virus replication within its wild species host has been observed through enzyme-linked immunosorbent assay tests (ELISA - A_{405}), the levels of resistance in both donor parent and segregating population have not been well characterized. The utilization of cDNA probes as a diagnostic tool for BYDV has proven to be a powerful technique; however, there is not an established method for quantification of viral RNA in plant tissue. The objectives of this investigation were: (i) to compare ELISA and cDNA dot-blot hybridization for evaluation of BYDV resistance, and (ii) to compare levels of BYDV resistance in a segregating host population based on relative viral RNA concentration using dot-blot hybridization analyzed with densitometry and scintillation counting. A population of BC_2 plants derived from a cultivated wheat x *Thinopyrum ponticum* cross was chosen because of its segregation for BYDV resistance. A cDNA clone, PPAV 26, that codes for part of the viral genome was used as probe in dot-blot hybridizations. In general, correlation between ELISA and densitometry readings was 0.81. However, both techniques depend on carefully controlled infestation and preparation of plant tissues, including inoculation, sampling and grinding. Correlation was significantly reduced ($r=0.40$) for short autoradiograph exposure periods as well as for short ELISA incubation periods. Relative virus RNA concentrations for cvs. Abe (wheat) and Clintland 64 (oat) were ca. 50 and > 100 ng/g plant tissue, respectively. *Th. ponticum* had values of 0 to 50 pg of virus RNA/g of plant tissue. Three levels of resistance were distinguished: resistant, moderate resistant, and susceptible. Resistant lines and densitometry absorbance values of 0.250 to 0.600 and ELISA values from 0.03 to 0.300. Scintillation counting was more variable and less sensitive than densitometry. Detection of RNA levels in plant tissues was slightly improved when chloroform was used for clarification of sap extracts. The greatest improvement in detection and uniformity in cDNA hybridizations was obtained using denaturing conditions. This is likely due to the substantial levels of dsRNAs present in plant tissues.

MSTAT-C -- Microcomputer Program for Agricultural Research

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MSTAT-C is a menu-driven program in color, requiring an IBM-compatible machine with 512K RAM. It will:

1. design experiments (RCB with 1-5 factors with 0-4 splits and simple or triple lattice designs)

2. print field books, labels, and maps

3. analyze data (ANOVA 1-2, factor, regression, multiple regression, nearest neighbor, latin square, nonorthogonal, lattice, correlation, LSD, duncans, and hierarchical)

4. manipulate data (sort, transform, select, and spreadsheet)

5. perform two plant breeding programs

6. do economic analysis.

MSTAT-C allows researchers to quickly and effectively design their research programs. The ease and speed of the design and analysis provide more timely research results and thereby facilitate the generation of new and appropriate technologies. Its output format also facilitates report writing and distribution of data to other researchers and extension personnel. The new program has a personal editor incorporated in the program which enables the users to edit their output tables/files. The program also produces and accepts ASCII files so that users can easily transport their files between other computer programs.

Heritability of Oat Mosaic Virus Resistance

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Detailed knowledge about the heritability of oat mosaic virus (OMV) resistance would help breeders to more effectively plan a strategy for incorporating OMV resistance into new cultivars. The objective of this study was to estimate the heritability of resistance to OMV using variance components, parent-offspring regression, and realized heritability. One hundred random $F_{2:3}$ lines and their $F_{2:4}$ progeny from a double cross population were evaluated in six replicates of hill plots at two North Carolina locations for two years. Resistance was estimated visually with a leaf mosaic symptom rating during the spring vegetative growth stage (G.S. 30). Broad sense heritability estimates based on entry means were 0.75 for $F_{2:3}$ lines and 0.84 for $F_{2:4}$ lines. The parent-offspring regression coefficient was 0.80. Realized heritability was 0.99, based on entry means from four environments. A second population, evaluated at one location over two years, yielded similar results. These high heritability estimates suggest that considerable progress may be expected from selection for OMV resistance in segregating populations.

Germplasm to Cultivar--Introgression of Unadapted Genotypes

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Five cycles of recurrent selection for grain yield in oat have increased grain yield nearly 8% per cycle. Concurrently, other important agronomic traits including height, maturity, and lodging resistance have deteriorated relative to commercial production standards. Thus our current objective is to correct these deteriorations while retaining most, if not all, of the yield increases. Earlier attempts to effect correction with mild secondary selection pressure were unsuccessful. Our current approach is to open the previously closed gene pool by adding parents which excel for the traits of concern and apply multiple trait selection among the progeny. Specifically we have employed three crossing schemes to produce such progeny, 1) intercrossing of selected progeny from initial outcrosses, 2) three-way crosses of these selected progeny with additional outside parents and 3) backcrossing to one of the initial outside parents. Each of these approaches has been used by plant breeders previously when they have attempted to incrementally move unadapted or commercially unusable germplasm closer to the level of desired phenotypes. Results from the comparison of these three approaches should be equally applicable to unadapted germplasm 1) from other production areas, 2) produced using a biotechnology technique or 3) from a single trait selection program.

Reaction of Winter Oat Cultivars to Powdery Mildew

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Powdery mildew of oats occurs sporadically in the southeastern United States but data from Europe indicates that it can be a destructive and yield-limiting factor in oat production. In the fall of 1988, a total of 32 winter oat lines were planted in four randomized blocks near Tifton, GA and a naturally-occurring epidemic of oat mildew was allowed to develop in the spring of 1989. The plots were rated on 14 and 18 April for the percentage of foliage covered with mildew and for infection type on a 0-4 scale. Differences existed between cultivars on both assessment dates. Severity levels increased from 29.2% to 32.9% during assessments and all cultivars showed symptoms ranging from 7.5-59.4% and 1.4-4.0 for severity and infection type data, respectively. These same cultivars were tested with a pure culture recovered from 'Brooks' oats under controlled conditions to determine if they could be effectively screened as seedlings. Cultivars were planted in 7 cm square pots in three replications with two plants per pot; the experiment was repeated. Entries ranged from 0 to 9 on a scale of severity and from 0 to 4 for infection type. Severity and infection type data were correlated in both environments with coefficients of 0.91 and 0.64 in the field and growth chamber, respectively. Severity in the field and growth chamber also were correlated ($r=0.44$, $p=0.02$). Based on all data, the most resistant lines were Coker 86-10, 'Coker 716', 'Simpson', AR-111-2, and AR 02848. The lines PA 014-608, PA 915-1342, and TAMO 386 were most susceptible. Six lines showed large differences between field and greenhouse evaluations. It appears that a mixture of pathogen phenotypes is present in the Southeast, despite the fact that no cleistothecia were observed in North Carolina or Georgia, making evaluation with a single isolate undesirable.

Identification and Characterization of Oat Mosaic and Oat Golden Stripe Viruses in Winter Oats in North Carolina

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A soil-borne mosaic disease of oats has been recognized on winter oats in the southeastern United States for over 50 years. Leaves of infected oats take on a chlorotic, mottled appearance in early spring. As temperatures rise in late March and April, mottling gives way to bright golden yellow stripes running longitudinally on both young and old leaves. Symptoms are often very apparent on flag leaves during tillering and grain fill; thus, severe infections may result in significant yield losses. The etiology of the disease has not been fully determined; therefore, we have undertaken the identification and characterization of the viruses associated with typical disease symptoms. Observations made with the aid of an electron microscope of partially purified virus preparations from symptomatic oat tissue indicated the presence of both long, flexuous, rod-shaped particles and short, stiff, rod-shaped particles. Based on previously published information, EM observations, and SDS-PAGE analysis, we have identified the long flexuous particles as oat mosaic virus (OMV), a member of the potyvirus group, and the short stiff particles as oat golden stripe virus (OGSV), a member of the furovirus group. We have shown the genome of OGSV to be composed of two distinct RNA molecules of approximately 6.2 and 3.5 kilobases in size and are in the process of synthesizing cDNA to these molecules. There have been no published reports of OGSV in the United States, however, it has been reported in Europe. The relatedness of OGSV isolated in North Carolina (OGSV-NC) and that from the United Kingdom (OGSV-UK) has not yet been determined. Polyclonal antisera produced in rabbits to the capsid protein (CP) of OGSV-NC does show activity against OGSV-UK. Specificity of this antisera to viral CP has been confirmed by both enzyme linked immunosorbant assays and western blots. We are in the process of producing polyclonal antisera to the CP of OMV. We are also attempting to synthesize cDNA from the genome of OMV. Serological assays and cDNA probes will be used to screen tissue from field plots planted during the fall of 1990 in order to identify oat cultivars with levels of resistance useful in future breeding programs.

Beta-glucan Concentration and Characteristics Among Avena Species

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As a part of a program to evaluate Beta-glucans in Avena species, selected samples from common oat cultivars and from related species were analyzed to determine the variability in Beta-glucan concentration in Avena germplasm. The range in total cell wall Beta-glucan, measured by a modification of the McCleary and Glennie-Holmes method, was similar between Avena species and cultivated oats. Subsequent analysis by chemical fractionation and by HPLC of enzymatic digests of the Beta-glucan indicated that there may be structural differences in the Beta-glucan polymer in related species which may be exploited to evaluate the nutritional value of Beta-glucan. The results of these evaluations may be used to enhance Beta-glucan characteristics in conventional oat cultivars through wide crosses or recombinant DNA techniques.

Assessment of Genetic Relationship Among *Avena sterilis* Accessions

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Avena sterilis constitutes a large reservoir of genetic diversity that is readily accessible to the oat breeder; however this gene pool remains under-utilized because it is difficult to identify accessions having desirable traits and evaluate the agronomic potential of any wild species. While *A. sterilis* is known to possess useful traits such as disease resistance and high protein grain, the large number of accessions available for sampling is bewildering to the breeder. A systematic grouping of A. *sterilis* accessions in the National Small Grains

Collection (NSGC) would facilitate the use of this gene pool for cultivated oat improvement by reducing the number of genotypes a breeder would need to evaluate and by increasing the probability of selection of desirable accessions for crossing. In addition, the genetic variation among different traits can be used to mark economically important alleles, place genes on a linkage map, and establish combining ability groups for making productive crosses in breeding programs. The primary objective of this research is determine the genetic relationships among *A. sterilis* accessions randomly sampled from the National Small Grains Collection by analyzing genetic variation for a range of morphologic and biochemical traits. This report presents the results of analyses of nuclear restriction fragment length polymorphisms.

From the *A. sterilis* accessions in the NSGC 174 representative accessions from different geographic regions representing 8 countries were selected, grown, and DNA was extracted. A library was constructed by digesting total nucleic acid extracted from oat cultivar 'Brooks' with restriction endonuclease *PstI*. The digest was size selected and ligated into dephosphorylated plasmid vector pGem4. A total of 268 clones were screened against radio-labelled rice chlorophyll DNA and total oat DNA to eliminate clones containing organellar or repetitive nuclear sequences. Only 200 of the clones carried an insert and 50 of those were either organellar or contained highly repeated sequences. The remaining 150 clones were used to probe survey filters containing *Eco*RI digests of 2 *A. sterilis* accessions *A. hirtula*, *A. strigosa*, 'Ogle', and Brooks. Out of the 150 clones, 19 did not label well, 4 were identical to another clone, 10 gave patterns indicating they carried repeats, 3 appeared to be organellar, 43 were single or low copy but had a high background (probably contain single copy and repeated sequences) (24%), 71 were single or low copy (<10 bands) (40%). Based on signal strength in the survey, 48 low copy number probes were selected to evaluate relationships among the 174 accessions. The probes produced a total of 230 bands that could be scored or an average of 4.8 bands per probe. Four of the probes were monomorphic for all 174 accessions.

The number of RFLP phenotypes ranged from 1 to 16 with an average per probe ranging from 2.48 for Ethiopia to 3.69 for Iran. Nucleon diversity as defined by Nei, may be considered to be an estimate of average genetic diversity with higher numbers indicating more diversity. This estimate was relatively similar across countries and ranged from 0.281 for Ethiopia to 0.685 for Morocco. Probe band diversity ranged from 0.0 to 0.89. Principle component analysis of Nei's similarity index indicated that 82.7% of the variation could be explained by the first principle axis. The diversity was relatively homogeneously distributed with the exception of Iran and Iraq accessions. Several of those accessions exhibited unique banding patterns compared to the rest of the countries. Based on RFLP analyses we conclude that breeders wishing to sample variation in *Avena sterilis* should select one group of dissimilar accessions from the Iran-Iraq cluster and a second group made up of diverse accessions from the rest of the countries. The data will be further analyzed for correlations between other available passport data and agronomic and morphologic traits.

Library Screening Summary

Pre-screen:

Total	268
No insert	68
Highly repeat./Organ.	50
Remainder	150

Survey:

Total	150
Poor label	19
Identical clone	4
Moder. repeated	10
Oganellar	3
High background	43
Single or low copy	71

***Avena sterilis* Diversity Survey Summary**

174 Accessions
48 Probes, 230 bands scored = 4.8 bands/ probe

Country	Nº RFLP Phenotypes	Nucleon Diversity
Ethiopia	2.48	0.281
Lebanon	2.96	0.338
Algeria	2.83	0.341
Morocco	3.39	0.347
Syria	3.19	0.348
Iraq	3.22	0.387
Israel	3.67	0.407
Iran	3.69	0.443

Latent Period of *Puccinia coronata* in Oat

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The rate of development of *P. coronata* in flag leaves of slow-rusting and fast-rusting oat lines was studied. Two lines developed at the University of Minnesota, MN841804-4 and MN841811-3, were selected in greenhouse studies for long latent period, which is defined as the number of days from inoculation to eruption of 50 percent of the infection sites on flag leaves. Parents and F2 populations from crosses of MN841824-2, a Minnesota fast-rusting line, and plant selections of the two slow-rusting lines, MN841804-4-1 and MN841811-3-1, were then evaluated for slow-rusting in the field. The latent period for MN841824-2 was 5.5 days. The latent period on MN841804-4-1 was 10.5 days and on MN841811-3-1 it was 11.0 days. The mean latent period on the F2 population of MN841804-4-1/MN841824-2 was 7.0 days and on the F2 population of MN841811-3-1/MN841824-2 it was 7.5 days. For percentage of infection sites erupted, differences between the mean of the F2 populations and either of the two respective parents were significant until 10 days after inoculation. Differences in latent period between the slow-rusting lines and the susceptible lines appear economically useful, but this hypothesis must be tested under field conditions. Additionally, the inheritance of this resistance must be determined to efficiently incorporate it into improved oat cultivars.

Evaluation of *Avena strigosa* for Reaction to BYDV by Symptomatology, ELISA and Dot Blot Assay

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Barley yellow dwarf virus (BYDV) is the most destructive disease of oats *(Avena sativa). A. strigosa,* an oat relative, is a potentially useful source of genetic variation for oat improvement. We screened 70 of the 71 accessions of the USDA-ARS world collection of this species by visual symptom score, 51 of these accessions by enzyme-linked immunosorbent assay (ELISA) and 37 by dot blot assay. All accessions of *A. strigosa* had significantly lower symptom scores than 'Clintland 64', ranging from 1.5 in PI 436107 to 7.0 in PI 436133 (0-9 scale, 9=sensitive). Eleven of the accessions had mean symptom scores of 3 or less, indicating a good level of resistance/tolerance. The correlation between symptom score and ELISA, symptom score and cDNA and ELISA and cDNA were 0.78, 0.46 and 0.49, respectively. ELISA values for 30-minute enzyme reaction time ranged from 0.75 to 2.00. It appears that these *A. strigosa* accessions differ in their level of tolerance and/or, more likely, low levels of resistance to BYDV. All the accessions with symptom scores of 3 or less were also the lowest in ELISA values. Mean cDNA densitometry readings ranged more than two-fold among the accessions. Based on symptom scores, and cluster analysis of ELISA and cDNA, three accessions (CI 9110GA23, CI 7121CD1007 and PI 436107) appeared to be superior for reaction to BYDV. We are studying whether or not the variation that we have observed for tolerance and/or resistance in *A. strigosa* is heritable and warrants introgression into cultivated oat.

Characterization of Oat Haploids and Their Progeny

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Haploid oat plants were recovered by embryo rescue following application of maize pollen to emasculated oat florets. Our objective was to analyze the chromosome constitution and meiotic behavior in these haploid plants and their progeny. Self-pollination in 14 fertile F_1 plants resulted in a range of anywhere from 1 to 40 plus seed each. Both euploid (42 chromosome) and aneuploid (40 and 41 chromosome) progeny were produced from each of the eleven haploids whose progeny have been analyzed to date: a total of 109 euploid and 78 aneuploid progeny have been identified at this point. Seed set on the haploid plants is thought to result from unequal chromosome distribution during meiosis rather than from sectors of spontaneous doubling. This interpretation is based on cytological analysis of microsporocytes showing unequal chromosome distribution, the uniformly scattered seed set on the panicles (as opposed to fertile sectoring), and the high frequency of monosomics in the progeny. Aneuploid plants recovered from haploids should be particularly valuable in developing monosomic stocks in a common background for genetic mapping purposes.

Computer-Assisted Identification of C-Banded Chromosomes in Monosomic Lines of the Oat Cultivar 'Kanota'

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Chromosome-deficient lines in oats are useful for assigning genetic markers such as RFLPs to chromosomes; these stocks should be characterized and rechecked each time they are grown in order to monitor cytogenetic changes which could adversely affect mapping accuracy. A complete series of 21 monosomic (2n-1) lines has been assembled by T. Morikawa in the hexaploid oat (2n=6x=42) cultivar Kanota (*Avena byzantina* C. Koch). The objective of this study is to identify the monosomic chromosome in each of these lines based on overall chromosome length, centromere position and C-banding pattern. The chromosomal complement in disomic C-banded Kanota root-tip cells consists of 7 pairs of dark-staining, heavily-banded chromosomes and 14 pairs which are light-staining and have telomeric, centromeric and/or limited interstitial C-bands. We are attempting to determine if the 7 pairs of dark-staining chromosomes represent one of the three component genomes (A, C, D) of allohexaploid oats. A Macintosh IIx computer linked to a Zeiss Axioskop microscope via a Cohu 4815-2000 video camera is being used to capture the images, with analysis using the Image 1.22 program developed at the U.S. National Institutes of Health.[+]

[+] Mention of a trademark, vendor, or proprietary product does not constitute a guarantee or warranty of the product by the University of Minnesota or the U.S. Dept. of Agriculture, and does not imply its approval to the exclusion of other products or vendors that may also be suitable.

Extraction and Identification of Antioxidants in Oats

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Ten separate solvent systems were tested on oat groats and oat hulls to determine which systems resulted in the most effective, rapid extraction of antioxidants. Several oat varieties were compared. Antioxidant activity was initially judged by using thin layer chromatography with a beta-carotene spray to locate antioxidants and to estimate the amount of antioxidants present. Next, antioxidant extracts derived from one variety of oats and oat hulls (Noble) were added to soybean oils and stored at 32^{o} and $60^{o}C$. The Stamm method was used to determine peroxide values of the oils and, therefore, the antioxidant activity of the oat extracts. Phenolic compounds in the oats and oat hulls were identified by thin layer chromatography. Finally, the antioxidant activity was tested in soybean oils at frying temperature.

Plant Regeneration from Friable, Embryogenic Oat Callus in Response to Exogenous Cytokinins

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The use of exogenous cytokinins in cereal cell culture has largely been ignored because callus growth and morphogenesis can occur in their absence. However, recent research in oat, maize, and wheat suggests that exogenous cytokinins can have dramatic and positive effects on plant regeneration. This research was initiated to examine the influence of two exogenous cytokinins on plant regeneration from friable, embryogenic oat callus. Six 30-month-old callus lines derived from a cross of 'Garland', 'Park', and Avena fatua accession 1223 were transferred from maintenance medium containing 2 mg/l 2,4-D to medium containing no 2,4-D and various levels of 6-benzylaminopurine (BAP) (0 to 15 mg/l) and kinetin (0 to 10 mg/l) for two weeks. Callus was then retransferred to medium containing no hormones for two additional weeks and then assessed for plant regeneration by determining the number of regenerated plants per gram callus. Addition of BAP and cytokinin increased plant regeneration up to six-fold, with the greatest response noted for lines regenerating most poorly on the control medium. Because only one genotype was studied, these results must be interpreted cautiously; however, these and data from other studies suggest that the utility of exogenous cytokinins to stimulate morphogenesis from cereal cell cultures may be greatly underestimated.

1989 Survey for Three Serotypes of Barley Yellow Dwarf Viruses in Oat and Wheat Fields in Illinois

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Fifty leaf samples were collected in a random pattern from each of 11 oat and seven wheat fields in Illinois during May and June 1989. Samples were assayed for three serotypes of barley yellow dwarf viruses (BYDV) in two types of enzyme-linked immunosorbent assay (ELISA). Double antibody sandwich ELISA systems used polyclonal antibodies for virus detection; triple antibody sandwich ELISA systems used monoclonal antibodies for detection. Incidences of BYDV-PAV serotypes were 0-42% in oat fields and 0-2% in wheat fields; incidences of BYDV-RPV serotypes were 0-8% and 0-4% in oat and wheat fields, respectively. No BYDV-MAV serotypes were detected. Results from the two BYDV-PAV ELISA systems and the two BYDV-RPV-ELISA systems were in agreement for over 99% of the 900 samples. Differences in disease incidence were noted among oat cultivars and across geographic regions of Illinois in 1989.

Plant Regeneration in Successive Callus Cultures of *Avena*

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Immature embryos of twenty-one lines of *Avena* (*A. sativa, A. byzantina, A. nuda* and *A. sterilis*) were cultured and regenerated through three subcultures. After the first subculture, 38% of all genotypes formed plants. Plant regeneration in any of the five genotypes of *A. sterilis* was not observed, but both accessions of *A. nuda* gave rise to plants only in the first subculture. *A. sativa* genotypes with the highest plant regeneration frequency were also placed in suspension culture. Four weeks later the suspension culture was plated onto proliferation media (2 mg L^{-1} 2,4-D) from which globular compact embryoids with lobed structures emerged particularly in 'Corbit', CI 1977, and 'Ogle' (*A. sativa*). The suspension cultures are maintaining 2 to 12 x 10^5 cells/ml levels inspite of several dilutions. The suspension cultures and plant cells are being further studied for embryogenesis and plant regeneration and as a source of cells for protoplast production.

Lipid Distribution in Oats Varying in Lipid Concentration

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Six oat samples varying in lipid concentration were analyzed for distribution of lipid within the tissues of the kernel. Kernels were hand-dissected into two fractions: bran (germ + aleurone) and starchy endosperm; whole kernels and fractions were analyzed for lipid content. Lipid concentrations in whole kernels were 5.8, 7.6, 8.6, 10.6, 11.5 and 12.5%, respectively for samples 1 - 6. Fractions were compared for lipid content and it was found that lipid content was increasingly greater as sample number increased. Lipid content was approximately equal in both bran and endosperm fractions at the higher lipid concentrations. Micrographs of half kernels showed that lipid was equally dispersed throughout the endosperm in higher concentrations (samples 4 - 6) and was more localized in the central portions of the cheeks in the lower concentrations (samples 1 - 3). Lipid was most abundant in scutellar and aleurone cells, part of the bran fraction.

Newly Identified Isozyme Polymorphisms Among Oat Cultivars and Avena Species

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Only a few isozyme systems have been described for cultivated oats (Avena sativa L.), and even fewer have been genetically characterized. In this investigation, previously reported isozyme systems were further characterized and some unreported systems were surveyed to supplement RFLP mapping and provide a simple set of markers for oat genetic studies. Twenty cultivars and one experimental line of A. sativa, three accessions of A. sterilis L., two accessions of A. fatua L., and one accession each of the diploid species A. hirtula Lagasca, A. ventricosa Balansa, and A. canariensis Baum, Rajhathy & Sampson were surveyed for electrophoretic variation of acid phosphatase, aconitase, glucosephosphate isomerase, glucose 1-phosphate transferase, isocitrate dehydrogenase, leucine amino peptidase, peroxidase, 6-phosphoglucose dehydrogenase, and shikimate dehydrogenase. Each enzyme system was tested with one alkaline and two acidic starch gel systems. Previously unreported polymorphisms were detected among cultivars and species for these enzymes. All banding patterns identified in A. sterilis and A. fatua were also found among the cultivars. Some isozymes of the diploid species were unique, and some had the same mobility as those of the hexaploids. Preliminary results indicate the presence of polymorphisms for alkaline B-D-galactosidase, N-acetyl-glucoseaminidase, and phosphoglucomutase. These enzyme systems and others will be further evaluated. The genetic basis for the polymorphisms among the hexaploids will be determined and the newly identified loci will be added to the oat molecular map.

The Initiation of a Molecular Gene Map for Oats

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The development of molecular markers and the subsequent accumulation of mapping information has been recognized as a valuable tool for crop improvement. However, little mapping information is available for the common cultivated oat, Avena sativa L. A previous experiment has indicated that sufficient restriction fragment length polymorphism (RFLP) exists among oat cultivars to enable the use of these markers in oat genetic studies. Sixty eight F_2 individuals derived from an 'Ogle' / 'Brooks' cross were scored for the variation of three avenin seed protein, three isozyme, and six RFLP loci. Recombinant inbred lines (RILs) derived from the same cross were also scored for seed protein, isozyme, and RFLP variation. A linkage block of two isozyme loci and one RFLP locus has been identified and linkage results from the two populations were compared. Markers will be assigned to monosome number with a 'Sun II' / A. sterilis F_1 monosomic/nullisomic series and additional linkage analyses will be conducted. As the map is developed, associations between molecular markers and quantitative trait loci will be determined using the Ogle / Brooks RILs.

Characterization of the Barley Yellow Dwarf Virus NY-MAV-PS1 and P-PAV genomes

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The NY-MAV-PS1 and P-PAV isolates of barley yellow dwarf virus (BYDV) are serologically related, but are not identical. Both BYDV isolates are transmitted by the aphid Sitobion avenae, but P-PAV is also transmitted bv Rhopalosiphum padi. To evaluate the genomic basis for these, and other differences, cDNA libraries were constructed from the RNA of each BYDV isolate in both plasmid and bacteriophage vectors. From these libraries, overlapping clones representing the genome of each viral isolate were identified by restriction analysis and by hybridization, and subsequently sequenced. Each genome is ~5.2 Kb in length with six identified (+) strand open reading frames (ORFs). The greatest diversity between the NY-MAV-PS1 and P-PAV sequences was found in ORFs located at the 3' end of the respective genomes, indicating that this region of the genome may be involved in the properties which differentiate BYDV-NY-MAV-PS1 and BYDV-P-PAV.

The Genome of the NY-RPV Isolate of Barley Yellow Dwarf Virus

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The group 2 isolate of barley yellow dwarf virus (BYDV), NY-RPV, can be distinguished from group 1 BYDV isolates by serological relationships, cytopathological ultrastructure of infected cells, and dsRNA profiles obtained from infected tissues. To investigate the genomic basis for these differences, cDNA libraries were constructed from NY-RPV viral RNA in both plasmid and bacteriophage vectors. From these libraries, overlapping clones representing the NY-RPV genome were identified by restriction analysis and by hybridization, and subsequently sequenced. The genome of NY-RPV is ~5.6 Kb in length, within which six major (+) strand open reading frames (ORFs) were identified. Based on both the sequence and the organization of the genome, NY-RPV is clearly different from group 1 BYDV isolates. Furthermore, the genome of the NY-RPV isolate of BYDV more closely resembles that of two other luteoviruses, beet western yellows virus and potato leafroll virus, than those of group 1 BYDV isolates.

Inheritance and Cytology of 'Monster Plant' Traits in Oat (Avena sativa L.)

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In 1985, a spontaneous mutant with 'monster plant' traits was observed in an F2 population developed from a cross between OT745 and 'Tibor'. This monster mutant was assigned the accession number 'LAO-456-MUT-01' and is being maintained at the Agriculture Canada Research Station in Lacombe, Alberta, Canada.

Some of the distinguishing characters of the monster mutant are: vigorous growth; a large and proliferous panicle; crookedness of the straw (peduncle) just below the panicle; very long, very wide and thick leaves; long internodes; very thick culms; delayed anthesis and ripening; partial sterility; a restricted tillering habit: and formation of brace roots. The brace roots usually originate from the second or third node above soil level.

To determine if the monster plant traits were genetically transmitted, F2 derived F3, F4 and F5 populations were developed by single seed descent. All lines were found to be true breeding and presumably homozygous for the 'monster plant' traits.

A genetic study was initiated in 1987 to determine the number of genes and the type of gene action that condition the monster plant traits. Crosses were made between LAO-456-MUT-01 and 'Cascade' by using LAO-456-MUT-01 as the male parent. Two hybrid seeds were obtained from this cross. The F1 plants were grown in a greenhouse at Lacombe during the winter of 1987. Due to a heavy infestation of aphids, and poor light and temperature conditions in the greenhouse, only 43 seeds were harvested from both F1 plants.

An F2 population consisting of 31 plants was grown in a growth chamber and the F2 phenotypes were classified as 'normal' and 'monster' by comparison with parental phenotypes. The F2 population segregated in a ratio of 24 normal: 7 monster plants. A Chi-square test indicated a good fit to 3:1 ratio, and suggested that the monster plant trait was conditioned by a single recessive gene.

The monster plants in the F2 population expressed all of the morphological abnormalities to approximately the same degree as in LAO-456-MUT-01. Cytological observations of meiosis and mitosis of normal and monster F2 plants revealed that aneuploidy or other forms of chromosomal aberrations were not involved in the expression of the monster plant traits. These observations indicated that the complex of morphological characters described above was inherited as a group, and its expression was controlled by a single recessive gene.

The morphological abnormalities in LAO-456-MUT-01 were very similar to the abnormalities observed by Zillinsky (1959) in M-7060. M-7060 is a monster mutant that was identified in an F2 population of the cross R.L. 2278/624-4-1. The symbol *'mon'* was assigned to the gene conditioning the abnormal genotype (*mon/mom*) of M-7060. The allelic relationships of the monster plant genes in LAO-456-MUT-01 and M-7060 could not be established because M-7060 had low fecundity and the line died-out several years ago. (F.W. Zillinsky, personal communications). Since LAO-456-MUT-01 and M-7060 were isolated from two different populations and about 30 years apart, the genes conferring the monster plant traits in these two genotypes should be considered as allelic until they are proven identical. It is proposed that the symbol ***'mon'*** be retained to identify the monster plant gene in M-7060, and the symbol ***'mon2'*** be assigned to the monster plant gene found in LAO-456-MUT-01.

REFERENCE

1. Zillinsky, F.W. 1959. Monster mutant oats. Cereal News 4(2):7-11.

III. SPECIAL REPORTS

Utilization and Quality

CEREAL CROPS RESEARCH UNIT
USDA, AGRICULTURAL RESEARCH SERVICE
Madison, Wisconsin

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Research on oat quality has emphasized fiber, in light of numerous studies indicating the beneficial nutritional properties of oat fiber, particularly the soluble β-glucan. Samples from the National Small Grains Collection are being screened for β-glucan concentration by a flow-injection analysis system. From among the first 1000 analyzed, β-glucan concentration ranged about 2-fold from about 3.5 to 7%. The same samples are also being analyzed for protein by near infrared reflectance analysis. Protein and β-glucan data are provided to the GRIN data base.

Dr. James L. Koch, Research Associate, is examining structural characteristics of oat endosperm cell walls, whose major components are the polymers, arabinoxylans and β-glucans. This data should assist in our understanding of oat fiber effects on human physiology.

A new graduate student has joined the project, Mr. Woo-Suk Jung from South Korea. Mr. Jung's thesis project has yet to be defined, but he is currently learning techniques of cell wall analysis from Dr. Koch.

Screening breeders' samples for protein continues as in prior years. The near infrared reflectance instrument is near the end of its useful life, and we hope we will be able to replace it soon with a current state-of-the-art instrument, possibly one that will analyze whole grains.

Acid-Extract Viscosity and B-Glucan Content of Oat

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Several fluorometric, enzymatic, and viscometric procedures are available for the determination of B-glucan in oat. Viscometric procedures are based on the extractability of B-glucan in aqueous solvents such as an acid buffer (pH 1.5) or water. The former may be preferable as very little starch is solubilized and indigenous B-glucanases need not be inactivated. However, protein is highly soluble at an acidic pH but it does not contribute to acid extract viscosity (AEV), which is largely determined by extractable B-glucan and to a minor extent extractable pentosans. In some experiments, the acid buffer extracted 70% of the total (groat) B-glucans, 22% of the pentosans and less than 1% of the starch.

A diverse collection of oat from several countries, containing 101 genotypes grown at the University of Saskatchewan in unreplicated observation plots in 1989, was used to determine the relationship between AEV and total B-glucan content. The genotypes were dehulled and sub-samples ground to meal and analyzed for total B-glucan and AEV according to procedures described elsewhere (Bhatty 1987).The table below gives some of the statistical parameters of the data obtained.

Parameter	Acid extract viscosity (centiStokes)	B-glucan (%)
Range	4.5-51.7	2.9-6.1
Mean	15.6	4.6
Deviation	9.4	0.6
Variability (C.V.)	60.3	13.0

The genotypes had a narrower range in total B-glucan (13% CV) than in AEV (60% CV). The correlation between AEV and total B-glucan, though highly significant (+ 0.27**) was low, most likely due to a limited range in total B-glucan content of oat and secondly perhaps to lower solubility of oat B-glucan in acid buffer at room temperature. Therefore, AEV does not seem to be suitable for rapid screening of oat for low or high B-glucan for feed and food uses, respectively.

Bhatty, R. S., 1987. Relationship between acid extract-viscosity and total soluble and insoluble B-glucan contents of hulled and hulless barley. Can. J. Plant Sci. 67: 997-1008.

Variation In % Beta-glucan and Groat Protein Concentration of Oat Genotypes Grown at the Crop Development Centre in 1990

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During 1990, replicated hill-plot trials were grown at two locations in the Saskatoon area to evaluate several sources of germplasm for increased beta-glucan and groat protein concentration. Both trials were designed as randomized complete block experiments with two replicates at each site, Saskatoon and Goodale.

Seventeen genotypes from nine countries were grown in the beta-glucan experiment and thirty-two genotypes from five countries in the groat protein experiment. The latter contained several Crop Development Centre breeding lines (0T337, SO89121 and SO89123), four lines with Avena marocanna background from the U.K. (AV lines) and eleven A. sterilis derived lines from the Iowa State Univ. program (JXXX-X and LXXX-X lines) as outlined in Table 2.

The materials were harvested at maturity, threshed and stored. They were later dehulled and ground for laboratory analysis. Beta-glucan was determined according to the method reported by Bhatty (1987), and groat protein concentration was determined using the Udy dye-binding technique. The results are described in Tables 1 and 2.

While significant variation did exist for % beta-glucan, which ranged from 3.78 to 5.55%, it was disappointing to see only a maximum 16% increase over the best local checks. Since these genotypes were chosen based on previous evidence suggesting maximum variation and come from very diverse backgrounds, it would appear that our search for high beta-glucan concentration may be difficult.

From the groat protein experiment we find more encouraging results, with the best lines tested exceeding the best local check (Riel) by more than 20%, and other local varieties such as Waldern by as much as 40%. The highest protein lines were certainly those from the USA. Particulary noteworthy were the A. sterilis background lines from Iowa State. While several other lines were significantly higher in % protein than the local checks, none reached the levels of these materials under these conditions. Unfortunately, only one of the A. maroccana derived lines from Wales was significantly higher than the local checks, and even that line, Av2027/3/1/27, was only moderately higher than the local checks, being in fact not significantly different from the local checks Riel and Jasper.

We will repeat these trials in 1991.

Bhatty, R.S., 1987. Relationship between acid-extract viscosity and total, soluble and insoluble β-glucan content of hulled and hulless barley. Can. J. Plant Sci., 67, 997-1008.

Table 1. Beta-glucan concentration (%) of 17 oat genotypes grown at two locations, 1990.

Genotype Name	% Beta-glucan		
	Saskatoon	Goodale	$\bar{X}$
Calibre (Local Check)	4.65	4.95	4.80
Cascade "	4.15	5.35	4.75
Dumont "	4.25	4.85	4.55
Waldern "	4.00	4.65	4.33
Dalyup (Australia)	4.95	5.10	5.03
Marion (Canada)	5.35	5.50	5.43
Otee (USA)	5.45	5.20	5.33
CI5575	5.65	5.45	5.55
Kirovskij (USSR)	4.40	4.70	4.55
Martin (Norway)	4.00	4.45	4.23
Magne (Sweden)	4.45	5.40	4.93
Bulban (Australia)	3.50	4.05	3.78
Karhu (Finland)	5.65	5.05	5.35
Madog (UK)	4.80	4.70	4.75
Envis (UK)	5.00	5.25	5.13
David (Czech)	5.00	5.40	5.20
Arne (Sweden)	5.15	4.90	5.03
Standard error	0.32	0.42	0.33

Table 2. Groat protein concentration (%) of 32 oat genotypes grown at two locations, 1990.

Genotype Name	% Groat Protein		
	Saskatoon	Goodale	$\bar{X}$
Calibre (Local Check)	15.5	17.0	16.3
Cascade "	15.4	17.0	16.2
Jasper "	16.4	18.2	17.3
Riel "	17.6	18.2	17.9
Waldern "	14.6	16.0	15.3
OT337 (U. of Sask.)	16.7	18.0	17.3
OT525 (Sweden)	15.5	17.0	16.2
SO89121 (U. of Sask.)	16.6	18.3	17.4
SO89123 (U. of Sask.)	16.9	18.2	17.5
Otee (USA)	19.5	21.7	20.6
Maldwyn (UK)	18.1	19.4	18.8
Elen (UK)	18.3	19.8	19.0
David (Czech)	16.1	17.8	16.9
Sv38529 (Sweden)	16.9	19.6	18.3
Trucker (USA)	16.7	19.5	18.1
SN404 (USA)	20.1	21.0	20.5
Dumont (Local Check)	15.1	16.2	15.7
Av2401/2 (UK)	16.0	17.3	16.7
Av2402/4 (UK)	16.4	17.4	16.9
Av2027/3/1/27 (UK)	17.0	19.9	18.4
Av2027/3/1/32 (UK)	16.6	18.2	17.4
J756-1 (Iowa State)	20.7	22.2	21.4
J762-1 "	20.3	20.9	20.6
J773-3 "	19.6	21.7	20.6
J758-3 "	21.0	22.6	21.8
J756-3 "	20.4	21.9	21.1
J775-1 "	20.0	20.4	20.2
J706-1 "	19.7	21.5	20.6
J740-3 "	19.4	21.4	20.4
J794-4 "	20.2	21.7	21.0
J829-3 "	18.7	19.5	19.1
L966-3 "	19.5	20.8	20.1
Standard error	0.41	0.24	0.42

FORAGE QUALITY OF OATS UNDER DIFFERENT SPACINGS OF POPLAR (*Poplus deltoides*) PLANTATION

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To increase forage availability on a limited forage production area, alternatives, including forage production under agro-forestry systems are utilized. Evaluation of the effect of different poplar tree plantation spacings on oat forage quality was desired.

Field studies were conducted in interspaces of 5 year old poplar (*Poplus deltoides*) planted at 2x2 m, 4x4 m, and 6x6 m spaciings with a plot size of 19.2 m^2, 36 m^2, and 60 m^2 respectively. The oat cultivar OS-7 was planted in November at a 75 kg/ha seeding rate with a 25 cm row spacing in a randomized block design. The crop was harvest at 50% flowering. Samples were dried, ground, and analyzed for crude protein content and in vitro dry matter digestibility (IVDMD).

Little variation in crude protein content or IVDMD was observed (Table 1). However, crude protein yield and digestible dry matter (DDM) yield increased with increasing interspaces of poplar and the highest yields were obtained with 6x6 m spacings. These results suggest good quality oat forage can be obtained in interspaces of 5 year old poplar planted at 6x6 m spacings under an agro-forestry system.

Table 1. Yield and chemical composition of oat forage in an agro-forestry system under various spacings of poplar plantation.

Spacing	% Crude Protein	IVDMD %	Crude Protein Yield (q/ha)	DDM Yield (q/ha)
2x2 m	5.25	54	2.47	26
4x4 m	5.54	54	3.87	38
6x6 m	5.10	53	4.60	48

IVDMD = In vitro dry matter digestibility
DDM = Digestible dry matter

VIRULENCE OF OAT CROWN RUST IN THE UNITED STATES IN 1990

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Cereal Rust Laboratory

Isolates of *Puccinia coronata* were obtained from 55 collections of oat crown rust received at the Cereal Rust Lab in 1990. Bulk urediniospore cultures were established on Marvelous oats, and a single-pustule isolate was obtained for each collection. Isolates were tested for virulence on 117 cultivars and lines of oats. Of these, 29 lines have single, designated crown rust resistance genes (Table 1). The host set also included 47 Iowa backcross lines with unidentified crown rust resistance genes from *Avena sterilis*. Most of the Iowa lines probably have single genes for crown rust resistance.

Although varying levels of resistance were observed among the isolate x line combinations, ratings were reduced to either resistant or susceptible for summarizing and presenting the data. A small proportion of the isolate x line combinations were excluded from the analysis either because of failures of the inoculations or because the reaction types were mixed or otherwise difficult to classify.

Seven of the named cultivars including Marvelous, the susceptible check, and eight of the Iowa backcross lines were susceptible to all 55 of the *P. coronata* isolates tested. The susceptible Iowa lines were X360, X422, X449-1, X476-1, X541, X719, X720, and X864.

Oat lines with *Pc 52* and *Pc 68* and the line H548 were resistant to all 55 isolates. Lines with *Pc 50, Pc 53, Pc 57, Pc 58, and Pc 62* were resistant to all but a few of the isolates (Table 1). H561 also was resistant to all but a few isolates (Table 2). Other notable cultivars and lines not shown in Tables 1 and 2 include: Saia (resistant to 96%), Centennial (resistant to 93%), Magnif 208 (resistant to 93%), WI X4361 (resistant to 94%), and WI N 569-4252 (resistant to 84% of the isolates).

A significant change from 1989 occurred with the appearance of virulence to lines with *Pc 38* and *Pc 39* in Texas and Arkansas in 1990. The combination of these two genes has been widely used in oat cultivars in the northern plains and in Manitoba. Combined virulence to *Pc 38* and *Pc 39* was first found in the northern plains in 1989, so it was surprising to see it spread so quickly to the southern plains, where these two genes have not been widely used. Virulences to *Pc 38* and *Pc 39* were highly associated. Eight of 10 isolates virulent on *Pc 38* were also virulent on *Pc 39*, and eight of nine isolates virulent on *Pc 39* were also virulent on *Pc 38*.

Crown rust collections were grouped by geographical region to determine whether virulence patterns differ in rust populations in different parts of the United States. Only five isolates were obtained from the lower Mississippi Valley (Louisiana and Arkansas) and seven from the Southeast (Georgia, Tennessee, South Carolina, and North Carolina), so comparisons involving these regions are not very rigorous. However, better comparisons can be made between the southern plains (Texas and Kansas) with 20 isolates and the north central states (South Dakota, Minnesota, and Wisconsin) with 22 isolates.

Populations of *P. coronata* in the southern plains and the north central states differed widely in frequency of virulence on *Pc 14, Pc 35, Pc 46, Pc 55*, and *Pc 61* and on X466, X475, and Y350. Although there were limited numbers of isolates for comparison, the populations in the lower Mississippi Valley and the Southeast appeared to differ in frequencies of virulence on *Pc 59*, X543, X716, and X765.

On average, isolates from the north central states and from the Southeast were more virulent than those from the southern plains and the lower Mississippi Valley. Considering virulence genes that correspond to the 30 designated *Pc* genes listed in Table 1, the mean number of virulence genes per isolate was 8.6 for the north central states, 8.1 for the Southeast, 6.6 for the lower Mississippi Valley, and 6.4 for the southern plains. The isolate from California was virulent on only three of these genes.

Table 1. Distribution and frequency of *Puccinia coronata* isolates in the United States virulent on oat lines with single, designated crown rust resistance genes

	% Isolates Virulent on Indicated Line				
Oat Line	TX,KS 20 isol.	LA,AR 5 isol.	GA-NC 7 isol.	SD,MN,WI 22 isol.	CA[a] 1 isol.
Pc 14 D504	56	60	57	95	A
Pc 22 Hudson[b]	45	25	14	45	V
Pc 35	5	40	43	50	A
Pc 36 D515	15	20	43	45	A
Pc 38	15	20	0	41	A
Pc 39	10	20	0	41	A
Pc 40	74	100	86	64	A
Pc 44 Kyto	90	100	100	100	A
Pc 45	25	20	57	0	V
Pc 46	5	20	43	45	A
Pc 48	5	20	0	5	A
Pc 50	15	0	0	5	A
Pc 51 X434	20	0	0	41	A
Pc 52 X421	0	0	0	0	A
Pc 53 H441	0	0	14	0	A
Pc 54	25	20	86	5	V
Pc 55	10	25	0	48	A
Pc 56	11	0	29	36	A
Pc 57 D640	0	0	17	5	A
Pc 58 TAM-O-301	5	0	29	5	A
Pc 59 TAM-O-312	25	0	43	9	A
Pc 60 Coker 227	55	40	43	45	A
Pc 61 Coker 234	45	0	14	5	A
Pc 62	0	20	0	0	A
Pc 63	10	25	0	32	A
Pc 64	11	25	0	14	A
Pc 67	55	60	71	18	A
Pc 68	0	0	0	0	A
Pc 70 H547	10	0	29	30	A
Pc 71 Y345	5	20	0	41	A

[A]Avirulence (A) or virulence (V) is noted for the single isolate from California.

[b]Hudson may have other gene(s) in addition to *Pc 22*.

Table 2. Distribution and frequency of *Puccinia coronata* isolates in the United States virulent on oat lines with unidentified crown rust resistance genes from *Avena sterilis*

Oat Line	% Isolates Virulent on Indicated Line TX,KS 20 isol.	 LA,AR 5 isol.	 GA-NC 7 isol.	 SD,MN,WI 22 isol.	 CA[a] 1 isol.
H548	0	0	0	0	A
H561	13	0	0	11	A
X104C-7	63	60	57	82	V
X117-1964-15-4	47	0	29	18	V
X122	100	100	86	100	V
X2505-4	11	0	33	18	A
X270	26	0	14	41	A
X292-1	55	67	71	86	V
X423	78	100	100	95	A
X424-2	16	20	29	0	A
X424-3	65	80	83	89	V
X434-1	21	0	0	45	A
X447	100	100	86	100	V
X465	100	80	71	100	V
X466	11	50	40	52	V
X467	100	100	100	95	V
X468-2	100	100	100	95	V
X470-1	80	100	86	95	A
X475	11	60	43	59	A
X536	84	100	100	100	V
X537	90	100	100	100	V
X539-1	100	80	86	100	V
X540	100	100	100	95	V
X543	25	0	57	45	A
X550-1	83	60	71	82	A
X551	85	80	86	86	V
X639-3	84	80	86	82	V
X716	45	20	71	45	A
X717	100	80	86	100	V
X718	100	80	100	100	V
X721	74	80	71	95	V
X765	25	0	71	45	A
X766	35	0	33	50	A
Y344	35	20	17	32	A
Y346	24	50	0	17	A
Y347	53	40	29	18	A
Y348	10	40	33	41	A
Y350	5	20	0	45	A
Y351	0	40	20	27	A

[a]Avirulence or Virulence for single isolate from California.

IOWA PATHOLOGY NOTES

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1. The systemic fungicides 'Tilt' and 'Bayleton' continue to offer excellent control of infection by *Puccinia coronata*. Conditions in 1990 were ideal for rust infection and development, yet there appeared to be little natural infection in the Ames area during the early part of the season--possibly the result of the absence of overwintering inoculum. The Bayleton treatments outyielded those of Tilt by about 8%. This difference is still unexplained.

2. Root endophyte studies have continued and we have been able to stimulate germination of spores of several mycorhizal fungi in the presence of nonsterilized soil. Further investigations have implicated several species of streptomyces which are capable of producing an apparently gaseous element that triggers germination of the spores. This confirms similar findings of workers in Georgia who supplied the streptomyces cultures. The germination triggering mechanism was very slow and it may be that out mycorhizal associations and germination inducing factors are different.

EVALUATION OF CULTIVATED AND WILD OAT SPECIES FOR TOLERANCE TO BYDV

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The N. I. Vavilov Institute of Plant Industry

Barley yellow dwarf virus (BYDV) infects many cultivated and wild cereals. Oat is one of the crops most susceptible to this virus. BYDV is transmitted by five aphid species, but the most intensive epiphytotics are due to transmission by the oat bird-cherry aphid (*Rhopalosiphum padi* L.)

In 1988, a severe BYDV epiphytotic was reported in the oat crop in the northwestern European part of the USSR. An oat BYDV evaluation trial, consisting of 450 varieties of 4 cultivated oat species and more than 100 accessions belonging to 10 wild oat species from the Vavilov Institute (VIR) collection, was conducted near Leningrad. More than 35% of the entries in the trial died completely indicating the severe BYDV infection in the trial. Up to 30% of the entries had sparse single surviving plants that produced panicles with 4-6 kernels and thousand kernel weights (TKW) of 15-20g.

Older Soviet varieties such as 'Kibiny 2', 'Samarsky samy rannii', 'Krasnodarsky 73' and 'Artemovsky 107' were among the entries exhibiting high BYDV tolerance (score of 3 or less). Accessions of *Avena strigosa* from Portugal and *A. byzantina* from Tunis also exhibited useful tolerance. Most of the highly productive cultivars from western Europe were severly damaged by the disease. Light damage (score of 1-3) was observed on 'Jo 1030', 'Vouti', 'Hankkija' (Finland), 'Bertus', 'Mutine' (France), 'Korsar', 'Flaningsnova' (Germany), 'Lidia' (Italy), 'Akiyutaka' (Japan), 'Donald' (Canada), 'Ogle', 'Otee', 'Okay', 'Porter', 'Pennlo', 'Pennline 6751', 'Kelly', and 'Coker 716' (USA), 'Tarahumara', 'Paramo', and 'Tulacingo' (Mexico). Of the accessions of the four wild diploid species, only an accession of *A. hirtula* from Italy exhibited tolerance, while all other wild diploid accessions of other species died in the first half of the vegetative stage of plant development. Of the tetraploid species, only one accession of *A. vaviloviana* from Ethiopia and one *A. magna* from Morocco manifested tolerance. Three of 20 accessions of *A. barbata*, WIR-230 and WIR-237 from Azerbaijan, and WIR-1759 (Ave 998/80) from Israel, were classified as tolerant.

The highest degree of tolerance was observed in the hexaploid species. Accessions of *A. ludoviciana* from Azerbaijan (WIR-250), Morocco (WIR-186) and Afghanistan (WIR-90), as well as *A. fatua* from Georgia (WIR-45), Ukraine (WIR-39), Poland (WIR-25), and Mongolia (WIR-28) exhibited high levels of tolerance. The study of a large series of *A. sterilis* accessions indicated high levels of tolerance in those from Morocco, Turkey, and Israel. Most of the resistant accessions from Israel bear numbers of the Canadian collection (CAV) that was made available to VIR by Dr. B. R. Baum.

All of the above varieties and accessions are of interest as sources of tolerance to BYDV that can be used in breeding.

Disease Report from Manitoba - 1990

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1. Oat Crown Rust in Canada in 1990

Crown rust was first detected in trace amounts in wild oat (Avena fatua L.) in southern Manitoba on July 10. In the past several years crown rust was not observed in commercial oat fields due to widespread use of resistant cultivars with both resistance genes Pc38 and Pc39 (Dumont, Riel, and Robert). In 1990 crown rust severities of 5% to 10% were commonly observed in commercial fields, indicating the widespread occurrence of crown rust isolates that can attack these resistant cultivars. Only traces of crown rust were found in eastern Saskatchewan.

In Ontario the incidence of crown rust generally ranged from moderate in most oat growing areas to moderately-heavy in oat fields that were adjacent to the alternate host. The aecial infections were likely an important source of primary inoculum for this area.

Crown rust collections were obtained from wild oat and susceptible oat lines or cultivars grown in uniform rust nurseries. For virulence studies, bulk urediospore collections were established on the cv. Makuru, and one single pustule isolate was made from each bulk collection. Using nineteen single gene backcross lines as differentials, 102 virulence phenotypes were identified from 174 isolates from Manitoba and Saskatchewan. Of these isolates, 43.1%, comprising of 39 virulence phenotypes, were virulent to both Pc38 and Pc39 and other Pc genes (Table 1). The sharp increase in virulences to Pc38 and Pc39 in the prairie rust population in recent years (Table 2) is due to widespread use of cultivars containing both of these genes. As in recent years, virulence to Pc39 appears to be strongly associated with Pc55; all the isolates virulent to Pc39 were also virulent to Pc55, including those isolated from eastern Canada in 1990. Also, virulence to Pc63 appears to be associated with virulence to Pc38, as all the isolates virulent to Pc63 were also virulent to Pc38. Virulences to Pc59 and Pc60 increased from 2.5% and 0% in 1988 to 17.8% and 29.3%, respectively, in 1990 (Table 2).

From Ontario, 49 virulence phenotypes were identified from 149 isolates (Table 1). The Ontario rust population is distinct from the prairie rust population (Table 2). Since 1987, isolates with virulences to Pc39 and other Pc gene(s) were prevalent in Ontario due to the release of the cv. Woodstock (containing Pc39) in 1983. In 1990 these isolates, comprising 36 virulence combinations, accounted for 77.2% of the Ontario rust population (Table 1). The cv. Woodstock has now been removed from the list of recommended cultivars for Ontario growers.

The strategy for rust resistance breeding at the Winnipeg Research Station is to pyramid additional resistance genes into currently well adapted cultivars, such as Robert and Dumont. Gene Pc68 continues to be effective against all Canadian crown rust isolates since 1982, and should prove to be useful in oat breeding programs.

2. Oat Stem Rust in Canada in 1990

Oat stem rust appeared in wild oat or in nurseries of susceptible lines about mid-July. After initially favorable conditions for rust development, the weather turned very warm and dry, and infections throughout the growing season remained light. Only traces of oat stem rust were found in Saskatchewan, and infections in Ontario remained light.

The races identified in Canada in 1990 are shown in Table 3. Race NA27 remained the predominant race in the prairie region, but was less frequent in Ontario or Quebec as compared to 1989. The currently recommended cultivars grown in the prairie region remained resistant to all races in this region. Commonly grown cultivars, such as Dumont or Riel, contain genes Pg13 and Pg9, both of which are effective against the prairie stem rust population.

Table 1. Percent of isolates and number of virulence phenotypes of *Puccinia coronata* in Canada in 1990.

Virulence phenotype	Percent of isolates (no. of phenotype)	
	Ontario	Man/Sask
Pc38,Pc....	2.0 (3)	16.1 (23)
Pc39,Pc....	71.8 (29)	1.2 (2)
Pc38,Pc39,Pc....	5.4 (7)	43.1 (39)
Other Pc....	20.8 (10)	39.7 (38)
Total		
no. of phenotypes	(49)	(102)
no. of isolates	149	174

Table 2. Frequency of virulence of isolates of *Puccinia coronata* on backcross lines of *Avena sativa* containing single genes (*Pc*) for crown rust resistance.

	Percent of isolates			
	Ontario	Manitoba/Saskatchewan		
Pc line	1990	1988	1989	1990
Pc35	24.8	29.6	50.6	32.2
Pc38	7.4	1.2	24.1	59.2
Pc39	77.2	0.0	21.6	44.3
Pc40	6.7	32.1	43.8	50.6
Pc45	3.4	0.0	3.7	3.4
Pc46	5.4	54.3	63.0	29.3
Pc48	0.7	0.0	0.0	1.1
Pc50	7.4	9.9	1.9	13.8
Pc54	4.7	9.9	3.1	3.4
Pc55	77.2	0.0	21.6	44.3
Pc56	29.5	8.6	4.3	8.6
Pc58	0.0	0.0	0.6	0.6
Pc59	0.7	2.5	13.6	17.8
Pc60	2.7	0.0	11.1	29.3
Pc61	2.0	0.0	0.0	8.6
Pc62	9.4	0.0	1.9	0.0
Pc63	6.0	0.0	21.0	48.9
Pc64	9.4	3.7	7.4	5.2
Pc67	2.7	7.4	7.4	22.4
Total no. isolates	149	81	162	174

Table 3. Distribution of races of *Puccinia graminis* f. sp. *avenae* in Canada in 1990.

		Ontario/Quebec		Man/Sask				Alberta			
		Field[a]		Field[a]		Trap[b]		Field[a]		Trap[b]	
Race No.	Avirulence/virulence formula (Pg genes)	No.	%	No.	%	No.	%	No.	%	No.	%
NA9	1,3,8,13,16,a / 2,4,9,15	1	5.3	0	0.0	0	0.0	0	0.0	0	0.0
NA12	1,8,13,10,a / 2,3,4,9,15	5	26.3	0	0.0	0	0.0	0	0.0	0	0.0
NA24	8,9,13,16,a / 1,2,3,4,15	1	5.3	0	0.0	0	0.0	0	0.0	0	0.0
NA25	8,13,16,a / 1,2,3,4,9,15	5	26.3	0	0.0	0	0.0	0	0.0	0	0.0
NA26	8,16,a / 1,2,3,4,9,13,15	3	15.8	0	0.0	0	0.0	0	0.0	0	0.0
NA27	9,13,15,16,a / 1,2,3,4,8	2	10.5	113	79.0	15	57.7	3	75.0	1	100.0
NA29	9,13,16,a / 1,2,3,4,7,15	0	0.0	27	18.9	10	38.5	0	0.0	0	0.0
NA32	1,8,16,a / 2,3,4,9,13,15	1	5.3	0	0.0	0	0.0	0	0.0	0	0.0
NA50	3,4,9,13,15,16,a / 1,2,8	0	0.0	2	1.4	0	0.0	0	0.0	0	0.0
NA64	1,3,4,8,13,16,a / 2,9,15	1	5.3	0	0.0	0	0.0	0	0.0	0	0.0
NA69	1,3,8,8,13,16,a / 2,4,15	0	0.0	0	0.0	0	0.0	1	25.0	0	0.0
NA75	3,4,8,9,13,15,16,a / 1,2	0	0.0	1	0.7	1	3.8	0	0.0	0	0.0
Total		19		143		26	100	4	100	1	100

[a] All field collections from lines or cultivars with no known resistance genes.

[b] All collections from trap nurseries were from lines with gene Pg 15 resistance.

3. Virus Diseases in Oat in Manitoba in 1990

a. Barley Yellow Dwarf Virus

In 1990 the most serious economic virus disease problem in oats in Manitoba was aphid-borne barley yellow dwarf (BYD). Losses due to BYD occurred almost only in late-seeded crops. Unusually heavy aphid showers in mid-July resulted in disease losses as high as 80% in late-seeded crops at some sites in the Red River valley and south-central Manitoba.

Serological and transmission tests identified approximately 90% of 1990 Manitoba BYDV isolates as 'PAV-like' in that they were most efficiently transmitted by the oat bird-cherry aphid but also transmitted by the English grain aphid. The English grain aphid, as in previous years, was the most commonly observed vector cereal aphid, and was the predominant aphid in the mid-July aphid showers. A virulent PAV-like isolate, Y8513, was used in 1990 for the purpose of selecting BYD-tolerant lines in disease nurseries.

b. Flame Chlorsis

Flame chlorosis (FC), a soil-transmitted, virus-like disease found to date only in Manitoba, was first observed in barley in 1985, in wheat in 1988, and in oat in 1989. The disease is characterized by striking symptoms unique among cereal diseses, a characteristic cytopathology, and a distinct set of double-stranded (ds) RNA species. The disease-specific dsRNAs of oat FC were compared with those of 'type' barley flame chlorosis by Northern hybridization analyses. Oat FCdsRNAs shared extensive sequence homology with their 'type' barley counterparts but were more distantly related than wheat FCdsRNAs or different geographic isolates of barley FCdsRNA. While the extent and intensity of barley FC, and to a lesser extent wheat FC, are increasing every year, oat FC has been found at only two sites and only in scattered individual plants.

RESISTANCE OF SOME OAT CULTIVARS AGAINST DISEASES

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Twentyfive cultivars of spring oats from the European Nursery of Oats obtained from Czechoslovakia were evaluated at the Institute for Small Grains at Kragujevac, Yugoslavia. The nursery was artificially inoculated with stem rust (*Puccinia graminis avenae*) ,crown rust (*P. coronata*), and powdery mildew (*Erisiphae graminis avenae*) in the field. Disease response was evaluated on a scale of 0-4 with 0=very resistant, 1 = resistant, 2 = moderately resistant, 3 = moderately susceptible, and 4 = very susceptible. The severity of infection was rated from 0-100%.

Table 1. The resistance of oat cultivars against stem rust, crown rust, and powdery mildew in 1989 at Kragujevac, Yugoslavia.

Cultivar	Stem Rust Response	Stem Rust Severity	Crown Rust Response	Crown Rust Severity	Powdery Mildew Response	Powdery Mildew Severity
Rodney A	0	0	4	70	4	20
Rodney B	0	0	4	70	4	20
Rodney H	4	40	3	Trace	3	5
Rodney M	0	0	4	80	0	0
Pg 15	4	20	4	60	4	20
Pg 16	4	5	4	70	4	10
Pg a	0	0	4	70	4	10
Pc 38	4	50	4	30	4	30
Pc 39	4	60	3	5	0	0
Pc 50-2	4	60	0	0	4	20
Pc 50-4	4	50	3	Trace	4	5
Pc 54	4	60	4	80	0	0
Pc 58 (TAM O-301)	0	0	0	0	3	20
Pc 60 (Coker 227)	4	50	3	40	0	0
Pc 61 (Coker 234)	4	40	3	40	4	5
Pc 62	0	0	2	40	4	5
Garland	0	0	0	0	0	0
Mostyn	4	60	4	70	0	0
Maelor	4	60	4	80	0	0
Maldwyn	4	60	4	60	0	0
Cc 4146	4	60	4	70	0	0
Cc 6490	4	60	4	80	0	0
Cc 4761	4	30	4	60	0	0
Roxton	0	0	3	20	0	0
Pan	4	50	4	70	4	5

Only Garland exhibited effective resistance against all three pathogens and is therefore useful as a source of resistance. Rodney A, Rodney B, Rodney M, *Pg a*, *Pc 58*, *Pc 62*, Garland, and Roxton were resistant to stem rust. Rodney H, *Pc 50-2*, *Pc 58* (TAM O-301), and Garland exhibited resistance to crown rust. Rodney M, *Pc 54*, *Pc 60*, Garland, Mostyn, Maelor, Maldwyn, Cc 6490, and others were resistqant to powdery mildew. The resistant lines may be used as sources of resistance to the mentioned diseases.

EUROPEAN OAT DISEASE NURSERY 1990

J. Sebesta, B. Zwatz, and L. Corazza

In Europe, an international oat disease project was established by the first author in 1969 ('Oat Rust Nursery'). The trials were planted at that time in several central European countries (Austria, Czechoslovakia, Germany-East, Poland). In 1973 the number of surveyed diseases was increased and the project was renamed 'European Oat Disease Nursery' (EODN). In 1976 the EODN trials were established at 31 locations in 11 countries of the Continent (Sebesta, Zwatz, 1980).

In 1990, the EODN was included into the European System of Cooperative Research Networks in Agriculture of FAO (ESCORENA), and 31 national cooperators in 18 countries participated in this project (Table 1).

The incidence of oat diseases in Europe in 1990

In general, weather conditions in Europe in 1990 (drought, high temperatures) were very unfavorable for the development of fungal diseases, e.g. in Belgium, Spain, Sweden and others. On the other hand, BYDV was extremely prevalent in some regions.

However, high or moderate occurrence of crown rust (*Puccinia coronata* var. *avenae*) was recorded in France, Italy and Austria and Czechoslovakia.

Stem rust (*Puccinia graminis* f. sp. *avenae*) incidence was high in Austria and Poland, moderate in Italy, and low in Bulgaria, Czechoslovakia and Norway.

Powdery mildew (*Erysiphe graminis* f. sp. *avenae*) incidence was high in France, Germany (East), Great Britain, Greece and Italy, moderate in Austria and Norway, and low in Czechoslovakia and Yugoslavia.

Septoria leaf blotch (*Septoria avenae*) incidence was moderate in Austria, Italy and Poland, and low in Germany (East).

Helminthosporium leaf blotch (*Helminthosporium avenae*) incidence was high in Poland, moderate in Sweden, and low in Czechoslovakia, Germany (East) and USSR.

High occurrence of BYDV (Barley Yellow Dwarf Virus) was reported in Germany (East), Great Britain and Poland; a moderate occurrence was reported in the Soviet Union (Table 2).

Effectiveness of disease resistance genes

Crown rust

Genes for crown rust resistance (Pc 68, 'Garland', *Avena sterilis* CAV 2648, IL 86-5698) were indicated to be effective in Austria, France and Italy where the pathogen occurred. In addition, in Austria and France, the resistance was effective in Pc 58, Pc 63, Pen^2 x CAV 1376, KR 288/73L/569, Rodney D, Rodney A, Rodney E, Rodney H, Rodney ABDH, IL 85-6467 and IL 86-4467.

Stem rust

As indicated in Austria and Poland, Garland remains resistant to stem rust. However, high effectiveness in many other sources of stem rust resistance (Pg 2, Pg 16, Pg 13, Pg 9, Pg 15 and Pg 4), was observed.

Powdery mildew

Effective resistance to powdery mildew was observed in several countries in Cc 4146, 'Mostyn' and Cc 6490 (*Avena barbata* translocation) (Thomas et al., 1975). Surprisingly, Mostyn (eg 3) was moderately attacked in Germany (East) at the Salzmunde location in the second half of the growing period. Therefore, the occurrence of a virulence factor overcoming the resistance gene Eg 3 was detected at this location this year and also in Czechoslovakia, at the Krukanice location. This finding has to be confirmed in glasshouse tests. The virulence on Mostyn in the west Bohemian population of mildew was demonstrated in glasshouse tests. In Greece, 'Maelor' (adult plant resistance), Cc 3678 and *A. sterilis* CAV 2648 were less infected than susceptible checks (Sebesta et al., 1987). On the other hand, in the United Kingdom, only Pc 54 and Cc 6490 (Eg 4) were relatively resistant.

Other diseases

The readings on reaction of oats to Septoria leaf blotch, Helminthosporium leaf blotch and Barley yellow dwarf virus are encouraging. However, research concerning the fundamentals of resistance breeding against these diseases (Barley yellow dwarf virus, *Helminthosporium avenae*, *Septoria avenae*) in Europe is necessary before starting breeding programs.

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Acknowledgement

The authors would like to express their sincere thanks and appreciation to all the co-workers participating in the European Oat Disease Nursery.

Table 1. National cooperators and countries in which the EODN was established in 1990.

National Cooperator	Country
Dr. Dipl. Ing. B. Zwatz	Austria
Dr. G. Clamot	Belgium
Dr. N. Antonova	Bulgaria
Ing. J. Cervenka	Czechoslovakia
Ing. H. Fisova	
Ing. I. Longauer	
Ing. P. Mikoska	
Ing. J. Pacolak	
Dr. J. Sebesta	
Dr. M. Rekunen	Finland
Ing. L. Sauer	France
Dr. B. Fischer-Engelen	Germany
Dr. P. Franck	
Dr. M. Kummer	
Dr. K. Muller	
Dr. G. Zimmermann	
Dr. N. H. Chamberlain	Great Britain
Dr. R. Clothier	
Dr. E. Theoulaki	Greece
Dr. K. P. Wouda	Holland
Dr. A. Palagyi	Hungary
Dr. L. Corazza	Italy
Dr. L. Reitan	Norway
Mgr. A. Swierczewski	Poland
Dr. M. Martinez Vazquez	Spain
Dr. B. Mattsson	Sweden
Dr. E. Lyzlov	USSR
Professor T. I. Krivchenko	
Dr. H. D. Kueuets	
Dr. V. V. Shopina	
Dr. S. Stojanovic	Yugoslavia

Table 2. Incidence (+ = low, ++ = moderate, +++ = high) of oat diseases in Europe in 1990 as found in the EODN.

Country	Pc	Pg	Eg	Sa	He	BYDV
Austria	++	+++	++	++		
Belgium						
Bulgaria		+				
Czechoslovakia	++	+	+		+	
Finland						
France	+++		+++			
Germany	-	-	+++[1]	+	+	+++[1]
Great Britain			+++			+++
Greece			+++			
Holland						
Hungary						
Italy	+++	++	+++	++		
Norway		+	++			
Poland		+++		++	+++	+++
Spain						
Sweden					++	
USSR					+	++
Yugoslavia			+			

1 = East Germany
Pc = crown rust (Puccinia coronata)
Pg = stem rust (Puccinia graminis)
Eg = powdery mildew (Erysiphe graminis
Sa = Septoria leaf blotch (Septoria avenae)
He = Helminthosporium leaf blotch (Helminthosporium avenae)
BYDV = Barley Yellow Dwarf Virus

Table 3. Oats tested in EODN in 1990.

Sources of Resistance to Crown Rust

1. Pc 38
2. Pc 39
3. Pc 48
4. Pc 50
5. Pc 50-2
6. Pc 50-4
7. Pc 54
8. Pc 55
9. Pc 56
10. Pc 58
11. Pc 59
12. Pc 60
13. Pc 61
14. Pc 62
15. Pc 63
16. Pc 64
17. Pc 67
18. Pc 68
19. Pen^2 x CAV 1376
20. KR 3813/73
21. Pirol
22. KR 288/73L/569
23. Garland

Sources of Resistance to Stem Rust

24. Rodney D (Pg 1)
25. Minrus (Pg 1 + ?
26. Rodney A (Pg 2)
27. Rodney E (Pg 3)
28. Jostrain (Pg-3 + ?)
29. Rodney B (Pg 4)
30. Rodney F (Pg 8)
31. Rodney H (Pg 9)
32. Rodney M (Pg 13)
33. Pg 15
34. Pg 16
35. Pg a
36. Rodney ABDH

Sources of Resistance to Powdery Mildew

37. Manod
38. Cc 4146 (Eg 1)
39. Mostyn (Eg 3)
40. Cc 6490 (Eg 4)
41. Cc 4761
42. Maelor
43. Maldwyn
44. Roxton
45. Cc 3678
46. Avena sterilis (CAV 2648
47. Orlando

Sources of Tolerance to BYDV

48. IL 85-2069
49. IL 85-6467
50. IL 86-1158
52. IL 86-4467
53. IL 86-5698
54. IL 86-6406

Control cultivar

55. Pan

ANTIBIOSIS OF OAT LINES TO THREE APHID SPECIES

C. I. Goellner and Elio Corseuil

INTRODUCTION

Aphids have been major pests of oat in South Brazil. The main species are the greenbug (Schizaphis graminum), yellow aphid (Metopolophium dirhodum) and English grain aphid (Sitobion avenae). These insects cause considerable damage to oat crops by feeding and transmission of barley yellow dwarf virus (BYDV).

A breeding program to develop aphid resistance in oat was initiated by 1982 at University of Passo Fundo. These studies showed the primary resistance mechanism is tolerance, which is ecologically advantageous and increases the value of resistant oats as a component in pest management (Goellner & Corseuil, 1986; Goellner & Corseuil, 1988).

Moderate levels of antibiosis may exist and may be important in decreasing the BYDV dissemination in plants. The aim of this work was to identify oat entries with this plant resistance mechanism to the three aphid species cited above.

MATERIAL AND METHODS

In a lab study oat selections were tested for antibiosis, evaluated as the decrease in fecundity to greenbug, yellow aphid and the English grain aphid. Tests to the three species were performed separately with eight replicates in a randomized design. Rearing cages with late nymphs from laboratory cultures were placed over two plants of each replicate at the second leaf stage during a 10-day period with 19°C ± 1°C and 60% ± 5% temperature and air humidity, respectively. The light phase was 12 hours. The antibiosis was expressed as decrease in aphid fecundity by the count of nymphs/adult.

RESULTS AND DISCUSSION

Table 1 summarizes data for 16 oat entries tested for antibiosis. UPF 77S030-1 and UFRGS 79A20 showed antibiosis to greenbug. They had significantly less fecundity expressed by the average number of nymphs/adult. JFRGS 78A05 showed antibiosis to the yellow aphid.

Fecundity of these species was significantly greater than the English grain aphid. UF RGS 78A05 showed antibiosis to yellow aphid and English grain aphid, and UF RGS 79A020 to greenbug and English grain aphid. Both lines will be excellent sources of resistance for cultivar development. Our effort will be directed toward development of cultivars with tolerance/resistance to the greenbug and yellow aphid because they are the predominant species in the field, but the antibiosis may be controlled by different genes, and entries exhibiting antibiosis could be valuable breeding material for development of cultivars with multiple genes, thus making it more difficult for these aphids to develop corresponding genes to overcome resistance.

REFERENCES CITED

Goellner, C. I. and Corseuil, E. 1986. Determinacao de fontes de resistencia em linhagens e cultivares de aveia (Avena spp) a afidios (Hom., Aphididae). Dissertacao Mestrado, JF RGS. 101p.

Goellner, C. I. and Corseuil, E. 1988. Resistance in oat entries to two aphid species (Hom., Aphididae). Oat Newsletter, vol. 39, May 1988. p. 57-60.

Table 1. Resistance response of oat entries to three aphid species. Passo Fundo, 1986.[a,b]

S. graminum		*M. dirhodum*		*S. avenae*	
Oat entries	Avg no. nymphs/adult	Oat entries	Avg. no. nymphs/adult	Oat entries	Avg. no. nymphs/adult
CI 7512	15.1 a	UPF 79S394	18.0 a	UPF 77S027	5.8 a
UPF 79347	13.5 a b	UPF 77S039	12.8 a b	UPF 77S101	4.4 a b
UPF 805021	18.0 a b	UPF 7913347	12.5 a b c	UPF 793444	3.5 b
UPF 77S465	11.0 a b	UPF 79344	12.3 b c	UPF 79S090	3.4 b
UPF 77101	11.0 a b	UPF 77S439	11.3 b c	UPF 79S152	3.4 b
UPF 77256-5-5b	11.0 a b	UFRGS 82105	11.1 b c	UPF 77S039	2.9 b
Suregrain	10.2 a b	UPF 77256-5	10.8 b c	UPF 79243	2.9 b
CI 2332	10.0 a b	UPF 803028	10.1 b c	UPF 79S040	2.5 b
UFRGS 82A05	10.0 a b	UPF 77258-1	10.1 b c	UFRGS 7812	2.4 b c
UPF 79229-1-7	9.8 a b	UPF 79S150	9.3 c c	UFRGS 82A07	2.3 c
UFRGS 82A12	9.6 a b	UPF 79229-1-7	8.8 c d	UFRGS 79A20	2.1 c
UPF 79344	9.3 b	UPF 80S018	8.5 d	UFRGS 78A05	2.1 c
UPF 785212	8.3 b c	UPF 80S097	8.5 d	UFRGS 81A02	1.9 c d
Coronado	7.9 c	UPF 78S702	8.1 d e	Suregrain	1.4 d e
UPF 77S030-1	7.8 c	UPF 80S057	7.5 e	UPF 79229-1-7	0.9 e
UFRGS 79A20	2.5 d	UFRGS 78A05	3.9 f	UPF 80S057	0.9 e

[a] Means are average of 8 replications.

[b] Means followed by the same letter are not significantly different according to the L.S.D. test (P = 0.05).

HERBICIDE RESISTANCE IN OAT

Solomon Kibite and K.N. Harker
Agriculture Canada, Lacombe Research Station, Lacombe, Alberta, Canada

Wild oat causes greater yield losses than any other weed species and infests approximately 85% of the cultivated land in Western Canada. Crop yield reductions ranging from 5 to 50% have been reported for fields in which wild oat was the dominant weed species.

Although acceptable chemical control of wild oat has been obtained in wheat and barley, similar control in cultivated oat has not been possible mainly because of a lack of suitable herbicides that can control wild oat without injuring cultivated oat. This problem could have been solved if new herbicides were developed or if new cultivars with resistance to existing herbicides were bred. Research in these two areas has not been strong. Because of stringent regulations pertaining to toxicological data, and the increasing cost of research and development, herbicide manufacturers have not had the economic incentive to develop new herbicides. On the other hand, oat breeders have been unable to develop herbicide resistant cultivars because adequate genetic sources of herbicide resistance are unavailable.

Large genetic variation exists in cultivated oats, and over 20,000 land-race varieties and cultivars are assembled in world oat collections. To locate the desired genes, the obvious place to turn is to these germplasm collections which have not been previously screened for herbicide resistance.

A field experiment was carried out at Agriculture Canada, Lacombe Research Station, to screen 3072 accession lines from the USDA World Oat Collection for resistance to wild oat herbicides. The experiment was carried out in a quasi split-plot arrangement with accession lines as main-plots and herbicide treatments as sub-plots. Each accession line was screened for seven (1 pre-emergence and 6 post-emergence) herbicides. The Pre-emergence herbicide Avadex was applied at the rate of 1.7 kg/ha and soil incorporated twice before planting. The post-emergence herbicides, Assert, Hoegrass, Poast, Avenge, Excel and Mataven were applied at rates of 0.50, 0.80, 0.30, 0.83, 0.20 and 0.26 kg/ha, respectively, when the majority of the seedlings were in the 2-4 leaf stage. All post-emergence herbicides were applied in 100 L/ha of water at 275 kPa using a motorized plot sprayer with TeeJet 8001 flat-fan nozzles. Two to three weeks after spraying, the accession lines were rated for herbicide resistance using a 0 (no resistance) to 9 (very resistant) scale. Resistance genes were deduced as present or absent by the reaction of the accession lines. A low score (1-6) was used to indicate that an accession line, presumably a heterogeneous land-race variety, was segregating for herbicide resistance. A high score (7-9) was used to indicate that the accession line possessed unidentified gene(s) or gene combinations for herbicide resistance. The experiment was carried out during the summer of 1990.

From among the 3,072 lines that were screened, about 131 lines representing six ***Avena*** species (viz. ***A. sativa, A. byzantina, A. strigosa, A. brevis , A. nuda and A. abyssinica***) were found to have some resistance to wild oat herbicides. Of these, 109, 38, 8, 10, and 2 accession lines showed resistance to Hoegrass, Mataven, Excel, Avenge and Assert, respectively. Since the six ***Avena*** species have evolved in different parts of the world and at different times on the evolutionary time-scale, it is postulated that several genes or gene combinations may confer resistance to wild oat herbicides.

Barr (1986) and Taylor and Codd (1986) have previously reported the existence of genes for Hoegrass tolerance. However, we believe that the Hoegrass resistance genes that we discovered in ***A. abyssinica, A. brevis*** and ***A. byzantina*** may be different from the Hoegrass tolerance genes discovered in ***A. strigosa*** (Barr, 1986) and ***A. sativa*** (Taylor and Codd, 1986). As far as we know, the existence of genes that confer resistance to Mataven, Assert, Excel and Avenge has not been previously reported in the scientific literature.

We plan to screen a second set of 4,000 lines during the summer of 1991.

References

Barr, A.R. 1986. The tolerance of oat varieties to Hoegrass (375 g/l diclofop-methyl). Proceedings of the Second International Oat Conference (eds. D.A. Lawes and H. Thomas) pp 183-197. Martinus Hijhoff, Dordrecht.

Taylor, H.F. and T.M. Codd. 1986. The chemical control of wild oats in oats - a progress report. Proceedings of the Second International Oat Conference (eds. D.A. Lawes and H. Thomas) pp 198- 201. Martinus Hijhoff, Dordrecht.

GUIDELINES FOR EXPORTING AND IMPORTING SEED

Harold E. Bockelman, USDA-ARS, National Small Grains Collection
Aberdeen, ID
David Manning, USDA-ARS, Plant Germplasm Quarantine Center
Beltsville, MD

Exporting. All seed sent to a foreign country should be inspected and receive a phytosanitary certificate. For large shipments of seed Animal and Plant Health Inspection Service (APHIS) personnel in your locality should be contacted. For small, research-sized samples the seed can be routed through the USDA Plant Germplasm Quarantine Center (address: USDA Plant Germplasm Quarantine Center, Attn: David Manning, Bldg. 320, BARC-East, Beltsville, MD 20705). Both ARS and APHIS personnel are located at the PGQC. All necessary customs requirements are handled at the PGQC. There is no charge for this service.

Address the package to the PGQC. Inside, place a second unsealed package containing the seed, addressed to the recipient. Also include: two copies of a listing of materials enclosed; a copy of your transmittal letter or a copy of the original request from the foreign scientist; and any import permits (supplied by the requesting scientist) or special shipping instructions. Failure to include necessary import permits can delay shipments by weeks since it will be necessary to request such a permit from the foreign scientist or country.

Importing. Any scientist importing seed should be aware of any restrictions that apply. APHIS personnel can provide current information on applicable restrictions.

Of particular importance to oat researchers are restrictions related to *Avena sterilis*, which is classified as a Noxious Weed. Any importation or movement across state lines requires a permit from APHIS.

PI ASSIGNMENTS IN AVENA SINCE VOL. 40

Harold E. Bockelman, USDA-ARS, National Small Grains Collection
Aberdeen, ID
George A. White, USDA-ARS, Plant Introduction Office
Beltsville, MD

PI Number	Species	Cultivar	Origin	Donor/Acquisition
537116	sativa	HORICON	U.S., WI	R.A. Forsberg, WI AES
537436	sativa	82Ab1142	U.S., ID	D.M. Wesenberg, USDA-ARS
538332	sp.		Yemen	R.J. Metzger, USDA-ARS
538412	sativa	NY OAT COMP I	U.S., NY	N.F. Jensen, NY AES
538414	sativa	WALDERN	Canada, AB	S. Kibite, Ag Can
538523	sativa	NY OAT COMP I-VR	U.S., NY	N.F. Jensen, NY AES
538800	sp.		USSR	K.H. Asay, USDA-ARS
538801	fatua		USSR	K.H. Asay, USDA-ARS
539874	sativa	IL 86-6404	U.S., IL	F.L. Kolb, IL AES
539875	sativa	IL 86-5698	U.S., IL	F.L. Kolb, IL AES
539876	sativa	IL 86-5262	U.S., IL	F.L. Kolb, IL AES
539877	sativa	IL 86-4407	U.S., IL	F.L. Kolb, IL AES
539878	sativa	IL 86-4189	U.S., IL	F.L. Kolb, IL AES
539879	sativa	IL 86-1150	U.S., IL	F.L. Kolb, IL AES
539880	sativa	IL 85-1538	U.S., IL	F.L. Kolb, IL AES
542090-542091	fatua		Nepal	S. Crawford, Pan Am. Co.
542591	sativa	PENNCOMP 29	U.S., PA	H.G. Marshall, USDA-ARS
542592	sativa	PENNCOMP 30	U.S., PA	H.G. Marshall, USDA-ARS
542593	sativa	PENNCOMP 31	U.S., PA	H.G. Marshall, USDA-ARS
544347	sativa	GOODLAND	U.S., WI	H.L. Shands, WI AES
544355-545480	fatua		U.S./Mexico	L.W. Briggle, USDA-ARS
545481	hybrid		U.S.	L.W. Briggle, USDA-ARS
546034	sativa	WRIGHT	U.S., WI	H.L. Shands, WI AES
546035	sativa	DAL	U.S., WI	H.L. Shands, WI AES
546036	sativa	FROKER	U.S., WI	H.L. Shands, WI AES
546037	sativa	PORTAL	U.S., WI	H.L. Shands, WI AES
546467	sativa	DANE	U.S., WI	R.A. Forsberg, WI AES

Please note that new accessions may not be immediately available due to low seed inventory.

AVENA ACCESSIONS IN THE NATIONAL SMALL GRAINS COLLECTION

Harold E. Bockelman, USDA-ARS, National Small Grains Collection
Aberdeen, ID

Taxonomy	No. Accessions
Avena abyssinica	228
Avena barbata	762
Avena barbata var. wiestii	1
Avena brevis	17
Avena bromoides	2
Avena byzantina var. anopla	806
Avena eriantha	7
Avena fatua	1617
Avena hybrid	249
Avena hybrida	1
Avena longiglumis	12
Avena maroccana	2
Avena murphyi	1
Avena nuda	199
Avena sativa	3278
Avena sp.	8295
Avena sterilis	6926
Avena sterilis subsp. ludoviciana	2
Avena strigosa	74
Avena vaviloviana	44
(Avenula pubescens)	(2)
Total	22525

Please note that some accessions may not be available due to low seed inventory.

ELITE GERMPLASM FOR THE NATIONAL SMALL GRAINS COLLECTION

Harold E. Bockelman, USDA-ARS, National Small Grains Collection
Aberdeen, ID

Breeders are encouraged to submit their elite lines for inclusion in the National Small Grains Collection (NSGC). Of special interest are lines that have been in uniform nurseries, but are not to be released as cultivars. Historically, uniform nurseries been the testing-grounds for the most advanced, elite germplasm from the various public and private breeding programs. Entries in uniform nurseries and other breeding materials that are never released as cultivars are still of potential value to breeders, pathologists, entomologists, and other researchers.

Breeders should submit 500 g of untreated seed to the NSGC (address: P.O. Box 307, Aberdeen, ID 83210). Seed from outside of the United States should be sent to the USDA Plant Germplasm Quarantine Center (address: Bldg. 320, BARC-East, Beltsville, MD 20705) with enclosed forwarding directions. Include a description of the germplasm, including: donor (breeder, institition); botanical and common name; cultivar name and/or other identifiers (breeder line or selection number, etc.); pedigree; descriptive information (of important traits and special characteristics); and growth habit. The request is then forwarded to the Plant Introduction Office. Upon PI assignment the Plant Introduction Officer returns documentation (PI card) to the NSGC Curator and the originating breeder. The NSGC Curator forwards a backup sample of seed to the National Seed Storage Laboratory and places the remaining seed in the NSGC.

Assignment of a PI number and inclusion in the NSGC makes the germplasm available for research purposes to bona fide scientists in the U.S. and worldwide.

Please note that a different procedure applies if you are obtaining Crop Science registration (see Crop Sci. 28: 716. 1988).

UK OAT COLLECTION

M. J. Ambrose

John Innes Centre for Plant Science Research

The AFRC cereal collections for wheat, barley, and oats have been moved from the site of the old Plant Breeding Institute, Cambridge to a new purpose bulit seed store at the John Innes Centre for Plant Science Research in Norwich. Conditions inside the store are maintained at 1.5 C and 7% RH. The management of the main institute collections is under the charge of Mike Ambrose. A catalogue of the collections was published in 1989 and is available free of charge. Requests for catalogues and seed material should be addressed to:

Mr. M. J. Ambrose
John Innes Centre for Plant Science Research
Colney Lane
Norwich
NR4 7UH
UK

Tel: 0603 52571
FAX: 0603 56844

WILD AVENA GERMPLASM

Mike Leggett

AFRC, IGER, Welsh Plant Breeding Station

Work continues on the collections of wild oats made by the author, Gideon Ladizinsky, The Hebrew University of Jerusalem, Faculty of Agriculture, Rehovot, Israel, and Per Hagberg, Svalof Plant Breeders, Svalov, Sweden, during 1985, sponsored by the International Board for Plant Genetic Resources. First multiplications of the bulk of population samples collected have been carried out, together with the initial characterization of these collections.

New sites and areas of distribution have been identitfied for a number of taxa, including several new records for *Avena damascena*, which was previously recorded from a single collection site in Syria. It would appear that *A. damascena* occurs quite widely in Morocco, and has been found growing in association with other *Avena* species. Two populations of *A. prostrata* (previously known only from Spain) have also been recorded in Morocco. Interestingly, the habitat where *A. prostrata* grows in Morocco is quite different to the habitat in Spain where this species has been collected.

The morphological similarities of a number of wild oats makes the identification of species difficult particularly between *A. hirtula, A. barbata, A. damascena*, and *A. prostrata* and it is possible that other collections from Morocco contain these species but have been misidentified.

From the initial characterization data recorded, a number of accessions of *A. damascena, A. prostrata, A. murphyi*, and *A. sterilis* have been observed to have resistance/tolerance to powdery mildew, and investigations into the utilization of such resistances, particularly from *A. sterilis* are underway.

EVALUATION OF NATIONAL SMALL GRAINS COLLECTION GERMPLASM
PROGRESS REPORT - OAT

H.E. Bockelman, D.M. Wesenberg, L.W. Briggle and M.A. Bohning*

National Small Grains Germplasm Research Facility, Aberdeen, Idaho
National Germplasm Resources Laboratory, Beltsville, Maryland

Systematic evaluation of accessions in the USDA-ARS National Small Grains Collection (NSGC) was coordinated by National Small Grains Germplasm Research Facility staff at Aberdeen during 1990. Cooperative evaluations for resistance to Russian Wheat Aphid, Hessian fly, barley yellow dwarf virus, barley stripe mosaic virus, spot and net blotch of barley, stripe rust of wheat, and dwarf bunt continued along with cooperative evaluations of oat germplasm for beta-glucan, protein, and oil content and ploidy analysis of _Triticum_ species. In addition to the ongoing evaluation program, the Aberdeen staff has been involved in the entry of NSGC evaluation data into the Germplasm Resources Information Network (GRIN) system; growth habit evaluations of 10,000 NSGC wheat accessions; grow out and taxonomic evaluation of over 600 NSGC spring wheat accessions; field taxonomic classification of over 2,200 NSGC oat accessions; laboratory taxonomic classification of about 2,800 previously unclassified NSGC oat accessions in addition to a similar number of accessions reviewed the previous year; quarantine and field grow out of 893 new accessions of _Avena_ _sativa_ from a collection made in Turkey in 1986; initiation of cooperative evaluations of NSGC barley accessions and other elite germplasm for reaction to stem rust race QCC in North Dakota and Puerto Rico; initiation of cooperative evaluations of NSGC barley accessions and other elite germplasm for reaction to barley stripe rust race 24 in Bolivia under the direction of Colorado State University staff; and increase and evaluation of a spring wheat germplasm collection derived from a series of interspecific crosses completed by Mr. William J. Sando in the 1930s and previously last grown in the 1960s. Cooperative ploidy analysis of _Triticum_ species were conducted by Dr. Gordon Kimber and staff, Columbia, Missouri. Dr. Lee Briggle completed the documentation and organization of his _Avena_ _fatua_ collection and the material has now been assigned PI numbers and entered in the NSGC. Location funds were also used to partially support the evaluation of Pioneer Seed Company developed hard red winter wheat germplasm at Manhattan, Kansas. Specific Cooperative Agreements or within ARS Fund Transfers involving such cooperative evaluations and related research for all small grains currently involve over 20 University and ARS projects in at least 16 states.

Descriptors appropriate for each of the principal small grain crop species - wheat, barley, oats, and rice - have been established in collaboration with the appropriate Crop Advisory Committees. Data on field descriptors have been obtained on approximately 35,500 wheat accessions, 11,000 oat accessions, and 9,000 barley accessions during the 1983-90 period. Special nurseries were grown for that purpose at Aberdeen, Idaho and Maricopa, Arizona, with grain being harvested from each field evaluation nursery to replenish NSGC seed stocks. Field evaluation data are recorded on such descriptors as growth habit, number of days from planting to anthesis (heading), plant height, spike or panicle density, lodging, straw breakage, shattering, and awn and glume characteristics, including color. Spikes or panicles are collected from each evaluation or nursery plot at maturity to facilitate detailed laboratory analysis for seed characters and for more precise spike or panicle descriptors than can be obtained under field conditions. Yield data are also recorded for each accession.

Evaluations for disease and insect resistance were initiated in 1983 along with the agronomic evaluations. Accessions of <u>Avena</u> submitted for formal NSGC disease and insect evaluations to date include the following:

Barley Yellow Dwarf	1983-90	<u>Davis, CA</u> 8,400 oats
		<u>Urbana, IL</u> 10,000 oats
Crown Rust	1983-86	<u>Ames, IA</u> 11,250 oats
Smut	1989-90	<u>St. Paul, MN</u> 1,500 oats
Beta-Glucan, Protein, & Oil	1988-90	<u>Madison, WI</u> 2,800 NSGC oats

Similar cooperative evaluations and related research are underway involving wheat, barley, and rice accessions at Aberdeen and a number of other locations across the United States. Specific Cooperative Agreements or within ARS Fund Transfers involving such cooperative evaluations and related research for all small grains currently involve over 20 University and ARS projects in at least 16 states.

The nearly 900 <u>Avena</u> <u>sativa</u> accessions collected by Dr. R.A. Forsberg in Turkey in 1986 were grown in five-hill rows in the field at Aberdeen after an initial 1989-90 greenhouse seed increase at Aberdeen, Idaho. These accessions were evaluated in the field by Dr. Forsberg and the Aberdeen staff during the summer of 1990. Additional lines of <u>Avena sterilis</u> from the same Turkish collection were increased in the greenhouse at Maricopa, Arizona during the 1989-90 season. The <u>A</u>.

sterilis collection has been prepared for planting in the field at Aberdeen in 1991.

Over 3,000 oat samples have been submitted to the USDA-ARS Cereal Crops Research Unit, Madison, WI for cooperative evaluations of beta-glucan content, including nearly 2,800 recent origin NSGC oat accessions. Seven hundred additional NSGC oat accessions stand ready for submission to the Madison laboratory. In addition, over 2,200 NSGC oat accessions were grown in the field at Aberdeen in 1990, primarily for evaluation of beta-glucan, oil, and protein content and also for taxonomic and other descriptor classification.

In related efforts, the project statement entitled "Coordination and Conduct of National Oat Germplasm Enhancement" was completed in early July 1990 in cooperation with the Oat Crop Advisory Committee. Cooperative funding from this project is being put in place through Specific Cooperative Agreements or direct fund transfers.

Oat descriptors with data entered in the GRIN system are summarized below. Systematic evaluations for descriptors such as beta-glucan, oil, and protein content are currently underway, with data in the process of being prepared for entry into the GRIN system. No evaluations have been conducted to date for other descriptors such as awn type, panicles per row, groat percent, winterhardiness, covered smut, Helminthosporium avenae, leaf Septoria, stem Septoria, powdery mildew, stem rust, Green bug, and cereal leaf beetle.

Evaluation Data on the Germplasm Resources Information Network

AWN FREQUENCY — Visual estimation of awn frequency

Data on GRIN:

None (1)	3440
Few (2-4)	3326
Frequent (5-7)	970
Numerous (8-9)	593
Total	8329

BYDV — Reaction to Barley Yellow Dwarf Virus

Data on GRIN:

Resistant (1-3)	439
Intermediate (4-6)	1860
Susceptible (7-9)	5888
Total	8187

SPIKELETS PER PANICLE — Average number of spikelets per panicle based on five mature panicles

Data on GRIN:

15 or less	492
16 to 20	905
21 to 25	1126
26 to 30	1152
31 to 35	988
36 to 40	689
41 or more	1001
Total	6353

STRAW COLOR — Color of straw of healthy plants at maturity

Data on GRIN:

Brown	17
Purple	1
Tan	550
White/Amber	470
Yellow	5587
Total	6625

STRAW LODGING — Degree of straw lodging at maturity

Data on GRIN:

None (1)	1854
Little (2,3)	3738
Moderate (4-6)	1611
Most or all (7-9)	1185
Total	8388

YIELD — Weight of grain in grams in harvested 2-meter row

Data on GRIN:

150 or less	549
151 to 200	736
201 to 250	1033
251 to 300	1269
301 to 350	1198
351 to 400	835
401 or more	922
Total	6542

BUNDLE WEIGHT — Bundle weight (unthreshed, cut straw) in pounds per harvested plot

Data on GRIN:

1.00 or less	190
1.10 to 1.50	695
1.60 to 2.00	1092
2.10 or more	2099
Total	4076

CHROMOSOME NUMBER — Laboratory determination of chromosome counts

Data on GRIN:

42 chr.	4430
Total	4430

CROWN RUST — Reaction to Crown Rust incited by *Puccinia coronata*

Data on GRIN:

Isolate 264A: races 264B,326,Pc53,Pc52,220-3-1

Resistant (1-3)	126
Intermediate (4-6)	106
Susceptible (7-9)	10249
Total	10481

Isolate 264B: races 264B,326,Pc53,Pc52,220-3-1

Resistant (1-3)	431
Intermediate (4-6)	88
Susceptible (7-9)	9969
Total	10488

Isolate Pc59: races 264B,326,Pc53,Pc52,220-3-1

Resistant (1-3)	106
Intermediate (4-6)	8
Susceptible (7-9)	1713
Total	1827

Isolate 202: races 264B,326,Pc53,Pc52,220-3-1

Resistant (1-3)	68
Intermediate (4-6)	35
Susceptible (7-9)	1339
Total	1442

Isolate Multiple 3: races 264B,326,Pc52,Pc47,Pc53

Resistant (1-3)	65
Intermediate (4-6)	41
Susceptible (7-9)	4470
Total	4576

Isolate Multiple 4: races 264B,326,Pc47,Pc51,Pc61,Pc62

Resistant (1-3)	202
Intermediate (4-6)	103
Susceptible (7-9)	1669
Total	1974

Isolate Multiple 6: races 264B,326,Pc37,Pc53,Pc59

Resistant (1-3)	102
Intermediate (4-6)	25
Susceptible (7-9)	2323
Total	2450

Isolate Multiple 7: races 264B,326,Pc53,Pc52,220-3-1

Resistant (1-3)	105
Intermediate (4-6)	38
Susceptible (7-9)	2216
Total	2359

GROWTH HABIT — Growth habit

Data on GRIN:

Spring	2045
Winter	1010
Facultative	481
Mixed	19
Total	3555

HEADING DATE — Days after January 1 when 50% of the panicles have emerged from the boot

Data on GRIN:

170 or less	528
171 to 180	2401
181 to 190	2423
191 to 200	1747
201 to 210	1112
211 or more	189
Total	8400

HULL — Presence of absence of a hull covering the kernel

Data on GRIN:

Covered	6210
Hulless	197
Intermediate or Mix	162
Total	6569

KERNEL WEIGHT — Weight of 250 randomly selected kernels used to calculate 1000-kernel weight

Data on GRIN:

25 or less	1094
25.1 to 30	1789
30.1 to 35	1411
35.1 to 40	459
40.1 or more	62
Total	4815

LEMMA COLOR — Color of the lemma on healthy plants at maturity

Data on GRIN:

Black	211
Black and White	32
Black and Brown	23
Brown	219
Brown and White	35
Gray	342
Red	528
Tan	502
White/Amber	3628
Yellow	2504
Mixed	284
Total	8308

PANICLE DENSITY — Visual estimate of relative panicle density

Data on GRIN:

Lax (1-3)	2715
Medium (4-6)	5318
Dense (7-9)	231
Mixed	146
Total	8410

PANICLE LENGTH — Average length in cemtimeters of five mature panicles measured from the lowest panicle node to the tip of the apical spike

Data on GRIN:

10 or less	7
11 to 15	478
16 to 20	1950
21 to 25	1671
26 to 30	375
31 or more	35
Total	4516

PANICLE TYPE — Shape and characteristic of the mature panicle

Data on GRIN:

Equilateral	8082
Intermediate	81
Unilateral	189
Mixed	46
Total	8398

PLANT HEIGHT — Height in centimeters at maturity of plant from ground to top of panicle, excluding awns

Data in GRIN:

75 or less	894
76 to 100	3795
101 to 110	1590
111 to 120	1157
121 to 130	559
130 or more	301
Mixed	144
Total	8440

SEEDS PER SPIKELET — Number of kernels per spikelet

Data on GRIN:

Two	3947
Three	540
Mixed	28
Total	4515

SHATTERING — Degree of shattering of seed from the spike

Data on GRIN:

None (1)	383
Little (2,3)	1656
Moderate (4-6)	1276
Severe (7-9)	881
Total	4196

STRAW BREAKAGE — Degree of straw breakage at maturity

Data on GRIN:

None (1)	3967
Little (2,3)	1777
Moderate (4-6)	727
Most or all (7-9)	100
Total	6571

TEST WEIGHT — Test weight of grain in pounds/bushel

Data on GRIN:

30 or less	260
30 to 35	1096
35 to 40	3940
40 or more	1223
Total	6519

* The authors wish to acknowledge the important contributions of the NSGGRF staff in this effort, with special thanks to Glenda B. Rutger, A. Lee Urie, Santos Nieto, John F. Connett, Dave E. Burrup, Kay B. Calzada, Vicki Gamble, Evalyne McLean, Judy Bradley, and Dallas Western.

A LIST OF *AVENA STERILIS* ACCESSIONS CHOSEN TO REPRESENT ISOZYME VARIATION IN THE NATIONAL SMALL GRAINS COLLECTION

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In an attempt to gain a further understanding of the amount and patterns of genetic variation in the wild oat gene pool, a sample of 1005 accessions of *Avena sterilis* L. was chosen from the National Small Grains Collection. This sample represented the geographical range of the species. Starch gel electrophoresis and enzyme activity staining of 29 systems were used to obtain isozyme polymorphism data on all 1005 accessions. Genetic distance between all pairs of accessions was estimated using band absence/presence data. A dendrograph constructed from these distance measures revealed six putative genetic groups. Using this genetic group information, we identified 172 accessions which represent the range of diversity at the isozyme level found in the 1005 accessions. This "core" group contains all of the 183 distinct enzyme banding patterns found using the 29 enzyme systems. The following list contains the 172 accessions with country of origin and genetic group for each accession. Further details of the procedures used to obtain this information and discussion of results will be available from publications in preparation.

These 172 accessions are serving as donor parents in a backcross program, the goal of which is to produce a broad-based breeding population containing approximately 87.5% cultivated and 12.5% *A. sterilis* germplasm.

Accessions of *Avena sterilis* L. representing the range of isozyme variation found in a sample of 1005 accessions from the NSG collection with country of origin and genetic group

Acc.	Country of origin	Genetic group
CI 9095	Italy	1
PI 220373	Afghanistan	5
324733	Italy	4
324743	Sicily	1
324747	Sicily	4
324758	Sardinia	4
324763	Sardinia	2
324777	Libya	4
324783	Libya	3
324789	Libya	4
367468	Spain	2
367484	Spain	4
367505	Spain	1
367529	Spain	1
367535	Spain	4
367540	Spain	2
367588	Spain	1
367624	Spain	2
PI 367629	Spain	1
367658	Spain	4
367666	Portugal	1
379751	Israel	2
379902	Israel	1
379944	Israel	2
379981	Israel	1
379990	Israel	2
380010	Israel	2
380075	Israel	1
380133	Israel	1
380148	Israel	2
380187	Israel	2
380227	Israel	4
380238	Israel	6
380305	Israel	6
380338	Israel	2
380435	Israel	3

Acc.	Country of origin	Genetic group
388829	Italy	1
393572	Morocco	1
393578	Morocco	1
393599	Morocco	1
393615	Morocco	2
393619	Morocco	1
393628	Morocco	4
411523	Algeria	1
411524	Algeria	3
411525	Algeria	1
411526	Algeria	2
411544	Algeria	2
411553	Algeria	1
411559	Algeria	1
411562	Ethiopia	5
411578	Ethiopia	1
411595	Ethiopia	1
411603	Ethiopia	1
411619	Ethiopia	6
411654	Ethiopia	1
411662	Ethiopia	4
411667	Greece	4
411680	Iran	1
411687	Iran	3
411706	Iran	5
411727	Iran	5
411743	Iran	5
411744	Iran	5
411766	Iran	5
411788	Iran	6
411831	Iran	3
411855	Iran	5
411856	Iran	5
411862	Iran	5
411868	Iran	5
411905	Iran	3
411913	Iran	5
411915	Iran	3
411936	Iran	6
411968	Iran	5
411972	Iraq	5
411982	Iraq	5
411983	Iraq	6
411988	Iraq	6
411990	Iraq	1
411997	Iraq	3
411998	Iraq	3
412006	Iraq	3
412009	Iraq	5
412010	Iraq	3
412017	Iraq	1
412021	Iraq	5
412026	Iraq	3
412028	Iraq	3
412031	Iraq	3
412033	Iraq	1
412060	Israel	4
412065	Israel	3
412088	Israel	2
412108	Israel	1
412129	Israel	1
412131	Israel	4
412144	Israel	4
412176	Israel	4
412200	Kenya	6
412208	Lebanon	3
412211	Lebanon	1
412215	Lebanon	2
412218	Lebanon	3
412221	Lebanon	2
412222	Lebanon	4
412231	Lebanon	6
412245	Lebanon	6
412246	Morocco	4
412248	Morocco	4
412252	Morocco	1
412264	Morocco	1
412266	Morocco	1
412275	Morocco	2
412292	Morocco	6
412295	Morocco	1
412296	Morocco	6
412297	Morocco	2
412298	Morocco	6
412302	Morocco	2
412305	Morocco	6
412306	Morocco	2
412308	Morocco	6
412322	Syria	2
412324	Syria	3
412325	Syria	4
412327	Syria	1
412333	Syria	6
412336	Syria	6
412340	Tunisia	1
412360	Tunisia	1
412363	Tunisia	3
412364	Tunisia	1
412367	Tunisia	2
412380	Tunisia	2
412386	Tunisia	2
412390	Tunisia	4

Acc.	Country of origin	Genetic group	Acc.	Country of origin	Genetic group
412426	Turkey	5	412578	Turkey	4
412433	Turkey	5	412598	Turkey	6
412442	Turkey	4	412604	Turkey	3
412475	Turkey	6	412608	Turkey	6
412485	Turkey	3	412609	Turkey	6
412494	Turkey	5	412616	Turkey	4
412498	Turkey	4	412624	Turkey	5
412516	Turkey	3	412628	Turkey	5
412523	Turkey	6	412636	Turkey	6
412534	Turkey	6	412639	Turkey	6
412539	Turkey	2	412657	Turkey	4
412541	Turkey	4	412665	Turkey	6
412543	Turkey	5	412680	Turkey	3
412558	Turkey	1	412690	Turkey	1
412565	Turkey	5	412706	Turkey	1
412570	Turkey	5	412708	Turkey	6
412576	Turkey	3	412712	Turkey	6

EVALUATION OF SOME OAT STRAINS AT ZAGREB, YUGOSLAVIA

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Five experimental lines from Yugoslavia and (Table 1) two American selections from the 1985 International Oat Rust Nursery were compared with the standard cultivars Flamingsnova, Flamingsregent, and Leanda in trials conducted during 1989 and 1990.

Table 1. Pedigrees of Yugoslav experimental lines

Designation	Pedisree
Bc-Z-183	'Cabana'/'Condor'
Bc-Z-344	'Ballad'/Flamingsnova
Bc-Z-345	'Ballad'/Flamingsnova
Bc-Z-8002	'Rollo'/ZG-5
Bc-Z-8004	Cabana/ZG-i

Seed for these trials was processed over screens with 2.25 x 20 mm openings and treated with Benit universal 4.75 DS treating agent. The previous crop was *Raphanus sativus* plowed under as a green manure. The experimental design was a randomized block with five replications. Plot size was 5 m^2 and plots consisted of 6 rows 16.7 cm apart. Seeding rate was 550 viable kernels/m^2. Seeding and pest control were done at appropriate times (Table 2).

Table 2. Cultural practices used in the trials.

	Year	
Treatment	1989	1990
Seeding date	02.20.1989	02.20.1990
Date of emergence	03.12.1989	03.13.1990
Date of harvest	07.25.1989	07.21.1990
Fertilizer: N	90 kg/ha	135 kg/ha
P205	105 kg/ha	135 kg/ha
k20	70 kg/ha	130 kg/ha
Herbicide	Lontrel 418c	Oxitril M
Insecticide:	1. Lebaycid	1. Decis EC 250
	2. Ekalux	2. Decis EC 250
	3. Ekalux	
Fungicide		Folicur

Of the diseases present, barley yellow dwarf virus caused the greatest amount of injury under the 1989 and 1990 growing conditions while crown rust and powdery mildew were sporadic in occurrence.

Grain yield, test weight, 100 kernel weight, days to 50% heading, plant height, lodging, and groat content were evaluated in the trials for the two years (Tables 3 and 4).

Table 3. Origin, grain yield, test weight and 1000 kernel weight of oat strains for 1989 and 1990.

No.	Cultivar	Origin	Grain yield (gk/ha)			Test weight (kg/hl)			100 kernel weight		
			1989	1990	X	1989	1990	X	1989	1990	X
1.	Flamingsregent	Germany	8242	6712	7476	48.4	51.6	50.0	31.3	27.0	1
2.	Bc-Z-344	Yugoslavia	7346	6832	7088	47.0	50.3	48.6	29.7	33.5	6
3.	Leanda	Netherlands	7244	6296	6770	46.9	52.3	49.6	28.8	30.0	4
4.	Bc-Z-8004	Yugoslavia	7522	5936	6744	47.0	53.2	50.1	30.6	33.5	0
5.	Bc-Z-183	Yugoslavia	7211	6212	6710	50.1	53.3	51.7	32.3	34.5	4
6.	Bc-Z-8002	Yugoslavia	7816	5488	6652	48.2	54.2	51.2	32.2	34.5	3
7.	ND-820603	United States	7552	5668	6610	51.0	53.5	52.2	34.8	35.0	9
8.	Flamingsnova	Germany	7464	5664	6564	48.5	53.3	50.9	27.3	29.0	1
9.	Bc-Z-345	Yugoslavia	6721	5652	6186	42.2	49.6	45.9	25.3	31.2	2
10.	ND-78385	United States	6972	5116	6044	48.1	51.0	49.5	35.6	37.0	3
	X		7411	5957	6684	47.7	52.2	49.9	30.8	32.5	6

LSD variety	5% =	680
	1% =	904
LSD year	5% =	309
	1% =	409
LSD variety/year		
	5% =	240
	1% =	319

Table 4. Length of vegetation, height, lodging and groat content of oat strains for 1989 and 1990.

No.	Cultivar	Days to 50% heading			Height of stalk cm			Lodging (%)			Groat content		
		1989	1989	X	1989	1990	X	1989	1990	X	1989	1990	X
1.	Flamingsregent	79	78	79	101	94	97	80	19	49	78.8	72.6	75.7
2.	Bc-Z-344	77	77	77	99	91	95	40	45	43	70.0	69.8	69.9
3.	Leanda	84	83	84	114	108	111	54	7	30	70.8	69.9	70.3
4.	Bc-Z-8004	80	79	80	112	106	109	40	1	20	70.6	71.8	71.2
5.	Bc-Z-183	79	78	79	114	107	110	78	7	42	72.3	72.1	72.2
6.	Bc-Z-8002	79	78	79	110	112	111	60	12	36	75.3	70.2	72.7
7.	ND-820603	78	76	77	111	100	106	12	2	6	72.2	70.5	71.3
8.	Flamingsnova	77	75	76	104	100	104	67	82	75	72.5	74.8	73.6
9.	Bc-Z-345	81	79	80	105	103	104	57	11	34	72.3	71.0	71.6
10.	ND-78385	79	78	79	115	108	111	49	1	25	73.9	70.0	71.9
	X	79	78	79	108	103	106	54	19	36	72.9	71.3	72.1

EVALUATION OF OAT GERMPLASM FOR DIFFERENT PLANT TRAITS

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Regular inflow of new genetic variability is a basic requirement for plant improvement. The present study was undertaken to evaluate one hundred exotic accessions obtained from Brazil. The material was evaluated in unreplicated single row plots, 3 m long, during the winter season of 1989-90, under irrigated conditions, and with normal fertilizer application at the Central Research Farm of the Indian Grassland and Fodder Research Institute, Jhansi (78^{o} E longitude, 25^{o} N latitude.

The crop season began with moderate cool temperatures, but a long dry period prevailed from November to January. However, normal plant development occurred after receiving adequate precipitation during February.

Data of nine morphological and metric traits viz., growth habit, leaf type, plant height, number of leaves/tiller, leaf length, leaf width, panicle length, days to 50% flowering, and number of spikelets/panicle were recorded. The accessions were grouped into different classes with respect to all characters. The accessions exhibited considerable range in variation for all measured traits (Table 1). Of the traits evaluated, the maximum range in variation was observed for number of spikelets/panicle followed by plant height.

Unimodal frequency distributions were observed for all traits except for the bimodal distribution exhibited for days to 50% heading. Most genotypes produced intermediate values for plant height, leaf length and width, panicle length, and number of spikelets. Identification of genotypes with high leaf number and tall stature combined with short/long flowering duration (UPF-81360, UPF-77s352, UPF-2, UPF-79B381-1, UPF-77S066, UPF-77S077, and UFRGS-13) suggested possible utilization of these genotypes in breeding programs leading to the development of forage types suitable for different cropping situations. Availability of genotypes with short and medium stature, but with a high number of spikelets per panicle, suggested their use in breeding oats for grain production.

Most accessions were free from symptoms when evaluated for reaction to plant diseases under field conditions. However, some exhibited susceptible reactions for bacterial leaf blight and fungal leaf spot. The future usefulness of such genotypes should be determined after judging their reactions under epiphytotic conditions.

CHARACTERISTICS OF *Avena sativa* X *A. moroccana* IN C_6 AMPHIPLOID PROGENIES

R. N. Choubey and S. N. Zadoo
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Wild oat species are a source of desirable characteristics for introgression into cultivated varieties. Three genotypes of *Avena sativa*, OS-6, UPO-94, and JHO-801, were used as female parents in crosses with *A. maroccana*. The resulting sterile F_1 were treated with colchicine to produce fertile amphiploids. Subsequent generations were studied for chromosomal and plant attributes (Oat Newsletter 40:28). The chromosome status and variability in five metric traits and five morphological attributes in the C_6 generation are discussed in this report.

Considerable variation, particularly in plant height, leaf length, and number of spikelets, was observed in the progeny of UPO-94/*A. maroccana* (Table 1). This C_6 population had a greater range of variation for plant height than populations derived from JHO-801 and OS-6. Most of the lines were taller than 100 cm. All traits exhibited a unimodal frequency distribution, except for leaf number that exhibited an incomplete unimodal distribution.

A high degree of variation for all traits was observed among 98 progeny of JHO-801/*A. maroccana*. The range of variation and the mean values for leaves/tiller and spikelets/panicle was greater in progeny derived from JHO-801 than from other parents. The frequency distribution was unimodal for all characteristics measured in this population.

Only 11 lines were obtained from the OS-6/*A. maroccana* cross, and a narrow range in variation of the traits measured was observed. These lines were taller and produced more leaves/tiller than those from other crosses. Most characters exhibited unimodal distribution.

Considerable variation in growth habit, number and type of awns, lemma hairiness and color, and pattern of spikelet separation was observed among lines from all cross combinations (Table 1). Many segregants with desired combinations of these traits may prove useful in deriving elite plant types.

Most of the lines derived from UPO-94/*A. maroccana* and JHO-801/*A. maroccana*, examined cytologically at the C_6 level had euploid chromosomal constitutions. However, lines derived from crosses involving OS-6 tended to revert to the hexaploid chromosome number more frequently than lines from UPO-94 followed by JHO-801.

Extensive variation of morphological traits was observed among the progeny of three different *A. sativa/A. maroccana* cross combinations. The segregants with variable combinations of characters suggest introgression was occurring at the species level. Exploitation of these introgressed populations may be useful for deriving elite genotypes that combine desirable traits for use in oat breeding programs.

Table 1. Frequency distribution of different characters of oat accessions.

Characters	Number of accessions in different class intervals 1	2	3	4	5	6	7	8	9	Range (Mean)
1. Growth habit	Erect (90)	Semi-erect (10)	-	-	-	-	-	-	-	
2. Leaf type	Droopy (72)	Semi-droopy (17)	Erect (11)	-	-	-	-	-	-	
3. Plant height (cm)	60-79 (5)	80.99 (23)	100-119 (51)	120-139 (14)	140-159 (6)	160-179 (1)	-	-	-	65-163 (108.4)
4. No. of leaves per tiller	5 (28)	6 (34)	7 (24)	8 (8)	9 (5)	10 (1)	-	-	-	5-10 (6.3)
5. Leaf length (cm)	20-29 (13)	30.39 (33)	40-49 (28)	50-59 (13)	60-69 (3)	-	-	-	-	22-65 (38.8)
6. Leaf width (cm)	1.0-1.5 (5)	1.6-2.1 (29)	2.2-2.7 (38)	2.8-3.3 (23)	3.4-3.9 (5)	-	-	-	-	1.2-3.8 (2.43)
7. Days to 50% heading	81-90 (18)	91-100 (19)	101-110 (29)	111-120 (15)	121-130 (4)	131-140 (13)	141-150 (2)	-	-	81-143 (106.1)
8. Panicle length (cm)	20-24 (11)	25-29 (29)	30-34 (31)	35-39 (21)	40-44 (5)	45-49 (1)	50-54 (2)	-	-	20-51 (31.3)
9. No. of spikelets per panicle	40-59 (20)	60-79 (28)	80-89 (24)	100-119 (10)	120-139 (10)	140-159 (5)	160-179 (1)	180-199 (1)	200-219 (1)	40-216 (89.5)

UTILIZATION OF *Avena maroccana* AS A GENE SOURCE FOR OAT BREEDING

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Beginning in 1985, the Institute of Plant Breeding Research, Quedlinburg, GDR initiated research to use the wild tetraploid oat species *Avena maroccana* Gdgr. (syn. *A. magna*) that has very high crude protein content in the caryopsis and high thousand kernel weight, for improving these characters in commercial oats. Isolation barriers between the two species (reduced crossability, hybrid sterility, and predominantly allosyndetic chromosome pairing in the F_1) had to be overcome to obtain a favorable interspecific transfer of characters from *A. marocanna* to *A. sativa*.

Of the various methods used to bridge the isolation barriers, the introduction of allohexaploid bridging forms ($A_{2x}A_{2x}A_mA_mC_mC_m$) appeared to be the most successful relative to the frequency of interspecific recombinants produced. The most useful parental diploid species for development of these bridging forms proved to be *A. longiglumis* Dur., *A. strigosa* Schreb, and *A. brevis* Roth..

The occurrence of desired recombinants was first observed in the F_4 and appeared more frequently in later generations (up to F_9/F_{10}). Manifestation of these recombinants proved to be dependent on the genotype of the allohexaploid bridging forms as well as the genotype of the recipient cultivars. Recombinants have been selected that are phenotypically similar to the recipient cultivars relative to important morphological characteristics. After initial problems in early generations, lines with adequate lodging resistance have been selected. Transgressive segregation for plant height and maturity was observed in the progeny.

Grain yield potential and physical grain quality equal to recurrent parent was obtained in some lines. Up to a 2% increase in grain crude protein content was achieved without reducing grain yield relative to the recipient variety. Greater increases in grain crude protein content were accompanied by reduction in grain yield. Generally, desirable recombinants could be selected after two backcrosses.

These recombinants have been used for several years by oat breeders in the GDR and breeders handle the recombinant lines using conventional breeding methods. In 1989, 153 F_3 to F_4 populations in the Petkus breeding program were derived from crosses with *maroccana/sativa* recombinants.

<u>1989 *magna/sativa* recombinant oat yield nursery (one location trial)</u>

	Genotype				
Trait	Alfred	No. 986	No. 987	LSD	CV
GY	4490	3834	4001	207.8	4.684
1000 GW	36.9	34.2	32.0	-	-
HP	13.9	31.6	28.9	-	-
GPP	13.6	15.7	14.9	0.549	2.418
GPY	525	518	512	34.3	5.801

GY grain yield kg/ha
1000 GW 1000 grain weight g
HP hull percentage %
GPP grain protein percentage %
GPY grain protein yield kg/ha

PROPOSED NOMENCLATURE FOR OAT RFLP PROBES AND LOCI

The proposed nomenclature is an attempt to develop the simplest, most efficient method of labelling RFLP probes and loci to be used universally by oat scientists. The goal is to keep the nomenclature simple while conveying the essential information. After consultation with several oat scientists, we now suggest the following:

1. The probe should be identified by a three-letter designator for the institute and a clone number:

   e.g. UMN12 where UMN designates the University of Minnesota and 12 designates the 12th useful probe isolated at that institution. If more than one lab at an institution is identifying probes, they are responsible for appropriate numbering.

2. The locus is identified by an X followed by the probe designator plus a, b, c, etc. denoting the fragment (e.g. Xumn12a would be the first locus mapped with this probe). The fragment designator will be replaced with the chromosome number when known (e.g. Xumn12-6A).

3. A database should be developed containing all the available items listed in the Database Information section below.

DATABASE INFORMATION

1. Probe designation cross referenced with any previous name (e.g. UMN12 (pTA71)).
2. Originator (investigator's name, telephone or FAX number and date).
3. Type of library (e.g. cDNA or genomic), source species and tissue used in library construction (e.g. *A. sativa* endosperm).
4. Vector, insert size and release sites or RAPDs (e.g. pBR322, 1.3 kb, *PstI*).
5. Copy number (e.g. single copy=1-3, low=4-10, medium=11-100 and high >100).
6. Species or cultivar, restriction endonucleases used to detect the variation, and size of the significant fragments. Up to 10 entries allowed. (e.g. Kanota EcoR1 0.8, 1.7, 3.0 kb.)
7. Parent(s), generation/cytogenetic stock, (F_2, F_6, etc. or mono, nulli, etc.), restriction endonuclease used and fragment(s) mapped. Up to 6 entries allowed. (e.g. Kanota Mono EcoRI 0.8, 1.7, 1.3 kb and/or (Kanota x Ogle) F_6 EcoRV 1.4, 1.8 kb).
8. Chromosome or locus assignment. (e.g. chromosomes 6A, 6C, 6D, and/or Locus Xumn17b).
9. Sequence data for RAPDs or primers, if available (5'-30 spaces allowed, 3'-30 spaces allowed).
10. Comments (references, further sequence and/or mapping information)

Submitted by S.F. Kianian, R.L. Phillips, L. Szabo and H.W. Rines

THE OAT GENOME PROJECT AT IOWA STATE UNIVERSITY

Michael Lee and P. John Rayapati

The objectives of the oat genome project are: to construct an RFLP linkage map for diploid oat species representing the A genome; to identify genetic linkages between RFLP loci and loci for resistance to crown rust (*Puccinia coronata*); and to investigate the genetic basis of traits important to oat breeding programs.

Three A genome diploid species (*Avena strigosa*, *A. wiestii*, and *A. nudibrevis*) have been screened for resistance to 35 races of crown rust. *Avena strigosa* was found to be resistant to almost all races. However, *Avena wiestii* and *A. nudibrevis* were susceptible to almost all races.

The following crosses were made: *strigosa* x *wiestii* and *strigosa* x *nudibrevis*. F_2 progeny were obtained and F_3 families are being produced. Progeny from the two crosses are being used to generate an RFLP linkage map and to identify DNA markers linked to resistance loci. Because *nudidrevis* is hull-less, we expect to find DNA markers for hull-lessness as well. Markers linked to quantitative trait loci for morphological traits can be studied in these populations.

The source of DNA probes is a cDNA library of genes expressed in roots of etiolated seedlings. The restriction enzyme used to generate RFLPs is *Hind*III.

Cross	*strigosa* x *wiestii*	*strigosa* x *nudibrevis*
# probes screened	344	80
# moderately repetitive	72	11
# low copy monomorphic	43	16
# low copy polymorphic	63	13

Near isogenic lines (NIL) of varieties are used to introgress specific loci from a donor parent into a productive and adapted recurrent parent. The multiline "Webster" is a combination of 9 NILs of a cultivated oat variety (Lang). Each NIL carries a unique gene for crown rust resistance. Eight of the nine NILs received its unique resistance from an accession of *Avena sterilis*. Previous work shows that significant DNA polymorphism exists between *Avena sativa* and *A. sterilis*. Therefore, we will attempt to find RFLP markers that identify DNA that has been introgressed from *sterilis* into *sativa*. Some of these markers should be linked to the resistance genes of interest.

AGRONOMY OF OATS IN MANITOBA - 1990

P.D. Brown, S. Haber, J. Chong, D.E. Harder and P. Thomas

In 1990, the growing conditions saw a return to near normal after two years of yield and grain quality reductions due to drought. Spring sowing occurred in late April to mid May. Although the soil was in a moisture deficit position at seeding, useful weekly rains promoted germination and plant growth from mid May to mid July. Seasonably warm temperatures during this time period encouraged tillering. In mid July, temperatures increased; there has been no significant rain since then. The good yields realized by producers were based on the adequate moisture that the plants received in the early part of the growing season. Grain quality was fair with no weathering but also reduced filling. In most of Manitoba, soil moisture levels after harvest were extremely low.

The area planted to oats in western Canada and Manitoba was down by 15% in 1990. In Manitoba, 200 000 ha of oats were planted. The major varieties grown in Manitoba along with the area each occupied were Dumont (48%), Riel (24%), Fidler (22%) and Robert (5%). Farmer acceptance of Riel and Robert is increasing; this may be due to the higher protein content of these two varieties.

In 1990, the most serious economic virus disease problem in oats in Manitoba was aphid-borne barley yellow dwarf (BYD). Losses due to BYD occurred almost only in late-seeded crops. Unusually heavy aphid showers in mid-July resulted in disease losses as high as 80% in late seeded crops at some sites in the Red River valley and south-central Manitoba. Serological and transmission tests identified approximately 90% of 1990 Manitoba BYDV isolates as 'PAV-like' in that they were most efficiently transmitted by the oat bird-cherry aphid but also transmitted by the English grain aphid. The English grain aphid, as in previous years was the most commonly observed vector cereal aphid, and was the predominant aphid in the mid-July aphid showers.

Oat stem rust and crown rust were first seen on susceptible wild oats in Manitoba in mid July. After initially favorable conditions for rust development, the weather turned hot and dry, and infections throughout the growing season remained light. Race NA27 remained the predominant stem rust race in the prairie rust area. In the past several years crown rust has not been observed in commercial fields of Dumont, Riel and Robert because these cultivars possess crown rust resistance genes Pc38 and 39. In 1990, crown rust severities of 5-10% were seen in commercial fields, indicating the presence of isolates that can attack the Pc38, 39 resistance combination. Results of virulence studies of field collections indicated that 43% of the isolates were virulent on both Pc38 and Pc39. A backcross breeding program to add Pc68 to Dumont and Robert is underway; this pyramiding of resistance genes should give additional protection.

The 1990 oat smut survey indicated that there was no loose or covered smut on oats in Manitoba. All oat varieties currently grown in Manitoba are smut resistant.

CHANGE IN PERSONNEL

Dr. J.J. Nielsen, the oat smut pathologist at the Winnipeg Research Station since 1963 is in the process of retiring and has been working part time to complete and summarize his research of the last few years.

Dr. Percy Thomas, who has had responsibility for barley smut research will now also assume Jens Nielsen's responsibilities for oat and wheat smuts.

OAT IN SASKATCHEWAN 1990

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Despite an expected reduction in acreage from the very high 1.5 million acres in 1989, the 1990 acreage of 1.25 million was still a strong indication that the oat crop remains a significant factor in the cropping system in Saskatchewan. For the first time in several years drought during the growing season was not a factor, with many record high yields reported by producers. Unfortunately, there has been no effective precipitation across the province since mid-July 1990 and prospects for 1991 are indeed bleak. It is in fact drier as of 1/2/91 than it has ever been before and there is no reserve soil moisture. Also of note is the fact that the "drought" area is considerably larger than was the case during the disaster of 1989. Due to the unseasonably dry harvest period oat quality was excellent in 1990 and good supplies of heavy, plump, white oat are available for all segments of the market.

The Crop Development Centre variety Calibre, released in 1983 continues to dominate the variety scene. In 1990 Calibre was grown on some 630,000 acres or >50% of the provincial oat acreage, up slightly from the 1989 figure of 48% . On a western Canada basis Calibre continued to be # 1, being planted on some 1.2 million acres or 33% of the total. It now out-distances its nearest competitor Cascade by nearly 8%, up from only a 2% difference in 1989. Calibre's increasing popularity, due to its demand in the high-quality marketplace, is demonstrated by its increased popularity in Alberta in 1990 versus 1989, 30% versus 24% of the seeded acreage.

Our newer release, Derby, registered in 1988, was grown on some 8,000 acres as Pedigreed Seed in 1990. As 1990 was a good crop year significant quantities of high quality seed were produced and will be available to commercial growers in 1991. It is anticipated that Derby's combination of yield potential, high test weight, low % hull and better grain plumpness than Calibre will lead to its wide acceptance by producers over the next few years.

We wish to acknowledge the financial support of the Quaker Oats Co. of Canada and Robin Hood Multifoods Ltd. for our oat research and variety development activities.

OAT BREEDING IN EASTERN GERMANY

Kurt Muller

Saatzucht Petkus GmbH

Between 160,000 and 180,000 ha of oats have been grown in the eastern part of Germany, even though oats is not the most important cereal crop in this region. The oat grain is used primarily for animal feeding and only 10% is used in human nutrition. Three stations (Petkus, Salzmünde and Granskevitz) participated in a common oat breeding program financed until 1990 by the state. Now the three stations will operate as private enterprises.

Cultivars released during recent years by these three stations (Table 1) were developed from different crosses between *Avena sativa* genotypes. 'Samantra' originated from a crosse between a chemically induced mutant and a Petkus strain, while the other husked cultivars originated in a national and international crossing program involving the three East German breeding stations together with Czech and Polish oat breeders. Material in this program includes high protein lines and one line resistant to powdery mildew.

Table 1. Oat cultivars recently released in eastern Germany

Cultivar	Year of Release	Breeding Station	Important characteristics
Samantra	1982	(Petkus)	middle early ripening, suited for light soils
Sanova	1986	(Salzmünde)	excellent lodging resistance small grained, low husk percent
Salvador	1987	(Salzmünde)	good lodging resistance, suitable for better soils
Magda	1988	(Salzmünde)	naked oats for producing oat flakes
Gramena	1989	(Granskevitz)	high yielding, low husk percent
Alf	1990	(Petkus)	
Salomon	1991	(Salzmünde)	naked oats, improved low percent of husked caryopses

The Petkus and Salsmunde Breeding Stations, and the Quedlinburg Breeding Research Institute (also in East Germany) are involved in crossing and selection programs between *A. sativa* and *A. magna* and between *A. sativa* and *A. pilosa* respectively. The progress in naked oat development is due to efforts at the Salzmunde Breeding station in cooperation with the Czech oat breeding program at the Krukanice Breeding Station.

Currently, in the united Germany, a new cereal breeding situation has developed relative to both financial support and market conditions for oats. It is not yet clear to what extent oat breeding work in East Germany will continue in the future.

DEVELOPMENT OF OAT CULTIVATION IN FINLAND

Marketta Saastamoinen

Oats have traditionally been the most cultivated cereal crop in Finland. During the period 1970-80 barley became the most cultivated cereal crop, and the cultivation of oats decreased.

The total yields of oats and yields per hectare have increased gradually (Table 1). During the last ten years, however, there have been great differences between years in both total oat yield and in yields per hectare (Table 1). There have been three poor years, namely 1981, 1987 and 1988; 1981 was rainy and quite cold, 1987 was rather rainy and very cold, and 1988 was dry and exceptionally warm. The 1984 season was also rainy but rather warm, and yields from that year were quite normal. The highest yields have been obtained in the last two years, 1989 and 1990.

The oat varieties cultivated in Finland during the last 25 years are listed in Table 2. Many Swedish varieties have been cultivated in Finland. Pendek, a Dutch oat variety, has been one of the predominant varieties since the beginning of the period, having a cultivation area of 3% as late as 1988. In 1965 three varieties had rather large cultivation areas, namely Pendek, 'Kyro' and 'Sisu'. Five years later, the cultivation area of Kyro and Sisu decreased and the Finnish variety Hannes and the Swedish variety Titus took their place. Titus has been one of the dominant varieties up to 1985 and is known for its earliness and good quality. In 1976 the most cultivated variety was the Finnish variety Ryhti, which was put on the market in 1970. Ryhti had much better lodging resistance than the older varieties. Three years later, the four dominating varieties were Titus, Ryhti, a new high yielding variety, Puhti, and a new early, lodging resistant variety, Nasta. In 1985, Veli took the place of the most cultivated variety due to its rather high yielding capacity and earliness. Veli has been the most cultivated variety for the last five years.

The cultivation area of Finnish varieties has increased during the last 25 years.

Table 1. Development of total oat yields and in yields per hectare in Finland.

Year	Total yield milj. kg	Yield/ha 100 kg
1921-25	501.2	11.7
1926-30	587.2	13.2
1931-35	672.0	14.5
1936-40	703.7	15.5
1941-45	430.0	12.3
1946-50	566.6	14.5
1951-55	769.2	16.4
1956-60	792.2	17.5
1961-65	827.8	17.9
1966-70	1070.4	22.0
1971-75	1280.3	23.8
1976-80	1243.3	26.7
1980	1258.3	28.1
1981	1007.5	23.2
1982	1319.0	28.7
1983	1406.5	31.3
1984	1320.9	31.6
1985	1217.8	29.6
1986	1174.5	29.1
1987	723.2	19.7
1988	857.3	22.1
1989	1443.8	32.3
1990	1661.9	36.7

Table 2. Cultivation of different oat varieties as percentage values of total oat cultivation area in Finland in 1965-88.

Variety	Breeder/ country	1965	1970	1976	1979	1982	1985	1988
Pendek	CB/NLD	22.6	21.9	14.3	5.5	6.1	2.5	3.4
Kyro	Hja/SF	19.6	7.5	1.5	0.2	0.2	-	-
Sisu	Hja/SF	14.4	9.7	2.0	0.6	0.3	-	-
Sol II	Sv/S	7.1	4.8	0.7	0.5	0.1	-	-
Eho	Hja/SF	8.3	2.6	0.2	0.1	0.1	-	-
Tammi	Hja/SF	6.2	0.8	0.1	0.0	0.1	-	-
Blenda	Sv/S	5.2	2.3	0.2	0.1	-	-	-
Nip	Sv/S	3.0	2.1	0.3	0.1	0.2	-	-
Orion III, II	Sv/S	2.0	0.4	0.2	0.3	-	-	-
Blixt	Sv/S	1.4	0.7	0.1	-	-	-	-
Marne	Hiljkema/NLD	1.1	0.2	-	-	-	-	-
Hannes	Hja/SF	3.7	26.6	10.9	5.0	1.4	0.5	0.3
Guldregn II	Sv/S	1.0	0.4	0.1	-	-	-	-
Juha	Jo/SF	0.2	0.1	-	-	-	-	-
Sorbo	Sv/S	-	2.1	0.6	0.5	0.3	-	-
Rhyti	Jo/SF	-	0.3	36.7	39.6	23.8	11.7	10.8
Titus	Sv/S	-	14.2	20.4	28.5	23.9	12.8	9.7
Hankkija-773	Hja/SF	-	-	3.5	3.6	0.7	0.2	0.2
Risto	Sv/S	-	-	5.1	3.6	1.5	0.8	0.2
Reima	Jo/SF	-	-	1.1	1.5	0.2	-	-
Hankkija's Valko	Hja/SF	-	-	-	4.8	4.4	1.4	0.5
Puhti	Jo/SF	-	-	-	2.4	23.0	22.2	17.7
Guldregn I	Sv/S	-	-	-	-	0.1	-	-
Kalott	Sv/SF	-	-	-	-	0.1	0.2	0.1
Nasta	Jo/SF	-	-	-	-	11.5	9.9	3.3
Veli	Jo/SF	-	-	-	-	0.6	27.3	38.8
Svea	Sv/SF	-	-	-	-	0.3	1.1	2.8
Hankkija/s Vouti	Hja/SF	-	-	-	-	-	5.0	4.5
Pol	SFV/N	-	-	-	-	-	0.2	0.1
Karhu (=Stil)	Sv/S	-	-	-	-	-	-	1.8
Virma	Hja/SF	-	-	-	-	-	-	0.8
Other varieties %		3.4	3.3	1.8	2.6	1.1	4.2	5.0
Cultivation area, 1000 ha		471.8	524.3	551.1	451.1	459.3	411.3	389.1
Finnish varieties %		52.4	47.6	56.0	57.8	66.3	78.2	76.9

Abbreviations: CB = Cebeco, Netherlands; Hja = Hankkija Plant Breeding Institute, Finland; Sv = Svalof AB, Sweden; Jo = Institute of Plant Breeding, ARC, Finland; SFV = Statens forskningsstasjon, Vagones, Norway.

OAT PERFORMANCE IN CHIHUAHUA, MEXICO - 1990

Philip Dyck and Jose J. Salmeron-Zamora

Campo Experimental "Sierra de Chihuahua" - INIFAP

Production. Because the rainy season began late (July 16), and oats are more frost resistant than corn, wheat, or field beans, oats were again seeded on a large scale. Dryland oats were seeded for forage on 128,000 ha (315,800 acres) and for grain production on 57,000 ha (456,000 acres). The average forage yield was 2,759 kg/ha (1.228 tons/acre) and average grain yield was 1.308 kg/ha (36 bu/acre). Twentyfive ha were seeded to irrigated forage oats and 944 ha were seeded for grain production under irrigation. Under irrigated conditions, the average forage yield was 3.20 kg/ha (1.425 tons/acre) and the average grain yield was 3.151 kg/ha (89.4 bu/a). 'Paramo' was seeded on 80% of the area, but some farmers are planting the newer cultivars, Papagochi, Babacora, Cusi, Raramuri, and Pampas. One farmer, who planted Babacora, obtained a grain yield of 4.400 kg/ha (123 bu/acre) and a test weight of 52 kg/hl. Excess precipitation (578 mm) occurred during the growing season and many fields lodged badly. Crown and stem rust infections occurred at low levels late in September and caused little damage.

Breeding. The oat improvement objective is to develop early, high yielding, and drought tolerant cultivars that are disease, shattering, and lodging resistant. Progenitors from Minnesota, Texas, North Dakota, and other regions were crossed with varieties well-adapted to this region. Selections were made in the F_2-F_4 generations using a modified bulk system where the late maturing, disease and lodging susceptible lines are eliminated. In the F_4 generation, 60-100 panicles were selected and seeded in panicle-rows. New lines were selected in the F_4-F_6 generations.

Yield Trials. Relatively good yields were obtained in the oat yield trials even though the oats were badly lodged. Because of low incidence and late rust infection, Paramo exhibited its potential for high grain yield. Good lines produced forage yields from 3-33% higher and grain yields 3-25% higher than Paramo. Papigochi was released for the Chihuahua region and Juchitepec was released for Estado de Mexico and other high plains regions close to this state and Mexico City. Both appear to perform well in the Chihuahua area (Table 1).

Table 1.

Variety	Days to Maturity	Grain yield kg/ha	Grain yield % of Check	Forage yield kg/ha	Forage yield % of Check	Rust reaction Stem Rust	Rust reaction Crown Rust
(Exp. XII)							
Papigochi	110	4.121	125	9.688	118	TMR	50S
Paramo (check)	99	3.284	100	8.167	100	63S	40S
(Exp. 02)							
Juchitepec	99	4.382	103	8.125	103	0	23S
Paramo (check)	94	4.266	100	7.916	100	37MS	10MS

Several lines in the preliminary yield trials produced higher grain yields and had better rust resistance than Paramo, but were somewhat later in maturity (Table 2).

Table 2. Agronomic performance of selected lines from preliminary yield trials

Line or variety	Grain yield kg/ha	Grain yield % of check	Days to maturity	Reaction to stem rust
3947-11C-5C-1C-8C-0C	6.283	194	109	0
3047-11C-5C-1C-3C-0C	5.667	175	108	0
Paramo (check)	3.233	100	95	10S

Performance of new oat varieties. Papigochi, Babicora, Raramuri, and Cusi were grown under conditions used by local farmers. Babicora produced higher grain yields (4.400 kg/ha) than other varieties in an area close to Cd. Cuahtemoc. Raramuri produced grain yields from 2.228 to 3.797 kg/ha at two locations and yielded 12 and 16% more than Paramo. The Oat Growers Association increased all the new varieties and approximately 1000 metric tons of seed was obtained.

ARKANSAS

R.K. Bacon
University of Arkansas

Production

According to the Arkansas Agricultural Statistics Service, acreage planted to oats in 1990 was 55,000 acres compared to 60,000 acres in 1989 and 40,000 acres in 1988. Approximately 45,000 acres were harvested for grain with an average yield of 60 bu/A, resulting in a total production of 2,700,000 bushels. Yields this year were the lowest in the state since 1975. Unfavorable weather conditions caused the crop to have rather rank growth and to mature later than normal.

Breeding and Genetics

The newly released cultivar 'Ozark' continues to perform well. In the state Small Grains Performance Tests for 1989-90, Ozark and the widely-grown cultivar 'Bob' had the highest average yields across locations (116 bu/A). Two experimental lines, AR FOB 30 and AR 02848, are being evaluated for possible release. Both of these lines have higher two-year average yields than 'Bob' across all locations in the state tests.

A study to evaluate the effects of vernalization on oat genotypes was completed by Mr. Stephen King for his M.S. degree. Thirty winter and spring oat genotypes were evaluated for responsiveness to vernalization. All of the winter oat genotypes tested responded to cold treatment with a decrease in days to heading, whereas none of the spring oats tested responded to any of the vernalization treatments for days to heading. Twenty-four days of vernalization or less at 5°C was sufficient to fully vernalize all winter genotypes. The heading dates for the 25 winter oat genotypes were reduced by the 24-day cold treatment an average of 18 days compared to the nonvernalized control. The cultivars 'Dubois' and 'Madison' were the most responsive to vernalization, after 24 days of cold treatment there was an average decrease in days to heading of 52 and 45 days, respectively. Vernalization reduced plant height in many of the winter oat genotypes. Dubois and Madison were the only genotypes that consistently increased in plant height in response to vernalization.

GEORGIA

P. L. Bruckner, J. W. Johnson, B. M. Cunfer,
W. W. Hanna, and J. J. Roberts
University of Georgia and USDA-ARS

Production: Georgia oat producers planted 65,000 acres in 1989-90 and harvested 40,000 acres for grain at an average yield of 56 bushels per acre. Oat production in Georgia was 46% lower than in the previous year.

Cultivar release: 'GA-Mitchell' winter oat was released in 1991. GA-Mitchell is a high-yielding, medium-maturity, semidwarf cultivar with stiff straw and excellent lodging resistance. A more detailed description of GA-Mitchell is given elsewhere in this newsletter.

Breeding: A limited cultivar development program continues at the Coastal Plain Station in Tifton. Participation in a southern regional cooperative oat breeding project involving advanced-generation oat screening and early-generation oat population exchange continues and is expected to enhance the cultivar development program.

Research: 'H-833' oat, a line which M. E. McDaniel reported to have a high frequency of three-lobed stigmas, was examined for possible association with apomictic reproduction. Frequency of the three-style pistil characteristic, frequency of twin seedlings, and embryo sac development were evaluated in 47 selfed progenies of H-833. Histological observation of embryo sacs from 216 three-style pistil ovules provided no evidence of apomictic reproduction in H-833.

Publications:

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IDAHO

Larry D. Robertson
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Production

According to the 1990 Idaho Agricultural Statistics Reporting Service, 60,000 acres of oats were seeded in 1990. This represents a decrease of 30,000 acres from 1989 and is the lowest acreage planted during the last ten years. Grain yield per acre in Idaho has averaged 53 to 76 bushels per acre in recent years and was 66 bushels per acre in 1990. Approximately 30,000 acres were harvested for grain and the balance was harvested for hay, silage or grazed. Oat production is widely spread throughout the state with no county having more than 5,000 acres. During the past 10 years, acres planted has ranged from 60,000 to 90,000 and averaged 69,000.

Variety trials

Irrigated varietal performance trials were conducted at three irrigated locations in the southcentral and southeastern areas of the state in 1990. Averages over the three locations are given below.

Mean grain yield, test weight, plant height and lodging for spring oats, 1990. Idaho Falls, Minidoka, and Kimberly.

Varieties	Yield bu/A	Test Wt	Plant Height*	% Lodging*
Ajay	206.6	36.0	45.4	00
Border	196.2	35.0	49.4	70
Calibre	167.4	37.4	55.4	50
Cayuse	200.1	35.4	49.0	80
Monida	182.2	35.1	54.4	90
Otana	171.6	36.7	53.0	50
Stampede	176.3	34.2	53.0	50
81Ab5792	205.8	35.8	47.5	50
83Ab3725	170.3	33.3	50.0	10
Minimax	167.3	33.2	41.2	00

* Kimberly and Minidoka only

Agronomic studies

Ajay, a new short, strong strawed cultivar was compared to Monida, a standard height, high yielding cultivar in a split plot arrangement with seeding rates and nitrogen rates as variables. In this study, Ajay exceeded Monida in yield (139.5 vs. 123.5 bu/A). Seeding rates varied from 600,000 to 1,200,000 seed/acre and nitrogen rates were 0, 53 and 105 lb N/acre from urea which was broadcast after planting and irrigated in. Seeding rates had no effect on any character except date head which

INDIANA

H.W. Ohm, G.E. Shaner, H.C. Sharma, R.M. Lister, G.C. Buechley, and K.M. Day

Production. As estimated by the Indiana Crop and Livestock Reporting Service, oat acreage harvested for grain in 1990 was 70,000. State average yield was 69 bushels per acre, within 3 bushels to the previous high of 72 bushels per acre in 1989. Ogle accounted for 47 percent of the oat acreage in 1990 followed by Noble at 25 percent.

Season. Nearly 30 percent of the oat acreage was seeded in March. Cool weather delayed oat emergence but good stands were obtained as temperatures warmed about mid-April. Weather conditions from mid-April through May were cool and wet with frequent rainfall. Temperatures from mid-June until harvest in mid-July were higher than optimum for oats resulting in test weights that were lower than normal.

Research. We are transferring slow- and partial crown rust resistances from several sources into adapted lines that have high levels of tolerance/resistance to barley yellow dwarf virus. We are continuing inheritance studies of resistance to barley yellow dwarf virus in selected lines of the diploid oat, Avena strigosa. Although there are statistical differences among the 71 A. strigosa accessions that we have tested by ELISA for reaction to BYDV, the level of resistance in A. strigosa is not nearly as high as in certain Agropyron species. However, the level of resistance in A. strigosa appears to be useful.

To initiate a study of slow rusting to crown rust in oats we obtained several lines of Avena sterilis from Iowa State University and some lines of A. sativa from the University of Minnesota that had consistently low rust severities in the buckthorn nursery. We also evaluated a few lines of A. sterilis provided by Dr. Brodny of Israel which he indicated to be slow rusting.

Plants were reared in the greenhouse and inoculated in the adult-plant stage with a composite of P. coronata cultures Pc 54, 58, 59, and 62. Twenty-four original lines were evaluated. Some lines were clearly heterogeneous for rust reaction, so in later experiments selected progeny were tested. In an overall analysis of variance, both inoculation date (i.e. the date on which an experiment was initiated) and genotype were highly significant, but the interaction of date and genotype was not. Interpretation of this overall analysis was confounded by the fact that not all entries were included in every experiment, and the number of replications was variable. However, within individual experiments there were differences in latent period and percent severity of rust. On 18 of the 34 lines, less than 100% of the infection sites on every tested plant eventually erupted into uredinia. The mean final percentage of infection sites that erupted ranged from 14% on PI 841804 to 96% on PI 841824. On the other 16 lines 100% of the infection sites erupted on all plants.

To investigate latent period and receptivity without the confounding effect of incomplete eruption of uredinia, we analyzed a subset of plants that met the criterion of having at least three replicates on which 100% of the uredinia erupted. Mean latent periods (expressed as T50) ranged from 6.6 days on CI 7694 to 10.6 days on Ts-1469. Clintford had a T50 of 6.9 days. Although a mean separation test indicated that a T50 of 7.6 days was significantly longer than the T50 on Clintford, the biological value of this difference in retarding rust development may be minimal. Simulation studies and field research with wheat leaf rust, however, indicate that latent periods longer than 9 days could reduce the rate of rust development in the field substantially. Four lines had T50 values in this range: A. sterilis lines Ts-1469, PI 380378, and PI 412163, and A. sativa line PI 841811.

In addition to differences in latent period we noted that on some lines uredinia were clearly smaller, although measurements were not taken. The fungus formed telia very quickly on a few lines, sometimes before many uredinia had erupted. Because telia do not contribute secondary inoculum to an epidemic on oats, this may be an effective resistance.

Grant Aldridge, M.S. student, has made plant selections of lines that showed slow rusting resistance to crown rust to develop highly homozygous and homogeneous lines for resistance. He is analyzing segregating populations from matings between certain of these lines.

IOWA

K. J. Frey, A. R. Campbell, A. H. Epstein,
P. J. White, and R. K. Skrdla

In 1990 oats in Iowa were grown on 500,000 acres harvested for grain and the yield was 68 bushels/acre. Total Iowa oat production was estimated at 34 million bushels. The season was good for oat production with moderate to high temperatures and timely and abundant rain. Crown rust and barley yellow dwarf diseases occurred in 1990, but generally, they did not cause significant reductions in oat yields.

Fifteen years ago a gene pool was initiated for increasing the groat-oil content of oats. The base population was initiated by crossing eight high-oil _Avena sativa_ cultivars with eight high-oil _A. sterilis_ accessions. These single crosses were mated to eight other _A. sativa_ cultivars that had good agronomic characteristics to provide three-way matings. Selection for agronomic type and high groat-oil content was practiced among S_1 plants from the three-way matings and the selected S_1-derived lines were intercrossed. Next, the S_0 plants from this mating were selected for agronomic traits and high groat-oil content and their progenies were randomly crossed to five other _A. sativa_ cultivars. The S_0 plants from these latter crosses were intermated to provide seed for the base groat-oil population. Three recurrent selection regimes were evaluated to measure the response of selection for groat-oil content of oats through six cycles of phenotypic recurrent selection. For Regime 1, selection for groat-oil content occurred among S_0 plants grown in the field; for Regime 2, selection occurred among S_0 plants grown in the greenhouse; and for Regime 3, selection among field-grown S_0 plants was followed by selection among and within $S_{0:1}$ progenies grown in the greenhouse. Groat-oil content increased significantly in Regimes 1 and 3, but not in Regime 2. Annual gains in groat-oil content were 0.60, 0.59, and 1.12% in Regimes 1, 2, and 3, respectively. Realized heritabilities were 0.95, 0.64, and 0.98 for Regimes 1, 2, and 3, respectively. The mean oil content for the Regime 3 population after six cycles of selection was 14.2%. The line with the highest groat-oil content in this population had 16.3% groat oil. In winter 1990-91 the C_8 cycle is being completed. The next overall evaluation will be conducted after the C_9 cycle has been completed. The oat lines with highest groat-oil content from this study are available to any breeder who wishes to use them in a crossing program.

Germplasm survey experiments with 250 and 300 entries, respectively, in 1989 and 1990 have been conducted for beta glucan content of oat groats. The range of beta glucan content discovered so far is 3.0 - 6.5%. _A. sativa_ and _A. sterilis_ seem to have approximately the same range of beta glucan content.

In 1990 Kevin Pixley completed his PhD degree and Steve Klein completed his MS degree. Kevin is a postdoc on the maize project at CIMMYT and Steve is an area agronomist for ICI-Garst Company at Sleepy Eye, Minnesota. Joel Holthaus, from Minnesota, joined the project to work on his MS degree.

decreased with increasing seeding rates and lodging for Monida which increased with increasing seeding rates. Nitrogen rates were non-significant for plant height but significant for the other characters measured. Increasing nitrogen rates advanced heading date for Ajay but not for Monida. Lodging increased with nitrogen rates for Monida. Test weight and grain yield both decreased with increasing nitrogen rates indicating that residual soil nitrogen was adequate for maximum yields.

MARYLAND

D.J. Sammons and R.J. Kratochvil
University of Maryland at College Park

Oats are not a crop of major current significance in Maryland, although there has been increasing interest in the crop amongst growers in recent years. Maryland is located in a transition zone between northern areas of the eastern United States where survival of winter oats is threatened by cold winters, and southern areas of the eastern United States where the occurrence of hot temperatures in the early summer threatens winter and spring oat yields due to physiological blasting. Consequently, oat production in the state is problematical. As a result of grower interest, however, a small oat variety testing effort for winter and spring oats has been initiated in Maryland as part of the small grains research program. Results from the 1990 trials are summarized in the accompanying tables.

<u>1990 Oat Production</u>: Maryland oat producers harvested 17,000 acres (6885 ha) of grain in 1990. Average grain yield in 1990 in Maryland was 58 bu/a (2079 kg/ha) for a total state harvest of 986,000 bushels (14,309 MT). In general, yields and test weights were good to excellent, favored by an excellent production year. The winter months were generally mild, and virtually no winter kill occurred in winter oats in the state. Spring regrowth was normal, encouraged by gradually warming temperatures and sufficient rainfall. These spring conditions were also favorable for the establishment and growth of spring oats in the state. During the grain fill and maturation period for both winter and spring oats, the climatic conditions were excellent - warm, sunny, and relatively dry.

Disease pressure was relatively mild on oats in Maryland in 1990, possibly because there is not a large acreage of these crops in the state to serve as a reservoir for disease-causing organisms. Sporadic occurrences of barley yellow dwarf virus (BYDV) were noted in some areas of the state. Insect damage was also mild, although sub-economic infestations of cereal leaf beetle (<u>Oulema</u> <u>melanopa</u>) were observed. Some incidences of physiological blasting were also noted in Maryland in 1990, principally in late harvested winter oats.

Fructans in Oats

Leon H. Slaughter
University of Maryland, College Park

<u>Physiology</u>

The possible relationship between winter survival and fructan metabolism has not been full investigated. Field studies were established to examine changes in fructan accumulation pattern during the growing season in oats, wheat, barley and rye. Results indicate fructans accumulate in leaf and crown tissues during early and late fall. Fructans either declined slightly or remained fairly stable from January through early April. With the onset of spring regrowth, fructan levels increased up to heading and completely disappeared prior to maturity.

Three trisaccharides believed to serve as precursors for higher DP (degree of polymerization) fructans were identified in leaf tissues of all species studied to date. Accumulation patterns of these sugars parallel the observations for total fructan. Oat leaf tissue contained higher trisaccharide concentrations than wheat, barley and rye but contained lower concentrations of higher DP (DP>5) fructans.

Studies are being planned to examine differences in enzyme activity associated with fructan metabolism among these cereals.

Average performance of winter oats for several characteristics at Queenstown, Maryland, 1990.

Entry	Yield (bu/a)	Test Weight (lbs/bu)	Lodging (0-9)*	Height (in)	Date Headed
AR FOB 30	131	42	5	43	May 8
AR FOB 61	88	43	6	46	May 3
AR 102-5	124	41	3	46	May 7
AR 111-2	137	40	6	47	May 3
AR 125-4A	136	41	5	46	May 3
AR 820B-114	117	40	2	45	May 8
AR 820B-965	152	42	7	45	May 5
Bob	146	42	6	45	May 4
Brooks	152	38	6	48	May 8
Citation	146	40	6	45	May 3
Coker brand 227	135	39	6	47	May 4
Coker brand 716	144	39	3	46	May 7
Florida 501	107	38	6	42	May 2
Florida 502	93	40	2	37	April 28
GA-T81-1249	128	40	2	40	May 8
NC 85-129	138	38	5	46	May 9
NC 86-6	151	40	4	41	May 8
Simpson	122	38	2	47	May 5
South. States 76-30	98	37	5	52	May 4
TAM 0386	136	42	1	48	May 6
833	121	37	3	41	May 8
Means	129	40	4.3	45	May 5
LSD .05	39.2				

*Lodging based on a score of 0-9 where 0 = no lodging and 9 = flat.
Soil type: Mattapex silt loam
Date planted: October 13, 1989
Date harvested: June 26, 1990
Fertility: 67 lbs. N/A (52 lbs. spring), 113 P_2O_5/A, 110 lbs. K_2O/A

Average performance of spring oats for several characteristics in Maryland, 1990. Test conducted at two locations in state: Queenstown and Clarksville.

Entry	Yield (bu/a)	Test Weight (lbs/bu)	Lodging (0-9)*	Height (in)	Date Headed
Bob	110	40	1	43	May 29
Coker brand 227	122	38	3	44	May 31
Coker brand 716	134	37	0	45	June 2
Coker brand 820	118	40	4	42	May 23
Coker brand X86-19	98	42	2	43	May 31
Dane	153	38	0	49	May 24
Florida 501	115	40	0	41	May 28
Florida 502	126	42	1	40	May 24
Garry	123	34	2	57	June 6
Hamilton	147	39	3	47	May 27
Hercules	133	37	1	50	June 6
Il 81-1882	144	39	0	47	May 31
Il 82-2154	147	36	0	50	June 4
Il 83-7641-1	152	42	4	48	May 31
Il 83-8037-1	149	39	0	46	May 30
Il 85-2069-1	153	37	4	47	May 31
Il 85-6183-1	138	38	1	45	June 2
Il 85-6264-1	166	37	1	46	June 1
Il 86-1973	145	38	1	44	May 31
In 7869-D1-5-17	161	37	2	48	June 3
Larry	147	38	0	47	May 29
Noble	139	39	1	48	June 2
Ogle	161	36	1	48	June 2
Ozark	117	39	3	44	June 1
Pennlo	137	39	2	37	May 31
Pennuda	103	51	1	46	May 26
X-5229-1	151	36	3	46	June 3
Means	137	39	1.5	46	May 31
LSD .05	18.0				

*Lodging based on a score of 0-9 where 0 = no lodging and 9 = flat.

Michigan

Russell Freed, Dale Harpstead, and Bryan Brunner

Oat production in Michigan of 230,000 acres averaged 58 bushels/acre (13.1 million bu) which is down 65% from our record yields in 1989. Barley yellow dwarf and rust along with some hot, dry weather at flowering were the major causes of the reduced yield. The major acreage was planted to Pacer (36%), Heritage (26%), Porter (23%), and Ogle (10%). Ausable, Korwood, and Mariner were also planted to a small acreage. Newdak and Dane were just added to our list of oat varieties eligible for certification in Michigan.

A three-year study looking at the effect of nitrogen fertilizer and environment on beta-glucan content is about completed. The genetics of beta-glucan inheritance is also being investigated. We have initiated routine rust and seed sizing evaluations of all our breeding material. Large seed size is desired for the horsefeed market.

A new release of our microcomputer program MSTAT-C has several new features including field book templates, nearest neighbor analysis, T-test, and a macro option.

MINNESOTA

D.D. Stuthman, H.W. Rines, R.D. Wilcoxson, R.L. Phillips, D.A. Somers,
S.R. Simmons, R.G. Fulcher, L.L. Hardman, L. Szabo, and K.J. Leonard
University of Minnesota

Oat production in Minnesota in 1990 was estimated to be 48.2 million bushels, about 3% more than in 1989 and almost double that of 1988. Approximately 730,000 acres were harvested out of the 1.1 million seeded. These numbers compare to 850,000 and 750,000 acres harvested in 1989 and 1988 and 1.25 million and 1.7 million planted in 1989 and 1988, respectively. The average yield per acre was 66 bu/A, which was 11 bu more than in 1989 and double that of 1988. The season began with dry topsoil in most areas but rainfall after planting ranged from timely and adequate to excessive across the state except for the northwest where the drought persisted. After mid-May, temperatures were below average and these conditions contributed to the most severe crown rust infection in perhaps 25 years. In addition, there were many violent thunderstorms in many areas causing considerable lodging in many oat fields. BYDV continues to be present and caused some damage in isolated areas.

Varieties

Premier enjoyed a successful first season and will probably become a dominant variety. Starter continues to be a popular variety although it was quite rusty in some fields. It was the most popular variety in the 1990 Iowa Variety survey. We are continuing to increase Mn 84231 with intent to release and distribute to growers for the 1992 season.

Research on recurrent selection

This past summer we selected the 21 C_6 parents and intercrossed them in November to produce C_6 progeny. Our evaluation of C_5 progeny included a BYDV screening with the cooperative efforts of Anna Hewings and Fred Kolb at Champaign-Urbana. Using these results, we also selected five lines which had significantly better tolerance than the remainder of the C_5 progeny.

Personnel

- Graduate students

Dr. Gary Pomeranke completed his Ph.D. and is now a soybean breeder for Agrigenetics at Madison, Wisc. His thesis research compared the parents from the first five cycles of recurrent selection in both hill and row plots at two locations. He also compared progeny from the traditional closed system with that derived from opening the crossing system.

Mr. Jim Reysack finished his M.S. degree and is now a corn breeder with Garst at Sleepy Eye, Minn. Jim's thesis examined the relative stability of the parents from the first four cycles of recurrent selection.

Mr. Dennis Dolan joined the breeding project after earning his M.S. degree at NDSU with Richard Frohberg on the spring wheat project. Dennis will evaluate the three groups of crosses, double crosses, three-way crosses and backcrosses, described in last year's Newsletter.

Mr. Kendall Hellewell will join the breeding project on May 1 after earning a B.S. at BYU. Kendall will use tissue culture to create and identify cells with tolerance to abscisic acid (ABA). He will regenerate plants from those cells which survive the selection protocol. Our hope is that these ABA tolerant plants might be more heat stress tolerant as the result of being resistant to ABA.

Mr. Steve Plehn will join the breeding project when he finishes his M.S. on the Minnesota soybean project. Steve will compare the parents of our recurrent selection program for differences for molecular markers which, in turn, might lead to "gene tagging" of yield genes in oats.

Mr. Song Yun is working on his Ph.D. under the direction of D.A. Somers. His research objectives are to characterize the B-glucanase activity in developing oat kernels and the cloning of B-glucanase genes. He received his M.S. in South Korea in soybean breeding.

Ms. Sandra Milach is working on her Ph.D. under H.W. Rines. Her research will involve RFLP assisted mapping of height (including dwarfing) genes in oat. She received her M.S. in Brazil on wheat tissue culture.

- Post-doctoral students

Dr. Shahryar Kianian is working on our oat RFLP mapping project with emphasis on using RFLP markers to compare recombination frequencies in A. sterilis x A. sativa crosses vs. A. sativa x A. sativa crosses. He received his Ph.D. from U.C.-Davis in April 1990.

Dr. Debra Martin is working on the characterization and expression of B-glucanase genes in oat kernels. She received her Ph.D. from the University of Iowa in October 1990.

Dr. Bai-Chai Wu is working on the RFLP project with emphasis on the use of ditelosomic stocks to locate RFLP markers to chromosome arm and position relative to centromere. He received his Ph.D. from Texas A&M in December 1990.

Ms. Weining Gu is working with Drs. Somers and Rines on DNA delivery with the particle gun and on selection of transformed oat tissue cultures.

Nebraska

Spring Oat Production in 1990

L. Oberthur, T. Berke, and P.S. Baenziger

The 1990 harvest of spring oat acreage was estimated at 300,000 acres, a drop of 10,000 acres from 1989. The state-wide average grain yield for oats was estimated at 48 bushels per acre.

Yield results from Saunders County were lower than the state average due to extreme weather conditions. Above average temperature in June and early July hampered crop development. A severe rainstorm prior to harvest caused severe lodging in plots and prevented harvest of quality seed.

The spring oat yield testing program will be limited in 1991. The Nebraska state Variety Trials, USDA Early Oat Performance Trials, and the USDA Midseason Oat Performance Trials will be planted and analyzed for yield.

Terry Berke has completed his Doctorate Degree at University of Nebraska - Lincoln (UNL) and has taken a post-doctoral position at Purdue University. Dr. Berke was responsible for the Winter Barley Breeding Program and Spring Grains Variety Testing while at UNL. Laura Oberthur has joined the UNL staff as a doctoral student to fill this position.

NEW YORK

M. E. Sorrells, G. C. Bergstrom, and S. M. Gray
Cornell University

1990 Spring Oat Production: The 1990 oat crop for New York State averaged 67 b/a on 125 thousand acres harvested, 8 b/a higher yield on 30 thousand less acres than for 1989. Ogle and Porter continue to dominate the acreage planted; however, there is some interest in Hercules. Newdak continues to perform well in our trials and certified seed will be available to farmers in 1992. Our backcross derived lines of Ogle with tan hull color will be released either as a germplasm or one selection will be released as an isoline.

Genetic Relationships Among Avena Sterilis Accessions: Our collaboration with Dr. Paul Murphy, on assessment of the genetic variability in *Avena sterilis* continues. Sam Beer is currently evaluating morphological traits of these materials as a part of his Master's degree research.

Oat Genome Mapping Project: Our collaborative project with Quaker, University of Minnesota, Ag Canada, and Iowa State University is underway. We are currently pre-screening clones from an oat cDNA library for polymorphism on both diploid and hexaploid parents of mapping populations. We have selected 2 mapping populations, one of which is diploid (*A. atlantica x A. hirtula*) provided by Mike Leggett at the Welsh Plant Breeding Station and one hexaploid (*Kanota x Ogle*). The diploid population is in the F3 generation and the hexaploid population consists of 150 F6 lines. Thus far, about 100 polymorphic, single or low copy clones have been identified for mapping. Dr. Louise O'Donoughue is in charge of the hexaploid mapping project and Dr. Zhenyuan Wang is conducting the diploid mapping work. In addition, we are collaborating with Drs. Charles Brown and Fred Kolb at the University of Illinois on a project to identify markers for loci controlling resistance to barley yellow dwarf virus.

Seed Treatment of Hulled and Hull-less Spring Oats:

Laboratory and greenhouse experiments were conducted to assess the effects of Nusan 30 EC and Vitavax 200 fungicidal seed treatments on germination, emergence, and growth of hulled ('Ogle' and 'Porter') and hull-less ('Penuda') spring oats after 0, 6, 12, and 18 months of storage. Seeds were treated with Nusan 30EC (at 1 fl. oz./cwt, or Vitavax 200 (at 3 or 4 fl. oz./cwt) or were nontreated. The seeds were stored under ambient conditions (maintenance heating ca. 10°C, no temperature control in summer) at the New York Seed Improvement Cooperative for assay at 6, 12, and 18 mo. The hull-less cultivar Penuda showed a differential response to seed fungicides whereas the two hulled cultivars did not. Laboratory germination (with and without pre-chill) and emergence in soil of hulled cultivars were not affected significantly by fungicide treatment after any storage interval. However, laboratory germination (in all but the initial assay) and emergence in soil (at all storage intervals) of the hull-less cultivar was reduced significantly by Nusan 30EC seed treatment. Height and dry weight were also reduced significantly. Emergence of 'Penuda' seedlings in soil was increased significantly by Vitavax 200 seed treatment. Germination and emergence of both nontreated and treated seed of each cultivar declined by ca. 10% between 12 and 18 mo. of storage. Product labels for oats currently serve as the legal guide for seed treatment of hull-less as well as hulled oats. Physical and physiological differences between these crop types dictate that they be treated as distinctly different crops. Considerable research needs to be done in order to ensure that product labels are appropriate for hull-less oats.

NORTH CAROLINA

Ron Jarrett, Steve Leath and Paul Murphy
North Carolina State University

Production and Growing Season. There were 80,000 acres (a 27% decrease) of oats planted in the 1989-90 growing season. Fifty percent of the acreage (40,000) was harvested for grain while the remaining acreage was grown for cover crops, hay, silage, etc. The 1990 season was very similar to the 1989 season. Temperatures were below normal for most of December and above normal in January and February. These conditions resulted in some management problems in the areas of topdressing and weed control. As usual, rainfall was more than adequate and harvesting was complete by late June.

Production was 2.44 million bushels, 22.2% less than in 1989. The state average yield per acre was 61 bushels compared to 57 bushels in 1989. The value of the 1990 grain production was $4 million. The recent decline in the oat acreage has been due to poor growing conditions and low prices. However, we expect the oat acreage to make a gradual increase within the coming years as the horse population continues to increase.

Plant Pathology and Breeding. A soil-borne, fungus-vectored, mosaic disease of oats has been recognized on oats in the southeastern United States for over 50 years. The etiology of the disease has not been fully determined; therefore, we have undertaken the identification and characterization of the viruses associated with typical disease symptoms. Electron microscope observations of partially purified virus preparations from symptomatic oat tissue indicate the presence of both long, flexuous, rod-shaped particles and short, stiff, rod-shaped particles. Based on previously published information, electron microscope observations and SDS-PAGE analysis, we have identified the long flexuous particles as oat mosaic virus (OMV) and the short stiff particles as oat golden stripe virus (OGSV). There have been no published reports of OGSV in the United States; however, it has been reported in Europe. We are presently attempting to determine relatedness of the OGSV isolated from North Carolina and that isolated in the United Kingdom.

OGSV capsid protein (CP) was isolated from partially purified virus on 12% polyacrylamide gels, excised, extracted under vacuum pressure and used as the antigen for polyclonal antisera production in rabbits. Specificity of this antisera to viral CP has been confirmed by both enzyme-linked immunosorbant assays and western blots. The genome of OGSV is composed of two distinct RNA molecules of approximately 6.2 (RNA-1) and 3.5 (RNA-2) kilobases in size. cDNA clones have been synthesized to these molecules. Specificity of these clones to OGSV RNA is presently being confirmed by Northern and Southern blot analyses.

An analysis of the isozyme variation in a sample of 1005 accessions of *Avena sterilis* L. from the National Small Grains Collection is being used to develop a strategy to exploit more efficiently the genetic diversity in this progenitor species. A mean of 6.4 different banding patterns per enzyme was observed over the 29 enzymes studied. A dendrograph based on genetic distances between accessions revealed five putative genetic clusters, each containing between 69 and 502 accessions. Accessions from Iran, Iraq and Turkey were predominant in two distinct clusters. Accessions from Turkey, Lebanon and Iraq contained the greatest genetic diversity. Accessions from each of the five clusters plus a sample taken from accessions associated with none of the clusters are being used to develop a germplasm pool that represents all the isozyme banding patterns observed in the study (see article in this volume).

NORTH DAKOTA

Michael S. McMullen and R. R. Baumann

Crop and Weed Sciences Department, North Dakota State University

Production

The 1990 growing season began with extremely dry soil conditions thoughout North Dakota. Topsoil moisture was adequate for emergence, but very little subsoil moisture was available. Dry soil conditions prevailed through May, but timely rains and moderate temperatures in June resulted in production of one of the best small grain crops in recent years. Nursery grain yields as high as 200 bu/acre were obtained at Fargo. Warm and dry conditions during July and August allowed harvest to proceed well, and much of the oat crop was harvested with minimal weathering.

The North Dakota Agricultural Statistics Service estimated North Dakota oat production in 1990 to be 30.6 million bushels, approximately 50% more than in 1989. Approximately 1.0 million acres were planted and 0.65 million acres were harvested for grain. The average grain yield was estimated at 51 bu/acre which is above the 5 year average. Diseases apparently had little affect on commercial production in 1990.

Diseases

The incidence of Barley Yellow Dwarf Virus was less than in previous years, with little natural infection observed in either commercial fields or research areas. Stem and crown rust were observed in commercial fields in eastern North Dakota, but developed late enough in the season that production was minimally affected. Lines with *Pg13* continue to exhibit good resistance to the prevalent stem rust races. Susceptible reactions to crown rust were observed on oat genotypes that possess the crown rust resistance genes *Pc38* and *Pc39*. 'Don', 'Troy', 'Fidler', and MN84231 were among lines exhibiting good resistance to the new virulence in the crown rust population in North Dakota.

Varieties

'Newdak', 'Valley', 'Monida', and 'Robert' produced the highest grain yields of entries in statewide variety trials. 'Settler' performed well in southeastern North Dakota. Valley appears to offer moderate resistance to the new virulence in the crown rust population.

Breeding

The change in crown rust virulence required selection of breeding lines with resistance to the new virulence in the crown rust population. Many of our advanced breeding lines, possessing *Pc38* and *Pc39*, produced susceptible reactions to natural crown rust infection in the field and will not be considered for release. Good progress was made in shifting our breeding materials toward genotypes with adequate resistance to the new crown rust virulence.

Personnel

Mr. Gene Leach completed his M.S. and is employed by Hybri-Tech Seeds International, Lafayette Indiana. Genes's research determined 'Steele' and 'Dumont' differ by a reciprocal translocation with *Pc38* in the interchanged segment. He found Dumont possesses *Pc38* in an interchanged position relative to *Pc63*, a gene that is allelic or tightly linked to *Pc38.*

Mr. William Wilson joined the oat project in June and will continue the work of Gene Leach. He is attempting to develop lines that possess various pairs of homozygous combinations of *Pc62*, *Pc63*, and *Pc38* by utilizing duplication-deficiency gametes transmitted through both the pollen and egg of the heterozygous translocation. Recombinants between the translocated *Pc38* locus and either *Pc62* or *Pc63* should provide an estimate of the genetic distance between *Pc38* and the translocation breakpoint.

Dr. Frank Manthey began working in a USDA post-doctorate position concerned with oat fiber quality.

OHIO

OARDC/OSU

R.W. Gooding and H.N. Lafever

Growing Conditions and Production

At harvest time, the majority of oat in Ohio was rated as good by the Ohio Agricultural Statistics Service. By early May, 96% of the crop was planted and 80% had emerged, about normal for Ohio. Rainfall in the oat growing regions of Ohio during the 1990 season was much greater than normal. May precipitation was 177% and July precipitation was 182% of normal while April and June amounts were near normal.

Oat production in Ohio was 16.1 million bushels, the result of 230,000 acres harvested with an average yield of 70 bu./acre. This is an increase in production over 1989 of 2% resulting from an increase in average yield of 11% offsetting an 8% decrease in harvested acres.

Disease pressure was minimal to moderate in 1990. No crown or stem rust was observed in test plots at any location in Ohio while barley yellow dwarf virus was more severe in 1990 than in previous years. BYDV apparently is becoming more prevalent with each season especially in the older cultivars. Breeding lines entered in the uniform nurseries clearly showed improved tolerance to BYDV in comparison to the older checks.

Cultivars

The most widely grown cultivars in Ohio continue to be Ogle, Noble and Porter. Some seedsmen feel that there will be an interest in and are producing Hercules and Hamilton. Both cultivars have shown exceptional resistance to lodging, as well as good quality and appearance. Two additional cultivars being produced by seedsmen to a limited extent are Heritage, mainly for the forage oat market, and the hulless cultivar, Pennuda.

Breeding Program

Plots evaluated in 1990 numbered 10,748, down by 219 plots from 1989. The decrease was mostly due to fewer plots in the headrow nursery. Other more advanced breeding nurseries were considerably larger in 1990.

We continue to make good progress towards our goal of releasing new improved oat cultivars for use by producers in Ohio and surrounding states. Advanced lines being considered for release in the near future include: OH1012, OH1022 and OH1007. All three of these lines were selected from bulk populations acquired from other breeding programs at the inception of the Ohio oat breeding project in 1984. Material from our own crossing program is just now entering the replicated yield trial phase of evaluation.

New initiatives in this program include a seedling crown rust screening procedure which will be used to evaluate numerous experimental lines in the greenhouse for their level of crown rust resistance. Although crown rust today is not an economic problem on oat in Ohio, we feel that if our cultivars are going to have wide adaptability and be of use outside of Ohio, crown rust resistance will have to be included as a trait. Under present circumstances, we have not been able to adequately screen for this disease in our field grown breeding nurseries.

A second new initiative is the evaluation of experimental lines and cultivars for aluminum tolerance. At this time we are developing a quick and efficient screening technique for aluminum tolerance. One of our long term goals has been to move oat production into the unglaciated regions of southern Ohio where acid soils predominate. To make this feasible, aluminum tolerance will need to be incorporated into our material. An efficient aluminum tolerance screening technique will allow us to screen the world collection, if necessary, for aluminum tolerance genes for use in our program. It will also allow us to screen our populations and lines in a non-destructive manner for the presence of aluminum tolerance.

No new personnel were assigned to the program in the last year. New equipment acquired this year includes an electronic test weight machine, a gravity table and additional storage facilities.

OREGON

Russ Karow, Patrick Hayes, Randy Dovel
Department of Crop and Soil Science
Oregon State University

Oats were harvested from 45,000 acres in Oregon in 1990. **This is the lowest harvested acreage for the state in the past 50 years!** Yield is estimated to be 102 bu/acre, a new state record according to USDA Ag Statistics Service figures. Late spring and early summer rains again contributed to high yields.

Among Oregon's 85 crops having a gross dollar value in excess of one million dollars, oats ranked 44th - below blueberries but above chewings fescue. Gross dollar value is estimated at $6,901,000.

'Cayuse' still occupies the majority of acreage in the state but other cultivars maintain niche market acceptance - 'Monida' and 'Otana' for milling and race horse feeding; 'Kanota' and 'Grey Winter' for hay and cover crop use etc.

'Crater', an OSU developed grey winter oat released in 1956, is being resurrected. A bag of 15 year old breeder seed was found at the Southern Oregon Experiment Station. Germination is low, but seed increase should be possible.

Research efforts include Western Regional trial evaluations in Western Oregon and Klamath Falls as well as agronomic studies involving cultivar, seeding rate and fertilizer factors. Randy Dovel is also conducting micronutrient and phosphorous response evaluations in the Klamath Falls area. Spring oats are being investigated for their potential as a winter cover/smother crop in vegetable and caneberry fields in Western Oregon.

PENNSYLVANIA

Oat Breeding and Physiology
USDA-ARS, University Park

David P. Livingston III, Joan C. Dietz, and Gerald F. Elwinger

Production: In 1990, 270,000 acres of oats were planted and 240,000 acres were harvested (2% less harvested acres than 1989). Average state yield was 66 bu/a (up 8% from last year). Moisture levels were high early in the season and toward the end of grain filling with a dry period during booting.

Breeding: Several lines which have consistently produced high bushel weights (PA8598-6290, PA8393-11138, and PA8598-11662) are being considered for germplasm release. A high incidence of BYDV, leaf and stem rust was noticed in 1990 field plots; Resistant lines were selected for use in the greenhouse crossing program. Single seed descent is being used to advance 2 generations during winter.

Physiology: Sugar increase during a -3°C prefreeze incubation (a phenomenon frequently observed in the field and related to increased low temperature survival) was significantly lower in winter oats. Controlled freeze-tests are being conducted to see if this may be one reason oats are so susceptible to low temperature injury. A simple and rapid procedure was developed to accurately estimate degree of polymerization (DP) in fructan. A simple procedure is being developed which will allow screening of a large number of plants for fructan content in a semi-destructive manner; preliminary results suggest that the procedure will work very well with species which accumulate mostly high DP fructan. Commercially available flow diversion systems for fraction collectors were shown to cause severe remixing of closely eluting compounds separated by liquid chromatography. Therefore an automated, microprocessor-controlled device which simulates the efficiency of manual collection of liquid chromatographic fractions was invented. The device will be used to automate collection of pure fructan of varying DP for use as substrates in enzyme studies.

BYDV: Preliminary freeze tests surprisingly showed little difference in survival between BYD infected and non-infected oats. Other freeze tests which measure the effects of different freezing stresses will be conducted to see if the virus may affect the response of the plant to one or more particular type of stress.

SOUTH DAKOTA

D. L. Reeves and Lon Hall

Production: Oat yields were good in 1990 with an average of 56 bushels/acre. This is 10 bushels above the next highest in the last 5 years. Planted acreage was the lowest on record in the state with only 1,250,000 acres planted. This was a decline of almost 14% from the previous year. The acreage harvested for grain was 150,000 acres less than in 1989. The southeastern part of the state was dry throughout the oat growing season. Temperatures were warmer than usual, but the higher humidity helped prevent greater losses during filling. Barley Yellow Dwarf was again quite prevalent. If the last few years are typical, BYDV appears to have become an annual economic problem. Infections of leaf and stem rust were erratic with very high CV's for disease readings in replicated nurseries.

Varieties: The varieties receiving the most favorable comments were usually Don and Settler. In the eastern part of the state the tolerance to BYDV in the last few years could be identified as the major factor causing a change in varieties. Kelly, Hytest and similar varieties were quite noticeably affected. Valley and Premier performed well this year.

Research: The selection SD 840104 which has been in the Uniform Midseason Oat Performance Nursery had a major increase in 1990 with intent to release in 1991. Most of the plants in this selection are resistant to the new leaf rust race. Tests by Mike McMullen at Fargo have shown 90% of the plants to be resistant. We have increased seed from single seed selections through three generations with two cycles of testing by McMullen. If anyone desires seed of these reselected lines for crossing, just let us know.

Field observations of numerous crosses in the F_2 to F_5 generations have shown Don, Settler and SD 840104 to have very good combining ability with much of the germplasm in our program.

Lon Hall, the oat project technician, completed his M.S. degree on the effect of herbicides on oats and is staying on the project. He has started a small hulless oat breeding program as his personal project.

Nigatu Tadesse completed his Ph.D. degreed on the study of plant water relations in oats. He found wide variation for relative water content, excised leaf water retention, solute potential at full turgar, stomatal conductance, and root traits. The relative rank of genotypes in relative water content and excised leaf water retention was consistent in stress environments.

The importance of using proper herbicides was quite evident in one test this year. As 0.5 lb/A rate of 2,4-D ester reduced the yield of Lancer 58%this year. The ester form is not recommended, but reports indicate some is often added for hopes of a better weed kill.

Padmaker Tripathi joined the project and will be working on a Ph.D. He is looking at the effects of timing and rate of nitrogen on grain yield and quality.

TEXAS

M. E. McDaniel, David S. Marshall, L. R. Nelson,
W. D. Worrall, Mark Lazar, John Sij, and E. C. Gilmore

According to Texas Department of Agriculture estimates, the planted acreage of oats has been stable at 1.1 million acres for the 1987 through 1990 crop seasons. Statewide yields have ranged from 33-45 bushels per acre over this period, with the four-year average being 41.0 bushels. The harvested acreage ranged from 200,000 to 225,000 for this period, with an average of 19.2% of the planted acreage being harvested for grain. The rest of the crop is harvested by livestock, or lost to various production hazards. A considerable proportion of the acreage harvested for grain has been damaged by heavy grazing; this contributes to the rather low statewide grain yield averages. Oats grown solely as a grain crop on good land in Central Texas frequently produce over 100 bushels per acre.

1990 was an unusual year. Despite receiving almost no rain from April through November at Beeville prior to planting early in December, we had 130 bushel yields due to timely (though not "generous") rainfall from planting through the grain-fill period. At McGregor, the oat nursery was planted about November 10, and promptly emerged about February 1 when rain finally was received; again, yields were as high as 130 bushels per acre. At Temple, oats survived a freeze of 2^{0} F with little stand loss except to the most "tender" genotypes. We would have expected much more severe winterkill at this low temperature. Yield level was as high as 140 bushels at Temple. However, winterkill at Dallas was much more severe, with the majority of entries suffering serious stand loss. Yields of 135 bushels per acre were produced by the most winterhardy varieties and experimental lines. Yields in excess of 100 bushels per acre also were produced at College Station and Overton, and in irrigated nurseries at Uvalde and Bushland. Test weights generally were very good in both nurseries and commercial fields, as crown and stem rust epidemics were relatively light, and rust development was rather late.

1991 also will be an "unusual" year. Planting in Central Texas was delayed by wet weather, and plants were rather small when temperature fell about 70 degrees over a 24-hour period December 21-22. Most commercial oats were lost in the area, including well-established early-planted oats for grazing. We lost both oat <u>and</u> winter wheat nurseries at McGregor, Temple, and College Station. We have never lost entire winter wheat tests in this area before; a large acreage of commercial winter wheat also was killed in the area, with younger plants suffering the most severe loss. The 1991 freeze damage was much more devastating to small grains than the one in 1990, although the temperature was several degrees colder last year. Plant and soil moisture status was different, as more rainfall was received in the fall of 1991. In addition, the weather had been very warm for two weeks prior to the severe freeze, and plants had little or no "hardening"; therefore, they were very vulnerable to freeze injury.

The loss of stands due to sudden temperature reduction by "blue norther" weather (in recent years, named "Siberian Express" or "Alaskan Express", etc.) makes oat production risky in Central Texas. A series of these events has reduced popularity of oats as a grazing crop in the area. Although the area generally has mild fall and winter temperatures favoring good forage production, and although livestock producers prefer oat forage to that produced by other small grains, they are shifting away from oats because a severe freeze leaves them with little or no forage for the rest of the grazing season. We simply need more winterhardy oats (or, at least, more "shock-resistant" ones) for use in the Central Texas area. However, the very prostrate oats which have the best winterhardiness do not produce adequate fall growth to make them attractive as grazing varieties. Although we believe that introduction of genes conditioning plant resistance to ice-nucleation active bacteria may significantly improve winterhardiness in oats, a real "quantum" leap is needed to make the crop a more reliable one in areas subject to the violent temperature "swings" we have in Central Texas.

We have conducted a series of fungicide experiments (both foliar and seed-treatment sterol-inhibitor chemicals) over the past several years. Baytan seed treatment gave yield improvement of about 8 bushels per acre at two locations in the 1990 season. Yield improvement of the most susceptible entries in the 1990 USDA Regional Oat Trial (combined Southern and Central nurseries) was as high as 60 bushels per acre from a single application of an experimental foliar fungicide applied at the late boot stage of development. However, our longer-term experience is that yields and test weights of susceptible oats treated with multiple applications of foliar fungicides do not equal those of untreated resistant genotypes under our heavy rust epidemics.

The Quaker Oat International Nursery coordinated by Texas A&M and the University of Wisconsin at Madison appears to be contributing significantly to oat improvement over a relatively wide range of environments. Last year's Oat Newsletter contained reports of promising results of nursery material in Colombia (new naked oat variety 'Selnudcast' released), in Morocco, and in Australia. New varieties developed from the Quaker nursery material continue to be released in Latin American countries, including Brazil, Argentina, and Chile. However, new sources of resistance to crown rust need to be incorporated into the program, as very virulent biotypes have overcome most of the resistance genes in Brazil, and these races also have moved into Argentina. Use of Tilt fungicide has helped stabilize oat production in Brazil in recent years.

Personnel: Mark Lazar joined the Small Grain Improvement team as a Biotechnologist-Breeder at the Texas A&M University Agricultural Research and Extension Center at Amarillo. His primary responsibility will be wheat improvement work. We were saddened by the untimely death of Dr. James Mulkey, Agronomist at Uvalde, in December, 1990, and by the death of Mrs. LaVoyce Gardenhire, wife of Dr. James H. (Bud) Gardenhire, in February, 1991.

UTAH

R.S. Albrechtsen

Utah State University

Production. Utah's 1990 planted oat acreage was up somewhat from that of the previous year, but that harvested for grain was down, with a larger portion being harvested for forage (over 2/3 of the planted acreage). Grain yield per acre was also down, resulting in the lowest total grain production in nearly a decade.

Losses from diseases were generally light. Simultaneous infestations of the Russian Wheat Aphid and the Cereal Leaf Beetle resulted in severe damage to some fields.

Oat program. Our oat program consists primarily of growing the Uniform Northwestern States Oat Nursery from which we identify cultivars adapted to our growing conditions.

Personnel changes. Dr. David J. Hole joined the small grains breeding program and began work January 1, 1991. Dr. Hole earned his BS degree from Texas A&M, MS from Iowa State and PhD from Texas A&M, followed by a two-year Postdoctoral at A&M. We are pleased to have Dr. Hole as a member of the department and of the small grains program.

WISCONSIN

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H. L. Shands, D. M. Peterson, C. A. Henson, R. W. Skadsen and
K. D. Gilchrist (Agronomy) and A. H. Ellingboe (Plant Pathology)

Production: Wisconsin farmers planted about 900,000 acres of oats in 1990 and harvested 710,000 acres for grain and straw. The statewide grain yield average was 67.0 b/a, similar to the 66.0 b/a yield in 1989. Although the oat crop was good to excellent in most parts of the state, yields and test weight were severely reduced in the southwest district by heavy crown rust infection and severe lodging caused by rain/wind storms. Stem rust and BYDV were widely prevalent but infection levels were light.

Varieties: Based on acreages of Certified Seed produced by Wisconsin seed growers in 1990, Hazel, Horicon, Ogle, and new variety Dane will be the leading varieties grown in 1991. Dane, an early oat, and Ensiler, a forage oat, were released and distributed in 1990. Descriptions of these two varieties are in the 1989 Oat Newsletter, pages 85 and 87, respectively.

A major increase of Wisconsin oat selection X5229-1 will be grown in 1991. This midseason selection was an entry in the USDA Uniform Midseason Oat Performance Nursery in 1989 and 1990, ranking first for grain yield both years.

Research: The Ph.D. research of Mr. Andreas Katsiotis involves studies of crosses between octoploid (2n = 8x = 56) and tetraploid (2n = 4x = 14) lines. The purpose is to acquire new knowledge concerning the cytological behavior of the chromosomes involved, to study the frequency and function of 2n gametes, to gather evolutionary information, to study gene transfer in these interploidy crosses, and to initiate development of new chromosome addition and substitution lines. So far, seven octoploid♀ x tetraploid♂ hybrids have been grown. Four were completely self-sterile while one F_2 seed was obtained from each of the other three F_1 plants. PMCs have been collected, and chromosome pairing at meiosis will be analyzed. A study of pollen grain size (an indicator of 2n gamete formation in *Solanum* and *Medicago*) in *Avena* tetraploid species has been initiated.

Crown rust inheritance study. Dr. Moustafa A. Moustafa, who completed his translocation-line studies in 1989, identified a family of lines highly resistant to crown rust under a heavy field (natural) epiphytotic in 1987. A similar resistant reaction occurred in our 1990 field nursery. The pedigree of these lines is N770-165-2-1/DCS 1789/2/MI64-152-47. An inheritance study has been initiated to determine if the resistant reaction of the MAM lines is due to a gene from translocation line N770-165-2-1, a gene from translocation line DCS 1789, or whether the MAM lines contain two genes for resistance, one from each of the two translocation lines. The resistance in line N770-165-2-1 traces to 6x amphiploid, and the resistance in DCS 1789 (from the thesis research of Dr. D.C. Sharma) traces to derived-tetraploid C.I. 7232. (Dr. Moustafa currently is wheat breeder and Director of the Nuboria Research Station, Alexandria, Egypt.)

CULTIVAR NAME CLEARANCE

Harold E. Bockelman, USDA-ARS, National Small Grains Collection
Aberdeen, ID

Breeders are encouraged to submit proposed names for new cultivars for clearance in order to avoid duplication and possible trademark and other infringements. The breeder should submit the proposed name to the NSGC Curator (P.O. Box 307, Aberdeen, ID 83210). If desired, more than one name may be submitted, listed in order of preference. This will save considerable time if a conflict is found with the first name. The NSGC Curator checks available records (GRIN, CI/PI cards, variety files, etc.) for conflicts with the proposed name. If a conflict is found (previous use of the name for that crop), the originating scientist is requested to submit a different name. If no conflicts are found in the available records, the requested name is forwarded to the Agricultural Marketing Service where the proposed name is checked for possible conflicts in trademarks, etc. Their findings and recommendations are reported to the NSGC Curator. The Agricultural Marketing Service does not guarantee that its findings are the final word since their files may not be complete and/or there may be unregistered trademarks. The NSGC Curator then responds to the originating scientist. The clearance procedure generally requires 4 to 6 weeks.

ARDO

J. Cervenka, J. Sebesta, and F. Benes
Krukanice Plant Breeding Station

'Ardo' spring oat, was developed from the cross 'Flamingsnova/'Pan'/2 /'Thor'/'Saturn' at the Krukanice Plant Breeding Station and licensed in 1990. Repeated panicle selection and testing of progenies was used during development.

Ardo has semi-erect growth habit with moderate tillering. Its leaves are long to very long, flag leaves are strongly erect to strongly recurved. Panicles are long and equilateral; spikelets are mostly bifloret; grain is very fine with very low lemma content and few double kernels. The glumes are yellow and plant height averages 1.25 m.

Ardo produces high yields of very good quality grain. In three years of State Cultivar Trials the grain yield of Ardo was 2 and 5% greater than Flamingsnova and 'Zlatak', respectively. The grain of Ardo is yellow and has very low hull percentage. The groat yield of Ardo was 6 and 8% greater than Flamingsnova and Zlatak, respectively. Ardo produced 8.84 t ha^{-1} in 1987 near Vysoka. Above average kernel number/panicle and productive tiller number contribute to high yields produced by Ardo. The thousand grain weight of Ardo is medium.

Ardo has better lodging resistance than Flamingsnova. It has midseason maturity, similar to Zlatak. Because of earlier flowering, Ardo is more resistant to the second generation of Oscinella frit. Ardo consistently produced high hectolitre weight (<50 kg hl-') and is the best Czechoslovak oat for milling purposes. Field resistance to rusts and powdery mildew of Ardo is similar to Zlatak and it exhibited the best resistance to *Helminthosporium* (*Pyrenophora*) leaf blotch in the three year trial. Ardo produces high straw yield and therefore is also recommended for haylage production.

Ardo is suitable for growing in medium and light soils of potato growing and mountainous regions. It is widely adapted and tolerates less favorable conditions. The recommended planting rate is 4 million germinable seeds per ha in the sugarbeet growing region and 5 million in other regions. The recommended N application rate after a good previous crop is 50-70 kg ha^{-1}.

Table 1. Characteristics of Ardo oat and control cultivars in CSFR STate Trials 1987-1989.

Characteristic		Number of experiments	Ardo	Fl.nova	David	Zlatak
Lodging resistance	9-1	40	5.6	4.7	6.2	6.2
Height of plant	mm	51	1250	1140	1210	1180
Growing period	days	51	131	128	132	131
Thousand grain weight	g	51	31.1	29.7	31.1	31.9
Volume weight	$kg.hl^{-1}$	51	50.2	48.6	48.6	49.8
Grain uniformity	%	51	68	65	71	71
Husk portion	%	51	25.4	28.2	27.7	27.5
Naked kernels	$t\ ha^{-1}$	51	4.63	4.37	4.13	4.30
Naked kernels	%	51	106	100	95	98
Fruit fly (2nd g)	%	35	10.4	11.5	15.8	13.7
Helminthosporium	9-1	46	7.1	6.6	6.6	6.6
Crude protein	% dry m	20	11.06	11.38	11.86	11.52
Crude protein	$kg\ ha^{-1}$	20	740	747	753	720
Crude protein	%/Fln.	20	99	100	191	97
Grain yield	%	51	102	6.09	94	97

'LABUD'

Dragoljub Maksimovic, Krstic Miodrag, and Ponos Branka

Institute for Small Grains - Krafujevac, YUGOSLAVIA

In 1990, the Yugoslav Variety Approvement Commission approved a new spring oat, 'Labud'. Labud was developed by Dr. Dragoljub Maksimovic from the cross 'Leanda'/UPBS-3024-74. Labud is botanically *Avena sativa* L. var. *mutica*. Labud has been tested at six locations in Yugoslavia during 1987 to 1989. Field trials were conducted in a randomized complete block design with five replications. Grain quality was estimated by standard methods.

Table 1. Some characteristics Labud and 'Condor' in variety trials of the Yugoslav Aprovement Commission.

Characteristic	Cultivar	
	Labud	Condor
Mean grain yield (kg/ha)	4.25	4.10
Mean grain yield (kg/ha) in Kragujevac (1986-1990)	6.20	5.87
Highest grain yield (kg/ha)	7.82	7.52
Mean 1000 kernels weight (g)	28.5	28.00
Mean grain test weight (kg)	40.03	39.53
Mean plant height (cm)	115	109
Grain dry matter content (%)	92	92
Grain organic matter content (%)	96.5	96.5
Grain non-nitrogen matter content (%)	53.3	59.2
Crude protein content in grain dry matter (%)	16.5	11.8
Crude fiber content in grain dry matter (%)	12.9	11.8
Crude lipid content in grain dry matter (%)	5.8	5.3
Mineral matter content in grain dry matter (%)	3.5	3.5

Labud produced higher grain yiel and better grain quality than the standard cultivar, Condor (Table 1). It produced 4.7% higher grain crude protein content and 0.5% higher grain lipid content than Condor. Labud was 6 cm taller than Condor and exhibited lodging and disease (crown rust, stem rust and powdery mildew) resistance equal to Condor.

GA-MITCHELL OAT

P. L. Bruckner, D. D. Morey, B. M. Cunfer, and J. W. Johnson
University of Georgia

'GA-Mitchell' winter oat was developed by the Georgia Agricultural Experiment Station and released in 1991. It was tested under the experimental designation, GA-T81-1249. GA-Mitchell was selected and bulked as an F_5 headrow in 1980 from the population, Coker 234/CMB-3/3/Coker 70-12/Coker 70-14//NC 2469-2. CMB-3 was an Illinois experimental with soilborne mosaic virus resistance developed by C. M. Brown.

GA-Mitchell is a high-yielding, medium-maturity, semidwarf cultivar with stiff straw and excellent lodging resistance. The primary justification for its release are its reduced plant height and superior lodging resistance relative to oat cultivars currently recommended for production in Georgia.

GA-Mitchell has a winter growth habit with a low vernalization requirement. Cold tolerance of GA-Mitchell is intermediate to 'Coker 227' and 'Florida 501' and it is expected that adaptation will be limited to southern Coastal Plain environments where winters are mild.

In Georgia trials over a 3-yr period, average grain yield of GA-Mitchell was similar to 'Bob', 'Coker 820', 'Florida 502', Coker 227, and Florida 501. Test weight was intermediate to Florida 502 and Coker 227. GA-Mitchell headed 2 days later than Coker 227 and 7 days later than Florida 501. GA-Mitchell was significantly shorter and showed significantly less lodging than all currently recommended oat cultivars. Forage production of GA-Mitchell at three locations in Georgia during 1989-90 was intermediate to Coker 227 (high) and Florida 501 (low).

In the 1989-90 Combined Uniform Winter Oat Nursery at 19 locations in 11 states, average grain yield of GA-Mitchell was 8% greater than Florida 501 and equivalent to that of Coker 227. GA-Mitchell was shorter and lodged to a lesser extent than Coker 227 and Florida 501.

GA-Mitchell is moderately resistant to prevalent races of crown rust and moderately susceptible to barley yellow dwarf virus, oat powdery mildew, and oat stem rust.

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