1986

OAT NEWSLETTER

Vol. 37

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April 1987

Sponsored by the National Oat Conference

1986

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VOLUME 37

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April 1987

Sponsored by the National Oat Conference

Michael S. McMullen, Editor

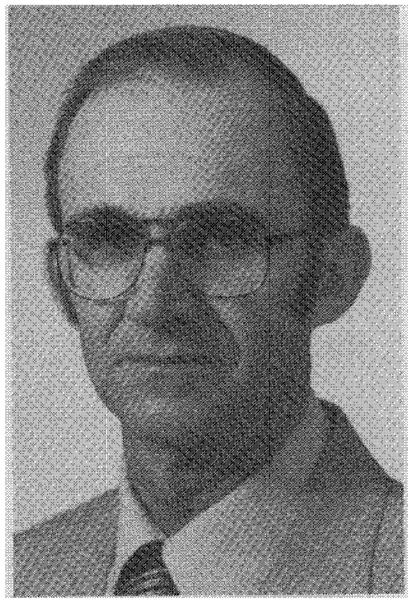
The 1986 Oat Newsletter is dedicated to

Harold G. Marshall

and

Paul G. Rothman

in recognition of years of
excellent service to oat improvement



HAROLD G. MARSHALL

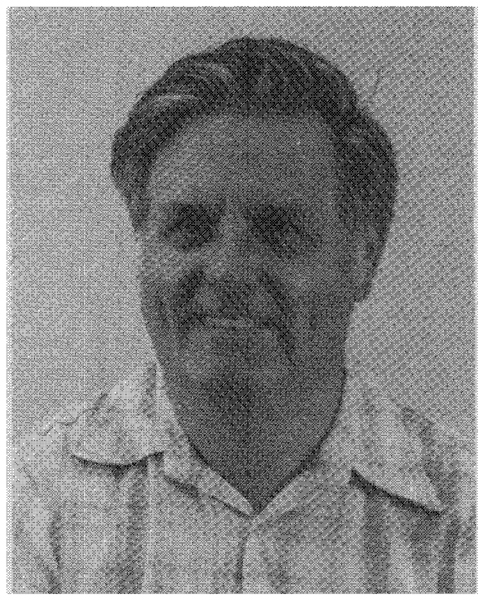
DEDICATION
To Harold Gene Marshall

Harold Marshall was born on May 7, 1928, in Evansville, Indiana, and was reared on farms near Dale and Selvin, Indiana. After receiving his B.S. degree from Purdue University in 1952, Harold moved to Manhattan, Kansas, to work on his M.S. degree in plant breeding. He obtained the M.S. degree in 1953, but more importantly, he met Barbara Jane Parsons and, on March 14, 1953, they were married. Their first son, Jeff, was born in 1957, while Harold was working on a Ph.D. degree in plant genetics at the University of Minnesota. Their second son, Greg, was born in 1960, shortly after Harold began his career with USDA-ARS at The Pennsylvania State University. Both sons have chosen careers in agriculture.

Harold's primary assignment in Pennsylvania was to expand the area of adaptability of winter oats by improving winter hardiness and other agronomic traits and by serving as a regional coordinator for winter oat nurseries. This was a difficult assignment. Most popular winter oats lacked winter hardiness and those with fair levels of hardiness were notoriously late and weak-strawed. He quickly established himself as a highly respected scientist. He developed a highly effective crown freezing test; he determined the inheritance of important traits relating to hardiness, straw strength, and feed grain quality; and he developed effective breeding methodology for the improvement of these traits. During the latter portion of his career, he also worked with spring cereals and has taken a lead role in the introgression of spring and winter oat germplasm.

Harold is a soft-spoken individual, but he is also a leader who inspires confidence. He was instrumental in establishing the Center for Cereals Research at The Pennslyvania State University. He has served as a regional coordinator, a national technical advisor, and as a permanent secretary for the American Oat Workers Conference. Most importantly, he has earned the respect of his peers. He is a fellow of the American Society of Agronomy and the Crop Science Society of America.

Harold is dedicated to his research, but the Marshall's do have another passion. Harold and Barbara "relax" by working on their farm. In 1966, they moved to a farm about 20 minutes from the campus. They have gradually built up a cow-calf operation with usually about 50 beef cows. They produce crossbred steers for sale as show calves to area youngsters and several have been champions. Their primary interest is improving purebred Red Angus. They produce hay and feed for the cattle and always have at least one field of oats. Harold also maintains a large garden, works on his fruit trees, and is a skilled carpenter. There will be no shortage of activities in Harold's "retirement."



PAUL G. ROTHMAN

DEDICATION
To Paul G. Rothman

Dr. Paul G. Rothman, Research Plant Pathologist at the Cereal Rust Laboratory and longtime oat researcher, retired on September 30, 1986, after 31 years of federal service. Dr. Rothman is a native of Michigan and a graduate of Michigan State University with B.S. and M.S. degrees. He received his Ph.D. degree from the University of Illinois in 1955. He was then employed by the Agricultural Research Service of the USDA and assigned to the Oat Investigations project at Stoneville, Mississippi. In 1967 he transferred to the USDA Cereal Rust Laboratory, located with the Plant Pathology Department on the University of Minnesota Campus in St. Paul. In addition to his federal employment he had an adjunct faculty appointment with the University.

Dr. Rothman is particularly noted for his development of rust resistant oat germplasm for use by oat breeders throughout the world. He has made many interspecies crosses from which he transferred rust resistance from lower ploidy species to the agriculturally adapted hexaploid oats. His work overcame many interspecies fertility problems and yielded rust resistant progeny lines that readily intercross with common oats. Much of the germplasm that Dr. Rothman developed is resistant to stem rust, crown rust, and barley yellow dwarf. Many of the stem rust resistant lines have been effective to all known races and isolates.

One of his earlier germplasm releases was a combination of Pg-11 (seedling susceptible, adult-plant resistant) with Pg-12 (seedling resistant, but moderately susceptible as adult plants). Another early release combined Pg-12 with slow rusting from *Avena sterilis*, giving rise to widely resistant Pg-a in lines designated as Alpha and Omega. Resistance from Alpha has been utilized in the development of commercial cultivars Mesquite II and TAM-O-386. Other derivatives have been entered in advanced regional test nurseries.

More recent germplasm releases have included a combination of Pg-6 and Pg-7 from *Avena strigosa* into hexaploid oats. Among the most interesting germplasm developed are lines from the cross of tetraploid *Avena magna* with diploid *Avena longiglumis*, providing fertile hexaploid oats, designated Amagalon. A number of derivatives from these lines have been placed in the National Oat Collection at Beltsville and are available to oat breeders worldwide.

Dr. Rothman was also a participant in the breeding of a number of oat cultivars released jointly by the Minnesota Agricultural Experiment Station and the USDA. Several of these possess a degree of resistance to crown rust which appear to be general in nature. The best known of these is the recently widely grown cultivar, Moore. In these efforts he has worked in cooperation with Deon Stuthman, Minnesota oat breeder and the late Matt Moore, longtime Minnesota Plant Pathologist.

Dr. and Mrs. Rothman are remaining in St. Paul.

CONTENTS

PAGE

III. SPECIAL REPORTS

PAGE

PAGE

V. STATE REPORTS

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
Agronomy 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. One suggestion that may help: 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."

HENRYK JEDLINSKI, February 15, 1924 - April 4, 1987

IN MEMORY

Henryk Jedlinski was born in Bialystok, Poland February 15, 1924. He married Helena Malinowska December 31, 1958 in Lincoln, Nebraska. Surviving are his wife Helena; son Michael; daughter Jeanine; two brothers, Jerzy of Bialystok and Stanislaw of Johannesburg, South Africa; and one sister, Halina Wielgosz of Toronto, Canada. His wife Helena resides at their family home of many years, 1610 W. Green Street, Champaign, Illinois 61820.

Henry received a diploma from Lyceum No. 1, Luebeck, Germany, in 1946. Higher education began at the University of Bonn, West Germany, from 1947-1949, where he obtained a Half Diploma in Agriculture. He then came to the U.S. and obtained his B.S. degree in Agriculture at the University of Nebraska, Lincoln, in 1950. Continuing his advanced studies there, he worked as a Graduate Research Assistant, obtaining his M.A. in 1954 and his Ph.D. in 1959 both in Plant Pathology under the guidance of W. B. Allington.

Henry was appointed a Research Plant Pathologist with the USDA and joined the Department of Plant Pathology, College of Agriculture, and Agriculture Experiment Station in March 1959, through their Memorandum of Agreement with the U.S.D.A., to help solve the serious barley yellow dwarf virus disease problem. He was appointed Collaborator, then Assistant Professor in 1966, and Associate Professor in 1979. Henry was appointed a life member of the Graduate Faculty, University of Illinois, in 1973.

Henry guided, as major professor, theses programs for several M.S. and Ph.D. students and served as thesis committee member for many graduate students in the Departments of Plant Pathology and Agronomy.

At the time of his death, Henry was enthusiastically and carefully preparing his final 5-year plan of work for the U.S. Department of Agriculture. The focus of his research for over 30 years has been on how insects transmit viruses to plants. He was a world authority on the barley yellow dwarf virus (BYDV) and the disease it causes in oats, wheat and barley. Henry has been a close colleague and partner with C. M. Brown in the small grains improvement program at the University of Illinois. Together they formed an integral and inseparable research team incorporating genetic resistance against infection by BYDV into oats and more recently into wheat. Oat varieties developed and released from their program have been and continue to be widely grown in the U.S. and Canada.

Henry was the expert to whom many plant pathologists and plant breeders across the U.S. and from other parts of the world sent winter wheat germplasm and breeding materials when they needed to test for genetic resistance against the soil-borne wheat mosaic virus. Henry graciously donated many hours each year to maintain the unique soil-borne mosaic nursery on the Agronomy/Plant Pathology South Farm, and to provide this much sought, indispensable service. In addition to testing against viruses, he was active in testing germplasm for resistance to rust and smut diseases of cereal crops. He was a close cooperator with oat breeders throughout the world in testing their oat lines for resistance to the BYDV.

Henry has published over 60 scientific journal articles, technical reports, book chapters and abstracts of presentations at meetings in addition to more than one dozen variety releases in which he participated. Those who knew Henry well can attest to the fact that few scientists were as up-to-date and as well informed about all aspects of plant virology. He was stimulating and thought-provoking in his discussions, and always asked penetrating questions.

Early life for Henry was not easy. Henry's knowledge of and ability to speak five languages helped him through some unusually difficult times and circumstances in the early 1940's. Those experiences made him a tough, yet a humble man appreciative daily of the many privileges of freedom and democracy that most of us who were born and raised in the U.S. take for granted.

Henry, generous with his time and assistance, was always quick to help anyone in need of personal or professional assistance or advice. Small grain workers across the nation will miss the ready, friendly help he provided. All of his friends and colleagues will miss his friendly smile, his wit, and his wise counsel. We have lost a respected colleague and friend.

MINUTES OF THE BUSINESS MEETING
AMERICAN OAT WORKERS' CONFERENCE
July 17, 1986

Chairman D. Stuthman presided.

McMullen reported for the Meeting Site Committee (McMullen, McDaniel, Sorrells, Rossnagel) and indicated that Wesenberg has invited the group to hold its next meeting in Idaho. Wesenberg discussed that possibility and stated that the meeting could be held at either Pocatello, Idaho, or Jackson Hole, Wyo. If the meeting is held at Jackson Hole, a one day tour to the Aberdeen Station would be made by bus. A new small grains facility may be completed at Aberdeen by the date of the next meeting. A motion to hold the next meeting in Idaho was passed.

Marshall reported for the Nominating Committee (Marshall, C. Brown, and Burrows) and gave the following nominations for officers of the AOWC:

Chairman	-M. Brinkman, H. Ohm
Secretary	-D. Brown, M. Sorrells
Editor of Newsletter	-M. McMullen

Frey moved that the nominations be closed and the motion passed. An election followed and officers elected were: H. Ohm, Chairman; D. Brown, Secretary; and M. McMullen, Editor, Oat Newsletter.

The next order of business was to elect three at large members to the American Oat Workers' Conference Committee. After S. Weaver, M. Brinkman, and D. Peterson had been nominated, Frey moved that the nominations be closed. The motion was passed and the nominees were elected by acclimation. Regional representatives already designated or elected for the coming 4 years are: M. Sorrells, Eastern Region; Harrison, Southern Region; Wesenberg, Western Region; Ohm, North Central Region; Burrows, Rossnagel, Comeau, Canada; and Navarro-Franco, Mexico. The USDA Federal Advisor is Wesenberg.

In accordance with policy adopted by US workers at the last AOWC, D. Stuthman will serve as Chairman of the National Oat Improvement Council (NOIC) during the next 4 years.

Brinkman next read the resolutions prepared by the Resolutions Committee (Weaver, Brinkman, Frey) as follows:

> Whereas this has been a most successful American Oat Workers' Conference, and whereas the success of this workshop and conference was due in large part 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 Agriculture Canada, especially the Plant Research Centre, Central Experiment Farm, and the Talisman Conference Center, for being most gracious hosts.
>
> Also, be it RESOLVED that the participants at this workshop and conference convey a special message of appreciation to Dr. Vern Burrows for his

contributing many hours towards making this event most worthwhile and successful and to Betty Burrows for organizing an excellent Companions Program. Thanks Vern and Betty, for a terrific job.

Whereas the Canadian Seed Growers Association; King Agro, Inc.; Research Branch, Agriculture Canada; Robinhood Multifoods, Inc.; Secan Assoc.; W. J. Thompson & Sons, Ltd.; Quaker Oats Co. of Canada (Peterborough); and Quaker Oats Co. (Chicago) provided generous financial support to the Conference,

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

Whereas, Dr. D. D. Stuthman has faithfully served the American Oat Workers' Conference as Chairman, therefore, be it RESOLVED that the members of the American Oat Workers' Conference extend a sincere thanks for his fine leadership, counsel, and guidance during the past 4 years.

Chairman Stuthman next led a discussion relative to restructuring to clarify the organizational relationships of the American Oat Workers' Conference, National Oat Improvement Council, and the Crop Advisory Council (CAC). The latter two groups only include US Oat Workers. Stuthman read a proposal (prepared by Forsberg) to have the entire group of US oat workers known as the National Oat Improvement Council. Marshall objected to the use of that name for that purpose and suggested that the NOIC should continue to be a smaller group, perhaps made up of the US representatives to the AOWC plus one representative from industry, if not already present, and a representative from ARS, USDA. After more discussion from the floor, Stuthman suggested that the US oat workers might be organized into a US Oat Workers' Association and that the CAC, NOIC, and Legislative Subcommittee be committees of that organization. Marshall indicated that the Legislative Subcommittee presently is a subcommittee of the NOIC (which was appointed by Forsberg when he was Chairman, AOWC), and that any changes like those proposed would require changes in the present charter of the AOWC. Weaver made a motion that a plan be developed and circulated to US oat workers for suggestions and eventual adoption. Motion was passed. Stuthman indicated that he would appoint a committee to develop such a proposal.

Frey reported that the Third International Oat Research Workshop is to be held in Sweden, probably during early July, 1988. Tentative plan is to have a program similar to the one during the meeting in Wales, i.e. sessions with a plenary paper followed by related volunteer presentations. Frey suggested that poster presentation also should be encouraged. Rossnagel suggested going to a program with all invited papers so as to assure more time for discussion. Individuals who must make a presentation to justify attendance could present a poster if not invited to present a paper.

McMullen reported on the status of the Oat Newsletter. A total of 388 copies were mailed to 35 countries. He plans to include telephone numbers with the mailing addresses in the back of the Newsletter. McMullen thanked Quaker Oats Co. for their financial support of the Newsletter.

Marshall reported on the status of preparation of a new Oat Monograph.

The Editorial Committee is Marshall (Editor), Simons, Schrickel, Peterson, and Kelling. Authors were assigned during 1985 with chapters due June 1, 1986. Only one complete chapter was in by the deadline and several authors had not turned in chapter outlines. Marshall expressed disappointment that authors have not been more responsive and concern that early chapters might become outdated while tardy authors are preparing their chapters.

Doug Brown reported that he now is chairman of the International Gene Nomenclature Committee (replacing McKenzie). When a new symbol is needed, he wants the request in the form of a letter and a copy of any paper that may be published regarding the gene or genes. Marshall indicated a need to mesh gene nomenclature established by the Committee with the chapter on genetics and inheritance to be included in the Oats Monograph.

Schrickel reported on activities of the Milling Oats Improvement Association. He indicated that the Association has had some funding problems and hopes to get more involvement of Canadian firms. He called attention to a newsletter prepared by Roskins and supported by the Association.

Wesenberg (Chairman, CAC) reported on progress in evaluation of the oats collection for various traits. Evaluations for agronomic, pathologic, and entomologic traits are 60, 20, and 40% complete, respectively, to date and 2000+ accessions will be grown at Aberdeen, Idaho, during 1987. Wesenberg indicated that the CAC is working to update the current Germplasm Enhancement Plan and that he had sent out a letter asking for suggestions. He requested that any suggestions be sent to him by late July.

Stuthman and Murphy discussed the need for a US Oat Worker Plan. Concern was expressed about the number of ARS scientists planning retirement in the near future and possible loss of their programs. Schrickel indicated that ARS administrators desire that a plan be developed to help them with decisions relative to research needs and critical positions. A motion was made and passed that Stuthman and Ohm appoint a task force to prepare a strategic plan for oat research needs in the US. A draft of the plan is to be ready for review by Dec. 1, 1986.

All old and new business having been completed, new Chairman Ohm adjourned the meeting at ca. 3:45 pm.

Respectively submitted,

Harold G Marshall

Harold G. Marshall
Secretary, AOWC

MINUTES OF THE JOINT SESSION OF REPRESENTATIVES OF AMERICAN OAT WORKERS' CONFERENCE AND THE NATIONAL OAT IMPROVEMENT COUNCIL
July 14, 1986

The joint meeting was called to order by D. Stuthman, Chairman, American Oat Workers' Conference (AOWC). AOWC representatives and National Oat Improvement Council (NOIC) members present were Forsberg, Stuthman, Murphy, Frey, Marshall, McMullen, Rines, Reeves, Sorrells, Ohm, Schrickel, Weaver, Burrows, Wesenberg, McDaniel, and Brown.

Stuthman reviewed committee assignments for the present AOWC meeting as follows: Nomination - C. Brown, Burrows, Marshall; Resolutions - Weaver, Brinkman, Frey; and Awards - Peterson, McDaniel, McKenzie, Rothman, Weaver.

Schrickel reported on the activities of the Legislative Subcommittee of the NOIC. The committee members have made annual trips to Washington (supported by the Milling Oats Improvement Association) and have been well received by legislators as well as ARS and other government personnel. He indicated that the ARS budget has been maintained, rather than cut like some agencies, and believes the committee activities have contributed to this success. Present members of the committee are Schrickel, Racey, Stuthman, Brown, Forsberg, and Frey. Schrickel stated that he has retired but will continue to be involved for at least another year. He emphasized the importance of keeping oat research needs in front of legislators and ARS personnel. He reported that the Milling Oats Improvement Association has had some funding problems, and hopes to get more involvement of Canadian firms. Forsberg further emphasized the importance of the visits by the Legislative Subcommittee, and commended the work done by Racey and Schrickel to lay the groundwork for the visits. He reported that a letter was received from Kinney, Administrator of ARS, complimenting the committee on their effectiveness.

Forsberg reviewed the formation of the NOIC and the oat Crop Advisory Committee (CAC), and reported that these two groups met in a joint session in Chicago on December 3, 1985. He summarized the minutes of that meeting and cited the following points made during a discussion of goals and emphasis in oat research: (1) the value of the oat crop to the farmer must be increased, (2) physiological trade-offs likely will slow progress during attempts to simultaneously improve oat grain yield, grain protein content, straw strength, groat percentage, test weight, oil percentage, and other traits, (3) limitations on changes in trait levels imposed by "GRAS" restrictions need to be reviewed, and (4) oat research goals would be a lively topic for panel discussion at the 1986 AOWC meeting in Ottawa. Forsberg also reported that he and Simons will make a germplasm collection trip to Turkey in the near future. It takes 2 to 3 years to arrange such a trip. Proposals should be reviewed by the CAC.

Frey reported for the committee planning the next International Oat Workshop. It will be held in Sweden during early July of 1988. Subsequent meetings will be held every four years. The plans are for the 1988 meeting to last 5 days including at least one day for an agriculturally oriented trip around Sweden. The general format of the meeting probably will be similar to that used for the Wales meeting. Stuthman inquired regarding the desirability of trying again to arrange travel as a group. Weaver suggested it is too early to decide about such arrangements but efforts should be started to seek funds to help support travel. Some individuals cited problems they had encountered with the group booking of travel to the Wales meeting.

Wesenberg reported for the oat CAC. He indicated that the CAC evolved from the AOWC Subcommittee for Improved Utilization of Oat Germplasm. Funds have been available for germplasm evaluation for the past 3 years but no funds have been provided for enhancement. The CAC met at Madison in May, 1986, and has been working to update the enhancement plan so as to increase the chances for funding. He asked oat workers to send him any suggestions they may have for updating the plan. He will circulate the plan to workers for suggestions and try to have it in place by early August. Wesenberg indicated that oat germplasm evaluation work probably is as far along as any of the small grains. Evaluations for agronomic, pathologic, and entomologic traits are about 60, 20, and 40% complete, respectively. Wesenberg reported that Henry Shands now is the NPS person responsible for germplasm.

Dr. C. Murphy of the ARS National Program Staff stated that a strategic plan for future oat research in the US is needed by late summer or early fall. Stuthman initiated a discussion of this need and mentioned several retirements by ARS scientists upcoming in the near future. Murphy expressed belief that such a plan could have an important impact on several target audiences, and may counteract criticisms or misunderstandings by groups such as the Office of Management and Budget. The plan should indicate to both ARS and state experiment station personnel the value and need for present oat programs well ahead of retirements. Murphy further indicated that the plan should project needs well ahead, as much as 20 years, and should include modern technology. Burrows suggested that the plan should point out the role oats needs to fill relative to rotations, nutrition, special uses, and economics of production. The plan should convince administrators that agriculture cannot afford to lose the crop. Discussion of committee composition to develop the plan followed. Frey stated that the work should be done by a specific committee rather than an existing group like the CAC. Murphy had no problem with this but indicated that the plan should be under the banner of the CAC, AOWC, and NOIC. Stuthman said that he would ask the new chairmen of those three groups to decide on a course of action and establish a committee with instructions to complete the plan by Dec. 31, 1986. Goal is to have a draft for review at the American Society of Agronomy meetings in early December. Murphy indicated that the approach in the plan should be based on existing resources, and expressed belief that asking for new positions would not be well received.

After a negative response to his call for any unfinished or new business, Stuthman adjourned the meeting.

Respectively submitted,

Harold G. Marshall

Harold G. Marshall
Secretary

REPORT OF NOIC LEGISLATIVE COMMITTEE

Deon D. Stuthman

The National Oat Improvement Council, Legislative Committee had another successful trip to Washington, D.C. The current members of the group are H.W. Ohm, K.J. Frey, D.J. Schrickel, and D.D. Stuthman. The group is most ably assisted by Mr. Patrich Racey, a professional "Washington person" from the Quaker Oats Company. Special thanks goes to R.A. Forsberg and C.M. Brown who completed tours of duty with the committee.

The group meets with staff of key Congressional Committees (mainly Appropriations and Agriculture) and of key congressman from important oat producing states. They also interact with Office of Management and Budget personnel and with USDA administrators in Washington and at Beltsville, MD. Our group's highest priority continues to be more adequate funding for the germplasm system, especially that which pertains to small grains. At this writing, the President's budget recommendation for FY '88 includes $7.3 million new moneys for plant germplasm. If fully approved, the total budget for germplasm would exceed $23 million, a substantial increase from $2 million when this group first went to Washington nearly ten years ago.

Although most budget recommendations of interest to us were positive, there was one to which we objected very strenuously. It has been proposed that the USDA institute a "user fee" for germplasm orders. Our group has continually argued against such a fee, primarily because of the anticipated negative action-reaction from other countries where most of the world's indigenous germplasm is located. We will maintain a continued vigilance on this issue.

We welcome any comments or suggestions from any of you which will aid the cause of future oat research and production. Just contact any of the current committee members with your ideas.

Minutes of the NCR-15 Business Meeting
Talisman Motor Hotel
Ottawa, Canada
July 15, 1986

The meeting was convened at 8:40 p.m. by Chairman Dale Reeves. The following were in attendance:

Marshall Brinkman	Leonard Michel
Charles Brown	Herbert Ohm
Douglas Brown	Dale Reeves
Vernon Burrows	Howard Rines
Robert Forsberg	Marr Simons
Russell Freed	Mark Sorrells
Kenneth Frey	Deon Stuthman
Robert Gooding	Sam Weaver
Harold Marshall	Dallas Western
Michael McMullen	

Business items were the initial order for the meeting. Action taken on each item is summarized below:

1. Electing a Secretary for NCR-15. It was moved, seconded, and passed unanimously that Herb Ohm be nominated and elected incoming Secretary of NCR-15.

2. Summer Field Day in 1987. The next NCR-15 Summer Field Day will be held in Urbana, Illinois and West Lafayette, Indiana.

3. Summer Field Day in 1988. It was decided not to have an NCR-15 Summer Field Day in 1988 because the Third International Oat Conference will be held in Sweden during the summer of 1988.

4. Electing a Representative to the AOWC. It was moved, seconded and passed unanimously that every other NCR-15 Secretary serve as the representative to the American Oat Workers Conference. This is being implemented because an NCR-15 Secretary serves a 2-year term and then automatically becomes the NCR-15 Chairman for 2 years. The AOWC Representative serves a 4-year term, so every other NCR-15 Secretary will serve as the Representative to the AOWC during the two years that he/she is Secretary, and the following two years that he/she is the NCR-15 Chairman.

5. Location for the NCR-15 winter meeting to be held in February, 1988. The 1980 meeting was at Madison, Wisconsin, and the 1984 meeting was at Ames, Iowa. It was moved, seconded, and passed to accept Wisconsin's invitation to have the 1988 winter meeting in Madison.

6. New Uniform Nursery procedures. Howard Rines expressed his appreciation for the cooperation that was extended in accepting the new procueudres for the Early and Midseason nurseries. Seed of new entries is now being sent directly from one state to another rather

than routing seed to Howard in Minneapolis. Howard would like to receive 1986 data by early November, if possible. The check varieties in the Early Uniform nursery were also discussed. Currently, the checks are Andrew, Bates, Clintford, Lang, and Otee. It was suggested that Lang and Otee be dropped, and that the new variety Don be added. After some discussion it was decided that Otee be retained because it has high protein percentage, high test weight, and good BYDV tolerance. The group also decided to replace Lang with Don.

7. Problem in sending seed to Canada. Harold Marshall noted that seed sent to Canada needs a phytosanitary certificate. Sam Weaver recommended that nursery cooperators send seed of new entries to Beltsville for a phytosanitary certificate, and Beltsville will return it to the sender. The seed can then be sent to Canada via Federal Express.

8. Sending treated seed to nursery cooperators. Some cooperators have sent treated seed, while most send untreated seed. Untreated seed is preferred if disease testing is a high priority. Herb Ohm stated that Purdue likes to receive untreated seed, use a portion for disease testing, and then treat the seed that will be planted in yield trials. It was decided to continue as we have in the past. Any cooperator can treat seed that is planted in his nursery, but this should be noted on the nursery report.

The remainder of the meeting consisted of State Reports. Following is a summary of items presented by each state:

Illinois: Charlie Brown reported that Illinois has its largest oat acreage in many years, and most of the oats look excellent. Many of the oats are in the government program. Ogle is the predominant variety in 1986. In the United States, 25% of the Certified oat seed was Ogle in 1985. Ogle is not showing as much crown rust in 1986 as it has in several previous years. Two new varieties released by Illinois are Don and Hazel. Don has very good resistance to crown rust and smut, but it lacks tolerance to BYDV and is not stiff. Don has had high grain yield and test weight in many tests, and it has a very attractive kernel. Hazel has a good combination of resistance to BYDV and crown rust. It stands well and has had high yields. The Illinois program is continuing its emphasis on BYD tolerance, and will increase its emphasis on smut resistance. The oat and winter wheat programs will be continued after Dr. Brown retires.

Indiana: Herb Ohm reported that the oat acreage has increased in Indiana. Ogle is the leading variety. Although oats in the Lafayette area have lodged, oats in most of the state look good. The major thrust of their breeding program is tolerance to BYDV. Herb would like to receive a copy of the data sheets from each location to assist in decision making on a Purdue selection.

Iowa: Ken Frey reported that he has been on sabbatical leave at the University of Georgia. Iowa has a relatively large acreage in 1986, much of it in the government program. The acreage of oats harvested for grain has been about 800,000/year in recent years. The Iowa program is emphasizing genes from *Avena sterilis*. They have a series of lines with as much as 13% oil, and have another series with high protein and high harvest index. An early line with *A. sterilis* cytoplasm, D623-15, has yielded 5% higher than Lang in five years of Iowa tests. The Iowa program is developing a multiline with B605 as a recurrent parent. This line has very stiff straw.

Winnipeg: Doug Brown reported that Dumont and Fidler are the leading varieties in Manitoba. Dumont has an attractive kernel type. Doug is expecting considerable rust in Manitoba this year. Ron McKenzie is switching from oats to wheat. Consequently, the Winnipeg oat program is being 'down-sized'. The overall objective is to stabilize yield through improved disease resistance, particularly resistance to crown rust.

New York: Mark Sorrells reported that the oat acreage in New York has been in the 250,000 acre range in recent years. Porter and Ogle are the most popular varieties. There is considerable demand for white oats, so the Cornell program is emphasizing white hull genes. The oat breeding program at Cornell has stabilized in effort and size.

Pennsylvania: Harold Marshall reported that Ogle is the most popular variety in Pennsylvania. Noble is still popular because of its high bushel weight. The semi dwarf variety Pennlo (35% shorter than Ogle) will be released shortly, as will the tall variety Hercules. Hercules is very stiff for a tall type, and is 2 lb/bu heavier than Ogle in test weight. Hercules is also resistant to smut. The state average yield of oats in Pennsylvania was 70 bu/a in 1985. This high average was attributed to better management and to large acreages of Ogle.

Ohio: Rob Gooding reported that there were 350,000 acres of oats harvested for grain in 1985, and he expects a similar acreage to be harvested for grain in 1986. Ogle is the leading variety. Heavy rains and thunderstorms have caused lodging problems in the Wooster area this year. The oat program at Wooster was re-established in 1984 and is proceeding ahead.

South Dakota: Dale Reeves reported that the South Dakota acreage is down somewhat because a long wet period prevented planting oats in some areas of the state. There is a considerable amount of crown rust in South Dakota this year. Susceptible varieties are likely to be dropped from their certification program. Crown rust broke out early and continued to develop as growth proceeded. Burnett continues to be the leading variety because it has high test weight and its white hull is favored by the race horse industry. Moore is still grown in some areas. The new variety Hytest has high test weight, but is slightly cream colored. Another new variety, Sandy, may not appear as uniform as desired, but it has very good straw stiffness in South Dakota. Sandy has white hulls and high test weight. Both Sandy and Hytest are from a Dal/Nodaway 70 cross.

Michigan: Russ Freed noted that Michigan has approximately 375,000 acres of oats in 1986, and that Porter is one of the leading varieties. There is more rust than usual in 1986, and BYDV is developing late. Oats in the East Lansing area have a considerable amount of blasting. Russ is expecting very high oat yields in the thumb-area of Michigan this year. Michigan is considering the release of a white oat, as many white oats are sent to the horse racing groups in New York and Kentucky.

Missouri: Neil Cowen has taken a position with United Agri Seeds in Urbana, Illinois. His position is expected to be filled. There are many oats in Missouri this year. The oats appear to have good quality.

Minnesota: Deon Stuthman reported that the new variety Starter is being grown on farms for the first time in 1986. Starter has excellent straw strength. Proat, grown on farms for the first time in 1985, is doing well. Proat is high in protein percentage. Minnesota has some interest in dwarf oats and annual alfalfa.

North Dakota: Mike McMullen reported that the North Dakota oat acreage is down slightly in 1986. Two selections, ND810104 and ND820603, are being increased for release. Both selections performed very well in the 1985 Uniform Midseason nursery. They have excellent rust resistance.

Wisconsin. Bob Forsberg and Marsh Brinkman reported that the oat acreage in Wisconsin increased to approximately 1.2 million acres in 1986. The crop looks good in most areas of the state, although susceptible varieties are showing symptoms of considerable BYDV infection in nurseries at Madison and Arlington. It appears that leaf rust infection is light in most areas of Wisconsin. Approximately 20-25% of the oat acreage is being harvested at heading as forage. Farmers in several parts of the state are mixing peas with oats at planting time, and are harvesting the pea-oat mixtures when the oats are in the late boot/early heading stage. Three selections from an Ogle cross, X4872-2, X4872-10, and X4872-13, are looking very good in 1986.

Quaker Oats: Sam Weaver noted that 1986 has been an interesting year in terms of buying oats. Oats in Illinois, Ohio, and Missouri have good quality because they missed the crown rust infection that is sweeping through the western Corn Belt. Quaker is concerned about maintaining an adequate number of oat breeders as state budgets are tightened.

The meeting was adjourned at 10:05 p.m.

Respectfully submitted,

Marshall

Marshall A. Brinkman
Secretary, NCR-15

MAB:kkb

AWARD FOR DISTINGUISHED SERVICE OT 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, and T. Rajhathy.

At the 1986 meeting of the American Oat Workers' Conference held at Ottawa, Ontario, three people were chosen in accordance with Conference procedures. Photographs and biographies of the three who were selected to receive the award for distinguished service to oat improvement at the 1986 meeting follow.

Kenneth J. Frey
Award for Distinguished Service to Oat Improvement

Dr. Kenneth J. Frey, Charles F. Curtiss Distinguished Professor of Agriculture at Iowa State University, was born in Charlotte, Michigan in 1923, and was raised on a farm in that state. He attended Michigan State University, where he was awarded the B.S. degree in Field Crops in 1944, and the M.S. in Crop Breeding in 1945. He obtained the Ph.D. degree at Iowa State University in 1948, and then served on the staff of the Department of Farm Crops at Michigan State University until 1953. In 1953, he moved to Iowa State University to take over the oat breeding program and to teach plant breeding in the Agronomy Department. Since then he has served at Iowa State, where he has compiled a truly outstanding record of accomplishment. Most of this accomplishment clearly and directly qualified as distinguished service to oat improvement.

Foremost among Dr. Frey's contributions to oats as a crop species is the list of over 200 publications that he has authored or co-authored with students and colleagues. The great majority of these have dealt directly with basic or applied aspects of genetics of oats. Taken together they constitute a very important addition to the fund of knowledge that is available for use in oat improvement.

Dr. Frey was among the first to recognize the potential of artificial mutagenesis as a source of useful variation in oats. The first work he published in this area, in the early 1950's was well ahead of the crowd. Some of this early work involved important oat pathogens, and his recognition of the potential of field resistance was again well ahead of the then current thinking that monogenic resistance would solve all the problems.

The quality of oat grain, especially in terms of protein and amino acid content, has been a topic of great interest to plant breeders for the past few decades. Dr. Frey, starting very early in his career, has made numerous important contributions to our knowledge of this area. The wild oat *Avena sterilis* is now recognized as a prime source of disease resistance, grain quality, and many other desirable traits in oats. Dr. Frey's work with this species has led to the publication of many individual studies on the theoretical or practical utilization of genes carried by *A. sterilis*.

Much of Dr. Frey's work, including most of the work with disease resistance, grain quality, and agronomic traits could be broadly, but conveniently, categorized as research on oat breeding. In addition to the items mentioned above, this includes his work in developing the microplot technique into a practical tool for evaluating quantitative traits, including yield. Widespread use of microplots, as compared with larger field plots, has significantly furthered progress in oat research because of the cost effectiveness of the microplots.

Dr. Frey, in cooperation with his colleagues, was the first to test the theory of the use of multilines for controlling the cereal rust diseases. In addition, his work in this area has included further development of theory and the mechanics of producing multilines, and finally, the release of successful multiline oat varieties. Additional multiline varieties are currently being developed.

Dr. Frey has had several important administrative assignments that directly relate to oats, and that have significantly contributed to the well being of oats as a crop species. For example, he has served on the Oat Legislative Subcommittee and on the board of directors of the Oat Milling Association. He has been chairman of both the NC Oat Technical Committee and the National Oat Conference, and was instrumental in establishing the International Oat Workshop series.

A summary of Dr. Frey's contributions to oat improvement should also include his work in applied plant breeding. In the course of his career, he and his colleagues have released 17 oat varieties for the use of midwestern farmers. Others are in advanced stages of development.

It is not possible to present a short account of Dr. Frey's service to oats as a crop species without mentioning his outstanding overall career accomplishments. The reputation he enjoys has resulted in a very long list of invitations to present lectures, seminars, and symposia all over the U.S. and in many foreign countries. He has drawn at least part of the subject matter for many of these from his work with oats, thereby giving the crop a significantly greater visibility. He has also made great contributions in terms of service to professional societies. His presidency of both the Crop Science Society of America and the American Society of Agronomy top a long list of such services. Oats, as a crop species, has benefited indirectly, but significantly, from this phase of Dr. Frey's career.

Donald J. Schrickel
Award for Distinguished Service to Oat Improvement

Mr. Donald J. Schrickel, as Director - Grain Research and Development with The Quaker Oats Company championed the support and needs of both the oats researcher and the milling oats industry. For over twenty years he strategically placed research funds for the development of productive, high quality oats varieties and for the professional development of graduate students. Additionally, he offered timely council to researchers, administrators and his associates.

Mr. Schrickel began his long association with The Quaker Oats Company in 1950. He held grain purchasing and grain merchandising positions for fifteen years. During these years, he became very aware of the need to continually improve oats varieties and management practices. In 1965, Mr. Schrickel joined Dallas E. Western in the Grain Research and Development department. Consequently, he was in a position to encourage oats research at both state and federal levels. He has appeared before the Agricultural Appropriations subcommittees of both the House and Senate to present testimony on behalf of USDA-ARS and State Agricultural Experiment Station Research. Also, Mr. Schrickel has appeared before ARS Administrators and before various State Agricultural Experiment Station administrators to encourage support for oats research and oats researchers.

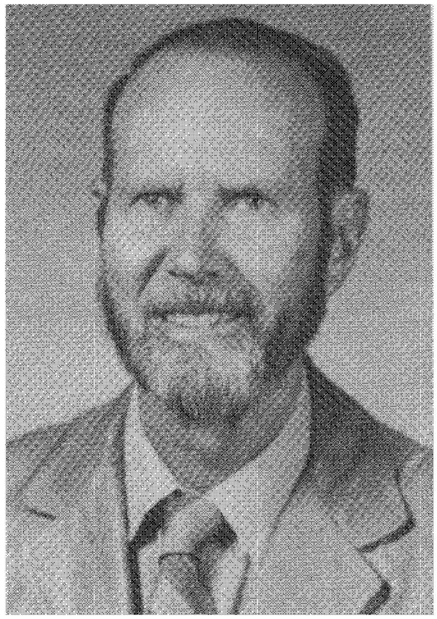
To strengthen the impact of these appearances, Mr. Schrickel founded and was the first president of the Milling Oats Improvement Association. He continues to serve as the chairman of the Legislative Committee which promotes oats research among state and federal officials.

Mr. Schrickel has promoted new oats varieties, management techniques and marketing strategies through several educational programs. The most notable program is the Oats Improvement Program for Future Farmers of America in Iowa, Minnesota, North Dakota and South Dakota.

Over 1000 students from 150 high schools participate in the program. Additionally, Schrickel developed educational materials for distribution to FFA advisors, farmers, elevator operators and grain merchants. Under his guidance, a series of radio programs and advertisements were developed to offer helpful hints concerning timely oats management topics.

Mr. Schrickel expanded the funding of oats research to include Canada and Latin America. In 1986, Quaker will fund sixteen programs in eight foreign countries with the objective of developing new and more productive oats varieties. Additionally, he has implemented the exchange of germplasm among oats researchers all over the globe. This action has significantly improved disease resistance in the Latin American varieties.

Mr. Donald J. Schrickel has made many noteworthy contributions to oats improvement. His untiring efforts to promote and support oats research are unequaled. His enthusiasm for improving the yield and quality of oats serves as a source of encouragement to high school vocational agriculture students and farmers as well. He is highly respected and liked by agricultural research scientists, graduate students, administrators and colleagues. Consequently, Mr. Schrickel is a very deserving recipient of the Distinguished Service to Oat Improvement Award.



Marr D. Simons
Award for Distinguished Service to Oat Improvement

Dr. Marr D. Simons, plant pathologist wish ARS-USDA and professor of plant pathology at Iowa State University, is the world's authority on crown rust disease of oats and a renowned leader in breeding disease resistant varieties of plants. He has been a contributing member of the world's oat research community for the past 35 years via fundamental research, advising graduate students, conducting rust surveys and providing genes for crown rust resistance, and variety development. And for the past decade he has served as local administrator for ARS-USDA plant scientists stationed at Iowa State University.

Dr. Simons has concentrated on research in two areas (a) the genetics and use of tolerance of oats to crown rust and (b) the genetics of vertical resistance genes extracted from *Avena sterilis*, the weedy progenitor of cultivated oats. Tolerance is a characteristic of an oat plant to yield normally in spite of being diseased. Dr. Simons has shown that this trait is quantitatively inherited with heritability generally above 50%. Genes for tolerance to crown rust were discovered in land races and cultivars of *A. sativa* and in several collections of *A. sterilis*, and mutations for this trait were induced by radiation and chemical mutagens. He developed the paired microplot method, in which one plot is diseased and one is maintained disease-free, for testing oat lines for tolerance and pioneered the use of seed weight reduction as an index for this trait. Dr. Simons has explained the inheritance of several vertical genes for crown rust resistance extracted from *A. sterilis*.

Each year, Dr. Simons has conducted a race survey of the crown rust pathogen in the U.S. These surveys, which have shown the trends in the race structure of the crown rust pathogen, have permitted oat breeders to predict what crown rust resistance genes to use in varietal development programs. His prebreeding program with resistance genes from *A. sterilis* has provided numerous parental lines for oat breeders throughout the world.

The research done by Dr. Simons has been recorded in over 100 technical papers. In 1970 he published a monograph entitled "Crown rust on oats and grasses" which serves as a "bible" for pathologists worldwide. Plant pathologists trained by him occupy positions in the U.S. and in foreign countries. He served as editor of the Oat Newsletter for a decade.

It is obvious that Dr. Simons is a productive researcher and teacher: However, his most outstanding attribute is being a friend to everyone. He has given of his time to advise colleagues on research projects and techniques, and during his term as local ARS-USDA administrator, the research facilities and resources for this unit have increased immensely. He is constructive in all things he does.

Dr. Simons has served on several national committees and task forces, given papers at international symposia, and received a number of research grants. He is a fellow of the American Phytopathological Society and has received the Distinguished Iowa Scientist Award from the Iowa Academy of Science.

Marr D. Simons was born May 7, 1925 in Murray, Utah. He received the BS degree from Utah State University in agronomy in 1949. His MS and Ph.D. degrees were earned at Iowa State University in 1950 and 1952, respectively, both in plant pathology. In 1952, he joined the ARS-USDA as a plant pathologist stationed at Iowa State University, a position he still holds. Also, he is a professor of plant pathology in the Department of Plant Pathology and Seed and Weed Sciences, Iowa State University.

AMERICAN OAT WORKERS CONFERENCE - 1986

PLACE: Talisman Motor Hotel
1376 Carling Avenue, Ottawa, Ontario
Canada K1Z 7L5
Phone: 613-722-7601

DATES: July 14-17, 1986.

PROGRAM

July 14 (Monday)

3:00 PM — Meeting of AOW Conference Committee and National Improvement Council, Talisman Hotel.

3:00-8:00 — Registration, Talisman Hotel

7:00 — Social Hour - Carleton West

July 15 (Tuesday)

8:00-10:00 AM — Registration, Talisman Hotel

SESSION 1 — OAT QUALITY (Centennial Room)

Chairman: R.G. Fulcher, PRC, Ottawa

8:10 AM — Opening Remarks - D. Stuthman, Chairman, AOWC

8:15 — Local Arrangements - V. Burrows, Chairman Host Committee

8:20 — Welcome to Ottawa and the Central Experimental Farm - E. LeRoux, Assistant Deputy Minister, Research Branch, Agriculture Canada

8:30 — Quaker involvement in oat research in U.S.: Past, Present and Future.
S. Weaver. Quaker Oat Company, Chicago, Illinois.

8:50 — Oat milling production - Ontario and Quebec.
S. Lockington. Quaker Oats Company, Peterborough, Ontario.

9:00 — Nutritional aspects of oats.
S. Ink. Quaker Oats Company, Chicago, Illinois.

9:20 — Oat bran as a source of dietary fiber.
P.J. Wood. Food Research Centre, Agriculture Canada, Ottawa.

9:40 AM	Internal starch lipids - potential for starch modification. D. Paton. Food Research Centre, Agriculture Canada, Ottawa.
10:00	Refreshments (coffee)
10:20	Improvement of functional properties of oat proteins by chemical modifications. Ching Y. Ma. Food Research Centre, Agriculture Canada, Ottawa.
10:40	Characteristics of good milling oats. M.K. Lenz and F.H. Webster. Quaker Oats Co., Barrington, Illinois.
11:00	Physical characteristics of oat seeds using digital image analysis. S. Symons and G. Fulcher. Cereal Section, PRC, Agriculture Canada, Ottawa.
11:20	Evaluation of lignified components in oat kernels. G. Fulcher and S. Symons. Cereal Section, PRC, Agriculture Canada, Ottawa.
11:40	Discussion.
12:00	Lunch

SESSION 2 GENETICS, BREEDING AND PRODUCTION (Centennial Room)

Chairman: K. Frey, Agronomy Dept., Iowa State University

1:30 PM	Recurrent selection for grain yield. D.D. Stuthman, P.P. Bregitzer, T.S. Payne, R.L. McGraw and N.G. Haugerud. Dept. of Agronomy, University of Minnesota, St. Paul, Minnesota.
1:50	Oat improvement in the high mountain valleys of Chihuahua - Use of the gravimetric method in selection. Philip Dyck. Campo Agricola Experimental Sierra de Chihuahua, Cd. Cuauhtemoc, Mexico.
2:10	Responses of oat poplations to mass selection for seed density. E. Souza and M.E. Sorrells. Department of Plant Breeding and Biometry, Cornell University, Ithaca, N.Y.
2:30	Inheritance of plant height and panicle type in oat (*Avena sativa* L.). L.C. Federizzi and C.O. Qualset. University of California, Davis, California.
2:50	Oat production in Quebec and recent progress in breeding at Ste-Foy Research Station J.P. Dubuc. Station de Recherches, Agriculture Canada, Quebec.
3:10	Refreshments (coffee)

3:30 PM Texas Potpourri: Equipment ideas and a male sterile oat.
M.E. McDaniel. Dept. of Soil and Crop Science, Texas A&M College, College Station, Texas.

3:50 Changes in germination responses of dormoats following stratification or high temperature-moisture treatment.
J. Frégeau and V.D. Burrows. Cereal Section, PRC, Agriculture Canada, Ottawa.

4:10 A methodology for clustering and evaluating crop testing environments.
M.E. Sorrells and E. Souza. Department of Plant Breeding and Biometry, Cornell University, Ithaca, N.Y.

4:30 Discussion

SESSION 3 NAKED OATS AND SPECIAL TOPICS (Centennial Room)

Chairman: E. Reinbergs, Crop Science Dept., Guelph University

7:00 PM Breeding naked oats at (Coker) CR seeds.
H. Harrison. Cokers Seed Company, Hartsville, South Carolina.

7:20 Oat improvement at the Plant Research Centre, Ottawa.
V.D. Burrows. Cereal Section, PRC, Agriculture Canada, Ottawa.

7:50 Seed treatment of Tibor naked oats.
R.V. Clark and D.A. Galway. Cereal Section, PRC, Agriculture Canada, Ottawa.

8:00 Discussion

8:20 NCR-15 Meeting

July 16 (Wednesday)

SESSION 4 DISEASES, NEMATODES AND HERBICIDES (Centennial Room)

Chairman: C. Murphy, USDA, ARS, NPS, Beltsville, Maryland

8:00 AM Breeding for resistance: Myth or reality. The example of BYDV Resistance
A. Comeau. Station de Recherches, Agriculture Canada, Ste-Foy, Quebec.

8:20 Inheritance of tolerance to barley yellow dwarf virus in three advanced - generation oat populations.
D.E. Baltenberger, H.W. Ohm and J.E. Foster, Dept. of Agronomy, Purdue University, Lafayette, Indiana.

8:40 Searching for resistance to barley yellow dwarf virus in oats.
C. Qualset, P. Zwer and L. Federizzi. University of California, Davis, California.

9:00 AM The inheritance of stem rust resistance from derivatives of CI9221.
J. Erpelling and M.S. McMullen. Agronomy Department, North Dakota State University, Fargo, N.D.

9:20 Duplication and pyramiding of crown rust resistance genes in nature.
L.J. Michel and M.D. Simons. ARS, USDA and Iowa State University, Ames, Iowa.

9:40 Quantitative response of oat breeding lines to crown rust infection.
M.D. Simons, K.J. Frey, L.J. Michel and G.A. Schuler. ARS, USDA and Iowa State University, Ames, Iowa.

10:00 Refreshments (coffee)

10:20 Modification of the international oat rust nursery program.
J.G. Moseman. ARC, USDA, Beltsville, Maryland.

10:40 The oat cyst nematode and its effect on oats in Michigan.
B. Burnett, R. Freed and G. Bird. Michigan State University, East Lansing, Michigan.

11:00 A revised look at herbicides on oats.
D. Reeves. Plant Science Department, South Dakota State University, Brookings, South Dakota.

11:20 Yield and quality of oat-pea, barley-pea mixtures harvested for forage.
M.A. Brinkman and J.B. Stevens. Dept. of Agronomy, University of Wisconsin, Madison, Wisconsin.

11:40 Discussion

12:00 Lunch

TOUR OF CENTRAL EXPERIMENTAL FARM PLOTS AND FACILITIES

2:00 PM Tour leaves Talisman Hotel by bus to Experimental Farm. Weather permitting we will visit yield tests, breeding nurseries, rust nursery, dormoat plots and naked oat plantings. We will also try to accommodate requests to see specific laboratories, other crops or special pieces of equipment. Special requests should be made at the time of registration.

6:00 PM BANQUET AND SOCIAL EVENING, TALISMAN HOTEL (Carleton East)

July 17 (Thursday)

SESSION 5 SYMPOSIUM - BIOTECHNOLOGY (Centennial Room)

Chairman: I. Altosaar, Biochemistry Dept., University of Ottawa

8:00 AM Molecular biology techniques for oat crop improvement.
I. Altosaar. Biochemistry Dept., University of Ottawa, Ottawa.

8:30 AM Application of biotechnology in crop improvement.
W. Keller. Genetic Engineering Section, PRC, Agriculture Canada, Ottawa.

9:10 Oat cell cultures for variation, selection, and gene-transfer.
H.W. Rines. Department of Agronomy and Plant Genetics, and USDA-SEA-AR, University of Minnesota, St. Paul.

9:50 Refreshments (coffee)

10:10 Disease resistance and molecular strategies.
A. Nassuth. Max Planck Institute, Munich, Germany.

10:40 Species relationships in *Avena* as defined by molecular probes.
S.F. Fabijanski. Molecular Biology Division, Paladin Hybrids Inc., Brampton.

11:10 Is recombinant DNA technology contributing to crop development?
R. Kemble. Plant Molecular Biology Section, Allelix Inc., Toronto.

11:50 Discussion

12:00 Lunch

1:30 PM Business Meeting - Chairman, Deon Stuthman (Centennial Room)

3:30 Conference closed.

AMERICAN OAT WORKERS CONFERENCE - 1986

July 14-17, Ottawa, Ontario

POSTER PRESENTATIONS

1. Processing Aqueous Treated Cereals.
   V.D. Burrows, R.G. Fulcher and D. Paton. Plant Research Centre, Agriculture Canada, Ottawa.

2. Phenolic Compounds in Oats: Structure and Biochemical Properties.
   F.W. Collins and D.G. McLachlan. Food Research Centre, Agriculture Canada, Ottawa.

3. Stem Rust Races on Oats in Eastern Ontario.
   R.V. Clark and L. Seaman. Plant Research Centre, Agriculture Canada, Ottawa, Ontario.

4. Molecular Biology of Storage Protein Biosynthesis in Oats.
   S. Fabijanski, A. Nassuth, S. Chang and K. Adeli. Biochemistry Department, University of Ottawa, Ottawa, Ontario.

5. Inheritance of Protein Content and Composition in Oats.
   S. Fabijanski. Biochemistry Department, University of Ottawa, Ottawa, Ontario.

6. MSTAT - A Microcomputer Program for Agricultural Research.
   F. Freed and B. Burnett. Michigan State University, East Lansing, Michigan, USA.

7. Dormancy Studies - Dormoats.
   J. Frégeau. Plant Research Centre, Ottawa, Ontario.

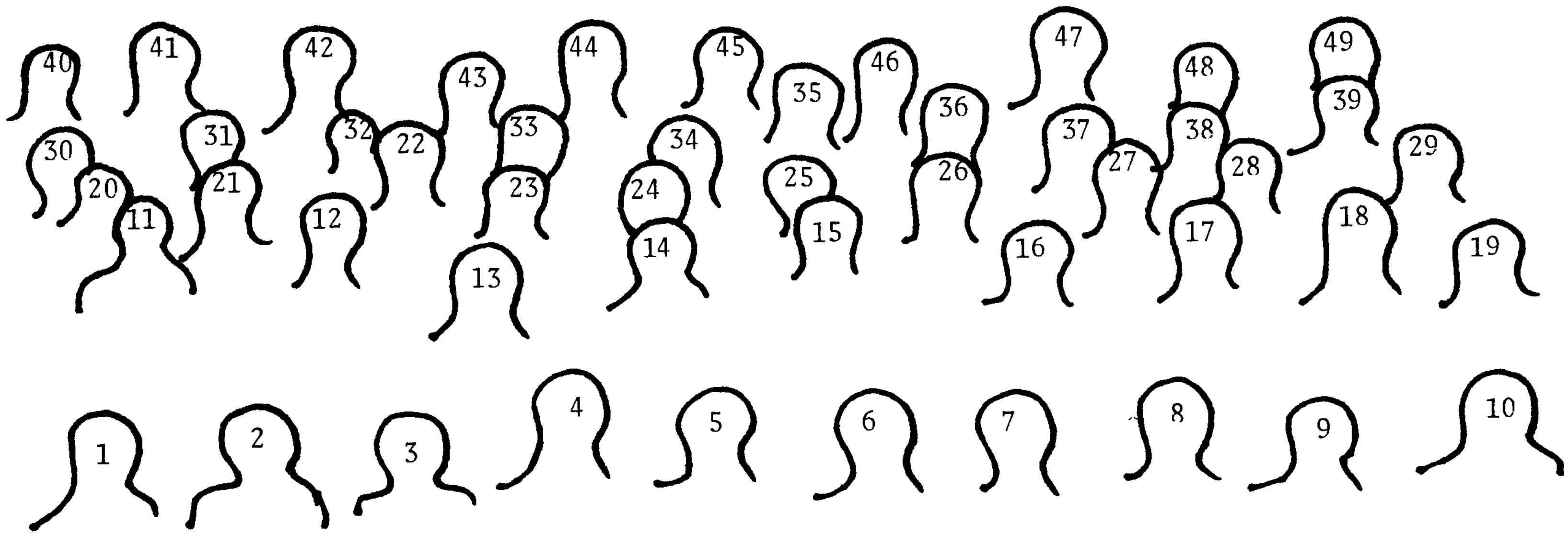
8. Investigations on Crown Rust/Puccinia coronata f. sp. avenae F. et Led./in Poland.
   Maria Mazaraki. w.l. D luga 11A/6, 31-147 Krakow, Poland.

9. Lipase Measurements in Oats.
   S. Miller. Biochemistry Department, University of Ottawa, Ottawa, Ontario.

10. Winterhardiness of USDA National Small Grain Collection Accessions in Idaho.
    D.M. Wesenberg, J.C. Craddock, D.H. Smith, and L.W. Briggle. USDA-ARS, Aberdeen Research and Extension Center, Aberdeen, Idaho, 83210.

11. Impacts of Processing and Cooking on Oat Complex Carbohydrates: A Histochemical Study.
    S.H. Yiu. Food Research Centre, Agriculture Canada, Ottawa.

Conference Members Attending Tour of Ottawa Oat Plots



1. C. Henson
2. H.L. Shands
3. B. Burnett
4. H.G. Marshall
5. R.A. Forsberg
6. D.D. Stuthman
7. M.S. McMullen
8. D. Western
9. J. Frégeau
10. V.D. Burrows
11. S.H. Weaver
12. K.J. Frey
13. B. Fedak
14. L.J. Michel
15. M. Brinkman
16. S. Kibite
17. H.W. Rines
18. G. McDiarmid
19. L. Federizzi
20. D. Paton
21. G. Fulcher
22. M. Lenz
23. E. Sousa
24. G. Sadaranganey
25. M. Sorrells
26. H.W. Ohm
27. D. Schrickel
28. D. Baltenberger
29. R.V. Clark
30. A.I. Comeau
31. T. Rajhathy
32. F. Webster
33. D. Goslin
34. C.M. Brown
35. J. Cretney
36. M.D. Simons
37. J.G. Moseman
38. J.P. Dubuc
39. H.R. Klinck
40. D. Brown
41. B. Roskens
42. D. Burnette
43. H. Smith
44. D.M. Wesenberg
45. R. Gooding
46. D.L. Reeves
47. C.F. Murphy
48. B. Rossnagel
49. D. Falk

AMERICAN OAT WORKERS CONFERENCE

July 14-17, 1986, Ottawa, Ontario, Canada

ABSTRACTS

THE QUAKER OATS COMPANY INVOVLEMENT IN OATS RESEARCH IN THE USA: PAST, PRESENT AND FUTURE

S.H. Weaver
Quaker Oats Company, Chicago, Illinois

The Quaker Oats Company has been involved in the development of oats improvement programs since 1941. Dallas E. Western placed the first grant at Iowa State University with the objective of introducing crown rust resistance into oats. Immediately following, he initiated a second program at Iowa State University which was specifically defined as an oats breeding program. The objective was to interface with the pathology position and to develop high yielding varieties with greater groat percentage. These two projects have evolved into the H.C. Murphy Assistantship in Plant Pathology and the Dallas E. Western Assistantship in Agronomy.

By the early 1960's, Quaker had expanded oats research funding to six additional experiment stations. There was also a major shift in research objective to increasing the groat protein percentage. Tremendous success was realized with the release of high protein varieties such as Dal, Iowa Multilines, Goodland, Lyon, Spear and Otee. However, by the mid 1970's grain yield per acre became the major area of emphasis with reduced interest in high groat protein percentage.

In order to realize the new objective of high grain yield with adequate groat protein percentage, Quaker, under the guidance of D.J. Schrickel, expanded its research funding to include fourteen experiment stations. Among these various research programs are a number of cooperative USDA programs. The excellent interaction among all the experiment stations, USDA and Quaker again proved to be very successful with the release of high yielding varieties.

The training and personal development of graduate students has been and will continue to be an integral part of Quaker's research programs. A significant number of private and public plant breeders have received assistance from Quaker for their educational programs.

Because of the value of oats to The Quaker Oats Company, research funds will continue to be made available for the development of new high yielding, disease resistant, stress tolerant and high quality, milling oats varieties. There will be an integration of basic sciences and biotechnology into the traditional breeding programs. The strong breeding programs will serve as a delivery mechanism for the new advances in biotechnology.

OAT MILLING PRODUCTION - ONTARIO AND QUEBEC

S. Lockington
Quaker Oats Co. of Canada Ltd., Peterborough, Ontario

It's an honour for me as a Quaker Oats of Canada representative to address this distinguished group of oat workers. Oat improvement in Canada began with the choosing of superior imported strains in the early 1600's in Quebec and then progressed through early efforts in breeding in the 1880's to the increasingly sophisticated breeding programs of today. There has been a marked decline in oat acreages over time but the productivity per seeded acre has increased due to better management practices and better varieties. Quaker Canada has contributed to oat growing by paying premiums for the delivery of milling quality oats and to oat improvement by contributing financial aid to breeding programs. In Ontario the introduction of Donald, Woodstock and Ogle oats has had a major impact on the image of oats as a crop and in planning crop rotations. The demand for milling oats will continue with premiums paid over feed quality. Quaker recommends the federal and provincial governments continue to fund oat research for the benefit of farmers and food processors. Ongoing research is necessary to provide profitable oats for industry and for producers. Experiences gained in the last five years have demonstrated that Ontario can produce sufficient quantities of high quality oats for finished products which will be recognized in foreign markets.

Let us not overlook the value of by-products and specialty products produced in the milling of oats. Fibre in feeds is all important to the dairy industry and becoming more so as new products are developed. The hulls and oat middlings obtained are in demand in Ontario feed and pet food industries, and therefore, are marketable and essential to these markets.

With collective support from industry such as Quaker Oats, I feel confident the oats produced in Ontario and Quebec will in the future provide our milling industry and the feed trade with opportunities to produce new products as well as maintain our present quality food products for Canadian and foreign consumers. Oats will continue to be a welcome nutritional product in every market.

Quaker Oats Company of Canada thanks the governments and personnel in every area who have supported research of oats for milling and feed, and especailly those who have dedicated their time for the improved results we enjoy today.

NUTRITIONAL ASPECTS OF OATS

Steven L. Ink
The Quaker Oats Company, Barrington, Illinois

When the nutrient composition of oats is compared to that of other grains, it becomes apparent that oats have unique nutritional qualities. Oats are high in protein of good quality, calcium, iron, phosphorus, magnesium, zinc, thiamine, riboflavin, folic acid, and vitamin E; and, as a result, oats can make a significant contribution towards meeting metabolic needs for these nutrients.

In addition to being a good source of the above nutrients, oats generally contain more water soluble dietary fiber than other cereal grains. This soluble fiber, which consists mostly of mixed β linked (1,3) and (1,4) glucans, has several health related implications for man, including a hypocholesterolemic effect. The physiological effects of soluble fiber in the gastrointestinal tract appear to mediate the hypocholesterolemic effect of oat consumption. The research supporting a cholesterol lowering effect of oats in man as well as the potential underlying mechanisms will be discussed.

OAT BRAN AS A SOURCE OF DIETARY FIBER

P.J. Wood
Food Research Centre, Agriculture Canada, Ottawa

The current public interest in dietary fiber provides food manufacturers, especially processors of cereals, with marketing opportunities and challenges those of us in research, particularly in government, to clearly demonstrate relationships between intake and health. Problems with definitions and analysis remain, and cause some confusion. For many, fiber is synonymous with wheat bran, and the different physiological responses to insoluble and so-called soluble dietary fiber are not widely recognized or understood.

Oat bran differs from wheat in that it is a source of soluble dietary fiber, and it is believed that this soluble fiber, or polysaccharide gum, has hypocholesterolemic and possibly hypoglycemic effects. The main constituent of oat gum is a (1→3) (1→4)-β-D-glucan which is distributed throughout the endosperm as the major cell wall polysaccharide. Greatest concentrations are found in the outer layers of the groat as a result of thick sub-aleurone endosperm cell walls. Oat bran is enriched in these thick cell-walled outer layers, and as a result may contain two to four times the amount of β-glucan found in whole rolled oats. A method for preparing oat bran containing 13-15% β-glucan will be described. The structure and properties of this polysaccharide will be discussed and compared to a similar polysaccharide from barley.

INTERNAL STARCH LIPIDS - POTENTIAL FOR STARCH MODIFICATION

D. Paton
Food Research Centre, Agriculture Canada, Ottawa

Most cereal starches are now known to contain small quantities of lipid bound within the structurally organized starch granule. Oat starch contains a higher amount of these lipids than corn, wheat or rice. An examination of this starch by Differential Scanning Calorimetry reveals the presence of a large endotherm due to the complexing of 60% of the available amylose by the internally bound starch lipids. These lipids control the way in which the amylose and amylopectin are leached from the granule and also the characteristics of the cooked starch gel. These findings raise the possibility of increasing the amount of internally bound starch lipids of oats through breeding/biotechnology to a level which would complex with all of the amylose, thus creating a novel naturally occurring modified starch.

IMPROVEMENT OF FUNCTIONAL PROPERTIES OF OAT PROTEINS BY CHEMICAL MODIFICATIONS

C.Y. Ma
Food Research Centre, Agriculture Canada, Ottawa

There is a constant world demand for less expensive proteins with food nutritional and functional properties. Proteins from oats have the best nutritive value among cereals, but are not used extensively for human consumption in the form of processed food. By chemically modifying the oat proteins, the functional properties can be improved, and the modified proteins can be used in a wider variety of food products. In this work, oat proteins were modified by acylation and treatment with linoleate or proteolytic enzyme. Some functional properties, including solubility, emulsifying capacity, and water and fat absorption, were found to be improved. The performance of these modified proteins in comminuted meat system was also assessed.

CHARACTERISTICS OF GOOD MILLING OATS

M.K. Lenz and F.H. Webster
Quaker Oats

Quaker's current specifications for milling oats consider five major factors. These are sound cultivated oats, foreign material, moisture, test weight and protein. Bonuses are paid for a minimum amount of unsound oats or foreign material. With proper procedures the grower can control foreign material levels and should be paid for the extra effort. Moisture is controlled to assure proper storage stabilities of the oats. Test weight has been de-emphasized as a critical parameter in the last several years. Oats with test weights greater than 34 lbs/bushel are considered to be acceptable for milling. Currently a minor premium is paid for oats over 38 lbs/bushel. Finally, our milling oat specification requires a protein content of 16.0% or higher. We would prefer groats with 17-18% protein.

Several new tests are under consideration for specifying milling oats. They are: groat percentage in the oats, milling yield of the oats and breakage susceptibility of the groat. Test methods, results and conclusions will be presented.

PHYSICAL CHARACTERISTICS OF OAT SEEDS USING DIGITAL IMAGE ANALYSIS

S.J. Symons and R.G. Fulcher
Cereal Section, Plant Research Centre, Agriculture Canada, Ottawa

Within any sample of a single variety of domestic oats, considerable structural variation exists since each sample usually contains the two or more populations derived from the primary, secondary, and perhaps tertiary locations within the spikelet. As part of an ongoing investigation into the relationship between oat quality and kernel organization, morphometric measurements were made using digital image analysis on oat varieties over two years at several locations in the Eastern Canada Co-operative testing programme. The measurements were used to determine a variety of kernel shape and size distributions, and to characterize more precisely the structural properties of the primary and secondary kernels within each sample. The results of the study will be discussed in relation to both milling quality and varietal identification.

EVALUATION OF LIGNIFIED COMPONENTS IN OAT KERNELS

R.G. Fulcher and S.J. Symons
Cereal Section, Plant Research Centre, Agriculture Canada, Ottawa

All oat kernel tissues contain phenolic compounds. In some cases such as in the hulls and groat pericarp, the compounds are highly polymerized to form lignin, and may contribute a significant percentage of the dry weight of the tissue. In other tissues, such as the aleurone layer and scutellum, phenolics occur as relatively simple esters and may also provide a significant proportion of the dry weight of the tissue. Although the variation and precise chemistry of the phenolics which occur in oat tissues has not been well documented, the fact that they often exhibit distinctive spectral characteristics suggests that these properties might have some potential for identification and quantitation of specific quality-related tissues and components in different oat cultivars. To this end, samples of whole and ground kernels from several different cultivars have been examined by microspectrofluorometry to determine the fluorescence emission wavelengths which are characteristic of different tissues. In addition, studies are underway to determine if specific wavelengths can be used to improve the speed and precision of estimating the proportion of certain tissues, such as hulls, in potential new oat varieties. Preliminary results indicate that there is a strong correlation between hull percentage and fluorescence intensity at certain wavelengths.

RECURRENT SELECTION FOR GRAIN YIELD

D.D. Stuthman, P.P. Bregitzer, T.S. Payne, R.L. McGraw and N.G. Haugerud
Department of Agronomy and Plant Genetics
University of Minnesota and USDA-ARS

In 1968 we initiated a recurrent selection program in oats by intercrossing 12 parents selected for their high yield and diversity. Our original objectives were to (1) assess the effectiveness of recurrent selection to improve grain yield; (2) generate high yielding germplasm; (3) measure correlated responses; (4) determine the relationship between parent and homozygous progeny performance; and (5) obtain estimates of relevant genetic variance parameters. F_2 progeny from those 12 original parents were advanced to the F_5 generation using SSD to produce 10 lines per cross combination. Yield evaluations of F_6 lines were conducted with replicated hill plots. The parents for the next cycle were selected by first identifying the 21 highest yielding cross combinations (average of 10 lines) and then choosing the highest yielding line within those 21 crosses. Those 21 parents were intercrossed using a circulant partial diallel to produce 63 crosses. In the fall of 1984, we intercrossed 21 C_4 parents to produce fourth cycle progeny. Yield of 1984, we intercrossed partial to produce 63 crosses. In the fall of 1984, we intercrossed 21 C_4 parents to produce fourth cycle progeny. Yield comparisons of the parents of each cycle C_0 through C_4 at two locations in 1985 indicated a 28% increase in grain yield from C_0 to C_4. Height and grain weight were also increased. In an associated study C_3 parents were compared to the original 12 parents for physiological and morphological traits. The length of the vegetative growth period was extended but vegetative growth rate was virtually unchanged. In contrast, the length of the grain filling period did not change but the grain growth rate increased. The increase in biomass (15%) was slightly larger than that for grain yield (12%), thus harvest index declined slightly. All plant parts measured increased in size; however, no one individually was consistently or closely enough related to grain yield to suggest that indirect selection for a single plant part would increase grain yield.

OAT IMPROVEMENT IN THE HIGH MOUNTAIN VALLEYS OF CHIHUAHUA - USE OF GRAVIMETRIC METHOD IN SELECTION

P. Dyck, Campo Agricola Experimental Sierra de Chihuahua,
Cd. Cuauhtemoc, Mexico

In the High Mountain Valley region of Chihuahua 100,000 hectares of oats are seeded annually. The oat improvement program involves producing high yielding oats for growing periods of 85 to 100 days, which is rust, lodging, shatter resistant and drought tolerance and has high protein and groat content. The methods used to produce such cultivars have been introduction of foreign material whereby such varieties as Texas, Newton, Clintland, Nodaway and AB-177, have been introduced to Mexico; pedigree selection method whereby the cultivars Cuauhtémoc, Chihuahua, Guelatao, Tarahumara and Paramo have been released; and in the last few years the new gravimetric bulk selection method. By this method we hope to release two cultivars.

RESPONSES OF OAT POPULATIONS TO MASS SELECTION FOR SEED DENSITY

E. Souza and M.E. Sorrells
Dept. of Plant Breeding and Biometry, Cornell University, Ithaca, N.Y.

Changes in seed quality characteristics of segregating oat populations after two cycles of mass selection for seed density in segregating oat populations were evaluated in a series of experiments. Two field experiments were conducted in the 1985 growing season. The first experiment compared the efficacy of the mass selection techniques that proved to be effective in preliminary experiments: aspiration and the gravity table with the seed polishing pre-treatment. The second experiment was conducted to measure the response of the populations to selection by aspiration. The ability of these selection methods to improve groat percentage appears limited.

The agronomic characters that changed with selection for seed density were tertiary floret fertility, heading and harvest index. There appears to be no difference between the two selection methods for response of milling percentage or most of the other traits measured. The aspiration selection gave non-linear changes for most of the traits evaluated over two cycles of selection. The aspiration treatment does select for genotypes that have a higher frequency of tertiary florets and increased number of fertile florets per spikelet. Compensation among florets within a spikelet probably limited gain from selection for test weight and groat percentage. This and earlier experiments indicate that selection should be made among larger seed size fractions that would be expected to be composed mainly of kernels from primary florets.

INHERITANCE OF PLANT HEIGHT AND PANICLE TYPE IN OAT (*Avena sativa* L.)

L.C. Federizzi and C.O. Qualset
University of California, Davis

In species of agronomic importance reduction of plant height has resulted in large increases in grain yield due to reduction of lodging, improved harvest index, and more efficient utilization of the environment. In oat few sources of dwarfing genes are available and new sources are desirable. An experiment was performed to: (1) study the inheritance of plant height in eight crosses involving tall genotypes California Red (CR), short-statured genotypes OT 207 (OT) and Curt (CT) and dwarf genotypes NC 2469-3 (NC) and Palestine Dwarf (PD); (2) determine the inheritance of panicle density in crosses of genotypes with lax panicle (OT and CT) with genotypes with compact panicles (NC and PD) where panicle density was obtained by scoring visually F_2 plants for compact, intermediary and lax panicles; and (3) estimate phenotypic correlations of mean plant height and panicle density of F_3 families.

Data from parents F_2 and F_3 populations indicated that two loci with multiple alleles accounted for the phenotypic differences in plant height observed in the genotypes utilized as parents. CT has two genes for reduced plant height which were recessive in the cross with CR. OT has a gene which was semidominant to one locus in CR. Cross of OT with CT did not give a three-gene segregation as expected from previous crosses. Two-gene segregation was observed which suggested that the gene for reduced plant height present in OT is allelic to one locus in CT. Crosses of NC and PD with OT indicated that the height reduction gene present in NC and PD is different from the gene in OT and these two genes can be recombined. Phenotypic expression of plant height in NC and PD was similar. However, it is unlikely that the genetic control is the same, and more consistent evidence is needed. Populations of the cross NC and PD with CT gave a single-gene segregation and no recombinant types were observed. These results indicated that the gene present in NC and PD is allelic to one of the genes of CT. The proposed genotypes of parents for plant height were: CR, AABB; CT, aabb; OT, AAb_1b_1; NC, a_1a_1bb; and PD, a_1a_1bb or $a_1a_1b_2b_2$.

In all crosses studied differences in panicle type (lax vs. compact) were due to one gene with no dominance. For panicle density families F_3 were visually classified in three groups: 1: homozygous compact, 2: segregating, and 3: homozygous lax. Phenotypic correlation of mean plant height and group value for panicle type of F_3 families were positive and high in the crosses of CT x NC and PD x CT^3 (r = 0.84 and 0.82, respectively). In populations from the crosses of OT with NC and PD phenotypic correlations of plant height and panicle type were not as severe as in the crosses mentioned above (r = 0.61 and 0.51, respectively). Several F_3 families with lax panicle type and mean plant height less than 100 cm were recovered, especially in the cross NC x OT.

The short-statured genotypes used in this study may be of considerable importance for breeding additional short-statured cultivars because of their genetic diversity and simple inheritance of height reduction and panicle type.

OAT PRODUCTION IN QUEBEC AND RECENT PROGRESS IN BREEDING AT SAINTE-FOY RESEARCH STATION

J.-P. Dubuc, A. Comeau and L. Couture
Agriculture Canada, Research Station, Sainte-Foy, Quebec

In 1985, the grain industry in Quebec included maize, barley, oats, mixed grains and wheat by order of importance. In 1970, there was four times more hectares seeded to oats than all other cereals together. Maize and barley really came forth with a seven-fold and sixteen-fold increase respectively since 1970.

Self-sufficiency in feed grain consumption in 1985 was 88% compared to 30% in 1970 but there is a slight overproduction in oats (10% in 1983); part of the surplus is now going to human food.

The following table shows the area, yield and production of oats since 1970:

	1970	1975	1979	1982	1985
Area (ha)	374 300	284 000	219 000	163 000	150 000
Yield (t/ha)	1.68	1.50	1.89	1.90	2.27
Production (t)	629 000	426 000	414 000	310 000	340 000
Farm value	$23 x 10^6$	$43 x 10^6$	$42 x 10^6$	$40 x 10^6$	$44 x 10^6$

The total production value of oats in 1985 was around $44 000 000, an increase of 9% over 1982 despite a drop of 8% in surface seeded. Total production was 340 000 t in 1985 up 10% from 1982 but only half of what was produced in 1970. Hectarage has been declining since 1970 and is now down to 150 000 ha (40% of 1970) with no sign of levelling off, as we still produce above our needs and the needs for animal feed may even decrease.

Average yield per hectare is relatively low but is steadily increasing, 35% since 1970. The 2.7 t/ha reached in 1985 are not due to favourable growing conditions only; the large areas seeded with recent high yielding varieties such as Laurent, Lamar, Manic and Woodstock are certainly responsible for a good part of the increment.

At the research station located at Sainte-Foy, near Quebec City, a small oat improvement project was initiated in 1957 and expanded greatly when a responsible breeder was appointed on a continuous basis in 1970.

The main objectives are yield, straw strength, resistance to BYDV, septoria and smut, grain qualities (% hull, size, color, 1000 Kwt and hL wt) and agronomic characteristics (height and maturity). The emphasis is put on increasing energy produced per hectare for it to be attractive to farmers. This is achieved by improving yield, lowering the hull content and improved grain size to a certain extent limiting losses at harvest. Unfortunately the rate of progress in oats is low and the slope of the yield improvement in farmers' fields is lower than in barley and wheat (half as much), increasing the pressure against the crop (following table). There are several causes to this and it is not only due to the crop itself. The tremendous increase in maize and barley hectarage has been made on the best soils under the best climatic conditions in the province displacing oats on marginal soils under restrictive climatic conditions. Knowing these factors, it is amazing to see that oats has even improved its yield by over 50% since 1974.

	1969	1974	1980	1985
Barley	1.98	1.68	2.62	3.35
Wheat	1.75	1.72	2.93	3.50
Oats	1.50	1.45	1.69	2.27

Resistance to diseases is being bred into the crop to stabilize yield over the years but there are not really limiting diseases in Quebec. Yellow dwarf is probably the disease that causes the most damage, we usually quote 10% +, but it is relatively unknown to farmers. The licencing of resistant cultivars will inform us on the real damage BYDV causes to the crop. We have an excellent cooperation between breeder and pathologists to screen for BYDV and smut reaction. It has worked very well with the result that most lines (90% +) in the project are now tolerant to BYDV and resistant to smut. In grain characteristics, emphasis is placed on grain size for farmer's acceptance, low hull for energy production and hectolitre weight to satisfy the grain trade. In agronomic characteristics, straw strength is by far the most important objective. Height and maturity are kept within an acceptable range. Early maturity was emphasized only when potato growers asked for a very early oats in rotation with their main crop. Early maturity was desired to allow them to achieve the grain harvest in time for the potato harvest.

The oat breeding project at Sainte-Foy has been quite successful in licencing cultivars. The fact that Sainte-Foy Research Station is charged with responsibility to improve oats for the Maritime provinces in addition to Quebec has contributed to the success. Out of eight cultivars licenced since 1974, three were to suit Maritime needs. A brief description of each is outlined.

1974 - Alma - 14% improved yield over Garry, the most popular cultivar, at the time, but had small yellow kernels. Resistant to smuts.

1979 - Manic - 4% improved yield over Alma with large white kernels. Tolerant to BYDV.

1979 - Lamar - 17.5% improved over Alma with medium size yellow kernels. A top yielder across Canada. Resistant to smuts.

1981 - Shaw - Licenced for the Maritimes. Better than any existing variety for every agronomic characteristic. Now recommended in Quebec also. Susceptibility to diseases is somewhat high.

1982 - Kamouraska - Yield potential of Lamar but 3 days earlier. No particular disease resistance but top grain quality: low hull, large white heavy kernel with a very high hectolitre weight.

1985 - Marion - Licenced for the Maritimes to fill in for the older early cultivars Fundy and Cabot. Marion is as early as these but produces 15-20% more grain on a much stronger straw.

1986 - Nova - Licenced for the Maritimes to replace Sentinel. Nova is much more tolerant to BYDV, is several days earlier and produces 10% more yield than Sentinel.

1986 - Cardinal - It offers the yield potential of Lamar, 3 days earlier, the top hectolitre weight. It is very tolerant to BYDV and resistant to smuts.

Macdonald College had a breeding improvement project since the early 1900's and has licenced several cultivars, the latest being Laurent, a popular early high yielding cultivar very well adapted to all regions of the province.

The most popular cultivars among Quebec farmers have a large kernel. They would go as far as choosing one with a 10-15% lower yielding potential to get the large grain size. Western Canadian cultivars have large kernels and were widely cultivated before the licencing of large grain cultivars adapted to the area.

At present, the Sainte-Foy Research Station has undertaken the improvement of triticale and wheat for human food. The limited resource are forcing our efforts out of breeding oats except for a small part in introducing dwarf genes into adapted genotypes.

TEXAS POTPOURRI: EQUIPMENT IDEAS AND A MALE-STERILE OAT

M.E. McDaniel, Dept. of Soil and Crop Sciences, Texas, A&M University, College Station, Texas

Equipment: We built a small grain planter which we think is quite convenient and efficient. The planter consists of a 3-point hitch mounted toolbar and operator platform with 7 trip-hoe row openers spaced 6 inches apart. A Hege "belt" cone seeder with an electric motor-driven seed distributor splits the seed into either a 7-row manifold (6" row spacing) or a 4-row manifold (12" row spacing); these spacings do not require moving the row openers on the tool bar. Single-row plots (including short "head-row" or panicle-row plots) are seeded with 4 small Hege belt cone seeders; we use the 12" row spacing for these plots. We use a 52" total plot width (center-to-center tractor tread distance) to provide a between-plot distance of 16" on multiple-row yield-trial plots to be harvested with a plot combine, and a 49" plot width on single row plots to provide relatively uniform spacing between all rows. Our scheme for planting head rows involves seeding two "tiers" of head rows in the same space that a single tier of longer-row nursery plots would occupy; we mark the areas to be seeded to head rows by driving wheel-on-wheel inside the alleyway on each end of the plot, and lightly "scratching" with the row openers. The cone seeders have a very precise seed "drop" distance, and it is easy to accurately align the ends of head-row plots while planting in both directions in the field.

Male-sterile oat: We found a spontaneous male-sterile oat among F_2 progeny in the greenhouse. The sterile has small "arrow-head" anthers similar to those of cytoplasmic-genetic male-sterile wheat. F_1 plants from a cross with the male-sterile plant were grown in the summer at Aberdeen, Idaho and F_2 seed were obtained. Sib F_1 plants grown in the greenhouse at College Station in 1986 appeared completely fertile; a number of F_2 plants from the F_1's grown at Aberdeen were sterile, and had the same anther morphology as the original F_1 plant. The sterile plants have normal floral morphology, and all plants for which root-tip chromosome counts were obtained had 42 chromosomes. Microspore formation appears normal through the tetrad stage, but pollen has no starch. It appears likely that the male-sterility is conditioned by a recessive allele; a reasonably large F_2 population from the original cross will be classified in Idaho this summer; additional crosses to sterile F_2's have been made. We also found a high frequency of 3-lobed stigmas in a commercial cultivar of oats in both field and greenhouse plantings at College Station in the spring of 1986; this topic will be discussed briefly.

CHANGES IN GERMINATION RESPONSES OF DORMOATS FOLLOWING STRATIFICATION OR HIGH TEMPERATURE-MOISTURE TREATMENT

Judith A. Frégeau and Vernon D. Burrows
Plant Research Centre, Agriculture Canada, Ottawa

Seed of dormoats (derivatives of crosses between Avena sativa L. and A. fatua L.) demonstrate various patterns of dormancy. Two dormoats differing in their primary dormancy were chosen for a stratification treatment (5°C/3 weeks) and a heat treatment under moist conditions (30°C/2 weeks): DC1358-7 and PGR8658. Before treatments both lines had approximately 25% of their seed population completely dormant and approximately 35% completely germinable under the laboratory conditions used: 7°C or 20°C, in both Petri plates and potting soil. The remaining 40% were in conditional primary dormancy. For DC1358-7, incubation in Petri plates as opposed to potting soil, regardless of temperature, allowed expression of this conditional dormancy whereas for PGR8658, both temperature and media of incubation influenced expression, high temperature being favorable to dormancy. Secondary dormancy was induced, in both lines at similar levels by both stratification and 30°C treatment bringing the percentage of ungerminable (but still viable) seeds to twice the value before treatments. The lines differed in one instance: drying of the seeds after stratification promoted 20°C germination of secondarily dormant seeds of DC1358-7 incubated in potting soil. Possible consequences of these treatments on field emergence in spring of fall planted seeds will be discussed.

A METHODOLOGY FOR CLUSTERING AND EVALUATING CROP TESTING ENVIRONMENTS

Mark E. Sorrells and Edward J. Souza
Dept. of Plant Breeding and Biometry, Cornell University, Ithaca, N.Y.

A methodology will be presented that is designed to improve the efficiency of cultivar testing by clustering nursery environments based on selected environmental variables, and by identifying optimum selection environments within clusters by linear regression of the performance of genotypes within an environment on mean genotype performance over all environments.

Environmental variables are selected by regressing the site mean on available climatic and edaphic variables. Selected variables are standardized and weighted by regression sums of squares for clustering. Environmental classification of environments allows the elimination of unnecessary or inefficient testing sites, improves the accuracy of testing for a given range of environments, and provides a basis for predicting genotypic performance at an untested site.

A genotypic index regression method is proposed to identify sites that are consistently able to discriminate genotypes. The model is a linear regression of the form $y_{ij.}=a_j+b_jy_{i..}+e_{ijk}$, where $y_{ij.}$ is the i^{th} cultivar mean response to the j^{th} environment, a_j is the j^{th} environment intercept, b_j is the j^{th} environment regression coefficient, $y_{i..}$ is the i^{th} cultivar mean response, and e_{ijk} is the error term. The slope of the regression line reflects the ability of an environment to distinguish between genotypes and the coefficient of the determination indicates the ability of the environment to accurately predict genotypic performance in other environments in the group.

The methodology was applied to three years of data from the Uniform Midseason Oat Performance Nursery. The test environments were placed into three groups based primarily on temperature and precipitation. The locations belonging to each group varied from year to year based on the weather at that location. Within each group, two or three locations were found to be more predictive of variety performance than others. More site specific information, such as soil characteristics, is needed to improve the assessment of the value of each test site. The methodology was helpful in determining which locations were most similar to the intended production region so that the additional data from those locations could be used in a variety release decision.

BREEDING NAKED OATS AT (COKER) CR SEEDS

Howard F. Harrison
Coker Seed Company, Hartsville, South Carolina

There is no known record of naked oats having been grown commercially in the winter oat belt of the Southern United States. Neither have there been any major efforts to develop varieties of naked oats for that region.

Poultry and swine production are important enterprises, and a high percentage of the feed ingredients are shipped in from other areas, adding long distance freight charges to the cost of production.

The nutritive value of oat groats is well known, but removing the hulls mechanically is difficult and expensive.

A program to investigate the feasibility of naked oats was begun in 1977. The naked donors used were C.I. 3030 and C.I. 3031. These donors were very poorly adapted, and several cycles of crosses were made to enhance the selection process. Some of the objectives considered were yield of groats, ease of dehulling, winterhardiness, resistance to diseases and straw strength.

Recent performance results show groat yields of nuda lines comparable to those of the better yielding non-nuda varieties.

Feeding trials with broiler chicks at the University of Georgia indicate that up to 50% oat groats may be used in a ration. At $12.75/cwt for soybean meal, the comparable value of oat groats was calculated at $8.25/cwt.

Studies at Florida indicate that naked oats can replace 100% of the corn and 48% of the soybean meal in a swine ration.

This program is being continued, and additional feeding trials will be conducted in 1986-87.

OAT IMPROVEMENT AT THE PLANT RESEARCH CENTRE, OTTAWA

V.D. Burrows, PRC, Agriculture Canada, Ottawa

Several different breeding strategies and programs have been formulated and instituted to breed oats more suitable for food and feed in Canada. Each program is designed to improve economic returns on the farm and extend the usefulness of oats in food processing and animal feeding.

Dormoats:

An experimental crop derived from hybrids between *A. sativa* and *A. fatua*. The strategy was to incorporate genes for seed dormancy from the wild oat into cultivated oats so that dormant seed is sown in autumn, remain dormant overwinter but emerges in springtime to take advantage of early spring moisture and cool temperatures to develop a high yield potential. Thousands of different dormoat strains have been bred but success will likely depend upon developing a protocol for handling the seed after harvest before planting to make certain that all the seeds follow the desired germination behaviour.

Daylength Insensitive Oats:

A DI gene was identified and transferred from *A. byzantina* (CAV2700) to Canadian cultivars of *A. sativa*. This made it possible to have a winter nursery in Brawley, California to speed our breeding program. It also resulted in strains that are high yielding but early flowering in Canada and have high quality seed for milling purposes (ie. cv. Donald). DI oats are used in mixtures with barley and can be used effectively for late spring seeding.

Dwarf and Semi-Dwarf Oats:

Designed to combat lodging and for intensive cereal management to raise yields. The original dwarfing gene was taken from OT207 and combined with a peduncle extender gene from a tall dormoat strain. No dwarf or semi-dwarf cultivar has yet been licensed but significant progress has been made in improving straw quality, seed size and yield.

Naked or Hull-less Oats:

The program was designed to breed a high quality naked cultivar of superior agronomic qualities whose seed would be superior to wheat, barley and corn in the combination of metabolizeable energy, protein content and amino acid composition. Tibor oats was licensed in 1985 and it has proved to be an outstanding feed for pigs and poultry. Tibor oats properly supplemented with minerals and vitamins can serve efficiently as the sole source of energy and protein for pigs. Also Tibor groats can substitute for up to 60% of the corn and soybean meal in broiler rations. Tibor represents a new standard for naked oats and it is now being used as a recurrent parent in backcrossing programs to incorporate added disease resistance, "bald" seeds, pre-harvest dormancy and genes from the wild oat that permits 100% expression of the hull-less genes.

SEED TREATMENT OF TIBOR NAKED OATS

.<.V. Clark and D.A. Galway
Plant Research Centre, Agriculture Canada, Ottawa

Seed of Tibor naked oats were treated with several combinations of seed treatment chemicals to determine their effectiveness in the field and in the greenhouse after several lengths of storage. The various treatments have involved mixtures of either maneb or carbathiin as liquids, powders, or dual purpose products. It has been found that treatment of seed considerably improves emeregence in soil with several combinations relatively effective. In general dusts such as Vitavax powder (DB) and Agrox NM (DB) have been the most effective formulation but liquid Vitaflo 280 has also given good results. Concentrations three times the recommended rate for wheat have consistently given the best emergence but lower concentrations have also been adequate. Emergence of untreated seed stored for 120 days was excellent in vermiculite (88%) with little improvement from treatment. The same seed emerged very poorly in soil in the greenhouse (43%) and most treatments improved emergence considerably.

BREEDING FOR RESISTANCE: MYTH OR REALITY? THE EXAMPLE OF BYDV RESISTANCE

André Comeau

A review of current ideas and definitions in warranted to generate a useful debate, as lack of agreement on definitions makes any dialogue impossible. There are strong indications that the "gene-for-gene" theory applies relatively poorly in the case of BYDV resistance. This is supported by the fact that the resistance given by the Yd_2 gene in barley held up for more than 30 years in North America and perhaps for millenia in Ethiopia. Other relevant data come from our studies of the genera Secale, Agropyron and Elymus, where BYDV-susceptible plants have not been found so far; it appears that BYDV resistance results from many genes in these three genera, and as these genera seem BYDV-resistant throughout the world, we must be dealing more with "horizontal" than "race-specific" genes. The present evidence indicates that multilines or variety mixtures could not be used against BYDV. As we conclude that the use of pure cultivars with BYDV resistance genes is not expected to suffer from resistance breakdown, the project of breeding BYDV-resistant oats becomes a very promising avenue of research.

Resistance, tolerance or both?

The Federation of British Plant Pathologists (1973) quotes two definitions of resistance as defined by APS. Their first one, "ability of an organism to withstand or oppose the operation of, or to lessen or overcome the effects of an injurious pathogenic factor" has the virtue of generality but the defect of confusing resistance and tolerance. Their second one, "the ability of the host to suppress or retard the activity of a pathogenic organism of virus", is general and rather neatly separated from the concept of tolerance. On tolerance, two definitions are also quoted: "ability to endure infection by a particular pathogen without showing severe disease" (BMS), and "the ability of the affected organism to endure the operation of a pathogenic factor or invasion by a pathogenic organism or virus with little or no reaction, as shown by the more or less complete absence of symptom expression and damage" (APS). One of their relevant comments is that it is important to relate tolerance to a known degree of infection of the host tissues.

Side effects of breeding for resistance: good or bad?

Recently, the idea that breeding for resistance could lead into poorly yielding plant types was developed (Smedegaard-Petersen and Tolstrup, 1985). This concept is quite disturbing to a scientist working on barley yellow dwarf virus resistance. The theory of the Danish scientists is based on the evidence that resistance is an active process causing an expense of energy in the examples discussed, regarding powdery mildew, rusts and *Cladosporium*. How general can this phenomenon be? Can it apply to resistance to other pathogens, viruses and insects?

I would like to present some discussion in response to this challenging theory, taking some examples on BYDV resistance and on resistance to fungi ecologically associated with BYDV.

The BYDV example

In our studies of BYDV resistance in oats, barley, wheat, durum, triticale and wild relatives of cereals, we found that virus resistance was more often present in the highest yielding cultivars for oats, triticale and durum (Comeau, unpublished). In barley and bread wheat, no trend could be observed. This could be taken at face value as a good example against the theory that resistant cultivars must be lower yielding.

However the analysis of reality is more complex. Resistance evaluation can be done practically only with the ELISA method, and it reveals that virus contents peaks after 7-15 days and then declines rapidly to reach a chronic level for the rest of the life of the plant. Therefore, the determination of the virus biomass varies very much on the time axis, and it is difficult to define *a priori* whether the early peak is more critical than the chronic level when defining resistance level. Essentially, resistance is present, but as a quantitative trait which is not all that easy to interpretate.

We are currently comparing field performance under BYDV inoculation with ELISA measurements of BYDV in wheat and wheat relatives, and finding out that in some genotypes, the good performance is related to low virus titers, but in others, a good performance can be obtained despite a relatively high virus contents. This points out that for a given degree of virus contents, genotype differ in their tolerance. So both resistance and tolerance are involved in wheat, and the same matter should be investigated for other cereal species.

As if this was not complex enough, it must be pointed out that BYDV has a strong interaction with various environmental factors and with other diseases. BYDV reduces drought resistance and also resistance to *Septoria* of oats. This should be viewed perhaps not as another technical problem but as a clear indication that selection should be pursued against a complex of disease and stress factors rather than against a single disease (Buddenhagen, 1983).

The BYDV blocks the phloem, starving the roots and accelerating leaf senescence; this decreases drought resistance and results in extra sensitivity to certain root and leaf pathogens. The selection for BYDV resistance in a realistic, complex environment which may include other stresses and diseases may therefore produce plants with better translocation, better root systems, and better resistance to Septoria and other fungi, as predicted by St-Pierre (unpublished) as early as 1973.

Some evidence that Septoria resistance can be obtained together with BYDV resistance is obtained when Septoria ratings are plotted against plant maturity. In absolute terms, the most BYDV-resistant cultivar grown in Canada, Ogle, has a relatively good resistance to Septoria. This fungal resistance is especially unexpected as early-ripening cultivars are usually susceptible to this fungus. We would therefore suggest Ogle as a parent in breeding for combined resistance to BYDV and Septoria. We would also suggest that before accepting the theory that disease resistance means low yields, we should pay attention to the fact that in the 1985 trials in Eastern Canada, the top yielding line was very resistant to BYDV, and this line yielded 6% above the highest-yielding check in a year where BYDV was not a problem.

Conclusion

It will take a long time to sort out what is the role of resistance and tolerance in the field performance of cultivars exposed to BYDV. It would seem however that BYDV "resistant" (or tolerant?) cultivars can be high yielding and have good agronomic characters. The recent licensing of two BYDV-resistant oat cultivars, Nova and Cardinal, from the Dubuc program in Ste-Foy, could be taken as another case showing that it is relatively easy to reconcile the goals of the breeder and those of the pathologist in order to achieve practical results.

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INHERITANCE OF TOLERANCE TO BARLEY YELLOW DWARF VIRUS IN THREE ADVANCED - GENERATION OAT POPULATIONS

D.E. Baltenberger, H.W. Ohm and J.E. Foster
Dept. of Agronomy, Purdue University, Lafayette, Indiana

Tolerance to the barley yellow dwarf virus (BYDV) has been shown to be quantitatively inherited in oats. The lack of identification of specific genes for tolerance to BYDV in oats may be partly due to the techniques used in infestation and evaluation of test plots. This study uses a procedure combining single seed descent, controlled infestation of seedlings and protection of plants in the field from natural aphid populations.

Four homozygous-tolerant oat lines were mated in the following three singlecrosses: 73109B7-132-101-7-1/72266B1-2-3-1, Acc. 1575/ 76163A1-14-5-3-1 and 72266B1-2-3-1/76163A1-14-5-3-1. A population of F_2 plants from each of the three singlecrosses was produced and F_2-derived lines from each of these populations were advanced to the F_7 generation by single seed descent. Each F_7 family and all parents were planted in flats in individual cells consisting of 10 seeds. Seedlings were infested at the one-leaf stage in the greenhouse with viruliferous Rhopalosiphum padi aphids carrying either the RPV or PAV isolates of BYDV. The infested plants and control were transplanted in the field in a split plot design with two replications. Lines and parents were assigned at random to whole plots. The treatments RPV, PAV and a control were assigned to subplots. Subplots were hill plots spaced 30 cm apart in a grid. The experimental area was protected by a wood frame cage covered with a nylon screen to exclude natural populations of aphids. Grain yield and a BYD symptom score were recorded for each subplot. Analysis of the means indicate that the parents in these crosses differ by few genes for tolerance to BYDV.

SEARCHING FOR RESISTANCE TO BARLEY YELLOW DWARF VIRUS IN OATS

C.O. Qualset, Pamela Zwer, and Luiz Federizzi
University of California, Davis, California

BYD continues to be an important disease of cultivated and wild oats in California. The cultivated crop, used mainly for forage, is relatively small in California. In some years wild oats are harvested extensively for hay. The total area planted each year seldom exceeds 400,000 acres. A major breeding effort has not been undertaken at the University of California since the retirement of USDA breeder C.A. Suneson in 1968, rather, extensive evaluation of introductions from other areas has been done with the hope that introductions may be used directly in California. BYD has been given top priority followed by crown and stem rust in the evaluation program.

We have evaluated selections from several breeding programs, the Quaker Oats International Nursery (QOIN), and, most recently, the USDA World Oat Collection. It was our intent that the results of BYD screening nurseries would be useful elsewhere in breeding. The method adopted has been to plant the BYD test plots in March to take advantage of spring aphid flights. Most of the California oat crop is fall-planted using varieties having spring growth habit. We have completed a 3-year study of BYD symptom expression in the QOIN with both fall and spring planting. Generally, the BYD scores (0 to 9, none to severe) were higher with spring planting and the best entries in the spring planting had the best scores in the fall planting. However, a few entries had acceptably low scores in the fall, but were not acceptable in the spring. The spring planting seems valid for identifying the best sources of resistance and would be useful for selection purposes in a breeding program. We have also evaluated the use of single-plant scores in space-planted fall and spring nurseries. Plot means gave a good representation of BYD reaction. The advantage of space-planting was that apparent disease-free plants could be identified and a high frequency of plants with 0 scores (escaping or resisting the disease) could be further investigated.

From these studies the good resistance in some U. Ill. lines has been verified, Cayuse and Appaloosa have useful resistance, Coker 81-32 and Coker 82-33 had the lowest scores in three years of the QOIN, and short-statured selections from an Australian cross have outstanding overall performance in California.

THE INHERITANCE OF STEM RUST RESISTANCE FROM DERIVATIVES OF C.I. 9221

John Erpelding and Michael S. McMullen
Agronomy Dept., North Dakota State University, Fargo, N.D.

Breeding lines derived from the germplasm line C.I. 9221 with the pg-a gene complex conferring resistance to stem rust (Puccinia graminis Pers. f. sp. avenae Eriks) have been used extensively as parents in the North Dakota oat breeding program. One of these derivatives, ND811386 (C.I. 9221/Otee//RL3038/Dal), has produced a progeny with a high level of stem rust resistance typical of pg-a and good agronomic performance. Segregating progeny from ND811386 were used to study the inheritance of stem rust resistance from this line. ND811386 was crossed with ND10439 (RL3038/Kelsey//M22/Kelsey) which is homozygous for pg-13 and lacks the pg-a complex. All of the 176 F_2-derived lines in the F_3 generation from this cross produced a type 2 reaction or less, typical of pg-13, when seedling inoculated with race NA27. The lack of susceptible progeny from this cross when inoculated with NA27 confirms the presence of pg-13 in ND811386. The combination of pg-13 with pg-a should provide resistance to a very wide range of stem rust virulence.

F_2 families in the F_4 generation were seedling inoculated with race NA26, which is virulent on pg-13 but avirulent on pg-a. The segregation of the high level of resistance to NA26 conferred by the pg-a complex fit a model of 3 recessive genes conferring the resistant reaction. F_4 families in the F_5 derived from the F_4 plants which were seedling tested with NA26 were evaluated in hill-plots infected with race NA27. Six susceptible lines were observed out of the 1700 lines evaluated. The susceptible lines examined cytologically appear to be aneuploids presumably involving the chromosome with pg-13. Comparison of the stem rust reactions involving NA27 obtained in the field with those of NA26 in the greenhouse suggests that NA27 may be used effectively in the field to select for the pg-a gene complex.

DUPLICATION AND PYRAMIDING OF CROWN RUST RESISTANCE GENES IN NATURE

L.J. Michel and M.D. Simons
A.R.S., U.S. Dept. of Agriculture and Iowa State University

Several years ago, a plant breeding graduate student at Iowa State University (A. Rezai) classified 457 lines of Avena sterilis for 15 agronomic traits and for seedling reaction to six races of crown rust (Puccinia coronata), all relative to the geographical origin of the collections. We selected 26 of these lines, which appeared potentially useful as sources of crown rust resistance, for testing at 20 and 27 C with three races of crown rust. From this group, seven lines (Table 1) were selected, primarily on the basis of resistance to the virulent race 264A, for intensive study.

Table 1. Putative relationships of genes of seven resistant lines of A. sterilis to previously known crown rust resistance genes, and the lines in which they occurred.

Present study			Gene originally described			
A. sterilis line	Res. gene(s)	Country of origin	Line	Res. gene	Source of Res.	Country of origin
PI 412284	Pc51 + new gene	Morocco	IA X434	Pc51	CI 8079	Israel
PI 324755	Pc61 + new gene	Sicily	Coker 234	Pc61	PI 287211	Israel
PI 320771	Pc57	Israel	IA H555	Pc57	CI 8295	Israel
PI 412277	Pc58	Morocco	TAM-O-301	Pc58	PI 295919	Israel
PI 412258	PcX	Morocco	IA H547	PcX	PI 318282	Israel
PI 309170	Not identified	Israel	--	--	--	--
PI 412271	Not identified	Morocco	--	--	--	--

These lines were crossed and backcrossed with Iowa Selection B605-1085, a high-yielding, crown rust susceptible line with good agronomic characteristics. The resistance of six of the seven lines was lost during backcrossing, but resistance of all seven was carried, by single seed descent, from the F_2 to the F_5 generation. Fifty to 66 F_5 lines from each of the original seven parents were tested for reaction to 12 races of crown rust. Results indicated that five of the seven A. sterilis parents carried different major resistance genes, but that these genes could not be distinguished from genes previously known to be carried by other oat cultivars or lines (Table 1). The sources of resistance in which the previously known genes occurred differed from the lines of A. sterilis we used, and four of the five had been collected in different countries. Two of these five parents (PI324755 and PI 412284) each carried an additional, uncatalogued resistance gene. None of the lines derived from the remaining two parents (PI 309171 and PI412271) were as resistant as their respective parents, and the number of resistance genes involved could not be discerned. This study (1) substantiated earlier conclusions of ourselves and others that lines of A. sterilis commonly carry more than one resistance gene, (2) showed that testing with appropriate races of crown rust is a fast, practical way to tentatively distinguish between resistance genes, and (3) indicated that the same resistance genes probably occur throughout large parts of the natural range of A. sterilis.

QUANTITATIVE RESPONSE OF OAT BREEDING LINES TO CROWN RUST INFECTION

M.D. Simons, K.J. Frey, L.J. Michel and G.A. Schuler
A.R.S., U.S. Dept. of Agriculture and Iowa State University, Ames, Iowa

The incorporation of crown rust (Puccinia coronata) resistance into both pureline and multiline oat varieties is a major objective in the breeding program at Iowa State University. Three types of testing are used: (a) reactions of seedlings to pure races of crown rust in the greenhouse or growth chamber assess presence of absence of major crown rust resistance genes; (b) reactions of breeding lines in small, isolated field plots, each inoculated with a single key race of the fungus assess field resistance; and (c) lesser degrees of field resistance and tolerance are detected by measuring reductions in yield and seed weight of lines grown in replicated hill plots infected with a mixture of crown rust races. To eliminate inherent differences in yield and seed weight among oat lines, values for these two traits obtained from control plots maintained free of rust with a fungicide are divided into corresponding values from rusted plots to give resistance or tolerance indexes. The 150, 250, 221 and 220 breeding lines and checks evaluated in 1982, 1983, 1984, and 1985, respectively, were continuously distributed with 35, 22, 32 and 19%, respectively, of the lines having seed weight indexes significantly above the overall means of the trials. The lines could be placed into several categories: (a) those rated visually as resistant in the field nurseries and that had high resistance indexes; (b) lines visually rated as susceptible with low resistance indexes; (c) lines rated visually resistant, but with significant damage from the disease; (d) lines resistant to some crown rust races and with moderate resistance indexes; and (e) visually susceptible lines that showed only moderate damage. The latter possessed a low degree of field resistance that would probably give satisfactory protection under commercial field conditions, and that might reasonably be expected to persist over time.

MODIFICATION OF THE INTERNATIONAL OAT RUST NURSERY

J.G. Moseman
USDA, ARS, Beltsville, Maryland

The USDA, ARS, International Oat Rust Nursery, coordinated by scientists at the Beltsville Agricultural Research Center, is being modified. The nursery which was started in 1954 has contributed to oat improvement in many countries. The objectives of the nurseries have been to evaluate the reactions of advanced and new cultivars to pathogenic rust strains worldwide, and to distribute oat germplasm with new genes and gene combinations for rust resistance.

Some entries in the nurseries have been released by cooperators as cultivars in their countries and other entries have been used as parents in new cultivars. The communications between individuals involved in oat improvement and the exchange of oat germplasm has increased greatly since the nursery was initiated. A primary factor in reducing the usefulness of the nurseries has been that over 2 years is required to evaluate the reactions of new entries.

A Modified International Oat Rust Program is being initiated to replace the International Oat Rust Nursery. The objectives of the modified program will be the same as for the International Oat Rust Nursery. The program will have evaluators and cooperators. The evaluators will be individuals with the expertise and facilities to determine reactions of oat germplasm to specific rust pathogens. The evaluators also may develop or identify oat germplasm with new genes or gene combinations for resistance to the rust pathogens. The cooperators will furnish seed of advanced selections and new cultivars to be evaluated for their reactions to specific rusts. Some of that germplasm may have new genes or gene combinations. The cooperators also may request oat germplasm with new genes or gene combinations.

In the modified program fewer individuals will be required to grow the nurseries and to take notes, the data obtained will be more reliable and will be returned to the cooperators in less than one year, and oat germplasm with new genes or gene combinations will be identified and the seed distributed to the cooperators.

THE OAT CYST NEMATODE AND ITS EFFECT ON OATS IN MICHIGAN

B. Burnett, R. Freed and G. Bird
Michigan State University, East Lansing, Michigan

The oat cyst nematode (Hetercodera avenae) is a small grain pathogen with world-wide distribution. In 1975, it was first found in the United States in Oregon. Eight years later, nematologists at Michigan State University identified it in a soil sample from Tuscola Country, Michigan. In 1985, field trials at tow sites on the farm thus identified gave information used in evaluating the nematode's effect on oats. A nematicide, Temik, was used as a treatment on half of the experiment. Nematode cyst counts from all plots indicated varying degrees of infestation within the trial locations. Height, yield and test weight measurements showed that the nematode was cuasing yield loss in oats.

A REVISED LOOK AT HERBICIDES ON OATS

D.L. Reeves and L. Lammers
Plant Science Dept., South Dakota State University, Brookings, S.D.

Eleven oat cultivars were treated with 0.50^{-1} kg ha^{-1} MCPA and 0.28, 0.56 and 0.84 kg ha^{-1} rates of 2,4-D. The cultivars used were: early - Nodaway 70 and Kelly; midseason - Burnett, Chief, Noble and Ogle; late - Moore and Porter.

Only two cultivars, Lancer and Kelly, had significant yield reductions when sprayed with the 0.56 kg rate of 2,4-D. Nodaway 70, Burnett, Chief and Noble had yield reductions at only the highest rate of 2,4-D and were classified an intermediate in tolerance. Moore, Porter and Ogle were resistant having no yield losses. Porter, Lancer and Kelly showed some sensitivity to MCPA.

There was no direct effect of 2,4-D on test weight. There was some indication MCPA might cause slight reduction in test weight. Where lodging occurred, it was significantly increased by 2,4-D (Table 1). Test weights were reduced when lodging was increased.

Table 1. Mean lodging percentage of 10 oat cultivars at three locations.

2,4-D rate	Watertown	Centerville	Brookings
0	10	9	17
0.28	16	36	17
0.56	35	43	29
0.84	43	44	28
MCPA	10	21	9

Two locations were sprayed at the 6-leaf stage instead of the recommended 3-4 leaf stage. Spraying 2,4-D at the 6-leaf stage produced much greater yield losses (Table 2).

Table 2. Mean yield reductions of 10 oat cultivars when sprayed at 3-4 leaf and 6-leaf stages.

	3-4 leaf		6-leaf	
2,4-D rate	1984	1985	Brookings	Centerville
0.28	0	-1	-7	-11
0.56	0	-2	-17	-16
0.84	-4	-5	-23	-22
MCPA	-3	-3	-3	-4

Late spraying did not increase lodging more than early spraying. A difference in cultivar tolerance was also quite noticeable at the later spraying time (Table 3).

Table 3. Mean yield reductions of 4 oat cultivars when sprayed at the 6-leaf stage.

2,4-D rate	Nodaway 70	Porter	Ogle	Chief
0.28	-7	+5	-3	-11
0.56	-20	0	-9	-21
0.84	-29	-5	-12	-25
MCPA	+9	+5	-3	-4

MCPA had about the same effects on the oats when sprayed at either stage. Test weights were reduced slightly by the late treatments of both 2,4-D and MCPA. However, at equal rates, the losses from 2,4-D were greater than for MCPA.

This study has shown there is a difference in oat cultivar response to herbicides, especially 2,4-D. MCPA caused less injury than 2,4-D. The importance of not spraying late was also demonstrated.

YIELD AND QUALITY OF OAT-PEA AND BARLEY-PEA MIXTURES HARVESTED FOR FORAGE

M.A. Brinkman and J.B. Stevens
University of Wisconsin

Small grains have been used by livestock producers as hay, silage, and pasture for many years. More recently, mixing field peas with small grains planted for forage has become popular in several areas of the U.S. Peas have been added to improve yield and quality of the forage.

The objective of this research was to evaluate forage yield and quality of oat-pea and barley-pea mixtures. The oat cultivars were Stout and Porter, and the barley cultivars were Morex and Bumper. The field pea cultivar was Trapper. The small grain seeding rate was 20 seeds/sq ft (2.0 bu/a) when planted with peas and when planted alone in a pure stand, and the pea seeding rate was eight seeds/sq ft (70 lbs/a) when planted with a small grain and 20 seeds/sq ft (175 lbs/a) when planted alone in a pure stand. The experiment was underseeded with Blazer alfalfa at a rate of 20 lbs/a. The experiment was conducted at Arlington, Wisconsin in 1984 and 1985.

Pure stands of small grains and small grain-field pea mixtures were harvested when each small grain cultivar was in the early heading (Feekes 10.2) stage of development. Pure stands of Trapper peas were harvested on the same dates that small grain-field pea mixtures were harvested.

The results of this study indicated that mixing field peas with small grains resulted in small to moderate increases in forage yield and significant increases in forage quality. Forage yields of the small grain-field pea mixtures were 1 to 12% higher than forage yields of pure stands of small grains. Trapper peas added more forage yields to the later heading small grains than to the early headers. Protein percentages of the oat-Trapper mixtures were higher than protein percentages of the barley-Trapper mixtures. The protein percentage differences may be attributable differences between oats and barley in early plant growth. The barley cultivars had more tillering and wider leaves than the oat cultivars, so pea growth may have been more restricted in barley than in oats. Protein yields of small grain-field pea mixtures were higher than protein yields of pure stands of small grains. Pure stands of Trapper peas had high percentages and low forage yields.

MOLECULAR BIOLOGY TECHNIQUES FOR OAT CROP IMPROVEMENT

I. Altosaar, S. Chang, K. Adeli, S. Dukiandjiev and E. Hansen
Biochemistry Department, University of Ottawa, Ottawa

Grain proteins offer the molecular geneticist a useful model system with which to study regulation of gene expression because storage proteins are synthesized from abundant mRNA in a developmentally controlled and tissue-specific manner. Developing oat endosperm mRNA was used as template to make a complementary DNA library in lambda gt10 as host vector. One clone, p3B3, has been identified as coding for a low molecular weight alcohol soluble protein. The complete cDNA sequence, determined by Sanger's M13 dideoxy technique, indicates an unusually long 28 amino acid leader sequence which may be implicated in the unique protein deposition mechanisms operating in oat endosperm tissue. The structural coding region of the gene, partly confirmed by N-terminal amino acid sequencing, shows a high content of methionine. By modifying certain DNA sequences in the 3B3 gene, it is now possible to test which domains of the protein are essential determinants of intracellular deposition by re-introducing modified sequence constructs into tobacco expression systems by gene-transfer technology. Recent Japanese developments in regenerating whole plants from rice protoplasts (e.g. Plant Cell Reports 5:85-88, 1986) indicate it may soon be possible to manipulate agronomically important genes in oat as well.

Grain proteins are also valuable diagnostic markers for cultivar identification. Stained protein banding patterns of commercial oat cultivars can now be achieved within sixty minutes using Phast gel electrophoresis (Pharmacia). Thus germplasm screening can be attempted on a much more comprehensive scale to look for diagnostic "fingerprints" correlating with traits such as disease resistance.

APPLICATION OF BIOTECHNOLOGY IN CROP IMPROVEMENT

W.A. Keller
Plant Research Centre, Agriculture Canada, Ottawa

Biotechnology includes a range of cell and molecular technologies which can be employed in the genetic improvement of crops. These technologies can be employed to achieve: (1) rapid production of homozygous lines, (2) induction of desirable mutants or variants and (3), transfer of genetic information into crops from foreign sources.

Haploid production has primarily involved anther, microspore and ovule culture. Substantial progress has been made with several crops including tobacco, rapeseed, cole crops, wheat, barley, corn and rice. Doubled haploids are under evaluation in several breeding programs throughout the world and in a number of cases new cultivars have been developed from such homozygous lines.

Cell culture technology offers the plant geneticist a powerful approach to mutant selection. Genetic changes can be achieved through the use of mutagens or through selection of tissue-culture-induced changes (i.e. somaclonal variation). Mutants/variants with desirable agronomic traits have been selected in a number of crops and include tolerance to herbicides, diseases, and toxic levels of salts.

Several strategies to achieve transfer of foreign genetic information into crops are available. Interspecific and intergeneric sexual and somatic hybrids have been obtained through embryo culture and protoplast fusion techniques, respectively. The major role of interspecific hybrids is that of a genetic bridge to facilitate transfer of desirable traits into the crop species. This may be obtained through tissue culture regeneration from hybrid cells or through backcrossing. For example, backcrossing somatic hybrids of *Nicotiana tabacum* + *N. rustica* with *N. tabacum* has resulted in the development of tobacco lines with enhanced disease resistance. Protoplast fusion can also be employed to efficiently transfer and/or combine cytoplasmic traits. Such objectives have been achieved with *Brassica* and *Nicotiana* species.

Presently, a great deal of attention is being given to the development of gene transfer technology with most of the activity focussed on the use of *Agrobacterium* Ti plasmid vectors. An approach pioneered at Agriculture Canada, Ottawa, involves intranuclear microinjection of genes. This approach has been successfully employed to transfer alfalfa and rapeseed protoplasts and may be applicable to cereals.

OAT CELL CULTURES FOR VARIATION, SELECTION, AND GENE TRANSFER

H.W. Rines
USDA-ARS and University of Minnesota

The ability to genetically manipulate plants at the cell level with each cell capable of regenerating into a complete plant can provide new sources of genetic variability, efficiency in selection, and means for novel gene transfer for crop plant improvement.

In oats, tissue cultures capable of plant regeneration have been initiated from immature embryos, shoot tip meristems, and other meristematic tissues. The frequency of production of regenerable cultures is highly dependent on the genotype of the source explant. Cytogenetic aberrations were frequent in tissue culture regenerated oats (McCoy, Phillips, and Rines. Can. J. Genet. Cytol. 24:37, 1982). Among characterized abnormalities, about 85% were due to chromosome breakage and often involved partial chromosome loss. Most breaks appeared to be in regions of pericentromeric heterochromatin and may be associated with late replicating DNA. The frequency of cytogenetic abnormalities was much greater in plants regenerated from cultures maintained for 16 to 20 months prior to regeneration than in plants from 4-month-old cultures. Tissue-culture-induced chromosome breakage is being exploited to produce cytogenetic stocks and to facilitate interspecific gene transfer.

Oat lines resistant to toxin produced by the fungal pathogen *Helminthosporium victoriae* were selected by placing tissue cultures initiated from toxin sensitive *Vb vb* oats onto toxin-containing medium (Rines and Luke, Theor. Appl. Genet. 71:16, 1985). This selected heritable gain in *H. victoriae* resistance, however, was always accompanied by coincident loss of *Vb*-mediated crown rust resistance. The tremendous selectivity of *H. victoriae* toxin makes this system a highly useful one for testing effects of culture conditions and chemical agents on induction of genetic and chromosomal changes in tissue cultures. It may also provide a tool to analyze molecular structure of a gene or gene complex associated with host-pathogen interactions in oats.

Callus formation from protoplasts was accomplished as a first step in attempts to develop an oat protoplast system for novel gene transfer either by cell fusion or by direct DNA uptake. These protoplasts had been produced from a rapidly growing cell suspension culture initiated from anther-culture-derived callus of the cultivar 'Stout'. However, no differentiation was obtained from these calli. The capability to regenerate plants from protoplasts, as has recently been reported in rice, is needed for exploiting the current technology for direct gene transfer.

DISEASE RESISTANCE AND MOLECULAR STRATEGIES

A. Nassuth
Max Planck Institute, München, West Germany

Current molecular biology techniques make it feasible to think about the introduction of (modified) genes that could lead to disease resistance into crops. Candidates for such genes arise from studies of host-pathogen interactions and of the replication cycle of a pathogen. These studies have included whole-plant as well as molecular approaches. Roughly two groups of genes can be recognized:

1. Genes encoding products that are involved in the natural defence mechanisms of the plant. Such genes are not always present and/or not expressed to a high enough quantity in the particular plant of interest.

2. Genes specially designed to encode a product (RNA or protein) that will interfere with the replication process of a certain pathogen.

Possibilities and examples of actually accomplished results by different research groups will be presented.

SPECIES RELATIONSHIPS IN AVENA AS DEFINED BY MOLECULAR PROBES

S. Fabijanski
Paladin Hybrids, Inc. Brampton, Ontario

Relationships between the species in the genus Avena were investigated by two methods, the first being seed protein patterns and the second being Southern blot analysis of genomic DNA probed with cloned repeated sequences. Seed protein patterns were obtained from Osborn fractionation of all of the Avena species, and the blot analysis data was generated using primarily two probes, pTa-71, a rRNA clone isolated from wheat, and RS-1, a repeated sequence clone isolated from a Ch 4A library of Avena DNA. The data demonstrate that it is possible to distinguish the different genomic karyotypes using this analysis and that genome-specific markers can be isolated. Comparing our results to those of others, we find that many of the species distinctions based on more classical methods of analysis hold true. By using these techniques we can also distinguish between the different sub-karyotypes in the diploids. The use of molecular probes to study the genomic relationships of Avena can provide some clues as to the origin of the commercially grown Avena species and can therefore provide breeders with directions for the efficient transfer of desirable traits of wild oats into commercial varieties.

IS RECOMBINANT DNA TECHNOLOGY CONTRIBUTING TO CROP DEVELOPMENT?

Roger J. Kemble
Division of Plant Biology, Allelix Inc., Mississauga, Ontario

The answer to the question posed in the title is undoubtedly, YES! However, if the question was altered to read 'is recombinant DNA technology contributing to oat development?', a definitive YES is probably not an honest answer. A main reason for the low level of molecular biology research on oats is the lack of a reproducible plant regeneration system from single cells. Without this basic tissue culture technique major oat improvements via molecular biology are unlikely. However, as Dr. Rines will outline in his talk, this barrier is rapidly being overcome.

Consequently there now exists, in oats, the potential to duplicate and improve many of the recombinant DNA 'successes' reported in other plants which are usually not major crop species. Some 'long term' improvements via molecular biology will be described such as pest control, virus resistance, herbicide tolerance and alteration in seed storage proteins. All these examples are dependent on an efficient DNA transformation system and the aforementioned plant regeneration procedure.

Examples where molecular biology can probably aid oat improvement 'now' include restriction fragment length polymorphisms to identify and classify genotypes at the nuclear and cytoplasmic DNA level (such a system can provide legal protection of an institutions germplasm), and rapid disease detection/ classification kits. However, if recombinant DNA techniques are to make a real contribution to oat development, molecular biologists must work together with breeders and tissue culturists. Optimally, other disciplines such as pathology, agronomy and physiology should also be represented in the 'team' effort which will be required.

POSTER PRESENTATIONS

LOCATION: Carleton East Ballroom

POSTERS ASSEMBLED: Tuesday, July 15 at 10:00-12:00 AM

POSTERS AVAILABLE FOR STUDY:

Tuesday afternoon 1:30 - 4:30 PM
Tuesday evening 7:00 - 8:00 PM

Wednesday morning 8:00 - 12:00 AM

POSTER REPRESENTATIVES (one of authors) will be present at their display for one hour to answer specific questions. The appointment time will be posted on the poster by the author.

ABSTRACTS

PROCESSING AQUEOUS TREATED CEREALS

V.D. Burrows, R.G. Fulcher and D. Paton
Plant Research Centre, Agriculture Canada, Ottawa

Oats may be fractionated into a high quality bran and a low lipase oat flour by a physiological process which causes the oat endosperm to liquify. The process will be described in flow chart form and is applicable to whole, dehulled, hulless or wild oats.

PHENOLIC COMPOUNDS IN OATS: STRUCTURE AND BIOCHEMICAL PROPERTIES

F.W. Collins and D.G. McLachlan
Food Research Centre, Agriculture Canada, Ottawa

Despite the widespread utilization of oats in the agri-food sector, little work has been done to characterize oat grain phenolic compounds. The structurally-dependent involvement of cereal grain phenolics in a wide variety of biochemical and nutritional processes makes a knowledge of the types and amounts of these phenolics extremely valuable. Such information is important in improving the quality of specialized oat-based food ingredients, in developing new oat processing technology, in evaluating dietary input data for human and animal nutrition, and as an aid in elucidating mechanisms of disease resistance. An in-depth study on oats was therefore carried out, to determine both free and covalently-bound forms of soluble phenolic compounds.

Aqueous methanolic extracts of cultivar SENTINEL oat groats were fractionated by ion-exchange chromatography into three classes of phenolics: anionic, cationic and neutral. Analysis of the anionic (acidic) fraction

revealed traces of free ferulic and *p*-coumaric acids. Substantial quantities of these and other phenolic acids however were covalently linked to anionically charged compounds. Further analysis of these bound acids produced a series of alkaloid-like amides, the avenanthramides, in which ferulic, *p*-coumaric, caffeic and several new phenolic acids occur as the N-acylamides of substituted anthranilic acids. These avenanthramides are the stable forms of the avenalumins, recently shown to be potent inhibitors of oat crown rust spore germination. Pharmacologically, some avenanthramides are known from synthetic drug modelling to possess antihistamine activity but were not known to occur naturally.

From the cationic (basic) fraction, O-glycosides of 2-aminophenol have been isolated. This aglycone is readily produced by the action of β-glucosidase and it undergoes rapid oxidative dimerization to 2-aminophenoxazin-3-one (Questiomycin B) a potent inhibitor of DNA-dependent RNA sythesis.

From the neutral fraction, in addition to a number of antifungal saponins, several acyl triterpene glycosides (Avenacins) were found, containing the rare phenolic amino acid N-methyl anthranilic acid, covalently attached to the terpene moiety. The Avenacines are potent antifungal agents, active against *Ophiobolus graminis* and several other non-pathogenic fungi. Over 30 flavonoid derivatives were also detected in this fraction.

STEM RUST RACES ON OATS AND BARBERRY IN EASTERN ONTARIO

R.V. Clark and W.L. Seaman
Plant Research Centre, Agriculture Canada, Ottawa

A program to eradicate barberry (*Berberis vulgaris*) from Ontario and Quebec was begun in 1964 and initially was successful both in reducing the barberry population and in delaying the annual appearance of stem rust in oats. However in many areas barberry populations have returned to original levels. In eastern Ontario the indigenous races of *Puccinia graminis* f. sp. *avenae* differ from those found in most areas of North America, and several, including NA25, NA12, NA20, and NA26 appear to be confined to this region. However NA27, the predominant race throughout the rest of North America, also occurs frequently on both oats and barberry in eastern Ontario. Races NA26 and NA54, first detected in eastern Canada in 1976 and 1983, respectively, are virulent on oat lines with resistance gene Pg 13 and thus pose a threat to new cultivars in which that gene has been introduced to provide resistance to race NA27.

MOLECULAR BIOLOGY OF OAT STORAGE PROTEIN BIOSYNTHESIS

S. Fabijanski
University of Ottawa, Biochemistry Department, Ottawa

We are interested in storage protein biosynthesis and genetics in oat (Avena). Oat is a unique cereal in that the majority of the storage protein is composed of the salt-soluble globulins, which account for up to 80% of the grain protein at maturity. The remainder of the storage protein is composed primarily of the alcohol soluble prolamins. Within both of these classes of storage protein there exists considerable heterogeneity not only among species but among cultivars as well. We have been investigating the biosynthesis of some of these storage proteins as well as the genetics of these proteins.

Globulin mRNA has been shown to be a major mRNA species in developing oat seed mRNA. This mRNA, which is approximately 18S in size, has been shown to direct *in vitro* the synthesis of globulin polypeptides with Mr of 58-60 K. One and two dimensional gel analysis of these translation products indicate that: (1) globulin is synthesized as a 60K precursor which is subsequently processed *in vivo* to yield the mature α (38000) and β (20000) subunits seen in authentic globulin fractions, (2) globulin mRNA constitutes 25 to 30% of the total polyA^+ mRNA, even though at maturity, globulins form over 75% of the seed protein and (3) multiple species of this 18S mRNA are suggested by 2-D electrophoresis of its translation products. Two other major fractions of mRNA were observed with sizes 12S and 15S, these two totalling 50% of the poly A^+ mRNA. We believe that these mRNAs code for the prolamins, a highly modified group of seed storage proteins, but which are not as abundant as globulins in the mature grain. Thus there may be considerable translational control in the developing oat seed with respect to storage protein biosynthesis.

INHERITANCE OF PROTEIN CONTENT AND COMPOSITION IN OATS

S. Fabijanski[1,3], S. Chang[1], V. Burrows[2] and I. Altosaar[1]
1. University of Ottawa, Biochemistry Department, Ottawa
2. Plant Research Centre, Agriculture Canada, Ottawa
3. Paladin Hybrids Inc., Brampton, Ontario

The inheritance patterns of protein content and composition was determined in oat crosses using biochemical and molecular techniques. Using high protein and low protein content oats, crosses were made which allowed for the determination of paternal and maternal influences in protein content of oats. Along with total protein content, protein composition in the segregants was determined by fractionation of seed proteins by SDS-polyacrylamide gel electrophoresis. DNA from these same segregants was isolated, restricted and probed with a prolamin clone, to detect arrangement or re-arrangement of genes coding for prolamins in oat. It was found that there are no paternal or maternal effects on total protein content within these crosses, implying that the protein percentage is controlled at the nuclear level. The composition of the proteins in the segregating lines were quite different and showed a large diversity, especially within the prolamin fraction of the seed protein.

However, there was no one particular pattern of protein composition that one could correlate with high or low protein. When DNA from these plants was analyzed for the presence of re-arrangements or amplifications for some of these prolamin genes, none was found. The results of these experiments suggest that control of expression of certain nuclear genes is the major factor in protein accumulation, and amplification or re-arrangement of certain genes does not play a major role in the determination of protein content or composition.

MSTAT - A MICROCOMPUTER PROGRAM FOR AGRICULTURAL RESEARCH

Russell Freed
Michigan State University

MSTAT Represents a software breakthrough that captures the low-cost, speed and accuracy of microcomputers to help generate technologies from our research programs. MSTAT can be used to design experiments (one to five factor with splits and single lattices), print fieldbooks and labels, manage and analyze data. Analysis routines include (1) one-way, (2) two-way, (3) factorial, (4) lattice, (5) hierarchical and (6) non-othogonal. It calculates mean separations including (1) LSD, (2) Duncan's Multiple Range, (3) Tukey's and (4) Student-Newman-Keuls. MSTAT also calculates correlation, regression, multiple regression, frequency tables, histograms and basic statistics. It also has two plant breeding programs to handle pedigree information, print field books and labels. MSTAT can be used on microcomputers with at least 64 K RAM, a CPM or MS-Dos operating system and a BASIC (MBASIC, BASICA, GWBASIC, etc.) interpreter.

DORMANCY STUDIES: DORMOATS

J.A. Frégeau and V.D. Burrows
Plant Research Centre, Agriculture Canada, Ottawa

Dormoats are derivatives of crosses between Avena sativa and A. fatua L. designed to be sown in the fall to germinate the following spring. Mechanisms influencing winter survival and spring emergence are likely to be related partially to the dormancy of the seeds. Seeds from two dormoats differing in their primary dormancy, PGR8658 and PGR16727, and from one oat cultivar, Donald, were each placed in mesh bags (500 seeds/bag, mixed with soil) and sown in the field in early September. Several bags were dug out at various times during fall and winter and the dormancy status of the seeds was assessed by incubating the retrieved intact seeds in soil and in petri plates at 20°C or 7°C. All the seeds from Donald germinated within a month of field planting. Line PGR16727 had approximately 50% of its seeds induced into a secondary dormancy during that same period; for PGR8658, the percentage of ungerminated seeds corresponded to the seeds still in primary dormancy at planting time.

Both dormoats have displayed good spring emergence when fall-planted but their mechanism for winter survival are most likely different. Biochemical parameters are being investigated and some of these results will also be presented.

INVESTIGATIONS ON CROWN RUST / PUCCINIA CORONATA f. sp. AVENAE F. ET LED IN POLAND

Maria Mazaraki
Cereals Department, Plant Breeding Institute, Poland

The subject for genetic analysis were F_2 hybrids created from crossing resistant Chechoslovakian strains KR 3813, KR 82-75; Polish strain POB 781 with Polish susceptible varieties: Boruta, Dragon, Lach, Rumak.

Seedlings were infected in the greenhouse with races 237 and 226.

Resistance to races 226 and 237 in F_2 hybrid /KR 3813 x Lach/ was conditioned by two recessive genes /3:13/. But resistance by three genes /54 : 10, 36 : 28/.

A dominant gene was a requisite for resistance to a culture of physiologic race in KR 82/75.

Resistance to a culture of physiologic race in strain POB 781 was conditioned by three complementary genes in cross with Dragon /45 : 19/.

The second group of hybrids was created from crossing susceptible varieties with each other.

Susceptible varieties Boruta and Dragon crossed with foreign susceptible varieties Larisa and Pirol segregated in F_2 hybrids /7 : 57/. In this group segregations in F_2 hybrids were unexpected. In the case of Polish varieties we suppose that it is connected with the origin of the cultivars Boruta and Dragon.

Observations on the distribution and virulence frequencies of *Puccinia coronata* population in Polish environmental condition were studied.

The pathogen appeared mainly in the eastern part of the country.

The virulence maximum and minimum of the samples collected from all over the country were compared on differential cultivars.

Generally resistance to crown rust in the majority of lines is controlled by complementary two or three genes. Independant genes are more useful in practical breeding. In Central Europe breeding programmes are based on the very effective gene Pc 39.

In the near future it will be necessary to introduce a wider spectrum of resistance genes.

LIPASE MEASUREMENTS IN OATS

S.S. Miller[1], I. Altosaar[1] and R.G. Fulcher[2]
1. Biochemistry Dept., University of Ottawa, Ottawa
2. Plant Research Centre, Agriculture Canada, Ottawa

A rapid and sensitive assay using the fluorogenic substrate 4-methylumbelliferyl heptanoate (MUH), which has been reported to measure lipolytic activity, was adapted for use with oats, and the results compared with those of a conventional lipase assay under varying conditions. Experiments with the esterase inhibitor di-isopropyl fluorophosphate showed that the MUH assay was, in fact, measuring primarily esterase. However, because of the ease and rapidity of the MUH assay, further experiments were conducted to determine whether this assay could be used as an indicator of true lipase activity under some conditions. Groats were subjected to moist heat at 60°, 72°, 80° and 95°C for varying lengths of time to monitor enzyme inactivation. At all temperatures, high correlations were obtained between the two assays. Enzyme activity was also studied under germination conditions, and, as in the inactivation experiments, the correlation between the lipase and esterase assays was high. Mature kernels of 20 domestic varieties were also screened and the values obtained for both lipase and esterase activity, when adjusted to equivalent moisture, protein and fat contents, yielded a significant correlation. These results suggest that the MUH (esterase) assay has considerable potential for use in the food industry, as well as for physiologists and plant breeders as a simple and rapid indicator of true lipase activity.

WINTERHARDINESS OF USDA NATIONAL SMALL GRAIN COLLECTION ACCESSIONS IN IDAHO

D.M. Wesenberg, J.C. Craddock, D.H. Smith and L.W. Briggle
USDA-ARS, Aberdeen Research and Extension Center, Aberdeen, Idaho

Available spring and winter oat accessions included in the U.S. Department of Agriculture - Agricultural Research Service National Small Grains Collection (NSGC) were evaluated for winterhardiness at Aberdeen, Idaho beginning in the 1973-74 season and concluding in the 1978-79 season. Initial screening was in nonreplicated hills. The surviving accessions from each season were continued with a new series of accessions added annually until the entire NSGC spring and winter oat accessions were evaluated for winterhardiness. The preliminary evaluations culminated in four-replicate evaluations of winterhardiness of 281 oat accessions in 1977-78 and 137 oat accessions in 1978-79. Sixteen 'Luther' winter barley checks planted in 1977-78 averaged 100% survival at Aberdeen whereas the 281 oat accessions ranged in average survival from 0.3% to 100%. Entries in the 1977-78 trial with average survival of 75% or higher were again evaluated in four-replicate trials in 1978-79. The 137 oat accessions included in the 1978-79 trial ranged in average survival from 0% to 59%. Seven 'Schuyler' winter barley checks included in the 1978-79 trial averaged 83% survival. The oat accessions with the best average winter survival in 1978-79 included CI 909 ('Lawson Rustproof', Virginia), CI 4216 (Arkansas), CI 7747 (Missouri), CI 7882 (Pennsylvania), CI 8115 (Massachusetts), CI 8184 (Oklahoma), CI 9168

(PA 822-7538, Pennsylvania), PI 221288 ('Novi Sad 6', Yugoslavia), and PI 251536 (Yugoslavia). Accessions included in the 1978-79 trials were classified for growth habit in spring plantings at Aberdeen and Tenonia, Idaho in 1985. About 20% of the accessions exhibited a strong winter growth habit at Aberdeen in a three replicate trial.

IMPACTS OF PROCESSING AND COOKING ON OAT COMPLEX CARBOHYDRATES: A HISTOCHEMICAL STUDY

S.H. Yiu
Food Research Centre, Agriculture Canada, Ottawa

The present study is designed to investigate effects of processing and cooking on the availability of starch and β-glucan in several oat products. Frozen or glycol methacrylate embedded sections of Regular, Quick and Instant Rolled Oats (R.O.) were stained with fluorescein-conjugated Lens culinaris agglutinin (a marker for starch), Congo Red or Calcofluor White (the latter two being markers for β-glucan). Fluorescence microscopic analysis revealed that the structural integrity of some of the compound starch grains and that of most endospermic cell walls were destroyed due to the impact of mechanical processing. There were relatively more broken structures in rolled oats that received more flaking and rolling, such as Quick and Instant R.O. than in Regular R.O. However, the aleurone and subaleurone cell walls were less affected by processing. Most starch grains had retained their crystalline characteristics, except those of instant R.O. which were partially birefringent, when samples were viewed under a polarization microscope. Cooking completely abolished all starch birefringence but only partially solubilized cell wall β-glucan. High performance liquid chromatographic analysis of the cooked rolled oat samples revealed that there were more extractable β-glucan in products of increased processing. Furthermore, cooking rolled oats (starting) in cold water yielded more extractable β-glucan than cooking them in boiling water, and the amount increased with time until it reached a plateau of maximum yield. Hence, the present study concludes that increased processing and cooking of rolled oats would increase the availability of most oat complex carbohydrates.

ACKNOWLEDGEMENTS

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- Quaker Oats Company of Canada, Peterborough, Ontario
- Quaker Oats Company, Chicago, Illinois

CEREAL PENTOSANS: THEIR ESTIMATION AND SIGNIFICANCE. III. PENTOSANS IN ABRADED GRAINS AND MILLING BY-PRODUCTS

S. Hashimoto, M. D. Shogren, L. C. Bolte, and Y. Pomeranz
U.S. Grain Marketing Research Laboratory
USDA-Agricultural Research Service
Manhattan, Kansas, U.S.A.

Water-soluble, enzyme-extractable, and total pentosans were estimated by the orcinol method in whole wheat, barley, oats, sorghum, and brown rice; in laboratory abraded grains; in pearlings from abraded grains; and in commercial samples of brewer's dried grain, wheat bran, oat hulls and bran, rice hulls and bran, corn bran and soybean hulls. The enzyme-extractable pentosans were estimated after treatment with a multi-component system of *Trichoderma viride*. Total pentosans were estimated after hydrolysis with 2N HCL at 100°C, neutralization, and fermentation with fresh, compressed baker's yeast.

Pearled grains, generally, contained less water-soluble, enzyme-extractable, and especially total pentosans than the whole grains. Those changes were reflected in the high concentrations of pentosans in the pearlings. Among the commercial milling by-products, water-soluble pentosans were highest in soybean hulls (1.55%) and wheat bran (1.02%). Enzyme-extracted pentosans were highest in brewer's dried grains (3.94%), soybean hulls (3.81%), and oat bran (3.16%). Total pentosans were highest in corn bran (34.72%) and wheat bran (22.53%). Oat bran (4.07%) and rice bran (5.63-7.15%) were low in total pentosans. The ranges were 0.2-1.6% for water-soluble, 0.3-4.0% for enzyme-extractable, and 4.1-34.7% for total pentosans.

Distinct linear regression lines were established for the plots between ash and total pentosan for individual grains from the abrasion series. Positive correlation coefficients between protein and enzyme-extractable pentosans were significant at the 0.01 level for the samples from the abrasion series, commercial by-products, and combined samples.

Determination of pentosans can be used in rapid routine estimation of dietary fiber. Bell (1985) found a correlation of 0.998 between the pentose values determined by the orcinol method and dietary fiber.

We have described previously (Hashimoto et al. 1986) a method for the estimation of water-soluble, enzyme-extractable, and total pentosans in wheat and milled wheat products. We now describe the use of the method in the estimation of pentosans in high-fiber whole and abraded cereal grains and in commercial milling by-products.

Reference: Cereal Chemistry. [In press]

GRAIN MILLING BY-PRODUCTS IN BAKING

J. D. Hubbard, M. D. Shogren, and Y. Pomeranz
U.S. Grain Marketing Research Laboratory
USDA-Agricultural Research Service
Manhattan, Kansas, U.S.A.

The effects of adding the following materials on breadmaking were investigated: a) 5% whole ground wheat, barley, oats, sorghum, and brown rice (regular and parboiled); b) 5% laboratory abraded and ground grains; c) pearlings from the abraded grains; d) 5, 7.5, and 10% laboratory milled fractions (four flours, coarse and fine bran, shorts, and red dog); and e) 5, 7.5, and 10% commercial brewers' dry grain, grain hulls (from oats, regular and parboiled rice, and soybeans) and grain bran (from wheat, oats, regular and parboiled rice, and corn). The pearlings increased water absorption and decreased loaf volume; the loaf volume decrease was largest for barley. The laboratory milled by-products increased water absorption and decreased loaf volume; the changes were related, generally, to the amount of milling by-product added. Commercial hulls from oats and soybeans (but not from rice); and bran from wheat, corn, and oats (but not from rice) reduced mixing time. Gassing power was increased by adding 10% oat hulls or brewers' dried grain and rice bran had an inconsistent effect. Brewers' dry spent grains significantly increased water absorption and decreased loaf volume. Oat hulls had the largest detrimental effect, rice hulls had little effect, and soy hulls were intermediate. Corn bran had a larger detrimental effect than wheat or oat bran. Parboiled rice bran was superior to regular rice bran in breadmaking without shortening.

Reference: Cereal Foods World 31:587. 1986. [Abstract]

GRAIN MILLING BY-PRODUCTS VIEWED BY MICROSCOPY

*L. A. Kaleikau, D. B. Bechtel, and Y. Pomeranz
U.S. Grain Marketing Research Laboratory
USDA-Agricultural Research Service
*Dept. of Grain Sci. and Industry, Kansas State University
Manhattan, Kansas, U.S.A.

High fiber flours obtained by laboratory milling and abrasion and commercial preparations of hulls (oats, rice, soybeans) and bran (wheat, oats, rice, corn) were examined by polarized light, fluorescence, and dark field light microscopy and by scanning electron microscopy (SEM). The presence of starch and unique features of the by-products were visualized by SEM. The dentate outer surface of rice hulls facilitated identification of this commercial preparation by SEM. Soybean hulls (seed coats) contained the characteristic hourglass cells of the subepidermal layer of the seed coat. These hourglass cells were distinct both in intact particles and isolated from the seed coats when viewed with the different types of microscopy. Commercial bran fractions from rice, oats, and corn were not easily distinguishable from one another although parboiled rice bran was much more porous than the other bran samples. Major anatomical features must be present if simple microscopic techniques are to be used for identification of high fiber flours.

Reference: Cereal Foods World 31:589. 1986. [Abstract]

FLUOROMETRIC DETERMINATION OF URIC ACID IN GRAIN

W. M. Lamkin, *N. C. Unruh, and Y. Pomeranz
U.S. Grain Marketing Research Laboratory
USDA-Agricultural Research Service
*Dept. of Grain Sci. and Industry, Kansas State University
Manhattan, Kansas, U.S.A.

Fluorometry was investigated as a possible method for determining uric acid as an index of insect contamination or infestation in stored grain. Because of its simplicity, sensitivity, and specificity, a fluorometric method was considered to possess advantages over other procedures which might be used. With the fluorometer employed, excitation at 342 nm gave an emission maximum at 408 nm. In sodium phosphate buffer, pH 12.32, a linear relationship was found between fluorescence at 408 nm and uric acid concentration. Over the range of 0 to 20 ppm, the coefficient of correlation between fluorescence and uric acid concentration was 0.9998. The procedure had a detection limit for uric acid of less than 1 ppm, which is considered to be sufficient to monitor infestation levels encountered in grain trade. In extracts of cereal grains, problems were encountered due to the presence of interfering substances, and methods for eliminating the interference were investigated.

Reference: Cereal Foods World 31:586-587. 1986. [Abstract]

Performance of hulless oat variety Caesar in Finland

Marketta Saastamoinen

The performance of a great many hulless oat varieties has been tested in Finland. Most of them are very tall and have poor lodging resistance. The most promising hulless oat variety has been the German lodging resistant variety 'Caesar'.

The average grain yield of Caesar has been much lower than that of normal oat varieties but the quality of its grain yield is far superior (Table 1). The average protein content of Caesar has been 19.2%. The hectoliter weight has been considerably higher, even 10 kg higher than that of the poorest variety Pol. The oil content of Caesar has also exceeded that of other varieties. The protein and oil yields of Caesar are, however, rather low due to its low grain yield.

Caesar seems to have good lodging resistance and is rather early, but the yield is low. During dry spring growing conditions the vegetation of hulless varieties is especially sparse. Germination of the hulless varieties is sometimes poor.

The quality of the hulless oat varieties is excellent. Owing to a shortage of high quality feed protein in Europe, soybean is imported from North America. Hulless oats would be one potential source of high quality grain feed that would reduce the need to import soybean to Northern Europe and to export the feed cereals, barley and oats.

Table 1. Performance of the hulless oat variety Caesar in variety trials at Jokioinen, Finland in 1979-86 (relation made to Caesar by paired t-statistics).

Variety	Number of trials	Grain yield kg/ha	Growing time days	Lodging %	Height cm	1000 grain weight g	Hl-weight kg	Hull %	Groat yield kg/ha	Protein content %	Protein yield kg/ha	Oil content %	Oil yield kg/ha
Caesar[1] = standard	8	3460 (=100)	94	28	96	26.3	59.8	5.2	2780 (=100)	19.2	570	8.9	275
Nasta	6	158*	-1	+10	+4	+4.6***	-6.7*	+22.0***	123	-3.6*	+165*	-2.9**	-22
Pol	7	145**	-6*	+26	+5*	+1.1	-10.2**	+28.2***	103	-4.6***	+68	-3.2**	-23
Puhti	8	163***	+2	+7	+11**	+6.7***	-8.2**	+22.2***	126	-4.6***	+137**	-2.8**	+31
Ryhti	6	165**	+5*	+28	+12**	+6.7**	-9.0*	+21.9***	130	-5.0**	+131*	-2.8**	+37
Stil	3	190	+4	+19	-4	+9.1*	-9.8	+26.7*	140	-7.2*	+97	-3.5**	+148
Svea	5	172**	+2	+27	+5	+4.4*	-8.6	+24.7***	130	-5.7**	+125*	-2.9*	+52
Titus	5	158*	-1	+47*	+5	+4.8**	-6.5	+24.5***	120	-4.2*	+137	-3.2**	+2
Veli	8	153**	-1	+22	+6	+6.9***	-5.9**	+24.0***	117	-3.9**	+120	-2.7***	+20

Significance: ***p < 0.001; **p < 0.01; *p < 0.05

1 breeder: Dr. P. Franck, 717 Schwäbisch-Hall, F.R. of Germany

VIRULENCE OF CROWN RUST ISOLATES IN THE UNITED STATES, 1981-1985

L. J. Michel and M. D. Simons
A.R.S., U.S. Dept. of Agriculture, and Iowa State University

During the 1950's, there were several very severe, wide spread epidemics of crown rust (Puccinia coronata) in the United States. The last of these occurred in 1957. Since then, both oat acreage and the relative importance of crown rust have decreased, but the disease remains a potentially serious threat to what is still an important crop. It occurs to at least some extent somewhere in the country every year, and often causes economic losses. For example, in Iowa crown rust was estimated to have caused losses of 10 and 8% in 1982 and 1986, respectively. In other recent years it has generally been present in Iowa oat fields at maturity, but has been too light and/or late to cause significant losses.

It should be noted that losses from crown rust would have been much greater if older, more susceptible varieties had been grown. This points up the need to continue efforts to maintain some degree of resistance in the varieties that are available to the farmer, because resistance is the only practical means of controlling the disease. The maintenance of resistance requires an on-going effort, because the crown rust fungus has the ability to evolve virulence to overcome host resistance that it encounters. It follows that the virulence of the crown rust population needs to be monitored in terms of existing and potential resistance to it. This is a report of such a survey of crown rust virulence during the 1981-85 time period. Results of a similar survey for 1976-80 were published earlier (Plant Disease 67:197, 200, 1983).

Virulence of the crown rust fungus, and the genes conditioning it, can be identified and evaluated only in terms of the reactions of host plants carrying genes for reaction to the pathogen. A total of 36 lines of oats were used in the work reported here (Table 1). Each carried a gene, or combination of genes, for resistance. Most of these genes had been derived from wild Avena sterilis. The 36 lines included six sets of pairs representing the same resistance genes. One member of the pair was used during some years, and the other member in the other years. These pairs can be identified in Table 1 by the fact that the same resistance gene is shown for both.

During the five year period, a total of 1484 isolates of crown rust (222, 415, 267, 272, and 308 in 1981, 1982, 1983, 1984, and 1985, respectively) originally collected from oats were evaluated (Table 1). Most of these were from Texas and the north-central states, but with significant numbers from the southeast. A few were from the northeast and from the west. A total of 353 isolates (55, 78, 103, 51, and 66 in 1981, 1982, 1983, 1984, and 1985, respectively) collected from buckthorn in the north-central states were evaluated (Table 2).

As measured against virulence in the crown rust population, some of the lines were outstanding for resistance. None of the 847 isolates from oats that were tested on Amagalon, which carries resistance derived from the tetraploid Avena magna, parasitized this line (Table 1). Eight of the lines (H 554, H 547, H 548, H 555, H 617-751, H 677, H 681, and IA Y345) were susceptible to less than 2% of the isolates to which they were tested. All carry resistance genes from A. sterilis. From 2 to 5% of the isolates were virulent on another seven (Ascencao, Coker 234, H 382, IA D640, IA D526, Pc-38, and Pc-39). Of these, Ascencao is a cultivated variety that was introduced from South America many years ago. Coker 234 is a commercial variety with resistance from A. sterilis, and the remainder, with resistance from A. sterilis, are lines that have potential breeding value.

Lines susceptible to 5 to 10% of isolates tested included H 561, IA X421, and Pc-50. In the cases of IA X421 and Pc-50, these figures represent what appears to be a significant increase in virulence on lines with a long history of high resistance.

TAM-0-301, shown as suseptible to over 14% of all isolates, was actually not "fully" susceptible to any isolates at 20C, the temperature used for testing. Thus, it may have some degree of protection in the field. This moderately susceptible reation, however, often breaks down to full susceptibility at higher temperatures.

Lines susceptible to over half the isolates, such as IA Y344 and IA D504, obviously would be poor choices to use as sources of resistance in a breeding program. The varieties Trispernia and Ukraine, susceptible to most isolates were not included for any potential practical value, but as links with the past as they were members of the old standard differentials.

Four lines (H 676, H 677, H 681, and Pc-38 + 39) each carried two genes for resistance. In the case of the first three of these, the combination of genes resulted in greater resistance than found in the most resistant member of the pair when it occurred alone. However, the crown rust population included isolates that attacked host lines carrying the combined genes. Such isolates presumably could increase rapidly if selection pressures favored them. The line designated Pc-38 + 39 was tested only in 1982, but in this year it was resistant to all isolates, while, individually, lines with genes Pc-38 or Pc-39 were susceptible to some isolates.

A total of 353 isolates originating as aecial collections on buckthorn (Table 2) were also tested for virulence during the period 1981 through 1985. Virulence of this group of isolates was essentially similar to that of isolates originating as uredial collections on oats.

Table 1. Virulence of Puccinia coronata isolates from oats on lines and cultivars of oats having potentially useful genes for resistance.

Cultivar or line	Gene[a]	Percent isolates virulent 1981	1982	1983	1984	1985	Total no. of isolates	Overall percent isolates virulent
Amagalon	--	--	--	0.0	0.0	0.0	847	0.0
Ascencao	Pc-14	1.8	8.0	3.0	1.1	3.2	1484	3.4
Coker 234	Pc-61	0.0	0.0	6.0	12.1	4.5	1484	4.5
H 382	Pc-36	4.9	--	--	--	--	222	4.9
IA D515	Pc-36	--	14.8	21.4	19.1	20.4	1262	18.9
H 441	Pc-53	9.9	27.6	3.4	10.7	4.2	1484	11.2
H 544	--	1.8	--	--	--	--	222	1.8
H 547	Pc-X-1	0.0	4.1	0.0	0.0	1.6	1484	1.1
H 548	--	0.5	--	--	--	--	222	0.5
H 555	Pc-57	0.9	--	--	--	--	222	0.9
IA D640	Pc-57	--	0.0	7.8	5.9	2.0	1262	3.9
H 561	--	2.7	3.9	7.8	4.4	7.4	1484	5.2
H 617-751	--	--	--	1.5	1.1	2.6	847	1.7
H 676	Pc-14+36	0.0	5.2	--	--	--	637	2.6
H 677	Pc-52+36	1.4	0.3	--	--	--	637	0.9
H 681	Pc-53+51	--	--	0.4	1.5	1.3	847	1.1
IA X421	Pc-52	3.1	4.3	8.6	7.5	8.7	1484	6.4
IA X434	Pc-51	13.2	--	--	--	--	222	13.2
IA D486	Pc-51	--	18.0	32.8	35.5	22.4	1262	27.2
IA Y344	--	55.3	--	--	--	--	222	55.3
IA D520	--	--	49.7	44.7	56.0	65.0	1262	53.9
IA Y345	Pc-X-2	0.9	--	--	--	--	222	0.9
IA D526	Pc-X-2	--	5.8	3.4	2.2	2.6	1262	3.5
IA Y349	Pc-46	47.1	--	--	--	--	222	47.1
IA D535	Pc-46	--	56.1	48.3	49.5	43.2	1262	49.3
IA D504	--	--	52.8	58.1	62.4	49.1	1262	55.6
IA D634	Pc-45	--	33.7	24.0	28.7	20.7	1262	26.8
Pc-38	Pc-38	1.8	2.2	6.3	1.8	5.1	1484	3.4
Pc-39	Pc-39	0.5	6.7	3.4	2.2	3.6	1484	3.3
Pc-50	Pc-50	4.4	8.5	12.8	11.5	10.7	1484	9.6
TAM-O-301	Pc-58	8.1	23.1	13.4	9.6	16.8	1484	14.2
TAM-O-312	Pc-59	30.0	--	--	--	--	222	30.0
Trispernia	Pc-6d	79.4	91.1	78.0	80.1	91.9	1484	84.1
Ukraine	Pc-9	92.4	90.0	90.0	90.7	92.2	1484	91.1
WI N569-42-52	--	--	--	--	23.1	16.6	580	19.9
Pc-38+39	Pc-38+39	--	0.0	--	--	--	415	0.0

[a]Indicates designation of gene for resistance to P. coronata.

Table 2. Virulence of Puccinia coronata isolates from buckthorn on lines and cultivars of oats with potentially useful genes for resistance.

Cultivar or line	Gene[a]	Percent isolates virulent 1981	1982	1983	1984	1985	Total no. of isolates	Overall percent isolates virulent
Amagalon	--	--	--	0.0	0.0	0.0	220	0.0
Ascencao	Pc-14	3.6	13.3	2.9	2.0	3.0	353	5.0
Coker 234	Pc-61	0.0	0.0	0.0	0.0	0.0	353	0.0
H 382	Pc-36	1.8	--	--	--	--	55	1.8
IA D515	Pc-36	--	42.4	24.1	7.8	56.1	298	26.6
H 441	Pc-53	0.0	3.8	0.0	0.0	0.0	353	0.8
H 544	--	3.6	--	--	--	--	55	3.6
H 547	Pc-X-1	0.0	1.3	0.0	3.9	0.0	353	1.0
H 548	--	0.0	--	--	--	--	55	0.0
H 555	Pc-57	0.0	--	--	--	--	55	0.0
IA D640	Pc-57	--	0.0	1.0	0.0	0.0	298	0.3
H 561	--	3.6	3.8	5.8	11.3	6.0	353	6.1
H 617-751	--	--	--	1.0	0.0	0.0	220	3.3
H 676	Pc-14+36	1.8	9.9	--	--	--	133	5.9
H 677	Pc-52+36	1.8	0.0	--	--	--	133	0.9
H 681	Pc-53+51	--	--	1.9	0.0	0.0	220	0.6
IA X421	Pc-52	3.6	3.8	4.9	7.6	4.6	353	4.9
IA X434	Pc-51	31.6	--	--	--	--	55	31.6
IA D486	Pc-51	--	28.7	33.9	42.3	16.4	298	30.3
IA Y344	--	62.5	--	--	--	--	55	62.5
IA D520	--	--	51.9	33.6	50.0	62.1	298	49.4
IA Y345	Pc-X-2	0.0	--	--	--	--	55	0.0
IA D526	Pc-X-2	--	0.0	3.9	12.7	1.5	298	4.5
IA Y349	Pc-46	45.2	--	--	--	--	55	45.2
IA D535	Pc-46	--	39.1	40.9	41.8	57.6	298	44.9
IA D504	--	--	78.6	63.9	74.5	53.0	298	67.5
IA D634	Pc-45	--	12.1	11.4	13.5	4.6	298	10.4
Pc-38	Pc-38	0.0	1.3	2.9	0.0	9.1	353	2.7
Pc-39	Pc-39	1.8	0.0	1.9	7.7	1.5	353	2.6
Pc-50	Pc-50	1.8	13.1	7.6	9.6	4.5	353	7.3
TAM-O-301	Pc-58	0.0	2.6	0.0	0.0	3.0	353	1.1
TAM-O-312	Pc-59	1.8	--	--	--	--	55	1.8
Trispernia	Pc-6d	78.2	91.4	70.3	86.3	83.3	353	81.9
Ukraine	Pc-9	90.9	58.4	84.9	92.3	63.6	353	78.0
WI N569-42-52	--	--	--	--	22.8	23.9	117	23.4
Pc-38+39	Pc-38+39	--	0.0	--	--	--	78	0.0

[a]Indicates designation of gene for resistance to P. coronata.

Evaluation of World Oat Collection for Resistance to Crown Rust

M. D. Simons and G. A. Schuler
A.R.S., U.S. Dept. of Agriculture, and Iowa State University

For the past three years, the writers, in collaboration with Drs. L. W. Briggle and D. H. Smith (ARS, USDA, Beltsville, Md.) have been evaluating entries of the World Oat Collection for reaction to the crown rust fungus (*Puccinia coronata* Cda.). The data will be incorporated into the GRIN (germplasm) system.

For seedling testing to specific crown rust races, plants were inoculated as soon as the first leaf was fully expanded, and were held in a growth chamber at 20C for 12 days, at which time reactions were recorded. Two races were used. Race 264A has a very wide range of virulence, but is usually only moderately aggressive in the field. The culture of 264B that was used is regarded as typical of the currently most common components of the fungus population in nature.

Field testing was carried out near Ames, Iowa. Plants in rust spreader rows were inoculated with a mixture of common crown rust isolates. The disease spread naturally from these spreader rows to the World Collection lines. They were also, of course, exposed to naturally initiated infection.

The results are shown summarized in Table 1. Over 9,000 lines of *Avena sativa*, which had previously been classified as having spring growth habit, were tested. The great majority of these were quite obviously fully susceptible in both the seedling and field tests. It should be noted that those rated susceptible in the field were not all equally susceptible. No distinction is made in this summary between those with only a low percentage of susceptible type uredia and those that were heavily infected. Some of the lines that had very low infection percentages may well represent good sources of field resistance; detailed data are available.

The 2,000 lines of Avena sterilis tested contained proportionately more resistant material than did the Avena sativa lines. This difference, however, was not as great as might have been expected. The relatively small total number of non-shattering diploid and tetraploid lines also produced a good number of resistant lines, but here again, a greater proportion of resistance might have been expected.

In summary, this testing has shown that while the great majority of lines in the World Collection are susceptible to crown rust, many sources of resistance are included. Additional and more detailed testing of these will be necessary to evaluate their potential value in practical breeding programs.

Table 1. Numbers of lines in the World Oat Collection in different categories of reaction[a] to crown rust.

Type of oats	Total no. of lines	Seedling reactions: Race 264A, no. of lines Susc	MS	MR	Res	Race 264B, no. of lines Susc	Ms	MR	Res	Field reaction[b] Susc	MS	MS	Res
A. sativa (spring habit)	9267	9108	50	23	86	9031	19	10	207	8958	60	21	228
A. sterilis	2000	1921	24	15	40	1720	26	30	224	1685	101	27	187
Diploid & tetraploid sp. (non-shat.)	356	304	7	2	43	304	5	6	41	290	11	13	42

[a]Sus = suceptible, MS = moderately susceptible, MR = moderately resistant; Res = resistant

[b]Exposed to artificially initiated mixture of currently common races of crown rust

Actually quite a number of lines were rated resistant, even in the seedling stage to race 264A. These figures, however, are not as good as they look for at least two reasons. One is that there are no doubt at least some duplications involved. Also there are some diploid and tetraploid species included here that are still in the process of being classified. These contributed disproportionately to the number of lines rated resistant.

In general, lines that were rated seedling resistant also appeared to be resistant in the field. Exceptions to this rule may be explained in part by the presence of different races of rust present in the field, or possibly by the fact that many of the lines were mixed. It should also be noted that most of the lines that were rated resistant as seedlings to Race 264A were also resistant as seedlings to Race 264B, but there were a few exceptions.

AUSTRALASIAN OAT RUST SURVEY 1985-86

J.D. OATES

PLANT BREEDING INSTITUTE, CASTLE HILL

UNIVERSITY OF SYDNEY

N.S.W. AUSTRALIA

Dry conditions throughout the cereal belts of Australia and personnel changes in Victoria have reduced the scale of this season's Rust Survey. Particular attention given to the survey in South Australia and Western Australia has retained the effectiveness of the Survey and does emphasise that even in dry seasons detailed surveys can produce enough samples for meaningful results.

272 samples were received, 50% were identified as being on wild oat species although this varied between regions from 22% in Victoria to 64% in Western Australia. 19 Samples failed to germinate. Two samples were on genera other than Avena.

Oat Stem Rust - *Puccinia graminis f.sp. avenae*

Of 94 viable accessions, 128 isolates were identified. The International Races and Local Strains recovered during the 1985-86 Survey are listed in Table 1, which also lists their Virulence Pattern, Frequency and Area from which each was recovered.

As could be expected from the low numbers, new strains were not isolated and rare strains were not recovered, with the exception of Race 14 from New Zealand. Generally, five races dominate the Survey (1,2,20,22 and 24). Race 20, particularly, dominates the Queensland oat rust flora.

Oat Leaf (Crown) Rust - *Puccinia coronata f.sp. avenae*

27 races were identified on the international set of differential varieties (Table 2); eight races recovered in the previous survey were not identified in 1985-86, and three new races were identified for the first time, 1 in N.S.W. and 2 in W.A. (* in Table 2).

From 159 viable accessions, 202 viable accessions were identified. Races 226, 230 and 237 remain the common isolates; however, race 216 predominates in Queensland and race 240 now dominates Western Australia. This latter race dominates, in particular, the rust flora that survive on the wild oats to the immediate south of Perth on the moist coastal region that is quite separate from the inland cropping region. Race 203 is not common, however, it is wide spread throughout Australia.

Table 3 lists the Frequency of each race and the area from which each was isolated through the Survey Period, April 1985 and March 1986.

By the use of the supplemental differential lines: Pc 38, 39, 45, 48, 50, 55, 56, Ascencao, TAM 301, TAM 312, Swan and Mortlock, a further 50 strains of the above races were identified. Line Pc 45 was susceptible to 46%, and Pc 38 to 14% of isolates. Strain isolates were identified with virulence for the combinations Pc 38,(45) Pc(38),45 and Pc45,(48) [() = partial virulence]. The Australian cultivar, Swan, is susceptible to most races of Leaf Rust, although it is genetically mixed to race 359, 211, and resistant to Race 260, and some strains of 226, 230 and 240; Swan is also susceptible to all strains of Stem Rust except the avirulent Race 1. The other Australian cultivar, Mortlock, is genetically mixed to both Leaf and Stem Rust.

TABLE 1

Frequency of Oat Stem Rust Strains

Identified During 1985-86

Australasian Oat Rust Survey

Race	Virul. Pg	Qld.	N.S.W. North	N.S.W. South	Vic.	S.A.	W.A.	N.Z.	Total
1	-		1	1		13	1		16
2	3		1	4		12	5	1	23
2 + Sa	3,Sa						3		3
6	1,2,3		1						1
14	4							1	1
20	1,2,3,4	15	2	6	4		1		28
22	2,3,4	2	1	5		8	17		33
24	2,4	2	1	7	2	2	2		16
59	1,3		1						1
Saia	Sa	1	1	1			3		6
		20	9	24	6	35	32	2	128

TABLE 2

Oat Leaf Rust Strains

Identified During 1985-86

Australasian Oat Rust Survey

DIFFERENTIAL VARIETIES

Race	ANTHONY	VICTORIA	APPLER	BOND	LANDHAFER	SANTA FE	UKRAINE	TRISPERNIA	BONDVIC	SALA	No. of Isolates
203	S	-	S	S	-	-	S	-	-	-	11
205	S	-	S	S	-	-	-	-	-	S	1
211	-	-	S	S	-	-	S	-	-	-	10
216	S	S	S	S	-	-	S	-	-	-	13
226	S	-	S	-	-	-	S	-	-	-	52
227	S	-	S	-	-	-	S	-	-	S	18
230	-	-	S	-	-	-	S	-	-	-	16
231	S	-	-	-	-	-	S	-	-	-	8
235	S	-	-	-	-	-	-	-	-	S	2
236	S	-	S	-	-	-	-	-	-	S	7
237	S	-	S	-	-	-	-	-	-	-	13
238	-	-	S	-	-	-	-	-	-	-	3
240	S	-	-	-	-	-	-	-	-	-	19
241	S	-	S	S	-	-	S	-	-	S	1
259	S	S	S	-	-	-	S	-	-	-	4
260	S	-	S	-	S	-	-	-	-	-	2
266	-	-	S	-	-	-	S	-	S	-	2
268	S	-	S	-	-	-	S	-	S	-	3
272*	-	-	S	-	-	-	S	-	-	S	1
276	S	-	S	S	S	S	S	S	S	-	1
278	-	-	S	-	S	S	S	S	S	-	4
290	S	-	S	S	S	S	-	-	-	-	1
293*	-	-	S	S	S	S	-	-	-	-	1
294	-	-	S	S	S	S	S	-	-	-	2
295	S	-	S	S	S	S	S	-	-	-	5
359*	S	-	S	S	S	S	S	S	-	-	1
416	-	-	S	-	S	S	S	-	-	-	2
											203

TABLE 3

Frequency and Distribution of Oat Leaf Rust Strains

Identified During 1985-86 Australasian Oat Rust Survey

Race	Area Qld.	N.N.S.W.	S.N.S.W.	VIC.	S.A.	W.A.	Total
203	4	2	1		3	1	11
205		1					1
211	6				3	1	10
216	8	2	2			1	13
226		6	14		25	7	52
227		14	4				18
230		3	5		5	3	16
231					1	7	8
235						2	2
236		5	2				7
237					7	6	13
238					2	1	3
240					1	18	19
241		1					1
259		2	1			1	4
260		2					2
266					1	1	2
268		2	1				3
272*			1				1
276						1	1
278	1	2			1		4
290						1	1
293*						1	1
294	1			1			2
295					1	4	5
359*						1	1
416			1	1			2
	20	42	32	2	50	57	203

EVALUATION OF SMALL GRAIN GERMPLASM
1986 Progress Report

L. W. Briggle
Plant Genetics and Germplasm Institute
Beltsville Agricultural Research Center

Systematic evaluation of accessions in the USDA-ARS National Small Grain Collection (NSGC) was initiated in 1983. Funding was obtained specifically for this purpose.

A set of descriptors appropriate for each of the principal small grain crop species - wheat, barley, oats, and rice - has been determined in collaboration with the appropriate Crop Advisory Committees (CAC's).

Data on field descriptors have been obtained on 23,900 wheat accessions, 8,500 oat accessions, and 7,000 barley accessions during the 1983-86 period. All barley and oat data were collected at the Aberdeen, Idaho grow-out location. A total of 13,400 wheat accessions were evaluated at Aberdeen; field descriptor data were obtained at Mesa or Maricopa, Arizona on 10,500 wheat accessions. Field data were recorded on such descriptors as number of days from planting to anthesis, plant height, spike (or panicle) type, spike (or panicle) density, straw lodging, straw breakage, awn and glume characteristics. Spikes or panicles were collected from each accession at maturity. Seed and more precise spike data on about 2/3 of the 1984 wheat accessions grown at Aberdeen were obtained during the winter of 1984-85 and will be finished during the winter of 1986-87. Similar data will be collected on as many oat accessions (panicles) and other wheat accessions as possible during the same winter. The remaining oat panicle and barley and wheat spike data will be recorded as it can be scheduled. Grain from each plot each year was harvested and the weight recorded. Grain was (or will be) returned to Beltsville for storage and for use in further evaluation (for disease and insect resistance, quality factors, etc.)

During the 1987 season approximately 3,000 wheat accessions will be grown at Maricopa, Arizona to meet quarantine and propagation requirements. Field descriptor data will be obtained at the same time. Approximately 2,500 wheats may be field evaluated at Aberdeen, Idaho in 1987. Duplicate oats and wheat accessions (named varieties that appear two or more times in the NSGC) will be grown and studied for identification. True duplicates will be bulked. Purification nurseries for wheat, barley, and oats may also be grown in 1987. Numbers have not yet been determined.

Evaluation for disease and insect resistance was initiated in 1983 and expanded in 1984, 1985, and 1986. Accessions evaluated so far are as follows:

Barley Yellow Dwarf:	1983-86	Davis, CA 10,000 wheats 7,000 barleys 4,500 oats	Urbana, IL 10,000 wheats 10,000 oats
Soilborne Mosaic Virus:	1985-86		Urbana, IL 10,000 wheats
Hessian Fly:	1983-86	Lafayette, IN 20,000 wheats	

Crown Rust:	1983-85	Ames, IA 9,250 oats
	1986	2,000 *Avena sterilis*
Leaf Rust:	1983-86	Manhattan, KS 25,000 wheats
Spot Blotch:	1985-86	Fargo, ND 5,000 barleys
Barley Stripe Mosaic Virus	1986	Aberdeen, ID 2,500 barleys
Common and Dwarf Bunt:	1985-86	Pendleton, OR 5,000 wheats
Stripe Rust:	1984-86	Pullman, WA 15,000 wheats

Growth habit (winter, facultative, or spring type) determinations have been done primarily at Bozeman, Montana from a late spring planting made in June. Data were also recorded on plots at Aberdeen, Idaho and Maricopa, Arizona when growth habit was apparent. During 1985-86 15,000 wheat accessions, 2,000 oats, 400 non-shattering *Avena* species, and 4,000 barleys were tested at Bozeman.

Many wheat accessions and some *Triticum* species in the NSGC are misclassified. Some misclassification occurs in the oats and *Avena* species, but to a lesser extent. The problem is minor in the barleys and *Hordeum* species, but all accessions need to be carefully checked.

Mixtures occur in some accessions in all three crop species. Some accessions were actually heterogeneous populations when obtained, and will be retained as populations. Where appropriate, accessions are rogued and every effort made to clean them up, including establishment of special "Purity Nurseries" at Aberdeen in which mixed accessions are thinly planted and plots separated by rows of strong straw borders of a different crop species.

An extremely valuable part of the National Small Grain Collection is that of the related species. About 250 accessions of *Aegilops* species were grown and classified in the greenhouse at Columbia, Missouri in 1983-84 and more in 1984-85. About 600 accessions of the *Triticum* species were grown and classified in the greenhouse at Beltsville in 1983-84 and another 1,200 in 1984-85. More were grown in 1985-86. When proper classification is difficult, chromosome counts are made at Columbia, Missouri. This procedure has proved to be very helpful. Approximately 700 ploidy analyses have been conducted.

A new metal storage and work space building (30' x 80') to be used for germplasm was erected at Aberdeen, Idaho in 1985. A full-time technician position for germplasm evaluation is funded at Aberdeen by ARS. A similar metal building (40' x 75') was built at Maricopa, Arizona, also in 1985, and it too will be used for evaluation and propagation of the NSGC. An ARS technician position will be established at Maricopa on January 4, 1987.

Approximately 600 new Avena collections from an expedition made by R. A. Forsberg and M. D. Simons in northeastern Turkey during the summer of 1986 were checked for species classification. Some collections were subdivided into varying morphological types. Additional subdividing may be done by the collectors. This procedure, prior to assignment of PI numbers, will help assure correct species classification and can provide more complete records on accessions after they become a part of the NSGC.

About 200 Triticum, Aegilops, Secale, and Hordeum (mostly Triticum) samples that were collected by Calvin Sperling in 1985 in southeastern Turkey were checked for species classification. Approximately 100 samples collected by Sperling and Alan Atchley in 1986 from the same area were also checked, primarily for species classification. Some subdividing was done, based on readily apparent morphological variation. Growing the individual collections under quarantine and for propagation before PI number assignment has definite advantages.

REPORT OF AVENA COLLECTING TRIP IN TURKEY

R. A. Forsberg, University of Wisconsin
M. D. Simons, ARS, USDA, Iowa State University

OBJECTIVES

The trip reported here was undertaken to collect representative samples of Avena species in the north-east quarter of Turkey. Such samples will first be used to determine and document the occurrence, distribution and relative abundance of different species of Avena growing in the region. The maintenance of such samples in a living condition will also insure their survival in the event that they become reduced or extinct in their native habitat. Genes carried by lines comprising the samples also represent sources of genetic diversity that may be valuable in future efforts to breed oat varieties having improved disease resistance, stronger straw, higher yield, etc.

PROCEDURE

The collecting party consisted of Dr. Cetin Tuten (Aegean Regional Agricultural Research Institute, ARARI, Menemen, Izmir, Turkey), Mr. Oscan Genc (ARARI, Driver), Dr. R. A. Forsberg (Plant Breeder/Geneticist, University of Wisconsin, Madison), and Dr. M. D. Simons (Plant Pathologist, ARS, USDA, Iowa State University). Upon arriving in Turkey, Forsberg and Simons met the others in the party and visited with various other staff members at ARARI whose interests and knowledge provided useful pre-trip information. We spent some time in the ARARI herbarium where we checked on what was known of the distribution of Avena species in the area in which we intended to collect. We also used this opportunity to compare and contrast different species that are sufficiently similar to make identification difficult or uncertain.

Most collections were made from Avena plants that had been spotted from the car while driving along major or lesser roads. In some cases, areas inaccessible by car were searched on foot. In general a minimum of three collections, one each by Tuten, Forsberg and Simons, were made at each site. In many cases, more collections, consisting of different species or types, were made at a site. A site ordinarily consisted of a single stop, where there were several fields or other areas containing Avena species that were within walking distance of each other. A collection sometimes consisted of seeds (spikelets) stripped from a single plant, especially if the plant was uniquely different. Most collections consisted of seeds from 2 to over 60 plants that were of the same species and were at least superficially uniform in agronomic type. The sites were generally at least five or ten kilometers apart, but because of a lack of uniform distribution of Avena, they were often much farther apart.

RESULTS

We travelled about 7,000 kilometers and made collections at 176 sites. Tuten, Forsberg, and Simons each made a total of about 300 collections. A very small percentage consisted of cultivated oats (Avena sativa). Cultivated oats were found growing in several situations. One of these was at high elevations. At the very highest elevations, it appeared that they would probably be used for hay or green fodder rather than for grain. Wild oats were almost never seen in such fields. At lower elevations, in certain regions, oats being grown for grain were fairly common. However, in the regions surveyed, the hectarage of cultivated oats would be considered small. Wild oats in these fields were also usually rare, but were common in a few fields that were inspected.

Three species of wild oats (Avena barbata, A. fatua, and A. sterilis) were found. A. barbata, which was rare relative to the other two, generally occurred in waste or disturbed places, such as fence rows and road sides. It apparently occurs only very rarely as a weed of any importance in cultivated cereals or other crops in the area we covered.

Most collections were Avena fatua or A. sterilis. These two species are very common, and often damaging, weeds over much of the area we surveyed. They also occurred to some extent on road sides, etc. Most collections of these two species were made in fields of barley or spring wheat. They were generally not present in winter wheat. They also occurred commonly in fields of sugarbeets, lentils, and chickpeas.

Averaged over all the area we observed, A. fatua and A. sterilis appeared to be roughly similar in prevalence. In certain given areas, however, one could be present at every site while the other could not be found at all. Preliminary examination of the data suggests that there is possibly a tendency for A. fatua to be dominant at higher elevations, and A. sterilis at lower elevations. It should be noted, however, that the two species occurred together in many fields.

Stem rust was relatively severe on Avena sterilis and Avena fatua at many sites. The selection pressure from such infection may mean that potentially useful sources of either oligogenic or polygenic resistance, or of tolerance, to stem rust might be found in this material. Crown rust was found only at a few locations, suggesting that there has been relatively little selection pressure for resistance to this disease.

AVAILABILITY OF GERMPLASM

The material collected by Forsberg and Simons has been returned to the U.S. for quarantine, final classification, and seed increase. It will then be entered into the USDA World Oat Collection for open distribution.

The Avena sterilis entries must be handled in accordance with noxious weed regulations. The shattering nature of A. sterilis, A. fatua, and A. barbata complicates the increase procedure and dictates that only limited sampling of collected populations can take place in any one year. Further (repeat) sampling and increases will be based upon agronomic and disease characteristics observed in initial (quarantine) increases, observed by breeders upon initial distribution, and as determined by disease screening exercises.

SPECIAL CONCERN

With a very few, very small exceptions, all of the land we saw on this trip (even in "remote" areas) fell into a few distinct categories: a) cultivated (wheat, barley, etc.), b) pasture or range, c) forest, d) waste (fence rows, ditch banks, roadsides, etc.), e) extremely steep, rocky etc. (not suitable for grazing, and we saw very little land that was too steep for the agile Turkish goats). We did not find Avena in either grazed areas or in areas that were too dry and rocky for grazing, nor in forests. Baum and his associates (Baum, et al. Can. J. Bot. 50:1385-1397, 1972) also noted that grazing and over-grazing in the middle east boded ill for the future of wild Avena in the area. They believed that the genus might make a come back when the pastoral way of life gave way. We saw no evidence in Turkey that a more settled life-style would in any way relieve grazing pressure.

Basically, we found Avena only as a weed in cultivated crop land or on waste land. This in no way reduces its value as a irreplaceable natural genetic resource, but does point up its extreme vulnerability. Modern farming methods are making rapid progress in the area, and weed control is one of the most important of these. As weeds are controlled, noncultivated Avena will disappear and will be gone forever. A question remaining is whether we collected a truly representative and sufficiently inclusive sample of the natural population or whether more collections should be made. Detailed study of the material collected should help to answer this.

THE GERMPLASM RESOURCES INFORMATION NETWORK: EASY ACCESS TO OAT GERMPLASM DATA

M. C. Perry and M. A. Bohning, Univ. of Maryland
and USDA-ARS

The Germplasm Resources Information Network (GRIN) is a computer database maintained by the USDA Agricultural Research Service (ARS). It is a central repository for detailed descriptive information for most plant germplasm maintained within the National Plant Germplasm System. This information includes: various types of passport (or introduction) data; complete and recently verified taxonomic nomenclature and geographic standards; the ARS funded location at which the germplasm is stored and maintained as well as associated inventory data; characterization and evaluation data including environmental conditions under which trials were conducted and publication citations concerning these trials; and descriptors and code values used with the crop description information. Twenty-four germplasm maintenance sites participate by updating, adding, and deleting information through telecommunication access to the central computer located in Beltsville, Maryland. This keeps all data very current and leaves responsibility for its integrity to those best suited to determine its validity.

Direct access to this information is possible for any plant scientist within the United States, Canada, and Mexico as well as scientists affiliated with international agricultural research centers. A "user-friendly" interface is available to assist researchers with little or no computer experience in obtaining the information they desire. Users can also take advantage of data manipulation software to select only the germplasm that fits their specific criteria. During a computer session, users may submit orders for this germplasm directly to the responsible maintenance site. After obtaining an access code from the GRIN Database Management Unit, individuals only need a computer terminal or personal computer with telecommunications ability to access GRIN.

At this time, GRIN contains some oat data. Taxonomic nomenclature exists for 26 species in the Avena genus. Passport information is available for 20,074 individual samples of germplasm maintained at the National Small Grain Collection (NSGC) in Beltsville, Maryland, with duplicates maintained at the National Seed Storage Lab in Fort Collins, Colorado. About 15,000 oat characterization and evaluation records are present with approximately 100,000 more scheduled to be loaded by the end of 1987. The NSGC currently maintains 20,003 oat inventory records.

For assistance and/or additional information on GRIN, or to obtain an access code and user documentation, please contact:

Database Manager
USDA/ARS/PGGI/GRIN, BARC-W
Building 001, Room 130
Beltsville, MD 20705, USA
Telephone: 301-344-1666

PLANT VARIETY PROTECTION OFFICE PROGRESS REPORT

Eldon E. Taylor
Examiner

From enactment of the Plant Variety Protection Act in 1970 to January 1, 1987, a total of 2,304 applications were received and 1,717 certificates of protection were issued. As of January 1, 1987, the Plant Variety Protection Office had received 27 applications for protection of oat cultivars, only one of which was received in 1987. Fifteen of the oat applications are from experiment stations. A total of 17 certificates have been issued on oat cultivars. There were 6 oat applications pending on January 1, 1987.

Of the 17 certificates issued on oat varieties, 16 specified that the variety was to be sold by variety name only as a class of certified seed. Four oat applications have been abandoned, withdrawn, or found ineligible since the Office began processing applications.

The Plant Variety Protection Office solicits descriptions of varieties which are being released without variety protection. Only adequate descriptions of existing varieties can preclude issuing certificates on varieties identical to previously released varieties. We would appreciate copies of any descriptions prepared for other organizations, such as the Certified Small Grain Variety Review Board of AOSCA. Review Board information is not used by the Office unless permission is granted by the applicant.

Application forms, Exhibit C forms (Objective Description of Variety) and information may be obtained from:

Plant Variety Protection Office
Livestock and Seed Division, AMS
U.S. Department of Agriculture
National Agricultural Library Building, Rm. 500
Beltsville, Maryland 20705
(301) 344-2518

Application should be made to the above address on Form LS-470 along with the necessary exhibits, at least 2500 viable untreated seed of the variety and the filing and search fee of $1800 payable by check or money order to the "Treasurer of the United States." The required exhibits and their contents are listed and described on the application form. Applications will not be filed until all required exhibits, fees and seed are received in the Office. A $200 allowance (issuance) fee will be requested by the Office when the search is completed and the application variety is deemed eligible for a certificate of protection.

In Fiscal Year 1986, the Office received a total of 164 applications and issued 208 certificates. During the first 3 months of Fiscal Year 1987, 39 new applications were received and 57 certificates were issued.

As of January 1, 1987, the Office was in the process of examining 246 applications for protection under the Act. To sustain these examinations, examiners continually update, expand and revise computerized variety description files for more than 100 crops. The following table summarizes the status of all applications in the Plant Variety Protection Office as of January 1, 1987:

Total applications received	2,304
Total applications received in fiscal year 1983	179
Total applications received in fiscal year 1984	157
Total applications received in fiscal year 1985	219
Total applications received in fiscal year 1986	164
Total applications received from foreign countries	214
Total applications received from public institutions	248
Total applications abandoned, ineligible, withdrawn, or denied	340
Total certificates issued	1,717
Total certificates in force	1,705
Total certificates issued as certified seed only	582
Total applications pending final action	246

The breakdown of applications pending final action is as follows:

Certificate stage	36
Search stage	108
Extended time	17
Pending examination	85
Reconsideration	0

Class Breakdown of:

Applications Received:			Certificates Issued:		
1,531	agricultural	66.4%	1,121	agricultural	65.3%
116	ornamental	5.0%	80	ornamental	4.7%
657	vegetable	28.5%	516	vegetable	30.1%

Certificates have been issued in more than 80 crops. The greatest number of certificates have been issued in the following crops:

soybean	394	fescue	52	tomato	25
pea	179	corn	63	tobacco	18
wheat	157	marigold	34	oat	17
bean	152	barley	36	cauliflower	17
cotton	141	alfalfa	41	watermelon	19
ryegrass	59	bluegrass	29	rice	14
lettuce	61	onion	23	China aster	11

MARYLAND

THE USDA NATIONAL SMALL GRAIN COLLECTION

D.H. SMITH, JR., Curator

USDA ARS PGGI
GERMPLASM INTRODUCTION AND EVALUATION LABORATORY

The principal activities of the National Small Grain Collection (NSGC) are: collection, maintenance, evaluation and distribution. However, there are ancillary activities that need to be reviewed from time to time so that our clientele can make full and effective use of our services.

ISSUANCE OF PI NUMBERS

PI numbers are assigned by the Plant Introduction Officer, Dr. G.A. White. The NSGC coordinates the assignment of these unique identifiers, but does not issue them. The simplest method to obtain a PI number is to send me a description of the line you are releasing (a copy of the release statement or even a draft of it) along with a sample of the seed. We would like to receive 500 g but can get by with 25 g. The description and seed sample are submitted to PIO, and they return the sample along with the PI record to us with a copy for the scientist requesting the number.

CLEARANCE OF CULTIVAR NAMES

This can be done by a phone call or letter to the NSGC. We check our files for conflicts and send the request on to Mike Davy AMS Seed Laboratory for additional review of their files. The clearance is returned to us for our records and a copy is sent to the requesting agency.

ACCESSION DATA FROM GRIN FOR Avena

PI NUMBER	GENUS	SPECIES	CULTIVAR
PI 503527	Avena	nuda	Pennline 2005
Nuprime/Noble			
PI 503528	Avena	nuda	Pennline 9010
Noble*2/Nuprime			
PI 503529	Avena	nuda	Pennline 9433
Pennline 116/Bates			
PI 504574	Avena	nuda	
James/CI 8447//Bates			
PI 504575	Avena	nuda	
James/CI 8447//Bates			
PI 501521	Avena	sativa	
F4 Sel from Clinton/PI 309432 (A. sterilis)			
PI 501522	Avena	sativa	
BC2 F4 Sel. from Clinton 2/PI 298129 (A. sterilis)			
PI 501523	Avena	sativa	
BC2 F4 Sel. from Clinton 2/PI 309561 (A. sterilis)			
PI 501524	Avena	sativa	Sandy
Dal/Nodaway 70//Moore			
PI 501525	Avena	sativa	Hytest
Moore//Dal/Nodaway 70			
PI 501535	Avena	sativa	
Lang3/CI 9170			
PI 501536	Avena	sativa	
Lang3/CI 9172			
PI 501537	Avena	sativa	
Lang3/CI 9176			
PI 501538	Avena	sativa	
Lang3/CI 9181			
PI 501539	Avena	sativa	
Lang3/CI 9285			
PI 501540	Avena	sativa	
Lang3/CI 9286			
PI 501541	Avena	sativa	
Lang3/CI 9290			
PI 501542	Avena	sativa	
Lang4//Clinton/PI 311624			

ACCESSION DATA FROM GRIN FOR Avena

PI NUMBER	GENUS	SPECIES	CULTIVAR
PI 501543	Avena	sativa	
Lang4//X122-12/CI 8295			
PI 502292	Avena	sativa	
PI 502921	Avena	sativa	Froat
Dal/Lyon			
PI 502922	Avena	sativa	Starter
Dal/3/Mn 67231/2/Diana/CI8344/4/Noble			
PI 502950	Avena	sativa	
Clinton/CI 8081			
PI 502951	Avena	sativa	
Clinton/PI 311624			
PI 502952	Avena	sativa	
Clinton/PI 318282			
PI 502953	Avena	sativa	
IA X122-12/CI 8295			
PI 502954	Avena	sativa	
Clinton/PI 309560			
PI 502955	Avena	sativa	
Clinton2/PI 298129			
PI 502956	Avena	sativa	
Clinton2/PI 309560			
PI 502957	Avena	sativa	
Noble2/H548//Noble2/H676			
PI 502958	Avena	sativa	
IA D486//Noble2/H676			
PI 502959	Avena	sativa	
Noble2/H548//Noble2/H677			
PI 502960	Avena	sativa	
IA D486//Noble2/H677			
PI 502961	Avena	sativa	
IA D526//Noble2/H677			
PI 503547	Avena	sativa	Steele
RL3038/Dal//Noble			
PI 503644	Avena	sativa	Hercules
Dal/Noble			

ACCESSION DATA FROM GRIN FOR AVENA

PI NUMBER	GENUS	SPECIES	
PI 504612	Avena	sativa	
PI 504613	Avena	sativa	PA Composite 12 Selection
PI 504817	Avena	sativa	Amasalon selection
PI 504818	Avena	sativa	Amasalon selection (early)
PI 504819	Avena	sativa	Amasalon selection
PI 504820	Avena	sativa	Amasalon selection
PI 504821	Avena	sativa	Amasalon selection
PI 504822	Avena	sativa	Amasalon selection
PI 504823	Avena	sativa	Amasalon selection
PI 504824	Avena	sativa	Amasalon selection
PI 504825	Avena	sativa	Amasalon selection
PI 504826	Avena	sativa	Don/Parent C
PI 504827	Avena	sativa	Don/Parent C
PI 504828	Avena	sativa	Don/Parent C
PI 504829	Avena	sativa	Don/Parent C
PI 504830	Avena	sativa	Don/Parent C
PI 504831	Avena	sativa	Don/Parent C
PI 504832	Avena	sativa	Don/Parent C
PI 504833	Avena	sativa	IL 77-2588/Parent C
PI 504834	Avena	sativa	IL 77-2588/Parent B
PI 504835	Avena	sativa	IL 77-2588/Parent B
PI 504836	Avena	sativa	IL 77-2588/Parent C
PI 504837	Avena	sativa	IL 75-5869//Parent A/Parent C
PI 504838	Avena	sativa	MO-0-0635/Parent C
PI 504839	Avena	sativa	Froker/Dal//Amasalon/Marvellous
PI 504840	Avena	sativa	Froker/Dal//Amasalon/Marvellous
PI 504841	Avena	sativa	Froker/Dal//Amasalon/Marvellous
PI 504842	Avena	sativa	Froker/Dal//Amasalon/Marvellous
PI 504843	Avena	sativa	Froker/Dal//Amasalon/Marvellous
PI 504844	Avena	sativa	Amasalon/Black Mesdas//OT-184/PGR 9200
PI 504845	Avena	sativa	Amasalon/Black Mesdas//OT-184/PGR 9200
PI 504846	Avena	sativa	Amasalon/Black Mesdas//OT-184/PGR 9200
PI 504847	Avena	sativa	Amasalon/Black Mesdas//OT-184/PGR 9200
PI 504848	Avena	sativa	Nakerust selections
PI 504849	Avena	sativa	Nakerust selection
PI 504850	Avena	sativa	Nakerust selection
PI 504851	Avena	sativa	Nakerust selection
PI 504852	Avena	sativa	Nakerust selection
PI 504853	Avena	sativa	Nakerust selection
PI 504854	Avena	sativa	Nakerust selection
PI 504855	Avena	sativa	Nakerust selection
PI 504856	Avena	sativa	Nakerust selection
PI 504857	Avena	sativa	Nakerust selection
PI 504858	Avena	sativa	Obee/3/Gopher/MN 2629//Fulshum/FLA. 500
PI 504859	Avena	sativa	Obee/3/Gopher/MN 2629//Fulshum/FLA. 500
PI 504860	Avena	sativa	Obee/3/Gopher/MN 2629//Fulshum/FLA. 500
PI 504861	Avena	sativa	Amasalon//A. nuda/Marvellous
PI 504862	Avena	sativa	Amasalon//A. nuda/Marvellous
PI 504863	Avena	sativa	Amasalon//A. nuda/Marvellous
PI 504864	Avena	sativa	Amasalon//A. nuda/Marvellous
PI 504865	Avena	sativa	Amasalon//A. nuda/Marvellous
PI 504866	Avena	sativa	Amasalon//A. nuda/Marvellous
PI 504867	Avena	sativa	Amasalon//A. nuda/Marvellous
PI 504868	Avena	sativa	Alpha/Amasalon/3/Amasalon//A. nuda/Marvellous

PI NUMBER	GENUS	SPECIES
PI 504869	Avena	sativa
Alpha/Amasalon/3/Amasalon//A. nuda/Marvellous		
PI 504870	Avena	sativa
Alpha/Amasalon/3/Amasalon//A. nuda/Marvellous		
PI 504871	Avena	sativa
Moore/3/Amasalon//A. nuda/Marvellous		
PI 504872	Avena	sativa
Moore/3/Amasalon//A. nuda/Marvellous		
PI 504873	Avena	sativa
Moore/3/Amasalon//A. nuda/Marvellous		
PI 504874	Avena	sativa
Moore/3/Amasalon//A. nuda/Marvellous		
PI 504875	Avena	sativa
Amasalon/Black Mesdas//Delredsa		
PI 504876	Avena	sativa
Amasalon/Black Mesdas//Delredsa		
PI 504877	Avena	sativa
Amasalon/Black Mesdas//Delredsa		
PI 504878	Avena	sativa
Amasalon/Black Mesdas//Delredsa		
PI 504879	Avena	sativa
Amasalon/Black Mesdas//Delredsa		
PI 504880	Avena	sativa
Amasalon/Black Mesdas//Delredsa		
PI 504881	Avena	sativa
Amasalon/Black Mesdas//Delredsa		
PI 504882	Avena	sativa
Amasalon/Black Mesdas//Delredsa		
PI 504883	Avena	sativa
Delredsa//Amasalon/Black Mesdas		
PI 504884	Avena	sativa
Mexican Multi-line Population IIa Selection		
PI 504885	Avena	sativa
Amasalon/Black Mesdas		
PI 504886	Avena	sativa
Amasalon/Black Mesdas		

PI NUMBER	GENUS	SPECIES
PI 504887	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504888	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504889	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504890	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504891	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504892	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504893	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504894	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504895	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504896	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504897	Avena	sativa
Amasalon/Black Mesdas//Fidler		
PI 504898	Avena	sativa
Dal/6 x B//DA/CI 8344/4/Noble/5/Amasalon/Marvellous		
PI 504899	Avena	sativa
Dal/6 x B//DA/CI 8344/4/Noble/5/Amasalon/Marvellous		
PI 504900	Avena	sativa
Dal/6 x B//DA/CI 8344/4/Noble/5/Amasalon/Marvellous		
PI 504901	Avena	sativa
Dal/6 x B//DA/CI 8344/4/Noble/5/Amasalon/Marvellous		
PI 504902	Avena	sativa
Dal/6 x B//DA/CI 8344/4/Noble/5/Amasalon/Marvellous		
PI 504903	Avena	sativa
Amasalon/Marvellous		
PI 504904	Avena	sativa
Amasalon/Marvellous		

PI NUMBER	GENUS	SPECIES
PI 504905	Avena	sativa
Amasalon/Marvellous		
PI 504906	Avena	sativa
Amasalon/Marvellous		
PI 504907	Avena	sativa
Amasalon/Marvellous		
PI 504908	Avena	sativa
Alpha/Amasalon/3/Amasalon/Marvellous//Amasalon/Black Mesdas		
PI 504909	Avena	sativa
Alpha/Amasalon/3/Amasalon/Marvellous//Amasalon/Black Mesdas		
PI 504910	Avena	sativa
Alpha/Amasalon/3/Amasalon/Marvellous//Amasalon/Black Mesdas		
PI 504911	Avena	sativa
Lyon/MA-70//Amasalon		
PI 504912	Avena	sativa
Lyon/MA-70//Amasalon		
PI 504913	Avena	sativa
Lyon/MA-70//Amasalon		
PI 504914	Avena	sativa
Osle//A. abyssinica/2* AB101		
PI 504915	Avena	sativa
Osle//A. abyssinica/2* AB101		
PI 504916	Avena	sativa
Lyon//Dal/MA-70/3/Don		
PI 504917	Avena	sativa
Lyon//Dal/MA-70/3/Don		
PI 504918	Avena	sativa
A. abyssinica/2* AB101/3/Amasalon/A. nuda//Amasalon		
PI 504919	Avena	sativa
A. abyssinica/2* AB101/3/Amasalon/A. nuda//Amasalon		
PI 504920	Avena	sativa
Delredsa #1//Alpha/Marvellous		
PI 504921	Avena	sativa
Alpha/Amasalon		
PI 504922	Avena	sativa
Alpha/Amasalon		

PI NUMBER	GENUS	SPECIES
PI 504923 Alpha/Amasalon	Avena	sativa
PI 504924 Alpha/Amasalon	Avena	sativa
PI 504925 Alpha/Amasalon	Avena	sativa
PI 504926 Alpha/Amasalon	Avena	sativa
PI 504927 Alpha/Amasalon	Avena	sativa
PI 504928 Alpha/Amasalon	Avena	sativa
PI 504929 Alpha/Amasalon	Avena	sativa
PI 504930 Alpha #2/Amasalon	Avena	sativa
PI 504931 Alpha #2/Amasalon	Avena	sativa
PI 504932 Amasalon/Gopher	Avena	sativa
PI 504933 Amasalon/Gopher	Avena	sativa
PI 504934 Amasalon/Gopher	Avena	sativa
PI 504935 Amasalon/Gopher	Avena	sativa
PI 504936 Amasalon/Black Mesdag//AoJss	Avena	sativa
PI 504937 Amasalon/Black Mesdag//AoJss	Avena	sativa
PI 504938 Delredsa/AoJss	Avena	sativa
PI 504939 Delredsa/AoJss	Avena	sativa
PI 504940 Delredsa/AoJss	Avena	sativa

PI NUMBER	GENUS	SPECIES
PI 504941 Delredsa/AoJss	Avena	sativa
PI 504942 AoJss/Delredsa	Avena	sativa
PI 504943 AoJss/Delredsa	Avena	sativa
PI 504944 AoJss/Osle	Avena	sativa
PI 504945 AoJss/Osle	Avena	sativa
PI 504946 AoJss/Osle	Avena	sativa
PI 504947 A. fatua/A. sterilis//AoJss	Avena	sativa
PI 504948 A. fatua/A. sterilis//AoJss	Avena	sativa
PI 504949 Don/Parent C	Avena	sativa
PI 504950 A. fatua/A. sterilis//AoJss	Avena	sativa
PI 504951 A. fatua/A. sterilis//AoJss	Avena	sativa
PI 504952 A. fatua/A. sterilis//AoJss	Avena	sativa
PI 504953 A. fatua/A. sterilis//AoJss	Avena	sativa
PI 504954 A. fatua/A. sterilis//AoJss	Avena	sativa
PI 504955 Moore/AoJss	Avena	sativa
PI 504956 Moore/AoJss	Avena	sativa
PI 504957 Moore/AoJss	Avena	sativa
PI 504958 Porter/AoJss	Avena	sativa

PI NUMBER	GENUS	SPECIES
PI 504959 Porter/AoJss	Avena	sativa
PI 504960 Porter/AoJss	Avena	sativa
PI 504961 Porter/AoJss	Avena	sativa
PI 504962 Porter/AoJss	Avena	sativa
PI 504963 Obee/Moore	Avena	sativa
PI 504964 Obee/Moore	Avena	sativa
PI 504965 Obee/Moore	Avena	sativa
PI 504966 Obee/Moore	Avena	sativa
PI 504967 Moore/A. barbata(?)//Amasalon/Black Mesdag	Avena	sativa
PI 504968 Moore/A. barbata(?)//Amasalon/Black Mesdag	Avena	sativa
PI 504969 Moore/A. barbata(?)//Amasalon/Black Mesdag	Avena	sativa
PI 504970 Amasalon//Obee/A. sterilis/3/Amasalon/Black Mesdag//Froker	Avena	sativa
PI 504971 Amasalon//Obee/A. sterilis/3/Amasalon/Black Mesdag//Froker	Avena	sativa
PI 504972 Amasalon//Obee/A. sterilis/3/Amasalon/Black Mesdag//Froker	Avena	sativa
PI 504973 Amasalon/Amasalon//MN 2629/Alpha	Avena	sativa
PI 504974 Amasalon/Amasalon//MN 2629/Alpha	Avena	sativa
PI 504975 Amasalon/Amasalon//MN 2629/Alpha	Avena	sativa
PI 504976 Marvellous/CI 3034	Avena	sativa

PI NUMBER	GENUS	SPECIES	
PI 504977	Avena	sativa	Marvellous/CI 3034
PI 504978	Avena	sativa	Marvellous/CI 3034
PI 504979	Avena	sativa	Amagalon/2* A. nuda//Delredsa
PI 504980	Avena	sativa	Amagalon/2* A. nuda//Delredsa
PI 504981	Avena	sativa	Amagalon/2* A. nuda//Delredsa
PI 504982	Avena	sativa	A. fatua/Marvellous
PI 504983	Avena	sativa	A. fatua/Marvellous
PI 504984	Avena	sativa	A. fatua/Marvellous
PI 504985	Avena	sativa	A. fatua/Marvellous
PI 504986	Avena	sativa	A. fatua/Marvellous
PI 504987	Avena	sativa	A. fatua/Marvellous
PI 504988	Avena	sativa	Obee/Obee//A. fatua
PI 504989	Avena	sativa	Obee/Obee//A. fatua
PI 504990	Avena	sativa	Obee/Obee//A. fatua
PI 504991	Avena	sativa	Obee/Obee//A. fatua
PI 504992	Avena	sativa	Delredsa/Aojss/3/A. abyssinica/2* AB101//Dal/Alpha
PI 504993	Avena	sativa	Delredsa/Aojss/3/A. abyssinica/2* AB101//Dal/Alpha
PI 504994	Avena	sativa	Delredsa/Aojss/3/A. abyssinica/2* AB101//Dal/Alpha
PI 504995	Avena	sativa	Obee
PI 504996	Avena	sativa	Obee
PI 504997	Avena	sativa	Obee
PI 504998	Avena	sativa	Obee/Satarpaso
PI 504999	Avena	sativa	Obee/Satarpaso
PI 505000	Avena	sativa	Obee/Satarpaso
PI 505001	Avena	sativa	Obee/Satarpaso
PI 505002	Avena	sativa	Obee/Satarpaso
PI 505003	Avena	sativa	Obee/Ora//Minhafer
PI 505004	Avena	sativa	Delredsa//Rodney-O *2/Omega
PI 505005	Avena	sativa	Moore//Amagalon/Marvellous
PI 505006	Avena	sativa	Moore//Amagalon/Marvellous
PI 505007	Avena	sativa	Moore(Aus)/Moore(USA)//Amagalon
PI 505008	Avena	sativa	Moore(Aus)/Moore(USA)//Amagalon
PI 505009	Avena	sativa	Moore(Aus)/Moore(USA)//Amagalon
PI 505010	Avena	sativa	Moore(Aus)/Moore(USA)
PI 505011	Avena	sativa	Moore(Aus)/Moore(USA)
PI 505012	Avena	sativa	Moore(Aus)/Moore(USA)
PI 505013	Avena	sativa	Amagalon/Echidna
PI 505014	Avena	sativa	Amagalon/Echidna
PI 505015	Avena	sativa	Amagalon/Echidna
PI 505016	Avena	sativa	Amagalon/Echidna
PI 505017	Avena	sativa	Amagalon/Echidna
PI 505018	Avena	sativa	Amagalon/West * Bob/5
PI 505019	Avena	sativa	Amagalon/West * Bob/5
PI 505020	Avena	sativa	Amagalon/West * Bob/5
PI 505021	Avena	sativa	Amagalon/West * Bob/5
PI 505022	Avena	sativa	Amagalon/A. fatua Celaya
PI 505023	Avena	sativa	Amagalon/A. fatua Celaya
PI 505024	Avena	sativa	Amagalon/A. fatua Celaya
PI 505025	Avena	sativa	Amagalon/A. fatua Celaya,
PI 505026	Avena	sativa	Amagalon/A. fatua Celaya
PI 505027	Avena	sativa	A. fatua Celaya/Alpha
PI 505028	Avena	sativa	Rodney Ps a/A. fatua Celaya
PI 505029	Avena	sativa	Rodney Ps a/A. fatua Celaya
PI 505030	Avena	sativa	Rodney o/A. fatua Celaya

PI NUMBER	GENUS	SPECIES
PI 505031	Avena	sativa
Rodney o/A. fatua Celaya		
PI 505032	Avena	sativa
Rodney o/A. fatua Celaya		
PI 505033	Avena	sativa
MN 2629/Obee		
PI 505034	Avena	sativa
Obee/Obee//A. fatua/3/Amagalon		
PI 505035	Avena	sativa
Obee/Obee//A. fatua/3/Amagalon		
PI 505036	Avena	sativa
Obee/Obee//A. fatua/3/Amagalon		
PI 505037	Avena	sativa
Amagalon/Black Mesdac//AoJss		
PI 505038	Avena	sativa
Moore/AoJss/3/Moore/A. barbata(?)//Amagalon/Marvellous		
PI 505039	Avena	sativa
Moore/AoJss/3/Moore/A. barbata(?)//Amagalon/Marvellous		
PI 505040	Avena	sativa
Moore//Amagalon #3/Black Mesdac		
PI 505041	Avena	sativa
Amagalon/Amagalon//MN 2629/Alpha		
PI 505042	Avena	sativa
Amagalon/Amagalon//MN 2629/Alpha		
PI 505043	Avena	sativa
Garland/3/Minhafer//Gopher/MN 2629		
PI 505044	Avena	sativa
Garland/3/Minhafer//Gopher/MN 2629		
PI 505045	Avena	sativa
Marvellous/CI 3034/Unknown		
PI 505046	Avena	sativa
Omega #2/MN 2629		
PI 505047	Avena	sativa
Allen/3/Minhafer//Gopher/MN 2629		
PI 505048	Avena	sativa
Delredsa//Rodney-o #2/Omega		

PI NUMBER	GENUS	SPECIES
PI 505049	Avena	sativa
Amagalon//Obee/A. sterilis		
PI 505050	Avena	sativa
Obee/SaJapaso//Amagalon/Black Mesdag		
PI 505051	Avena	sativa
Obee/SaJapaso//Amagalon/Black Mesdag		
PI 505052	Avena	sativa
Obee/SaJapaso//Amagalon/Black Mesdag		
PI 505053	Avena	sativa
Amagalon/Marvellous//Amagalon/Black Mesdag		
PI 505054	Avena	sativa
Amagalon/Marvellous//Amagalon/Black Mesdag		
PI 505055	Avena	sativa
Amagalon/Marvellous//Amagalon/Black Mesdag		
PI 505056	Avena	sativa
Amagalon/Marvellous//Amagalon/Black Mesdag		
PI 505057	Avena	sativa
Amagalon/Marvellous//Amagalon/Black Mesdag		
PI 505058	Avena	sativa
Amagalon/Marvellous//Amagalon/Black Mesdag		

ENHANCED SPREADING OF OAT CHROMOSOMES FOR MEIOTIC ANALYSIS

W.P. Bullock, H.W. Rines*, and R.L. Phillips
University of Minnesota and *USDA-ARS

Meiotic analysis of oat chromosomes is often hindered by the lack of adequate spreading of the bivalents. A modified PMC (pollen mother cell) preparation method has been found to provide enhanced separation of individual cells, resulting in improved spreading of bivalents. The technique centers upon the use of glass slides coated with a silicon film and the removal of all debris from the teasing/macerating step. The terminal quarter of an anther is removed to determine if the PMCs are at the required meiotic stage. The remaining portion of the anther is then hydrolyzed for 3 and 1/2 minutes in 1N HCL at 56^{o}C. Staining is accomplished by placing the anther in a drop of Schiff's reagent for 15 minutes. The darkly stained anther is then placed in a drop of 45% propionic acid for the teasing process.

The removal of the PMCs from the anther is accomplished by gentle teasing, which is greatly facilitated by the use of a dissecting microscope. If the material has been adequately hydrolyzed, the cells should easily come out of the anther with very little pressure. Some PMCs will remain together in small groups and should be gently teased or pulled apart with fine needles so that as many individual cells as possible are available. At this point, it is essential that all anther wall material be removed from the drop of stain.

The application of the cover glass to the drop of stain should be done gently, by slowly lowering it down onto the drop of stain with aid of a bent needle. The slide can then be heated to clear the cytoplasm. A very slight pressure can then be applied to the cover glass to insure flattening of the cells. The step is critical, as much more than a light pressure will destroy the cell. The chromosomes will be lightly stained and can be viewed under brightfield or phase contrast conditions.

Characteristics of *Avena sativa* x *A. maroccana* Decaploid C_2 Progenies

R. N. Choubey, S. K. Gupta and S. N. Zadoo

The wild relatives of cultivated oats possess many desirable genes which can be successfully transferred by means of interspecific hybridization. *Avena maroccana* is a tetraploid species (2n = 4x = 28) with high protein content and tillering potential. At the Indian Grassland and Fodder Research Institute, this species is being utilized for transfer of these characters to *Avena sativa* by following various approaches (Oat Newsletter, 36:20-21). The present communication pertains to some observations on decaploid C_2 progenies of *A. sativa* x *A. maroccana*.

During the winter 1983-84, amphiploidy was successfully induced in three pentaploid F_1 hybrids involving three strains of *Avena sativa* and one collection of *A. maroccana*. In 1984-85, eight F_1 plants were successfully raised and observed to have chromosome number 2n = 10x = 70 or near about 70. The seed setting, pollen fertility and pollen size varied among these plants (Premachandran, M. N., Choubey, R. N. and Gupta, S. K., Plant Breeding 97:268-271, 1986). One C_1 plant, SM 13-1, did not produce any seed, thus only seven C_2 progenies were raised during 1985-86.

A wide range of variation for all traits was observed within as well as among the C_2 progenies (Table 1). On an average, the progeny of SM13-3 were taller and had longer peduncles and rachis than those of other progenies. These plants also had high tillering. The widest range for spikelets per panicle was observed in the progeny of SM 8-2 though the average expression of this character was the highest in SM 13-2.

Many segregants for the lemma pubescence, lemma color and hairiness of awn were observed in all the progenies. It was interesting to find white lemma color in 18 out of 492 plants studied while such color was not observed in seeds of C_0 nor C_1 plants. *A. maroccana* type of spikelet separation was observed in 32.3 and 19.5 percent plants of SM 8-1 and SM 8-2 progenies respectively, whereas, all other plants had persistent spikelets. The spikelet separation by abscission was not observed in the earlier generations, i.e., F_1, C_0 and C_1.

The cytological analysis of many plants taken at random from SM 8-1, SM 8-2, SM 11-1, SM 11-2 and SM 11-3 exhibited the decaploid status of these progenies (2n = 10x = 70). However, the progenies SM 13-2 and SM 13-3 could not be categorically analyzed because of the stickiness of chromosomes at diakinesis as observed in the case of their C_1 progenitors.

In spite of the stable chromosome number (2n = 70) of the C_2 progenies, the frequency distribution for various spikelet characters did not fit into any of the segregation ratios. It is felt that further cytological and morphological observations on the C_3 progenies would elucidate the cause of such segregation. The realization of amphiploids with bold white seeds, high tillering and dark green leaves in the C_2 generation indicates that stable decaploids with desirable characteristics of both the species may be obtained in the succeeding generations.

Table 1: Morphological characteristics of various A. sativa x A. maroccana C_2 progenies

Sl. No.	Observations	C_2 Progenies*						
		SM 8-1	SM 8-2	SM 11-1	SM 11-2	SM 11-3	SM 13-2	SM 13-3
1	2	3	4	5	6	7	8	9
1	No. of plants observed	89	87	98	56	47	7	8
2	Plant height (cm)	82-165 (116.6)**	62-144 (103.6)	90-189 (127.6)	84-133 (109.9)	93-150 (117.6)	126-183 (155.5)	107-189 (159.3)
3	Peduncle length (cm)	29-54 (40.0)	11-49 (32.1)	29-56 (40.9)	20-48 (35.0)	23-57 (37.1)	40-54 (45.8)	36-62 (49.7)
4	Rachis length (cm)	22-50 (32.5)	11-44 (30.0)	25-54 (36.8)	27-41 (34.3)	27-46 (34.2)	33-52 (41.4)	27-54 (45.4)
5	Tiller number per plant	5-31 (14.8)	6-23 (14.1)	6-37 (14.9)	3-24 (12.7)	8-29 (16.8)	8-18 (13.1)	8-33 (19.0)
6	Spikelets per panicle	21-94 (54.7)	12-107 (44.9)	20-56 (36.9)	16-58 (34.8)	20-50 (30.0)	45-75 (58.1)	33-65 (43.1)
7	Primary lemma hairiness (Pubescent/Glaborous)	89/0	84/3	98/0	56/0	47/0	7/0	7/1
8	Secondary lemma hairiness (Pubescent/Glaborous)	78/11	57/30	93/5	50/6	45/2	4/3	0/8
9	Lemma colour (White/Grey/Black)	2/30/57	7/10/70	7/51/40	1/37/18	0/29/18	1/3/3	0/5/3
10	Awn hairiness (hairy/nonhairy)	82/7	68/19	10/88	4/52	4/43	4/3	1/7
11	Awns per spikelet (one/two)	17/72	30/57	98/0	56/0	47/0	5/2	7/0
12	Spikelet separation - Breakage	13	43	98	56	47	6	6
	- Semiabscission	47	27	0	0	0	1	2
	- abscission	29	17	0	0	0	0	0

* SM 8-1 = 'JHO 801' x A. maroccana - 1
SM 8-2 = 'JHO 801' x A. maroccana - 2
SM 11-1 = 'UPO-94' x A. maroccana - 1
SM 11-2 = 'UPO-94' x A. maroccana - 2
SM 11-3 = 'UPO-94' x A. maroccana - 3
SM 13-2 = 'OS-6' x A. maroccana - 2
SM 13-3 = 'OS-6' x A. maroccana - 3

** The mean values are given in parenthesis

OATS IN MANITOBA - 1986

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

In 1986, inopportune rains frustrated many farmers in Manitoba. Seeding was delayed by 2-3 weeks due to spring showers, heavy rains in June caused flooding in low lying areas and mid-September rains slowed the harvest. Those farmers who were able to harvest their crop before the fall rains reaped crops of good quality. For others, however, weather conditions resulted in both yield and quality losses.

Estimated grain yields of 2.40 tonnes per hectare (66 bu/acre) on 223,000 hectares (550,000) harvested for grain were the same as in 1985. Most of the oats harvested before the onset of fall rains was graded as No. 1 Feed or better and was acceptable to the local millers, whereas that grain harvested later was of poor quality. The four main oat varieties (with the percent of the area sown to each) were Dumont (40%), Fidler (39%), Harmon (14%), and Hudson (6%). The variety Dumont is continuing to increase in farmer acceptance at the expense of the variety Fidler. Within Manitoba, the inspected areas of all generations of pedigreed seed of Dumont, Fidler and Riel were 1400, 21 and 753 hectares, respectively.

Alison Baillie received her Masters degree from the University of Manitoba in October, 1986. Her thesis project involved three related investigations. Of the 171 diploid and tetraploid accessions screened for oat stem rust resistance, nine were resistant to the two tester races used. The inheritance studies showed that one gene was involved in resistance of the five diploid accessions studied and three genes were involved in resistance of the nine tetraploid accessions studied. The third aspect of this research showed that transferring this resistance into a useful hexaploid background will be difficult.

Tom Warkentin also received his Masters degree in October, 1986. His thesis research project involved a study of oat tolerance to the wild oat herbicide HoeGrass (diclofop-methyl). Of the 240 oat genotypes screened for HoeGrass tolerance, nine showed some tolerance but none had the same level of tolerance as the Australian oat cultivar Savena 1. An inheritance study of the tolerance to HoeGrass found in Savena 1 showed that this trait was controlled by a few genes, probably two, and that this trait could be readily incorporated into a breeding program.

The outbreak of oat crown rust in the Red River Valley, southwestern Manitoba, and southeastern Saskatchewan in 1986 was one of the earliest and most severe in recent years. Inoculum of crown rust arrived in southern Manitoba around mid-June, which is much earlier than normal. Conditions were favorable for subsequent development of the disease. The widespread use of the resistant cultivars Fidler and Dumont in Manitoba was effective in reducing the incidence of crown rust; neither of these cultivars was damaged by crown rust.

There were no important changes in virulence combinations of crown rust from those in recent years. The main virulence of this natural population in Manitoba was on lines containing gene Pc35, Pc40, or Pc46. None of the field isolates poses a threat to the resistant gene combinations currently used in the oat breeding program at the Winnipeg Research Station.

In contrast to crown rust, the incidence of oat stem rust in the rust area of the Prairies was one of the lightest in recent years. Only trace infections were detected on wild or cultivated oats throughout the growing season. There were no major changes in the physiologic races of oat stem rust in 1986.

Early season conditions appeared favorable for an outbreak of barley yellow dwarf in 1986: planting was delayed in the eastern part of the province due to wet weather and strong southerly winds which were potential carriers of viruliferous aphids were frequent in May and June. A BYD epidemic did not materialize, however, and the disease was generally limited to isolated patches or scattered individual plants within fields. The most common vector species found on oats were the English grain aphid (Sitobion avenae) and the cherry oat-bird aphid (Rhopalosiphon padi). All BYD virus isolates from oats were of the cherry oat-aphid non-specific strain (PAC-type).

Though field collections of the oat smuts have been taken for the last several years, the races represented by them are no longer determined. The collections were, however, tested for possible virulence on the cultivars Fidler, Dumont, Riel and Tibor. No such virulence was found in the 10 to 15 collections that were tested each year.

In the test of the reaction to smut of the Uniform Midseason Oat Performance Nursery of 1985 and 1986 a few entries were susceptible to the inocula used at St. Paul, MN and Urbana, IL, whereas they were resistant at Winnipeg. This difference in virulence of the inocula was not obvious from the reaction of the 13 smut differentials, although at Winnipeg infection on Clintland 64 was generally lower than at the other locations. It appeared that the inoculum used at Winnipeg (a mixture of races A60 and A617) did not contain the gene(s) for virulence on these entries. Two of them, IL79-4924 and ND810104, were therefore inoculated with 10 known races, seven of them originally collected in the U.S. and received from C.S. Holton, and three that originated in Canada. Six of the races were virulent on IL70-4924, three on ND810104. Of these races, A13, originally collected in Saskatchewan, Canada, will be added to the inoculum used for screening breeding material for smut reaction at Winnipeg. Line IL79-4924 (Coker 227/2/Clintford/Portal/3/Ogle) will be added to the set of differentials used here for future race determination.

OATS IN SASKATCHEWAN

B.G. Rossnagel and R.B. Bhatty
Crop Development Centre
University of Saskatchewan, Saskatoon, Canada, S7N 0W0

Despite dry conditions throughout June and early July most areas of Saskatchewan produced very high yields in 1986. These resulted from good moisture conditions at planting time and more than adequate rainfall from July 10 - August 5. While these later than normal rains did lead to generally excellent yields, they did cause the crop to be later maturing which in approximately one-half of the grain oat crop eventually led to poor quality due to a very wet, delayed harvest.

Oat acreage actually increased in 1986 by some 10+%, with seeded acreage at 1.1-1.2 million acres (500-550 hectares). This increase was associated with low prices and market opportunities for wheat and canola and a recent upswing in the cattle business. Much of the increased acreage was intended for forage production.

At the commercial level, the old variety Harmon was still the most widely grown cultivar, although its share of the acreage (38%) is rapidly dropping from its high of 57% in 1981. The new improved varieties Calibre (7%), Cascade (21%) and Dumont (12%) are rapidly replacing Harmon. The acreage of the U. of Sask. variety Calibre is especially noteworthy since 1986 was the first year that certified seed was available in quantity for this variety. Of further note is that, among pedigree seed growers, Calibre has become the most popular variety in Saskatchewan and Alberta, occupying 46% and 38% of the pedigreed acreage in those provinces respectively in 1986. This acreage totals some 10,500 acres. Calibre's combination of superior grain quality and high yield potential in the non-rust area obviously is pleasing to the producers.

One major objective is to now improve upon Calibre especially in terms of maturity, grain plumpness and smut resistance. Thanks to continued support from the Quaker Oats Co. of Canada Ltd. we hope to achieve these goals in the near future.

Cultivation and Utilization of Oats in Finland

Marketta Saastamoinen

The cultivation area of different cereal crops has changed very much during this century. Oats were the predominant cereal crop in Finland at the beginning of this century. Their cultivation was very popular especially because of their good adaptation to acid peat soils which abound in Finland. The cultivation of barley has increased substantially during the last 25 years (Table 1). Barley became the most cultivated cereal crop about ten years ago. The total cultivation area of oats has not, however, decreased radically in Finland in comparison to some other European countries. The grain yield of oats has increased nearly by the same degree as that of barley and wheat (Table 2).

Oats are used in Finland as a feed for cows, pigs and hens. Some feed factories produce high quality feed for hens by dehulling the oat grains. Oats usually have a slightly higher protein content than barley, the other major feed cereal crop in Finland, and the amino acid composition of oats is superior to that of barley. The high level of hull in the grain yield is the most limiting factor which decreases the use of oats in feed mixtures.

In Finland oats are utilized for human nutrition as well. Oats are employed in special mixture bread production, in the production of oat biscuits, as well as in the form of oat flakes and special breakfast products. The food industry has become increasingly interested in expanding the use of oats in food products because of their high nutritional value.

Table 1. Cultivation area of cereal crops in Finland in 1960-85 (1000 ha)

	Year						
	1960	1971-1980	1981	1982	1983	1984	1985
spring and winter wheat	181	166	108	143	160	154	157
%	18	14	9	12	13	13	13
rye	111	52	41	16	47	44	31
%	11	4	4	1	4	4	2
barley	213	510	570	540	550	562	646
%	21	42	49	47	46	48	52
oats	490	500	434	459	449	419	411
%	49	41	38	40	37	36	33

Table 2. Grain yield (kg/ha) of different cereal crops in Finland in 1960-85

	Year							
	1960	1971-1980	1981	1982	1983	1984	1985	1981-1985
spring and winter wheat	2033	2610	2184	3046	3440	3100	3000	2954
rye	1680	2155	1570	2150	2490	2090	2320	2124
barley	2070	2578	1900	2960	3210	3050	2870	2798
oats	2260	2522	2320	2870	3130	3160	2960	2888

Forage Quality of Oat and Barley

Bhagwan Das and K. R. Solanki

Systematic evaluation of oats for improvement in Forage Quality has been in progress for the last several years. During our studies conducted so far we have not obtained digestibility percentages higher than 80 percent in oats at the 50 percent flowering stage as reported by Manchanda and Ghosh (Oat Newsletter 36:24-25, 1985). Therefore, we felt it worthwhile to test the performance of oats and barley under our conditions.

The samples were taken at 50 percent flowering stage from the trial conducted with fourteen oat varieties and six varieties of barley in R.B.D. with three replications. The samples were analyzed for crude protein and *in vitro* dry matter digestibility.

Crude protein of oats ranged between 6.12 and 9.62% with an average of 8.07% (Table 1) whereas crude protein of barley varieties ranged from 6.78 to 9.84% with an average value of 8.16%. The *in vitro* dry matter digestibility varied from 66.60 to 72.80% and 68.60 to 72.80% in oats and barley respectively, with overall averages being 69.00 and 70.43%.

Crude protein yield of oats varied from 5.16 to 10.88 g/ha with an average value of 6.92 q/ha whereas in barley it ranged from 4.01 to 6.34 q/ha with an overall average of 4.99 q/ha. Digestible dry matter yield ranged from 49.66 t6o 77.23 q/ha and 34.25 to 48.92 q/ha in oats and barley, respectively. The average value of digestible dry matter was 58.75 q/ha in oats and 43.06 q/ha in barley. These differences were due to the high dry fodder yield (71.97 to 115.62 q/ha, average 85.8 q/ha) in oats compared to barley (49.64 to 49.30 q/ha, average 61.13 q/ha).

The present results conform to our earlier observations suggesting the higher percentages of digestibility observed by Manchanda and Ghosh could be due to enviromental effects.

Table 1. Range and average values of different components.

Crop	CP %	IVDMD %	Yield (q/ha) CP	Yield (q/ha) IMD
Oats range	6.12-9.62	66.60-72.80	5.16-10.88	49.66-77.23
Average	8.07	69.00	6.92	58.75
Barley range	6.78-9.84	68.60-72.80	4.01-6.34	34.25-48.92
Average	8.16	70.43	4.99	43.06

CP = Crude Protein
IVMDM = *In Vitro* dry matter digestibility
DMD = Digestible dry matter

Susceptibility of *Avena Sterilis* L. to Root-Knot Nematode, *Meloidogyne Javanica* - A New Host Record

R. K. Jain, N. Hasan, R. N. Choubey and S. K. Gupta

During the course of a survey of plant-parasitic nematodes associated with 9 *Avena* species at the Indian Grassland and Fodder Research Institute, Jhansi, a heavy population of second stage larvae of the root-knot nematode, *Meloidogyne* sp. were recovered from the soil collected from the rhizosphere of an early flowering *Avena sterilis*. Root examination of this genotype exhibiting unthrifty growth under field conditions revealed the presence of root galls due to root-knot infection. The galled tissues contained different stages of nematode development including mature females with fully developed egg masses. On the basis of the perennial pattern of the mature females examined, the nematode was identified as *Meloidogyne javanica* (Trueb, 1885) Chitwood, 1949. Preliminary studies on host parasite relationship with *M. javanica* give conclusive evidence of the destruction potential of this parasite on *A. sterilis* as revealed by the poor root growth of the plant. *A. sterilis* seems to be a new host record for this nematode species as far as known to the authors.

The worldwide distribution, extensive host range and involvement with fungi, bacteria and viruses in disease complexes, causes *Meloidogyne* spp. to rank high on the list of disease agents causing heavy losses to many economically important crops.

A. sterilis, the presumed ancestor of cultivated oats, constitutes a very heterogenic reservoir of resistance to many oat diseases including the cereal cyst nematode, *Heterodera avenae*. It is being used as a source of genes for resistance to many diseases to protect high yielding cultivated oat varieties.

Another *A. sterilis* collection growing in the vicinity of the one reported above was found to be free from *Meloidogyne* infection indicating that various strains of *A. sterilis* may have varying degrees of susceptibility to this nematode. Therefore, it is suggested that breeders should use only those *A. sterilis* genotypes as parents which have been tested for resistance to this new parasite of oats. Further detailed studies on this aspect are underway.

New Oat Cultivars Developed for Multicut System

B. S. Jhorar, D. S. Jatasra, C. Kishor and R. S. Dhukta

Since oats were recognized as an important winter cereal fodder for Northern India, research work was initiated at Haryana Agricultural University which resulted in the development of a high yielding oat variety HFO 114, suitable for single and two-cut systems. Further, breeding led to the development of cultivars OS6 and OS7 which have improved yield and quality. OS6 is now used as the national check in the All-India Coordinated Trials. Breeding directed toward developing multicut oat varieties has resulted in promising strains that have been evaluated for a two-cut system for three years. The performance of these strains is discussed in this communication.

Twenty strains of forage oats were evaluated over a period of three years from 1983-84 to 1985-86. Plots were planted in November in a randomized block design with three replications in 20 m^2 with 30 cm row spacing. The data for green fodder and dry matter yields were recorded for two cuttings; first cut at 55 days after sowing and second cut at 50 percent flowering.

Twenty recently developed lines having better regeneration capacity were evaluated for green fodder and dry matter yield for a two-cut system. The performance of six promising strains along with the check variety OS6 is presented in Table 1. During 1983-84, OS-121 followed by OS-134 gave highest green fodder and dry matter yields. Maximum dry matter yield was recorded in OS-132 during 1984-85. The grain OS-129 ranked first for both green fodder and dry matter yields during the third year of testing (1985-86). OS-134 exhibited high first cutting yields and appeared to have early vigor and had very broad leaves indicating better palatability of its fodder. OS-124 was another broadleaved strain.

Green fodder and dry matter yield averaged over 3 years (Table 1) indicate the advantage of OS-129 for use in a multicut system. The line OS-132 ranked second. OS-134, OS-121, OS-123 and OS-124 were other promising lines. These high yielding lines are expected to be the future oat varieties suitable for multicut system.

TABLE 1

Performance of recently developed oat varieties for two-cut system

Strain	1983-84			1984-85			1985-86			Mean	Rank
	1st cut	2nd cut	Total	1st cut	2nd cut	Total	1st cut	2nd cut	Total		
					Green fodder yield (q/ha)						
OS-129	80.8	330.7	411.5	149.9	355.7	505.6	147.4	366.5	513.9	477.0	1
OS-132	85.5	295.7	381.2	144.1	355.7	499.8	130.8	381.5	512.3	464.4	2
OS-134	119.1	305.7	424.8	152.4	358.2	510.6	144.1	298.2	442.3	459.2	3
OS-121	77.5	369.0	446.5	122.4	322.4	444.8	139.9	314.0	453.9	448.4	4
OS-123	77.5	310.7	388.2	141.6	360.7	502.3	94.1	343.2	437.3	442.6	5
OS-124	83.3	316.5	399.8	147.4	333.2	480.6	112.5	309.9	422.4	434.3	6
OS-6	91.6	249.9	341.5	164.1	347.4	511.5	131.6	237.4	369.0	407.3	11
					Dry matter yield (q/ha)						
OS-129	15.3	60.0	75.3	19.5	59.3	78.8	28.4	63.9	92.3	82.1	1
OS-132	15.5	55.3	70.8	19.7	59.4	79.1	23.5	68.7	92.2	80.7	2
OS-134	22.7	60.0	82.7	19.0	57.3	76.3	28.9	50.2	79.1	79.4	4
OS-121	14.7	70.7	85.4	17.2	60.1	77.3	25.2	53.7	78.9	80.6	3
OS-123	13.2	55.1	68.3	18.1	59.1	77.2	26.0	55.1	81.1	75.5	6
OS-124	15.8	63.1	78.9	18.6	55.6	74.2	21.7	55.7	77.4	76.8	5
OS-6	18.3	51.5	69.8	20.4	48.6	69.0	26.1	39.3	65.4	68.1	13

Biparental Matings for Improvement in the Base Population of Forage Oats

C. Kishor, R. S. Paroda and D. S. Jatasra

Oat is now becoming popular among Indian farmers as a winter forage crop owing to its various merits like low water requirement, nutritious fodder, good regeneration capacity and absence of toxic constituents. In northern India, especially in areas with restricted water supply, oat is the only reliable winter cereal forage crop. Genetic improvement of this important cereal fodder appears to be the immediate research need. The present communication is a part of the oat breeding programs at this university.

The experimental material for the present study consisted of two parental inbreds (OS 7 and Flamings Gold), their F_1, F_2 and F_3 generations and intermated populations in F_2 in the fashion of North Carolina design I (NC I), design II (NC II) and triple test cross (TTC). The material was sown during winter of 1981-82 in four different randomized block designs with three replications in each in contiguous field. Five competitive plants from each progeny in all three designs, ten plants from each parent and F_1 and 45 plants each from F_2 and F_3 population were selected at random and data was recorded for forage yield and its components.

The mean performance along with standard error of ten economic traits for different populations are presented in Table 1. Comparison of F_1 mean values with their corresponding parental means revealed significant heterosis for green fodder and dry matter yields including three important components, viz., plant height, green stem weight and dry stem weight. Inbreeding depression was observed for almost all the characters in the F_2 generation. Further declind in F_3 mean values was also noticed. Populations generated through the three mating designs had invariably higher mean values for various characters than that of parent I (OS 7) whereas, five characters (plant height, green stem weight, dry stem weight, green fodder yield and dry matter yield) exhibited higher mean values than parent 2 (Flamings Gold). In addition to these five characters, two more characters (green leaf weight and dry leaf weight) also exhibited higher mean values in North Carolina design II than parent 2.

The mean values for all the characters in NC II, for four characters in NC I and for six characters in TTC were higher than those of the F_2 population, whereas the mean values of three mating designs for all the traits were higher than their corresponding mean values of the F_3 except plant height in NC I and the number of tillers in TTC. It indicated that through intermating in the F_2, the mean values improved in all the three mating designs in comparison to the F_3 population. Obviously, instead of simply advancing the generation by selfing F_2 plants, intermating had improved the base population for further genetic improvement through selection. The mean values in NC II even surpassed the mean values of F_1 generation for most of the characters ecept plant height and dry leaf weight. Superior mean performance of all the biparental progenies in the present study appeared to be due to the creation of more desirable genetic variability by breakage of undesirable linkages. Biparental matings indicated considerable potential for improvement in mean values of most of the characters. Since the mean values of populations generated by NC II were higher for most of the characters in comparison to the other two designs, North Carolina design II appeared to be the best for improving the base popualtion. These improved populations could be further exploited for the genetic improvement of oats.

Table 1: Mean performance of various populations for forage yield and its components in oats.

Character	OS 7 (P_1)	FG (P_2)	F_1	F_2	F_3	NCI	NCII	TTC
Days to 50% flowering	120.70 ± 0.95	132.90 ± 0.99	123.00 ± 1.26	123.60 ± 2.06	122.66 ± 2.26	122.87 ± 1.70	123.16 ± 1.55	124.18 ± 1.69
Plant height (cm)	129.77 ± 2.10	120.30 ± 3.47	151.17 ± 8.55	135.85 ± 9.68	133.16 ± 9.04	129.97 ± 3.94	146.54 ± 3.40	150.57 ± 4.23
Number of tillers/plant	6.90 ± 0.58	9.93 ± 1.02	8.30 ± 0.72	8.68 ± 1.27	8.00 ± 1.11	8.41 ± 0.50	9.52 ± 0.58	7.89 ± 0.48
Number of leaves/plant	44.47 ± 2.71	66.40 ± 8.40	54.90 ± 6.14	60.72 ± 8.91	51.36 ± 7.68	55.45 ± 3.24	64.07 ± 3.45	53.57 ± 2.72
Green leaf weight/plant(g)	67.83 ± 4.95	88.67 ± 9.43	89.67 ± 6.71	90.30 ±11.44	76.67 ± 9.99	88.44 ± 5.08	96.10 ± 5.31	85.54 ± 4.27
Dry leaf weight/plant(g)	12.77 ± 0.96	15.84 ± 1.72	16.72 ± 1.04	15.98 ± 1.82	14.17 ± 1.67	15.38 ± 0.66	16.28 ±0.76	14.42 ± 0.66
Green stem weight/plant(g)	256.50 ±18.16	281.00 ±22.25	355.00 ±13.50	314.85 ±58.96	316.11 ±39.69	321.15 ±13.85	366.53 ±15.32	324.58 ±12.62
Dry stem weight/plant(g)	52.22 ± 4.33	48.04 ± 4.61	64.52 ± 2.61	58.56 ±10.00	55.92 ± 7.48	60.63 ± 2.84	70.43 ± 3.07	61.10 ± 2.37
Green fodder yield/plant(g)	324.33 ±20.20	369.67 ±30.00	444.67 ±17.64	405.15 ±66.59	392.78 ±47.58	409.59 ±18.11	462.63 ±19.74	410.12 ±16.63
Dry matter yield/plant(g)	64.99 ± 4.42	63.88 ± 5.92	81.24 ± 2.79	74.24 ±11.06	70.09 ± 8.65	76.01 ± 3.49	86.71 ± 3.74	75.52 ± 0.44

Tillering and Regeneration Capacity of Oat Cultivars

C. Kishor, D. S. Jatasra, K. R. Solanki* and B. S. Jhorar

In India, oats are mainly grown for livestock fodder. Tillering is an important forage yield component in forage oats. To investigate this important attribute, studies were undertaken concerning the effect of cutting, days from planting to cutting, and stubble height on tillering and regeneration in oats.

Ten oat cultivars, differing in their tillering capacity, were sown in a randomized block design at Haryana Agricultural University, Hisar. Planting was done in three-row plots of 3 m length with a plant spacing of 30 x 15 cm with three replications. Number of tillers per plant was recorded from three stubble heights, 5 cm, 10 cm and 15 cm, cut 60, 70 and 90 days after planting. Twenty days after cutting, the tillering observations were taken. Effective tillers were also noted at maturity from all the treatments.

In the treatment cut 60 days after planting, maximum tillering was observed in the variety 'Algerian' (Table 1) from all three stubble heights. 'Weston-11' ranked second in tillering. The fewest tillers were produced by 'Flamings Gold' in all nine treatments. Algerian had maximum tillers when cut 70 days after planting except at the 10 cm stubble height, where Weston ranked first. With a few exceptions, Flamings Gold produced the fewest tillers. Algerian and Weston-11 ranked first and second, respectively, when cut 90 days after planting. Fewest tillers were again observed in Flamings Gold.

Comparison of tiller number at cutting and 20 days after cutting indicated varietal differences in regeneration capacity. 'FOS I/29' produced the most extensive regeneration. The overall percentage of tillering 20 days after cutting was 109, 31 and 11 percent for cutting 60, 70 and 90 days after planting, respectively. There was a sharp decline in regeneration with delayed cuttings. Hence, in a multicut system, the first cut should not be delayed beyond 60 days after planting.

There was a drastic decrease in regeneration when cutting was delayed from 60 to 90 days in all the three stubble height treatments (Table 2). The tiller number harvested at the first cut increased linearly across the 60, 70 and 90 days cutting treatments with the 5cm stubble height. A similar trend was observed in the 10 and 15 cm stubble heights. The overall averages for the 60, 70 and 90 day cutting treatments were 6.4, 7.2 and 10.1 tillers per plant, respectively. Increased tillering was obtained with delayed cutting, because more time was available for the production of tillers.

At the 5 cm stubble height mean tillers recorded at cutting, 20 days after cutting and effective tillers at maturity were 7.16, 9.63 and 7.74, respectively (Table 2). Similar trends were observed for 10 cm and 15 cm stubble heights. Maximum tillers were recorded 20 days after cutting since at this stage both old tillers and regenerated tillers contributed to the total number of tillers. The number of effective tillers declined at maturity since all tillers could not produce panicles.

When averaged over nine treatment combinations, 8.18, 7.84 and 7.71 tillers/plant were observed for 5, 10 and 15 cm stubble heights, respectively (Table 2). Although the decline in tillering was slight with increased stubble heights, there was no apparent advantage to increased stubble heights. Taller stubble heights resulted in loss of some forage yield in the form of stubble left in the field. The regeneration of old tillers was affected adversely and effective tillers declined with increased stubble height.

In conclusion, Alergian and Weston-11 had better tillering capacity. FOS 1/29 produced the most regeneration. These cultivars could be used in oat hybrid breeding programs aimed at developing genotypes with high tillering and with better regeneration capacity. A marginal decline in tillering with higher stubble heights indicated that the 5 cm stubble height was optimum in oats. A sharp decline in regeneration with delayed cuttings suggested that first cut should not be delayed beyond 60 days of sowing in oats.

Table 1. Tiller number per plant under different treatments in oat cultivars

Cultivar	Stubble height								
	5 cm			10 cm			15 cm		
	At cut	20 days after cut	At maturity	At cut	20 days after cut	At maturity	At cut	20 days after cut	At maturity
				CUT AFTER 60 DAYS OF SOWING					
HFO 114	3.4	6.8	7.1	3.5	6.3	5.6	2.8	5.0	6.2
Kent	3.5	7.6	4.8	2.5	4.2	5.1	1.8	6.1	5.6
Weston-11	4.9	9.0	7.2	4.7	8.8	7.7	4.6	8.7	7.2
OS 6	3.1	6.2	6.0	4.6	6.3	5.7	2.6	3.9	5.5
OS 7	2.9	5.9	4.7	2.2	4.8	4.4	2.2	5.2	3.7
OS 8	4.7	8.6	6.6	3.6	6.2	5.1	2.3	4.7	5.5
FG	2.6	5.7	4.3	3.0	6.9	7.1	1.8	5.6	5.2
3021	4.1	7.4	6.8	2.6	4.6	5.4	2.6	4.7	5.8
Algerian	10.3	21.8	10.5	13.9	25.9	12.5	7.6	16.8	9.3
FOS 1/29	5.5	14.4	7.8	5.8	15.8	7.3	4.7	13.1	7.6
				CUT AFTER 70 DAYS OF SOWING					
HFO 114	5.4	6.4	7.9	5.6	7.3	6.0	5.1	6.9	6.0
Kent	6.1	7.3	7.6	4.5	6.1	5.7	5.2	6.5	7.2
Weston-11	10.1	12.2	9.5	10.2	13.4	10.9	8.9	11.1	9.4
OS 6	4.6	6.1	6.0	4.0	5.9	4.4	4.6	6.1	4.6
OS 7	5.0	6.6	6.3	4.4	5.7	5.6	6.3	8.2	7.2
OS 8	5.1	5.4	5.6	4.5	5.9	5.7	4.9	6.4	6.6
FG	4.6	6.3	6.2	3.7	5.3	4.8	3.8	5.1	4.1
3021	5.3	6.8	5.8	5.7	7.4	5.6	5.6	7.3	5.9
Algerian	10.0	13.3	9.9	9.5	12.4	9.4	10.3	14.5	11.1
FOS 1/29	9.1	12.1	8.1	9.4	12.8	7.4	9.4	12.8	8.5
				CUT AFTER 90 DAYS OF SOWING					
HFO 114	6.8	10.1	5.9	6.6	7.0	6.9	5.5	6.6	6.5
Kent	7.2	7.5	7.9	7.5	8.3	7.6	7.6	9.1	6.6
Weston-11	11.8	13.7	11.5	10.9	13.5	9.0	13.3	15.9	10.6
OS 6	7.7	6.6	7.4	9.1	9.1	8.8	6.0	7.2	6.3
OS 7	7.4	5.8	8.6	7.3	6.9	6.7	6.7	6.7	6.8
OS 8	7.1	7.4	7.4	7.9	9.1	8.3	8.2	9.7	7.5
FG	5.4	5.2	6.7	8.3	9.0	10.8	6.8	8.1	7.0
3021	8.0	8.0	8.1	7.2	8.1	7.6	7.3	8.0	7.1
Algerian	25.3	28.5	16.5	16.2	19.3	12.2	20.8	24.7	15.0
FOS 1/29	17.8	20.1	13.6	14.7	17.4	12.8	19.4	22.4	12.4

Table 2: **Mean performance for tillering** averaged over ten varieties at three stages when cut 60, 70 and 90 days after sowing with three stubble heights in forage oats.

Stubble height (cm)	Cutting (days after planting)	At cut	20 days after cut	At Maturity	Mean	Regeneration (Per cent)+
5	60	4.50	9.34	6.58	6.81	107.55
	70	6.53	8.25	7.29	7.36	26.33
	90	10.45	11.29	9.36	10.37	8.03
	Mean	7.16	9.63	7.74	8.18	34.49
10	60	4.61	8.98	6.59	6.73	94.79
	70	6.15	8.22	6.55	6.97	33.65
	90	9.57	10.81	9.04	9.81	12.95
	Mean	6.78	9.34	7.39	7.84	37.75
15	60	3.30	7.38	6.16	5.61	123.63
	70	6.41	8.49	7.09	7.33	32.44
	90	10.16	11.84	8.58	10.19	16.53
	Mean	6.62	9.24	7.28	7.71	39.58
	Overall Mean	6.85	9.40	7.47	7.91	37.23

+Regeneration per cent was computed as the increase in tillers 20 days after cutting divided by tiller number at cut and multiplied by hundred.

Disjunct Distribution of *Avena fatua* as a Weed in Ladakh

Bimal Misri

Avena fatua, the common wild oat is a well known weed of cereal crops. The presence of *A. fatua* in cereal crops is often not apparent until flowering when the wild oat panicle is taller than the crop. In most of the cases, grains of *Avena fatua* are shed before the actual crop is harvested. These grains have a prolonged dormany and their germination is erratic. Its control in cereal crops by selective herbicides is difficult (Gill and Vear, 1969).

During a recent plant exploration and collection trip to Ladakh in the month of September, 1986, an interesting distribution pattern of *Avena fatua* was observed. Ladakh is situated in the northeast of the Kashmir valley and is much different from Kashmir in its topography and climate. It is demarcated from the Kashmir valley by a 3,485 m high pass called Zoji La. The route from Zoji La up to Leh, the headquarters of the area, traverses through dry and rocky terrain interspersed with two more passes known as Namik La (alt. 3,697 m) and Fotu La (alt. 4,060 m). Ladakh has rightly been described as a cold desert since the total annual precipitation in the area may not exceed 90 mm and the winter temperatures may go down to -20^{o} C. Agricultural activity is restricted to irrigated areas around the Indus River and consists mostly of barley cultivation.

Though the soil, topography and climate is similar in most of Ladakh, excepting Dras, the distribution pattern of *Avena fatua* is distinctly disjunct. The route of the plant exploration trip and the places where *Avena fatua* was found growing wild or as a weed are shown in Fig. 1. The first place where it was found growing wild on the bunds of fields is Thasgam, a village near Dras. All the fields where barley had attained maturity were devoid of this weed though it was growing on the bunds. For the next 100 km it was not found anywhere. This 100 km stretch has many areas like Kargil and Mulbek where extensive agriculture is practiced and the major crop grown is barley. *Avena fatua* was not found anywhere growing either as a weed or in wild. The next place to find it was Bodhkharbu situated at the base of Namik La. Here it occurred frequently as compared to other areas. Its growth was more luxuriant in the wild. For the next 97 km it was again absent from the cultivated fields as well as from the natural vegetation. It is interesting to note here that from Khalsi up to Leh and beyond there are no high mountains which could have acted as a geographical barrier and stopped the dispersal of seed. Yet *Avena fatua* was found growing only in Nimu as a weed in both barley and wheat crops. The next place to find it was Thikse, beyond Leh. The occurrence of this plant species at only four places on and around a 290 km stretch of road makes its disjunct distribution quite interesting. Considering the climatic and soil condition similarities, the restricted growth of this plant at only four places needs investigation. The prolonged dormancy and erratic germination behavior of its seeds cannot be a reason for this restricted distribution since that would hold true for the whole area. It seems the seeds have remained confined to these four places only and their dispersal has not taken place. From the information collected from local farmers and the visual field observations no abnormality was found in these four areas as far as the agro-climatic parameters are concerned. Pending detailed investigations the only two reasons to which this preferential distribution can be attributed are:

a. In Ladakh, the farmers preserve a part of their own harvest for seed. There is hardly any exchange of the seed material even among the farmers of the same village (Gohil and Misri, 1986). It may be possible that the farmers of these four places have Avena infested seeds of their crops which are being grown continuously without any exchange with surrounding farmers, thus inhibiting the spread of this weed to other areas.

b. In whole of the Himalayas it is very common to find ecological niches in a particular eco-system. In such niches, if all agro-climatic parameters are the same, variation may exist at the micro-climate level of the soil. Perhaps these four areas are such ecological variants in this cold-arid eco-system which are suitable for the growth of *Avena fatua*.

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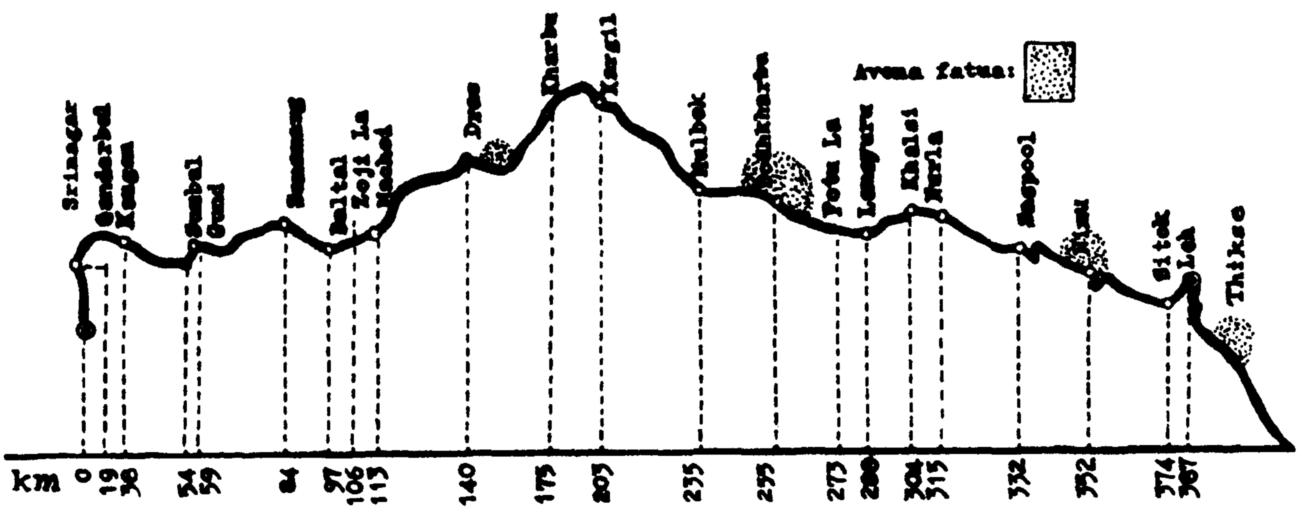

Fig. 1. Plant exploration route and the places where Avena fatua was found.

Performance of New Oat Strains for Forage Production Under Mid-hill Conditions in Kashmir Region

M. H. Shah

Jammu and Kashmir like other Northern hill states of India suffer from a chronic shortage of fodder which places a severe constraint on livestock development program. The livestock population of 5.8 million (1984-85) is not in good condition due to inadequate fodder resources. The deficit is around 2.4 million tons on a dry matter basis which is on the increase due to irrational increase in the livestock population. Out of the total geographical area of 2.41 million hectares, the area of forage production is less than 3 percent and it is not possible to increase the area since that state itself has a food grains deficit and an increasing human population further accentuates the problem. An area of .28 million hectares is presently occupied by paddy crop which almost remains fallow during part of the season and has tremendous potential for producing forage crops like oats, berseem and rape seed.

During 1985, Sher-e-Kashmir University of Agricultural Sciences evaluated eleven strains of Oats for their suitability, adaptability and duration of growth to fit in the double cropping system (Paddy-Oats-Paddy). The present study was undertaken at the Exotic Cattle breeding Farm, Manasbal under rainfed conditions. The strains were sown September 21, 1985, and harvested at milkstage of growth June 5, 1985 without delaying land preparation and transplantation of the next paddy crop. The cultivar, "Black nip" was superior to all other cultivars (Table 1) for plant mortality percentage, tiller number and forage yield. The leaves of Line 1 were characterized by deep green color with broader leaf size. A plant population of 30 plant/m row was maintained initially.

Reference:

IGFRI, Jhansi. 1972. Annual report, Indian Grassland and Fodder Research Institute, Jhansi.

Jayan, P. K., and Velayudhan, D. C. 1971. Annual report, Indian Grassland and Fodder Research Institute, Jhansi.

Table 1. Performance of oat cultivars for different forage attributes.

S. No.	Strain	Plant height (cm)	No. of Plants/m row	No. of tillers/m row	GFY** (q/ha)	DMY*** (q/ha)
1.	Kent	82	24	240	230	50.70
2.	JHO 801	76	26	101	132	33.12
3.	JHO 819	81	28	105	149	37.2
4.	Collabar	97	30	210	187	46.7
5.	Cobber	92	20	140	320	80.0
6.	JHO 815	82	23	92	195	49.3
7.	Algarian	75	25	201	210	50.2
8.	EC 1704	87	26	210	238	59.2
9.	JHO 802	75	28	142	115	28.7
10.	JHO 810	81	30	173	280	70.0
11.	Black nip	99	29	360	339	84.5

** Green forage yield.
***Dry matter yield.

Promising Oat Lines for the High Plateau Valley of Chihuahua Mexico

Jose J. Salmeron and Philip Dyck

The high plateau valley of Chihuahua Mexico is, according to some oat researchers (D. Western, D. Schrickel and D. Stuthman), the "Largest Concentrated Oat Producing Region in the Western Hemisphere". Last year, 210,000 hectares of oats were planted for grain and forage in this region. The crop is grown under dryland conditions. Usually the rainy season begins between July 1 and July 10 and ends with the first killing frost at the end of October. Besides the short growing season, stem rust infections and irregular rainfall are the most limiting factors of oat production in this region.

Since 1962, twelve varieties have been released resulting from introduction, selection and hybridizations. At the present time the variety Paramo occupies 90% of the growing area. However, rust infection reduces yields of this variety each year. As a result of selection, five advanced lines have outyielded Paramo in five consecutive seasons. In Table 1, the yield data averaged across years as well as other characteristics are presented. The highest yielding line (Line 1) produced 39% more grain yield than Paramo, except for Line number 2, which is 10 days later in heading days than Paramo - all are similar in maturity to Paramo. All lines were more resistant to stem rust and had improved groat percentage. The protein in the grain was the highest (21.5%) in Line four.

The next step is to check the performance of each line under farmer conditions and decide which of them are going to be released as a variety.

Table 1. Comparison of five lines and Paramo variety across five years 1982-1986.

Line No.	Cross	Yield kg/ha	%	Days to heading	Plant height (cm)	Reactions to stem rust	Groat %	Protein percent
1	Cate-Hua "S" F1-Hua"S" F_3 (Jim-Inca)Colli F_4 (Tpc x Mhf-7114)ENAx In-N x Jim-Inca) F_4	1,842	139	54	85	5MS	66.8	19.4
2	ML-III-80-5	1,788	134	59	90	5MR	67.7	17.7
3	ML-III-80-6	1,732	130	57	85	TrR	68.0	20.0
4	ML-II-80	1,563	118	51	85	5MR	64.8	21.5
5	Tpc x Mhf-7114/ENA/In N/(Jim-Inca)^2/(JIM-ENA) Elliots	1,470	111	52	80	10MS	65.2	20.8
6	Paramo	1,330	100	52	80	40S	59.9	19.6

ARKANSAS

R. K. Bacon and J. P. Jones
University of Arkansas

Production: According to the Arkansas Agricultural Statistics Service, Arkansas farmers planted 43,000 acres of winter oats during the 1985-86 growing season. Approximately 33,000 acres were harvested for grain with an average yield of 67 bu/A. This total production of 2,211,000 bushels is a two-fold increase over last year's production but is below the 10 year average of 2,509,000 bushels. There appeared to be higher than normal incidence of BYDV this year. This disease along with winterkill and water damage were major yield limiting factors.

Breeding: Panicle selections were made this year of AR 102-5 to purify for possible release. It has shown good winterhardiness, having the highest survival rate at Fayetteville in the 1985-86 Uniform Oat Winter Hardiness Nursery. AR 102-5, along with PA 7915-55, were the top yielding entries in the Uniform Central Winter Oat Nursery at Stuttgart.

Personnel: Mr. Steve Schuler has replaced Mr. Russell Sutton as Research Assistant for the small grains program. Mr. Sutton is now working as a Research Associate with the Texas Agricultural Experiment Station in Dallas.

GEORGIA

P. L. Bruckner (Tifton), A. R. Brown (Athens),
J. W. Johnson and B. M. Cunfer (Experiment)

Oat acreage and production continued long-term declines in Georgia in 1985-86. The Georgia Crop Reporting Service reported that state growers planted 60,000 acres of oats in 1985-86 and harvested 35,000 acres at 39 bushels per acre for a total production of 1,365,000 bushels. Total rainfall for the year was well below normal throughout the state for the second consecutive year, with the most severe moisture deficits occurring during the grain filling period. Rainfall deficits were most severe in north Georgia where growing season precipitation was about 65% of normal. Moderate losses occurred in the state in response to cold damage. Relatively low levels of disease were reported.

Dr. P. L. Bruckner assumed leadership of the small grains breeding program at the Coastal Plain Experiment Station in Tifton, GA replacing Dr. D. D. Morey who retired in 1985 after 32 years of service. A limited oat breeding effort will be continued at the Coastal Plain Station with emphasis on winterhardiness and disease resistance.

INDIANA

H. W. Ohm, J. M. Hertel (Breeding, Genetics), J. E. Foster (Entomology), G. E. Shaner, G. C. Buechley (Pathology), R. M. Lister (Virology), K. M. Day and J. J. Beaty (Variety Testing), and C. L. Harms (Extension).

Production. Oat production for 1986 is estimated by the Indiana Crop and Livestock Reporting Service at 6.4 million bushels, 16 percent lower than in 1985. The state average yield was a record 71 bu/acre. Of the 400 thousand acres seeded to oats, the crop on 90 thousand acres was grown and harvested for grain and the crop on the remaining acreage was grown for soil conservation and was not harvested.

Season. Oat seeding began in late March and progressed rapidly in early April and was earlier than normal. Emergence and plant growth were excellent except in extreme northwestern Indiana, where dry weather prevailed. Although rainfall during April was below normal there was ample soil moisture and air temperatures were cool. During May and June rainfall was frequent and above normal and temperature averaged above normal -- excellent conditions for rapid oat growth. Oats produced record vegetative growth. Diseases were negligible.

Varieties. The varieties Noble and Ogle were grown on 36 percent and 32 percent respectively of the state oat acreage.

Research. We continued emphasis to combine new resistances to the crown and stem rusts with tolerance to barley yellow dwarf virus. Many matings were also made to continue the recurrent selection program for population improvement. We continued a backcrossing program to incorporate crown rust resistance from several new and unrelated sources into several adapted lines with excellent tolerance to barley yellow dwarf virus.

Environmental conditions were unusually favorable for oats (early planting, adequate moisture, cool temperatures) in 1986 and consequently the plants were 6 to 8 inches taller than usual. Because of the excellent plant growth, we made much progress from selection in head-row nurseries for morphological and agronomic characters. Induced infections of crown rust and barley yellow dwarf virus were also very good and significant selection progress was made. A windstorm on 19 June caused severe lodging of all yield plots. Grain of early-flowering lines was sufficiently filled to avoid much, if any, yield loss due to lodging, but yields of lines later than Ogle likely were somewhat reduced.

David Baltenberger evaluated progress from two cycles of selection for BYDV tolerance in a recurrent selection program originating from a broad based oat population was evaluated in 1986. Remnant seed from the C_0, C_1, and C_2 populations along with parents were infected with the PAV isolate as single plants. The plants were transplanted to the field in a completely randomized design with plots represented by 10 individual plants. A visual symptom score was recorded for each plant.

Analyses of the means for each population reveal that significant progress has been made for BYDV tolerance level. The visual symptom score mean for the C_0 population was 5.2, the C_1 population was 5.0 and C_2 population was 4.3. BYDV tolerant oat lines were selected from the C_2 population in 1986 to be incorporated in the overall oat breeding program.

We are continuing intercrossing within these populations in the greenhouse and have begun a program of screening the lines for resistance to stem rust and crown rust before crossing. A third cycle of selection will be carried out in the field in the summer of 1987. This study shows that recurrent selection for BYDV tolerance in oats is feasible and can be effective.

IOWA

K. J. Frey, M. D. Simons, A. H. Epstein,
R. K. Skrdla, G. A. Patrick, and L. J. Michel

About 630,000 acres of oats were harvested for grain in Iowa in 1986. Mean yield was 60 bushels per acre, so the state production was about 38 million bushels. Oats were sown at the normal time in 1986, and there was adequate moisture for plant development and grain filling. Oats grew tall which resulted in much lodging. Crown rust was more severe in Iowa in 1986 than in any year since 1957. This disease caused low test weight and reduced yield. Small amounts of barley yellow dwarf and stem rust occurred, but neither did significant damage to the oat crop.

Three experimental lines of oats, B605-1085, D226-30, and D227-32, have been mated to donor parents to provide isolines with different crown-rust resistance genes for use in constructing multiline cultivars for these strains. All three experimental lines have high test weights and high yields. D226-30 and D227-32 are tolerant to yellow dwarf virus and B605-1085 is the most lodging resistant oat that has been developed recently. Crossing to develop the isolines of these experimental strains has been completed and by fall 1987, six or seven isolines will be available for each strain. These will be composited into experimental multilines for testing in 1988.

A study has been completed on the effects of cytoplasms from *Avena sterilis* on productivity of oats. In wheat, a type of nuclear-cytoplasmic heterosis occurs when certain wheat genomes are substituted into alien cytoplasms. In the oat study, which tested 10 *A. sterilis* cytoplasms in combination with 4 *A. sativa* genomes, *A. sterilis* introgression improved all traits in Tippecanoe variety, had little influence on CI 9268, were slightly detrimental to CI 9170, and very detrimental to the performance of all traits of Ogle. These general trends were modified by specific cytoplasms, but *A. sterilis* cytoplasm generally provided superiority of performance. No significant cytoplasmic effects *per se* were observed and all traits exhibited significant nuclear-cytoplasmic interactions. Positive nuclear cytoplasmic heterosis was detected for all traits in 5-20% of the isopopulations with *A. sterilis* cytoplasms.

Efforts to enhance the protein percentage of cereals including oats has been hampered by its general negative association with grain yield. Yet any program involved in protein yield improvement must consider both grain yield and protein percentage. Recently, several oat lines were identified in the Iowa gene pool that utilized both grain yield and protein percentage increases to enhance protein yield. These unusual, but desirable lines, were combined with other lines with high protein-yield to form three populations. Selection for protein-yield, utilizing recurrent selection was applied for three cycles (all three years) to each population as follows:

Line of descent	Strategy
HG	Select for high protein yield, emphasing grain yield
HP	Select for high protein yield, emphasing protein percentage
HGP	Select for high protein yield, *per se*

Increases in means of groat protein yield per cycle were significant in all three lines of descent ranging from 21 kg per hectare (4.7%) in HG and HGP, to 27 kg per hectare (5.3%) in HP. Correlated responses of groat yield were highest in HG (150 kg per hectare) and least in HP (100 kg per hectare). Groat-protein percentage increased by 0.31 per cycle in HP, decreased by 0.15 per cycle in HG, and did not change in HGP. Genetic variability for all traits remained high in all three lines of descent indicating potential for further gains in these traits. Harvest index and bundle weight were increased in all populations. Heading date, plant height, and seed yield were unaffected by selection whereas groat percentage and test weight decreased in populations HP and HGP. The genetic correlation of groat yield and protein percentage was -0.85 in HG and HGP, and +0.13 in HP.

Several changes have occured in the ISU oat breeding personnel during 1986. John McFerson finished in Ph.D. degree and is now a corn breeder with Asgrow Company in Janesville, Wisconsin. New faces on the small grains project are Peter Lynch from Minnesota who is studying for an M.S. degree, and Hal Moser from Colorado and Harm Schipper from The Netherlands who are working toward Ph.D. degrees.

MINNESOTA

D.D. Stuthman, H.W. Rines, L.L. Hardman, R.D. Wilcoxson,
and P.G. Rothman (retired)

Production

Nearly 45 million bushels of oats, the smallest production in this century, were harvested from 850,000 acres. A major reason for the sharp reduction both in production and in acres harvested is that nearly 50% of the acres planted were not harvested for grain. Many things coming together contributed to a near disaster. First a cold and wet spring delayed planting by as much as one month from normal in many parts of the state. Soon after planting was completed it became hot and for a short time the soil surface was short of moisture in some areas. This shortage and the high temperatures reduced tillering. By the middle of June (normal heading time) rainfall was again excessive and temperatures were again above average. These conditions continued off and on through harvest, which was not completed in some areas until late September. The season ended with up to 10 inches above normal rainfall. Crown rust infection was heavy, stem rust and barley yellow dwarf were noticeable in many locations. Lodging also reduced production in some areas.

Research

Progeny from the fourth cycle of recurrent selection will be evaluated in hill plots in 1987. In hill plots in 1985 fourth cycle parents yielded 28% more than the original set of parents. In row plots in the contrastingly poor 1986 season the increase was only 12% or three percent per cycle. Test weight and lodging resistance were both reduced as grain yield was increased.

Personnel

Mr. Gary Pomeranke joined the project in September as a Ph.D. student. Gary will be evaluating the fourth cycle of recurrent selection. He will also compare the performance of the fourth cycle progeny with an equivalent number of progeny produced from crossing the fourth cycle parents to Starter, Ogle, and an OT 207 dwarf derivative.

Ms. Lynn Dahleen also started a Ph.D. program in September 1986. She will be evaluating somaclonal variation in lines obtained from Lodi and Tippecanoe tissue cultures of varying ages. She earned a M.S. degree from the University of Kentucky. Mr. Eric Jellen started a M.S. program in June 1986. Eric earned a B.S. at Brigham Young University and will be assessing the potential of RFLP's as genetic markers in oats.

As indicated elsewhere in the ONL, Dr. Paul Rothman has retired. At this time we are awaiting decisions in the USDA on the nature and timing of identifying his replacement. Our group is also restructuring to enable continuation of the buckthorn nursery.

MISSOURI

Paul Rowoth, N. M. Cowen (Columbia)
and C. Hoenschell (Mt. Vernon)

Production: Spring oats harvested for grain increased three-fold in 1986 over the low in recent years in 1984. The increase in spring oat acreage planted and harvested is probably related to the reduction of wheat acreage that was planted in the fall, of 1984 and 1985, because of adverse weather conditions. The farmers feeling a need to have a cover crop for protection against soil erosion, probably selected spring oats as an alternative cover crop, thus increasing acreage planted to spring oats. When favorable weather and soil conditions exist at early spring oat planting time, there is usually an increase in spring oats planted in Missouri. These conditions existed in the spring of 1986. The last two years spring oats have increased in yields slightly. Perhaps this is a result of relative cool temperatures during grain filling and using varieties of better barley yellow dwarf virus tolerance.

Disease: Even though barley yellow dwarf virus inoculation was early, the effects of this inoculation were reduced by more favorable weather conditions for higher yields. The rusts inoculation appeared late in the maturing stage of growth and seems to have little effect on yield.

Varieties: Ogle is probably the most widely grown spring oat in Missouri. Missouri has developed a spring oat line that is intended to be released in the near future which has high yield potential with good test weight, good tolerance to barley yellow dwarf virus, moderate rust resistance and excellent groat yield.

Personnel Changes: Dr. Ann McKendry a graduate from Univeristy of Manitoba, Canada will assume the responsibilities in small grain breeding on June 1, 1987. She will fill the vacancy left by Dr. N. M. Cowen who accepted a position with the United Agriseeds on June 1, 1986. Dr. Jim Schaffer has served as the faculty coordinator for the small grains breeding program from June 1, 1986.

NEBRASKA

P. S. Baenziger and T. S. Payne
University of Nebraska

Harvested oat acreage in Nebraska stood at 360,000 acres in 1986, approximately 20,000 acres less than the 1985 value. Severe lodging and shattering in eastern Nebraska may have contributed to this harvested acreage decline. Albeit lodging stress, a near record statewide grain yield of 59.0 bu/A was reported, second only to the 1985 firgure of 60.0 bu/A. Mild weather in March and April and above average early summer precipitation may have contributed to this expression of grain yield potential. At our Mead, NE nurseries, Barley Yellow Dwarf and crown rust epiphytotics were greater than recent years.

In the spring of 1986, P. Stephen Baenziger accepted the position of "Small Grains Breeder",the University of Nebraska position formerly held by John. W. Schmidt. Steve (former Research Manager, Monsanto Agricultural Products Co., St. Louis, MO) assumed the helm on June 9, 1986 and has since become involved and aquainted with the vagaries of cereal breeding in the upper Great Plains. In addition to his research responsiblities, Steve is teaching the introductory, graduate level Plant Breeding course. Steve will represent Nebraska in the NCR-15 Oat Improvement committee.

NEW YORK

Mark E. Sorrells and G. C. Bergstrom

1986 Spring Oat Production: The 1984 oat crop for New York State averaged 65 b/a on 190 thousand acres harvested. This is 12 b/a lower yield and 40 thousand fewer acres than for 1985. The yield reduction was probably due to a warmer and dryer than average early spring followed by very wet cloudy weather during grain fill. Ogle and Porter continue to dominate the acreage planted.

Mass Selection for Oat Milling Quality: The three main conclusions of this project were: 1) the gravity table and air screen cleaner are similar in their selection efficiency; 2) mass selection by seed density does not uniformly improve the groat percentage of all populations nor all seed size classes within a population, particularly classes heterogeneous for seed size; 3) mass selection by seed density selects for high groat percentage seeds that may not necessarily come from high groat percentage genotypes. An example of this third conclusion was the increase in tertiary floret fertility in families that had been selected for high seed density. Seeds from tertiary florets have higher groat percentages than seeds from primary or secondary florets, however, tertiary floret fertility is a trait that is strongly negatively correlated to a genotypes overall groat percentage.

Two recommendations were made based on these conclusions: 1) prior to selection by density, seed should be stratified by size into fairly uniform classes to limit selection for seed size because inadvertant selection for size results in poor selection efficiency for groat percentage; 2) since most tertiary seeds are small, discarding smaller seed prior to selection would reduce selection for high tertiary floret fertility and result in greater improvements in groat percentage. This project was conducted by Edward Souza as a part of his Master's thesis.

Genetic Diversity and Parental Selection in Oats: This project has two goals: 1) to describe the genetic distance or relationship between 70 North American oat cultivars that have been widely used by breeders and growers; 2) evaluate the usefulness of estimates of genetic distance between parents in predicting the progeny performance from a cross. Three different estimates of genetic distance are being used in this project. Edward Souza is conducting this work as part of his Ph.D. dissertation.

Genotypic Stability of Groat Percentage: Groat percentage in oats has been identified important indicator of an oat cultivars milling performance and its relative value as a feed grain . Groat percentage is a heritable trait that can be improved by selection; however, there are no reports in the literature of the genotypic stability of the character across enviroments and years. To study the genotypic stability, data from the Uniform Mid-Season Oat Performance Nursery (UMOPN) was examined using two types of stability analysis: 1) a Finlay-Wikinson type of joint-regression analysis, 2) a within-location variance that measures the average variance of a trait within locations across years.

Four check cultivars from the UMOPN Ogle, Clintland 64, Dal, and Gopher were compared for all locations for the years 1976 through 1985. For the joint-regression analysis the groat percentage of each check cultivar at a location in a given year was regressed on the mean groat percentage of all cultivars at that year-location combination. The within-location variance was estimated by pooling across locations the year to year variance within a location. This was calculated for nine locations that most frequently reported (Winnipeg, Man., Urbana IL, Dickson ND, Fargo ND, Brookings SD, Madison WI, Ames IA, Rosemont MN). These two stability analyses were repeated for eight breeding lines that were tested from 1983 through 1985. All locations were used for both stability statistics calculated for the breeding lines.

The joint-regression analysis shows that there are significant differences among the check cultivars for stability of groat percentage. A slope of 1.0 indicates that the variety has an average stability across enviroments. A comparison of Ogle and Clintland 64, the two cultivars with the highest groat percentage, shows that these two cultivars differ significantly with Ogle being more stable than average (b=0.73) and Clintland 64 average for stability (b=1.05). The within-location variance is the stability that a grower or an area purchaser would be interested in since it reflects the consistency of the character for a cultivar within a location. Gopher has a significantly higher within-location variance; however, there does not appear to be significant variation among the modern check cultivars for this character .

The breeding lines show significant differences for both types of stability statistics; however, these estimates are probably less reliable than the check cultivar estimates because of the fewer number of enviroments. Of these lines IL75-302 and SD790400 appear to have the best combination of average groat percentage and stability across environments and within locations. For the genotypes measured, there is a positive association between the two types of stability; however, there is negative association between mean groat percentage and genotypic stability. Of the cultivars examined, Ogle appears to be the best genotype for stable, high groat percentage.

Genotypic stability statistics for stability across enviroments and within locations. Varieties were grown in the UMOPN for the years listed in the table.

Years grown	Cultivar	Average groat percent (%)	Joint-regression slope and standard error	Within-location variance ($\%^2$)	95% C.I. for within-location variance (Chi^2 distribution)
1976-85					
	Ogle	73.4	0.73 ± 0.08	8.46	10.61 - 5.71
	Clintland 64	74.0	1.05 ± 0.07	9.34	11.77 - 6.31
	Dal	72.8	0.93 ± 0.07	7.67	9.66 - 5.18
	Gopher	73.3	1.14 ± 0.08	11.36	14.31 - 7.67
1983-85					
	IL75-302	73.1	0.86 ± 0.13	1.67	3.28 - 1.17
	IL80-3072	73.5	0.95 ± 0.17	4.74	8.78 - 3.13
	IA B605-1085	70.1	0.59 ± 0.12	2.74	5.38 - 1.98
	SD790400	72.4	0.64 ± 0.12	1.52	2.98 - 1.06
	MN81128	72.4	0.91 ± 0.07	1.62	3.18 - 1.14
	MN81129	74.0	1.12 ± 0.16	5.57	10.95 - 3.91
	P72288RB1343	72.0	0.94 ± 0.14	2.89	5.68 - 2.03

NORTH CAROLINA

Ronald E. Jarrett and J. Paul Murphy

Growing Season

The 1985-86 growing season was overall poor for growing oats. Rainfall was well below normal for the second consecutive year as there was a prolonged drought over most of the state. Diseases were present but were not a major problem. Harvest proceeded rapidly and was completed by early July.

Production

There were 107,000 acres of oats planted in North Carolina. Forty-nine percent of the acreage (52,000) was grown for cover crops, hay, silage, etc. while 51% (55,000 acres) was harvested for grain. Most of the acreage was planted with the varieties Brooks, Coker 716 and some Madison. Production was 2.2 million bushels. The average yield per acre was 40 bushels. The value of grain production was 2.86 million while the total value of the entire crop was approximately 5.56 million.

Problem Areas

The main problems continue to be winterhardiness, diseases, insects, and competition. Many oats suffer winterkill, particularly in western North Carolina (Piedmont and Mountains). The main disease problems are barley yellow dwarf virus (BYDV) and crown rust. The cereal leaf beetle continues to spread over the entire state. In addition, interest in doublecropping with wheat, pursuing maximum economic yields or conducting intensive management practices with wheat, compete heavily and prevent any major increases in oat acreages. However, there may be some increased opportunities for oat utilization by the increasing pleasure horse market for use as feed, bedding etc.

N. C. Small Grain Grower's Association, Inc.

A North Carolina Small Grain Growers Association, Inc. was formed in 1986 by a group of small grain producers and agribusiness representatives from across the state. A statewide referendum was held to propose an assessment on wheat, barley, oats and rye. The assessment was approved by a large majority of producers in North Carolina.

Personnel

David Uhr, an MS candidate, joined the Small Grains Breeding Project in the Fall of 1986. He is utilizing several _A. Sativa_ populations to study the heritability of tolerance to the Soil-Borne mosaic virus, and gains under selection. David is also investigating several greenhouse and field screening techniques to increase efficiency in our efforts to find additional sources of tolerance to this pest in the _A-sterilis_ World Collection.

North Dakota

Michael S. McMullen

Production

The North Dakota Agricultural Statistics Service reported 38.5 million bushels of oats were harvested from .7 million acres of the 1.05 million acres planted. An average yield of 55 bushels/acre was estimated. The growing season was generally characterized by adequate moisture over the entire state which contributed to production of high yields and good quality, particularly in the western half of ND.

Diseases

Heavy crown rust infection developed earlier than normal particularly in the eastern third of the state. Reduction in yield and test weight due to due to crown rust in susceptible varieties in yield trials at Fargo was estimated to be 28 and 13% respectively relative to resistant varieties.

Heavy stem rust infection developed on varieties such as Don which has excellent crown rust resistance, but is susceptible to the prevalent stem rust race. Varieties which were susceptible to crown rust had little stem rust infection apparently due to the competitiveness of crown rust.

Barley yellow dwarf virus infection was more extensive than normal. Although yield losses in most commercial fields were minimal, some late planted fields in which oats was used as a cover crop were severely infected by the virus.

Breeding program

ND820603 (Froker/RL3038//Hudson/3/Porter) was increased to 50 bushels during 1986. Further increase in 1987 is planned with the intent of its release in 1988. ND820603 appears to have excellent straw strength and has produced high yields and high test weights, particularly in eastern ND.

ND810104 (RL3038/Goodland//Ogle) is being increased for potential release in 1989. ND810104 has an excellent yield record in ND relative to its maturity. Both ND820603 and ND810104 have stem and crown rust resistance derived from RL3038. ND810104 has exhibited a useful level of bydv tolerance in our trials.

Personnel

Hal Fisher left the oat project to work in farm management after ably serving as technician since 1978. Robert Bauman was hired to fill the technician position.

OKLAHOMA

J. A. Webster and R. L. Burton
USDA, Agricultural Research Service

The Russian wheat aphid, Diuraphis noxia Mordvilko, (RWA) was found in the United States for the first time in 1986. It was initially found in Texas, and later in New Mexico, Colorado, Oklahoma, Kansas, Wyoming, and Nebraska. According to the South African literature, oats are relatively resistant to RWA attack compared with other small grains. Our 1986 laboratory tests with oats were in agreement with the South African data; however, we noted some stunting when comparing infested versus noninfested seedlings in tolerance tests with individual seedlings. In greenhouse flat tests, the only survivors were the two oat cultivars in the tests, 'Nora' and 'Okay'. All other small-grain entries, including wheat, barley, rye, and triticale, did not survive. Although it appears that in most cases oats will not be severely damaged by the RWA, oat growers should monitor this pest carefully because it damaged and even killed some oat stands in DeBaca Co., New Mexico, in 1986.

OREGON

R.S. Karow and P.M. Hayes
Crop Science Department, Oregon State University

Oats were harvested from approximately 80,000 acres in Oregon in 1986, down nearly 20,000 acres from 1985. The average yield was 87 bu/A. Planted acreage was in excess of 105,000 acres.

The major area of production was in the Willamette Valley (western Oregon). Roughly three-fourths of total state acreage is normally found in this region. Other significant production areas are in the high elevation counties - Klamath, Harney, Union, and Baker.

The Willamette Valley has a Mediterranean-type climate in that rainfall is during late fall, winter and early spring and temperatures are mild. Both winter and spring varieties are successfully grown. The common winter cultivars are Walken and Grey Winter. Newer cultivars such as Kenoat (Kentucky) and an older Oregon bred cultivar, Amity, occupy some acreage.

White and red spring oats are grown. Kanota, Swan, Sierra, and Montezuma are grown for hay while Cayuse, Otana, Border, Monida and others are grown for grain. Approximately 75% of the oats produced enter market channels. Heavy or extra heavy white oats can be produced and find a ready market in the California horse trade. In recent times, extra heavy oats have had a greater value than soft white wheat.

Oats are a valuable rotation crop for many grain producers. Oats are commonly grown in rotation with wheat as take-all (Gaeumannomyces graminis), a common wheat rot rooting fungi, is suppressed by oats. Stiff-strawed, heavy grained cultivars are a necessity. Few diseases other than common smut and barley yellow dwarf virus are a problem. Scattered and economically insignificant infestations of crown rust were found in 1986.

In the higher elevation areas of the state, spring oats are grown. Winter wheats and barley can survive, but winter oat production is not possible. Often harvest and planting of cereal crops occurs simultaneously, hence, spring grains add flexibility to management plans.

As is in the Willamette Valley, both red and white varieties are grown. In Klamath Falls, more than half of the planted acreage is traditionally cut for hay.

No breeding work is being done in Oregon at this time. Cultivars from Kentucky, Pennsylvania, and other eastern states and from Idaho are obtained and tested. An effort may be made to establish an Oregon breeding stock of Grey Winter and Kanota oats as these varieties are widely grown and seed other than common stock is unavailable. Oat acreage in the state is expected to continue at its current level.

SOUTH DAKOTA

D. L. Reeves and Lon Hall

Production: Harvested acreage was the lowest since 1936, at 1.05 million acres. Planted acres were a record low of 1.5 million acres. The average yield was 44 bu. per acre. Production was 46.2 million bushels, the lowest since 1959. Production fell 42% from the previous year. In spite of this dramatic decrease, South Dakota still ranked second in oat production.

We are aware of three factors contributing to last years poor production. First, the spring was very wet. By the time some farmers could get in the field, it was later than they wanted to plant oats. Second, the government program was more favorable for farmers to plant barley rather than oats. The final problem was the crown rust which came in very early and (extensive) in the major oat growing region. The varieties with little effective crown rust resistance were severely affected. This was quite evident for entries in the Uniform Midseason regional oat test. As an example, at the Watertown station we seldom get much crown rust. Last year the variety Gopher produced 79 bu/A with a test weight of 31.8 lbs/bu there, but this year Gopher produced only 7.4 bu/A with a test weight of 12.7 lb/bu. The difference was due primarily to crown rust effects.

Varieties: Burnett is still very popular in the central and western parts of the state; however, it is now rare to find it in the eastern portion. Moore is also quite popular and has produced very well. The crown rust ratings on Moore were much above the previous years. Varieties which were severely hurt by crown rust in the eastern part of the state included Lancer, Noble, and Porter. Kelly continues to do well as an early white oat. We are expecting the newer varieties of Don, Hytest and Sandy to become important.

Research: The breeding program continues to emphasize heavy test weight with white hulls with good yields. Crown rust has been very prevalent the last three years, so we've selected heavily for field resistance. Whether coincidence or typical, we're not certain, but many of our high test weight lines with good yield often have dusty- or reddish-colored hulls.

The line SD 810109 will be increased during 1987 with plans to release in the following spring. It is a sister line to Hytest but slightly later. It was in the 1986 and 1987 Uniform Midseason Nursery.

Herbicide research is continuing with Lon Hall looking at several herbicide combinations which are often used by farmers. His 1986 plots had considerable increases in lodging when 2,4-D was used. This is now four consecutive years we've seen that trend.

Abdul Belal completed his Ph.D. and returned to Egypt. He looked at six oat varieties under dryland and irrigated conditions. Overall root length was different between varieties. Variety differences in root distribution were more marked on dryland plots. He also found some varieties showed more osmotic adjustment than others.

To make it easier to find your location in a large nursery, we've developed a line we call "BUGS". The naming procedure follows the one used by Rothman on his rust lines. The original objective was to have a readily identified line so your location in a nursery could be verified before plots were staked. The pedigree is Nip Black/Golden//Stout, hence the name "BUGS". Golden has virescent (yellow) plants and was obtained from Charlie Brown. The Black Golden we used in the past was the first cross. However, like Golden the straw was weak.

The final cross with Stout served to strengthen straw and give a moderately compact panicle. BUGS therefore has brown to black seed, pale yellow plants and moderately compact panicles. This line was in the field last summer at the Ottawa meeting. Limited seed is available if you would like to try it a a plant marker.

UTAH

R.S. Albrechtsen

Utah State University

Production. Oat production in Utah remains small but stable. Harvested acreage was down slightly in 1986. However, yields were slightly above those for a number of prior years, keeping total production near constant. Some of our oat acreage is harvested for forage but the majority is produced for grain; essentially all for both uses is irrigated.

Losses from diseases are generally small. Grasshoppers are sometimes a problem and the Cereal Leaf Beetle has damaged some fields in recent years.

Oat Program. Our oat program is confined primarily to growing of the Uniform Northwestern States Oat Nursery to identify cultivars well adapted to our growing conditions.

OATS IN WASHINGTON

C. F. Konzak and K. J. Morrison

Washington State University

Oat production has continued at about the same level as in previous years, with large amounts used as a cover crop for legume seedings and for hay. Recently, the advancing oat market prices and decreasing prices for barley growers have renewed an interest in oat production.

The recently released new Idaho cultivar, Monida, is proving to have a greater straw height and weakness than expected from earlier results. However, the variety has continued to perform well and it produces higher test weight grain than Cayuse and Appaloosa. 1986 oat yields in plots were generally good, but performance varied considerably with location, as might be expected from the weather pattern over the spring and summer. Early cultivars had reduced yields as a consequence of forcing following high late spring temperatures. However, cool development and maturation temperatures which followed, especially in the Palouse region, were conductive to high test weight grain production, even though a summer rainfall deficit occurred.

No new lines of special promise were identified in regional trials.

WISCONSIN

R. A. Forsberg, M. A. Brinkman, R. D. Duerst, J. B. Stevens
E. S. Oplinger, D. M. Peterson, C. A. Henson, H. L. Shands, and
K. D. Gilchrist (Agronomy) and A. H. Ellingboe (Plant Pathology)

Production, Diseases, and Varieties

Wisconsin farmers planted 1,200,000 acres of oats in 1986 and harvested 850,000 acres for grain and straw. The statewide grain yield was estimated at 62 bu/a, down 4 bu from the 1985 average. As in 1985, straw yields were somewhat lower than average in some areas of the state because heading was early and plant height was relatively short. Much of the acreage that was not harvested for grain and straw was harvested as oatlage between mid-boot and heading.

Although dry conditions prior to heading were common in the state, the 1986 growing season was relatively good for oat growth. There was very little leaf and stem rust, but barley yellow dwarf infection was extensive in susceptible varieties such as Lodi, Lyon, Rodney, and Dal. Ogle was the most widely grown variety in Wisconsin. Ogle is well adapted to Wisconsin growing conditions, and although it is susceptible to leaf rust, prevalence of this disease has been low in recent years. However, its susceptibility to leaf rust, stem rust, and smut remain a concern. Centennial, from Wisconsin, has performed well on farms in 1984, 1985, and 1986. Porter, a late oat from Indiana, also has yielded well. Steele, a new variety from North Dakota, performed very poorly statewide in 1986. Its future in Wisconsin remains uncertain. Hazel, a new variety from Illinois, has produced high grain yields in Wisconsin tests, and Certified Seed will be produced by Wisconsin seed growers for the first time in 1987.

Many dairy farmers who are harvesting their oats as oatlage are mixing Canadian field peas with oats at planting time. Agronomic and quality evaluations have shown that oat-pea mixtures provide high yields of excellent quality forage. On the basis of seed number, ratios in the area of 1:1 for oat-pea seedings should provide a forage that has 16 to 20% protein and an NDF of 50% or lower. Oat seeding rates that exceed 1.5 bu/a in these mixtures may reduce the yield of alfalfa that is harvested later in the establishment year.

Selection X4872-2 performed very well in Wisconsin tests in 1986, outyielding all other varieties and selections except Ogle. The selection, which was developed from an X3530-47/Ogle cross, is resistant to crown rust and has good tolerance to barley yellow dwarf virus. It is midseason in heading and has high groat percentage. Wisconsin is increasing X4872-2 for release. It will be entered in the 1987 Uniform Midseason Oat Performance Nursery. Three sister selections of X4872-2 were in the 1986 Uniform Midseason Nursery.

Quaker-South American Nursery

There were 160 pure lines and 140 segregating populations in the Quaker nurseries grown in South America in 1986. M. E. McDaniel (Texas A and M University), S. H. Weaver (Quaker Oats Company) and M. A. Brinkman visited nurseries in Brazil, Argentina, and Chile in November of 1986. Oats production in Brazil would have been excellent in the Entre Rios area of Parana, but a hail storm caused considerable damage. Rust pressure appeared to be heavy in much of Rio Grande do Sul. Oats production in Argentina appeared to be lower than average in 1986 because of dry conditions and a shortage of seed for planting. Oat growth and development in the Temuco area of Chile was slightly behind normal due to cool conditions in the latter half of 1986.

The Quaker project has been fulfilling its objectives in South America. Eighteen varieties have been released from the project since its inception in 1974. These varieties have improved oats production on South American farms and have contributed to improving the profitability of Quaker's milling operations.

Cereal Crops Research Unit

Dr. David Peterson, research leader, is on a sabbatical leave from June 1986 - June 1987 at the Rothamsted Experimental Station in Harpenden, England. During his sabbatical he has been studying gene regulation of specific proteins during maturation of barley. It is his expectation that he will be able to apply the techniques and knowledge gained to problems of oats upon his return to Madison.

C. A. Henson's laboratory is studying degradation of fructans in both oats and barley. Emphasis has been on the biochemical characterization of fructan exohydrolase, the major enzyme responsible for fructan degradation. Studies on other complex carbohydrates, such as B-glucans, are planned.

Thesis Research Projects

Mr. R. A. Bunch is conducting research on oat plant morphology. Groat percentage is an important quality factor in oats, and selection for high groat percentage is practiced in nearly all oat improvement programs. In the Wisconsin oat breeding program, it has been noted that vigorous and productive breeding lines often have hully kernels. Mr. Bunch is conducting research to measure precise relationships among vegetative weight, seed production, and groat percentage of various genotypes representing a wide range in kernel conformation and quality.

Results of Mr. Bunch's M.S. Thesis research were presented in the 1985 Oat Newsletter and 1985 Agronomy Abstracts: 49. (Paper presented at the American Society of Agronomy annual meeting, Dec. 1-6, 1985, Chicago, IL).

This research is being expanded to:

1. Determine the relationships between groat percentage and productivity among segregating lines from crosses between high x high, low x low, and high x low groat percentage genotypes.

2. Gain insight into developmental mechanisms which cause differences in groat percentage among various genotypes.

3. Determine the relationship between groat percentage and productivity among various genotypes using data from yield trial plots (replicated 4-row, 10-ft plots).

4. Study relationships between specific kernel conformation (shape) types with kernel quality traits and grain productivity.

Mr. M. A. Moustafa is studying transfer of rust resistance in oats. Crosses between crown rust resistant Wisconsin translocation lines and A. sativa result in conventional 3R:1S and/or unconventional 1R:1S F_2 segregation ratios. Mr. Moustafa is continuing studies to elucidate causes of the abnormal gene-transfer frequencies, including examination of chromosome pairing, pollen development, and gene transmission through both the egg and pollen.

Abduljabbar Salman is studying pre- and post-heading dry matter accumulation for his Ph.D. research. Thirteen oat cultivars and two selections were evaluated at Madison and Arlington in 1985 and 1986. Ogle produced the highest grain and dry matter yields, and accumulated the most dry matter, in all four environments.

Hyunki Lim is working with hull-less oats for his M.S. research. The hull-less genotypes that are being tested were developed by Dr. Harold Marshall, USDA, Penn State University. Crosses were made to develop hull-less oats with resistance to crown rust. In two yield tests, the mean yield of eight hull-less entries was similar to the mean yield of eight Avena sativa cultivars on a groat basis in 1986. The experiment was designed to compare production of hulled and hull-less oats in rusted and rust-free (fungicide treated) conditions, but rust development was minimal in 1986.

Lou Chapko initiated his Ph.D. work in June of 1986. Lou worked on hybrid wheat breeding with Rohm and Haas for two years after completing M.S. studies with Dr. Don Rasmusson at the University of Minnesota. Lou is participating in our oat-pea research, and he will also be continuing our dry matter accumulation work that has been ongoing in oats and barley.

MAILING LIST

M. Aartsma
Small Grain Centre
Private Bag 2C29
Bethlehem 9700
SOUTH AFRICA

Bari Abdallah
Station Centrale des Plantes Fourrageres
INRA BP 415 Guich
Rabat
MOROCCO

Dr. Alberto Zuloaga-Albarran
Apartado Postal No. 10
56230 Chapingo, MEXICO
421-88

Abdelkader Benbelkacem
Institut Des Grandes Cultures
Station Experimentale
Khroub - W Constantine
ALGERIA

Bryce C. Abel
109 Plant Introduction
Iowa State University
Ames, Iowa 50011
(515)292-6502

Dr. Aristeo Acosta-Carreon
Universidad Autonoma Agraria
"Antonio Narro"
Buenavista Saltillo
Coahuila, MEXICO

Rulon S. Albrechtsen
Plant Science Dept.
UMC 4820
Utah State University
Logan, UT 84322
(801)750-2243

Dr. Illimar Altosaar
Professor, Biochemistry Dept.
University of Ottawa
40 Somerset St
Ottawa, Ontario, Canada K1N 6N5
(613)564-2953

M. J. Ambrose
John Innes Institute
Colney Lane
Norwich Norfolk
ENGLAND

H. M. Anderson
Long Ashton Research Station
Univ. of Bristol
Long Ashton
Bristol, B518 9AF UK

Deane C. Arny
Dept. of Plant Pathology
University of Wisconsin
1630 Linden Dr.
Madison, WI 53706
(608)262-9815

Sr Jose Ascoli
Quaker de Guatemala
6 Av 060 Zona 4
Torre Professional II Oficina 411
Guatemala City, GUATEMALA

Mr. I. M. Atkins
521A West 15th St
Hereford, TX 79045

Dr. R. E. Atkins
Agronomy Department
Iowa State University
Ames, IA 50011-1010
(515)294-6863

Dr. Robert Bacon
Agronomy Department
115 Plant Science Bldg.
University of Arkansas
Fayetteville, AR 72701
(501)575-5725

Francisco Bagulho
Natl Plant Breeding Station
P - 7351
Elvas Codex
PORTUGAL
Phone: 62844

J. H. Baldwin
15 Langley Way
Hemingford Grey
Huntingdon Cambs. PE18 9DB
ENGLAND
Phone: 358911 Cambridge

David Baltenberger
Agronomy Dept.
Purdue University
Lafayette, IN 47907

R. D. Barnett
University of Florida
Route 3 Box 4370
Quincy, FL 32351

Andrew R. Barr
South Australian Dept. of Agric.
G P O Box 1671
Adelaide
SOUTH AUSTRALIA 5001

Manuel T. Barradas
Nat'l Plant Breeding Station 00-068-62847
7350 Elvas
PORTUGAL
Telex 40189 ENMP P

Luis Barrales
120 Agronomy
Iowa State University
Ames, Iowa 50011-1010

Director
Nat'l Seed Storage Lab
Colorado State University
Ft. Collins, CO 80523

D. B. Bechtel
U.S. Grain Marketing Res. Cen.
1515 College Ave.
Manhattan, KS 66502
(913)776-2713

Dan Belgum
310 Bessey Hall
Iowa State University
Ames, Iowa 50011-1020

Edmundo D. Beratto
Carillanca Experimental Sta.
Casilla 58-D
Temuco, CHILE

Gary C. Bergstrom
Dept. of Plant Pathology
Cornell University
334 Plant Science Bldg.
Ithaca, NY 14853
(607)255-7849

Ron Bhatty
Dept. Crop Science
Univ. of Saskatchewan
Saskatoon, Sask.
Canada S7N OWO

Biblioteca Estacion Exp Carillanca
Casilla 58 D
Temuco, CHILE

Bibliotheek de Haaff
Stichtng Voor Plantenveredeling
Postbus 117 - 6700 AC
Wageningen, NETHERLANDS

Ulrike Bickelmann
Bleichenhofstr. 5
D-7500 Karlsruhe 41
WEST GERMANY

Robert A. Black
Border Oats Limited
Edington Mill
CHIRNSIDE, Duns
Berwickshire U.K.

Dr. Jane Brace
Dept. Biol. Sci.
Manchester Polytechnic
Oxford Road, Manchester Lancs.
ENGLAND

G. R. Boughton
Experimental Farm
P.O. Box 760
Indian Head, Saskatchewan
Canada SOG 2KO
(306)695-2274

Chris Branson
6 Agron Rm 1
Iowa State University
Ames, Iowa 50011-1010

Phil Bregitzer
Dept of Agron/Pl Genetics
University of Minnesota
1509 Gortner Ave.
St. Paul, MN 55108

L. W. Briggle
USDA S&E ARS PGGI
Germplasm Resources Lab
Room 334 B-001 BARC-WEST
BELTSVILLE, MD 20705

Marshall A. Brinkman
Agronomy Dept.
University of Wisconsin
Madison, WI 53706
(608)262-9571

Dr. Uzi Brodny
Department of Botany
Tel-Aviv University
Ramat-Aviv
Tel-Aviv 69978 ISRAEL
03-420028

Jan B. Broower
Victorian Crops Res. Inst.
Horsham, Victoria 3400
AUSTRALIA

A. R. Brown
Rm 3111 Plant Sci. Bldg.
University of Georgia
Athens, GA 30602

Dr. C. M. Brown
Dept. of Agronomy
University of Illinois
Urbana, IL 61801

J. F. Brown
Botany Dept.
Univ. of New England
Armidale, N.S.W. 2351
AUSTRALIA

P. D. Brown
Agriculture Canada
Res Station De Recherche
195 Dafoe Rd
Winnipeg, Manitoba R3T 2M9
(204)269-2100

J. A. Browning
Dept. of Pl. Path. & Microbiology
Texas A & M Univ.
College Station, TX 77843
(409)845-8288

P. L. Bruckner
Dept. of Agronomy
Coastal Plain Experiment Station
Tifton, GA 31793-0748
(912)386-3351

John Bullock
General Mills, Inc.
Box 15003, Commerce Station
Minneapolis, MN 55415
(612)540-4671

William P. Bullock
35 Crosscreek Dr., Apt. A-7
Charleston, SC 29412

Ron Bunch
Dept. of Agronomy
1575 Linden Drive
Madison, WI 53706

Trond Buraas
Bjorke Forsokgard
2344 Ilseng
NORWAY

David Burnett
The Quaker Oats Company
Merchandise Mart Bldg.
Chicago, IL 60654

E. Burnett
Soil & Crop Sciences
Texas A & M Univ.
College Station, TX 77843

Dr. Peter A. Burnett
CIMMYT
Apdo Postal 6-641
06600 Mexico 6 DF
MEXICO
(915)4-21-00 X2217

Vernon D. Burrows
Res. Branch Central Region
Ottawa Res. Station Bldg. 75
Ottawa, Ontario
Canada K1A 0C6

Hector L. Carbajo
Istilart 189
7500 Tres Arroyos
Buenos Aires
ARGENTINA

Gilberto Carvalho
Rua Voluntarios da Patria. 2055
90.230 - PORTO ALEGRE-RS
BRAZIL
(054)225722

David H. Casper
Cereal Rust Lab
University of Minnesota
St. Paul, MN 55108

Central Scientific Agricultural
Library
Dept. of Intern. Book Exchange
Orlikov bystreet, 3.
Moscow, B-139, USSR

Lou Chapko
Department of Agronomy
University of Wisconsin
Madison, WI 53706

B. D. Chaudhary
121 Mohalla Chaudharian
Hisar-125 001
INDIA

James Chong
Research Station
195 Dafoe Road
Winnipeg, Manitoba
Canada R3T 2M9
(204)269-2100

R. N. Choubey
Indian Grassl.& Fod. Res. Inst.
Pahuj Dam
Jhansi-Gwalior Road
284003 U P, INDIA

O. K. Chung
1515 College Ave.
USDA/ARA Grain Mkt Res. Ctr.
Manhattan, KS 66052
(913)776-2703

Director
USDA-ARS Grain Mkt Res. Ctr.
1515 College Ave.
Manhattan, KS 66052
(913)776-2703

G. Clamot
Stat. D'Amelioration des Plante
Rue du Bordia, 4
B-5800 Gembloux
BELGIUM

R. V. Clark
Research Station Res. Br.
Agriculture Canada Bldg. 75
Ottawa, Ontario
Canada K1A 0C6

B. C. Clifford
Welsh Plant Breeding Station
Plas Gogerddan Negr Aberystwyth
SY23-3EB
Wales, UNITED KINGDOM

R. B. Clothier
University College of Wales
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
Wales, UNITED KINGDOM

T. M. Codd
Long Ashton Research Station
Weed Research Division
Begbroke Hill
Yarnton, Oxford OX5 1PF ENGLAND

Dr. Fred Collins
Dept. of Agronomy
University of Arkansas
Fayetteville, AR 72701

Andre Comeau
Agriculture Canada
2560 Boul Hochelaga
Sainte-Foy, Quebec
Canada G1V 2J3

Roger Cook
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
SY23-3EB
Wales, UNITED KINGDOM

Cornell University
Aquisitions Division
Albert R. Mann Library
Ithaca, NY 14853-4301

Jose Coutinho
National Plant Breeding Station
7351 Elvas Codex
PORTUGAL

Neil Cowen
106 Curtis Hall
University of Missouri
Columbia, MO 65211

Lynn Dahleen
Dept. of Agron. & Pl. Genetics
University of Minnesota
St. Apul, MN 55108

Bhagwan Das
Dept. of Plant Breeding
Haryana Agri University
Hissar - 125 004
INDIA

M. A. Davis
Agronomy Dept.
Washington State Univ.
Pullman, WA 99164

K. M. Day
Agronomy Dept.
Purdue University
Lafayette, IN 47907

Lealand Dean
P O Drawer B
Denton, TX 76201

Amos Dinoor
Dept. of Plant Path & Microbio.
Faculty of Agriculture
Rehovot, ISRAEL

Editor
Diversity Magazine
727 8th St. S.E.
Washington, D.C. 20003

Direccion Del CIAMEC-INIA
Apdo. Postal #10
Chapingo, MEXICO

Merrill Donoho
General Mills
Box 15003 Commerce
Minneapolis, MN 55415

J. P. Dubuc
Agriculture Canada
2560 Boul Hochelaya
Sainte-Foy, Quebec
Canada

Ronald D. Duerst
Agronomy Dept.
University of Wisconsin
Madison, WI 53706
(608)262-1650

Philip Dyck
Camp Agricu Exptal Sierra de Chih
Apdo Postal 554
CD Cuauhtemoc Chih
Mexico

Dr. A. H. Ellingboe
Dept. of Plant Pathology
University of Wisconsin
Madison, WI 53706

Dr. A. H. Epstein
Dept. of Plant Pathology
Iowa State University
Ames, Iowa 50011

Janet Erb
1496 Agronomy Dept.
Iowa State University
Ames, Iowa 50011

C. Erickson
Soil & Crop Sciences
Texas A & M University
College Station, TX 77843

Lars Eskilsson
Weibullsholm PBI Box 520
S-261 24 Landskrona
SWEDEN
418-785-00

Estacao Nacional
De Melhoramento de Plantas
ATTN: J. Contusky
Elvas
PORTGUAL

Kenneth H. Evans
Plant Variety Protection Office AMS
National Agricultural Library Bldg.
Rm 500
Beltsville, MD 20705

Mary Evans
3 Agronomy
Iowa State University
Ames, Iowa 50011-1010

Rhiannon Evans
Twyford Seeds Ltd.
Scotts Farm, Kings Sutton
Banbury Oxon
ENGLAND

Dr. Diane Exley
MAFF, Great Westminster House
Horseferry Road
London SW1P ZAE
UNITED KINGDOM

Dr. Zahir Eyal
Dept. of Botany
Tel-Aviv University
Ramat-Aviv, Tel-Aviv 69978
ISRAEL

Duane E. Falk
Dept. of Crop Science
Ontario Agricultural College
University of Guelph
Guelph, Ontario, Canada N1G 2W1

Mark Farnham
Dept. of Agron. & Pl. Genetics
University of Minnesota
St. Paul, MN 55108
(612)625-5220

H. A. Fisher
Agronomy Dept.
North Dakota State University
Fargo, ND 58105-5051

R. W. Fitzsimmons, Dept. of Agric.
7 Womora Ave.
Wahroonga
N.S.W., AUSTRALIA 2076

John Flahavan
E. Flahavan & Sons Limited
Kilmacthomas
County Waterford
IRELAND
051-94107

Eng Agr Elmar Luiz Floss
Caixa Postal 5690 NOMIA
Embrapa
Passo Fundo, RS
BRAZIL

Dr. R. A. Forsberg
Dept. of Agronomy
University of Wisconsin
Madison, WI 53706
(608)262-1390

J. E. Foster
Agronomy Dept.
Purdue University
W. Lafayette, IN 47907

Dr. Brad Fraleigh
Head Plant Gene Resource, Canada
Ottawa Research Station
Ottawa, Ontario
Canada K1A 0C6

Dr. Russell Freed
Crop & Soil Science Dept.
Michigan State University
East Lansing, MI 48824

Dr. Judith Fregeau
Plant Physiologist
Plant Research Center
CE.E.F. Bldg 75
Ottawa, Ontario, Canada K1A 0C6
(613)995-2700

Dr. K. J. Frey
Agronomy Dept.
Iowa State University
Ames, Iowa 50011-1010

Sue E. Fritz
205 Curtis Hall
University of Missouri
Columbia, MO 65211

M. Frost, Librarian
Division of Animal Production
CSIRO, P O Box 239
Blacktown N.S.W.
AUSTRALIA 2148

David W. Gaffney
Quaker Products Australia Ltd
Sunshine Road West Footscray
Melbourne Victoria
AUSTRALIA 3012

Lynn W. Gallagher
Rabat-ID
% USAID
Washington, DC 20523

Salvador Galvan-Lamas
INIA-CIAN-CAESICH
Calle 4a. No. 262, APDO. Postal No 554
CD. Cuauhtemoc, Chic.
MEXICO

Robert G. Ganly
12 Cannes Court
Highton, 3216
Victoria, AUSTRALIA

Wendel Ganssman
Muhlenwerke am Hafen
D-220 Elmshorn
WEST GERMANY

James H. Gardenhire
607 Mimosa
Denton, TX 76201

K. D. Gilchrist
Agronomy Dept.
University of Wisconsin
Madison, WI 53706
(608)262-6588

E. C. Gilmore
Soil & Cop Sciences
Texas A & M University
College Station, TX 77843

C. I. Goellner
Caixa Postal 569
Embrapa
Passo Fundo R S
BRAZIL

C. A. Jimenez Gonzalez
Invest Prog. Avena
Apdo Postal 10
Chapingo, MEXICO

Robert W. Gooding
Dept. of Agronomy
Ohio Ag Res & Dev Center
Ohio State University
Wooster, Ohio 44691

David G. Goslin
The Quaker Oats Co. of Canada Ltd
Quaker Park
Peterborough, Ontario,
Canada K9J 7B2

Bruce Grant
North Eastern Farmers Ltd.
Bannermill
Aberdeen AB9 2QT
SCOTLAND

Dr. Craig Grau
Dept. of Plant Pathology
University of Wisconsin
Madison, WI 53706

Mrs. J. Green, Librarian
Plant Breeding Institute
Trumpington Cambridge
ENGLAND CB2 2LQ

T. E. R. Griffiths
University College of Wales
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
Wales, UNITED KINGDOM

Teresa Gruber
Dept. of Agronomy/Pl Genetics
University of Minnesota
1509 Gortner Ave.
St. Paul, MN 55108

Dr. S. K. Gupta
Indian Grassland & Fodder
Research Institute
Jhansi 284003
INDIA

Steve Haber
Agriculture Canada
Research Station de Recherche
195 Dafoe Rd
Winnipeg, Manitoba R3T 2M9
(204)269-2100

Per Hagberg
Svalof Ab
S-26800 Svalov
SWEDEN

Lon Hall
Plant Science Dept.
South Dakota State University
Brookings, SD 57007

Richard P. Halstead
Agronomy & Plant Genetics
University of Minnesota
St. Paul, MN 55108
(612)625-1994

Cebeco-Handelsraad
Plant Breeding Station
P O Box 139
8200 AC Lelystad
NETHERLANDS

James J. Hanzel
Agronomy Dept.
North Dakota State University
Fargo, ND 58105
(701)237-8160

D. E. Harder
Research Station
195 Dafoe Rd
Winnipeg, Manitoba
Canada R3T 2M9
(204)269-2100

Leland L. Hardman
Agronomy & Pl Genetics
University of Minnesota
1509 Gortner Ave.
St. Paul, MN 55108

C. L. Harms
Agronomy Dept.
Purdue University
Lafayette, IN 47907

H. F. Harrison
Coker's Pedigreed Seed Co.
P O Box 340
Hartsville, S.C. 29550
(803)332-6013

Stephen A. Harrison
Dept. of Agronomy
M.B. Sturgis Hall
Louisiana State University
Baton Rouge, LA 70803-2110
(504)388-1308

Robert Harrold
Animal Science Dept.
North Dakota State University
Fargo, ND 58105

Prof. J. D. Hayes
Univ. College of Wales
Dept. of Agriculture
Penglais Aberystwyth Dyfed SY23, 3DD
UNITED KINGDOM

M. D. Hayward
Crop Improvement Division
Walsh Plant Breeding
Plas Gogerddan Near Aberystwyth
Wales, UNITED KINGDOM

Dr. James Helm
Agronomy Dept.
North Dakota State University
Fargo, ND 58105-5051

Dr. Cynthia A. Henson
Dept. of Agronomy
University of Wisconsin
Madison, WI 53706

J. M. Hertel
Agronomy Dept.
Purdue University
Lafayette, IN 47907

C. Hoenschell
106 Curtis Hall
University of Missouri
Columbia, MO 65211

John Holden
The Steading
Yarrow
Selkirk
SCOTLAND

Geraldine R. Horton
Quaker Oats Research Library
617 W. Main Street
Barrington, IL 60010

H. David Hurt
The Quaker Oats Company
617 West Main St.
Barrington, IL 60010

Head Library Services
Indian Agric. Research Inst.
(Pusa) Library
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International Rice Research Inst.
Library & Documentation Ctr.
P O Box 933
Manilla, PHILLIPINES

Norio Iriki
Agronomy Dept.
Hokkaido Nat. Agr. Exp. Sta.
Hitsujigaoka, Toyohira
Sapporo 004, JAPAN

R. E. Jarrett
Crop Science Dept.
North Carolina State Univ.
Raleigh, NC 27695-7620

Dr. H. K. Jedlinski
Plant Pathology Dept.
N 431 Turner Hall
University of Illinois
Urbana, IL 61801

Eric Jellen
Dept. of Agron. & Pl. Genetics
University of Minnesota
St. Paul, MN 55108
(612)625-5220

Neal F. Jensen
5416 Thomas Court N.E.
Albuquerque, NM 87111
(505)299-3022

Ing Gerardo Valdes Jimenez
U A A A N Programa De Cereales
Buenavista
Saltillo COAH
MEXICO

David R. Johnson
Cereal Rust Lab
University of Minnesota
St. Paul, MN 55108

E. W. C. Jones
University College of Wales
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
Wales, UNITED KINGDOM

I. T. Jones
Pathogen & Pest Resistance Group
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
SY23-3EB, Wales, UNITED KINGDOM

J. E. Jones
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
SY23-3EB Wales, UNITED KINGDOM

Omar Kafawin
Plant Science Dept.
South Dakota State University
Brookings, SD 57007
(605)688-5121 X125

Russ Karow
Crop Science Dept.
Oregon State University
Corvallis, OR 97331
(503)754-2771

D. S. Katiyar
Scientist-S2
Indian Grass. & Fod. Res. Inst.
Jhansi, INDIA

Keizo Katsuya
Inst. Agr. & Forest
University of Tsukuba
Ibaraki 305
JAPAN

P. J. Keane
Latrobe University
Botany Dept.
Bundoora Victoria
AUSTRALIA 3083

R. L. Kirkby
The Oats Marketing Board
Box R196, P O Royal Exchange
Sydney N.S.W.
AUSTRALIA

A. E. Kirton
Canadian Wheat Board
423 Main St. Box 816
Winnipeg, Canada R3C 2P5

Dr. H. R. Klinck
Fac. of Agric., Plant Science Dept.
MacDonald Campus of McGill Univ.
21111 Lakeshore Road
Ste Anne De Bellevue, P Quebec H9X 1C0

F. L. Kolb
Agronomy Dept., Tyson Bldg.
Pennsylvania State Univ.
University Park, PA 16802

Peter Kolln
Muhlenwerke
D2200 Elmshorn
WEST GERMANY

C. F. Konzak
Agronomy Department
Washington State University
Pullman, WA 99164
(509)335-3635

Kiro Dimov Kostov
Plant Introduction Inst.
Sadavo
Plovdiv, BULGARIA

Bo Kristiansson
Svalof AB S-268 00
Svalov, SWEDEN

Takeshi Kumagai
Hokkaido Nat Agr Exp Sta
Higashi 1 jo 10 chome 2-15
Tsukisamu, Toyohira
Sapparo 062, JAPAN

J. Kumar, Senior Research Officer
Hill Campus
G.B.Paut
Ranichuri 249199
Tehri (U.P.) INDIA

Greg Kushnak
Agr Research Center
P O Box 1474
Conrad, MT 59425
(406)278-7707

Hans Kuuts
The Jogeva Plant Breeding Station
202 350 Jogeva
Estonian SSR
USSR

Gideon Ladizinsky
Faculty of Agriculture
The Hebrew University
P. O. Box 12
Rehovot, ISRAEL

Dr. H. N. Lafever
Agronomy Dept.
Ohio Agr. Res. & Dev. Ctr.
Wooster, OH 44691

T. Lambert
Twyford Seeds Ltd.
Scotts Farms, Kings Sutton
Banbury
Oxon, ENGLAND

Arthur Lamey
Plant Pathology Dept.
North Dakota State University
Fargo, ND 58105-5012

Risto Lampien
Lansi-Hchkiala
SF-14700 Hauho
FINLAND

Michael Lane
Pillsbury Company
480 Grain Exchange
Minneapolis, Mn 55415

D. A. Lawes
Welsh Pl Breed Station
Plas Gogerddan Near Aberystwyth
SY23-3EB Wales
UNITED KINGDOM

J. E. Lea
Morning Foods Limited
Northwestern Mills
Crewe, CW2 6HP
Cheshire, UNITED KINGDOM

P. Lea
Morning Foods Limited
Northwestern Mills
Crewe, CW2 6HP
Cheshire, UNITED KINGDOM

Steven Leath
Dept. of Plant Pathology
Box 7616, NCSU
Raleigh, NC 27695-7616

J. M. Leggett
Welsh Plant Breeding Sta.
Plas Gogerddan Near Aberystwyth
SY23-3EB Wales
UNITED KINGDOM

Norbert Leist
Lufa-Augustenbberg
Nesslerstrasse 3
D-7500-Karlsruhe 41
WEST GERMANY

Marvin Lenz
Quaker Oats Co.
617 W Main St.
Barrington, IL 60010
(312)381-1880

D. Lewis
University College of Wales
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
Wales, UNITED KINGDOM

R. M. Lister
Agronomy Dept.
Purdue University
W. Lafayette, IN 47907

Dr. G. Lockhart
USDA
1515 College Ave.
Manhattan, KS 66502
(913)776-2736

S. M. Lockington
The Quaker Oats Co. of Canada Ltd
Quaker Park
Peterborough, Ontario
Canada K9J 7B2

Roland Loiselle, P Ag
Head Plant Gene Resources Canada
Ottawa Research Station
Ottawa, Ontario
Canada K1A 0C6

David L. Long
Cereal Rust Laboratory
University of Minnesota
St. Paul, MN 55108
(612)625-1284

O. W. Luetkemeier
Agronomy Dept.
Purdue University
Lafayette, IN 47907

H. H. Luke
Plant Pathology Dept.
Fifield Hall, Univ. of Florida
Gainesville, FL 32611

R. D. Lyons
Odlum Group Ltd.
Sallins
Co. Kildare, IRELAND

E. V. Lyzlov
Agricultural Research
Institute Nonchernozeme Zone
143013 Nemchinowka-1
Moscow Region, USSR

Anne L. McKendry
Dept. of Agronomy
106 Curtis Hall
University of Missouri
Columbia, MO 65211

James Mac Key
Swedish Univ. of Agr. Science
Plant Breeding
S-750 07 Uppsala
SWEDEN

Benvindo Martins Macas
National Plant Breeding Station
7351 Elvas Codex
PORTUGAL

M. C. Mackay, Curator
Australian Winter Cereals Collection
Private Mail Bag, R M B 944
Tamworth, N.S.W.
AUSTRALIA 2340

W. F. Mai
Plant Pathology Dept.
Plant Science 310
Cornell University
Ithaca, NY 14853

Dragoljob Maksimovic
Institute for Small Grains
Kragujevac
YUGOSLAVIA

Uriel Maldonado A.
Victoria #310-110
Centro CP 31000
Chihuahua, Chih.
MEXICO
12-52-27

P. L. Manchanda
Cummings Laboratory,Div.of Genetics
IARI
New Delhi 110012 INDIA

Jacob Manisterski
Dept. of Botany
Tel Aviv University
Ramat Aviv, 6997-8 ISRAEL

Dr. H. G. Marshall
R.D. 2, Box 230
Bellefonte, PA 16823
(814)383-4118

Dr. J. W. Martens
Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, Manitoba R3T 2M9

Jim Martin
LaCrosse Milling Co.
Cochrane, WI 54622

Matilde Martinez Vasquez
Gogunidad de Madrid
Servicio Investigacion Agraria - Ap.127
Alcala de Henares (MADRID)
SPAIN

Bengt Mattsson
Svalof AB 268 00
Svalof, SWEDEN

Maria Mazaraki
Plant Breed Institute
30-423 Cracow
4 Zawila Str
POLAND

Dr. M. E. McDaniel
Soil & Crop Sciences Dept.
Texas A & M University
College Station, TX 77843

J. M. McEwan
Crop Research Division
D SIR, Private Bag
Palmerstown North
NEW ZEALAND

John McFerson
Asgrow Seed Co.
3501 N. Town Hall Rd. RR2
Janesville, WI 53545

R. L. McGraw
Agronomy & Plant Genetics
University of Minnesota
St. Paul, MN 55108

W. T. McGraw
Jacob Hartz Seed Co. Inc.
P O Box 946
Stuttgart, AR 72160

Anne L. McKendry
Department of Agronomy
106 Curtis Hall
University of Missouri
Columbia, MO 65211

Dr. R.I.H. McKenzie
Agriculture Canada
Research Station
195 Dafoe Road
Winnipeg, Manitoba R3T 2M9

R. J. McLean
W. Aust. Dept. of Agriculture
Baron-Hay CRT
South Perth
WESTERN AUSTRALIA 6151

Mike McMullen
Agronomy Dept.
North Dakota State University
Fargo, ND 58105-5051

Marcia V. McMullen
Plant Pathology Dept.
North Dakota State University
Fargo, ND 58105

Renato Borges De Medeiros
Av. Panamericana, 337/302
90.050 - Porto Alegre - RS
Brasil

Leonard Michel
77 Westbury Drive
Bella Vista, AR 72714

A. Micke
FAO-IAEA Div Wien
P O Box 100
A-1400 Vienna
AUSTRIA

B. Middleton
University College of Wales
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
Wales, UNITED KINGDOM

K. Mikkelsen
Norwegian Grain Corp.
Prinsensgt. 7, N-1500 Moss
NORWAY

James Mills
Nor Oats, Inc.
P.O. Box 399
St. Ansgar, Iowa 50472

J. D. Miller
Plant Pathology Dept.
North Dakota State Univ.
Fargo, ND 58105

S. N. Mishra
Dept. of Plant Breeding
G. B. Pant Univ Agr & Tech
Pantnagar 263 145 Dist
Nainital (U.P.) INDIA

Dr. Bimal Misri
Indian Grass & Fod Res Inst.
Manasbal 196 504
J & K State
INDIA

Dr. Darrell Morey
Agronomy Dept.
Coastal Plains Exp. Sta.
Tifton, GA 31794

David R. Morgan
B.O.B.M.A.
6 Catherine Street
London WC2 B5JJ
ENGLAND

George H. Morgan
Small Grains Bldg.
Agronomy Dept.
Oklahoma State University
Stillwater, OK 74078

Toshinobu Morikawa
College of Agricultureure
University of Osaka
Mozuumemachi, Sakai City
Osaka 591 JAPAN

John G. Moseman, USDA, ARS
Germplasm Quality & Enhancement Lab
PGGI Bldg. 001, RM 327
Beltsville, MD 20705

Jimmie Mowder
USDA/ARS/DA/PGGI
BARC-W, Bldg. 001, Rm 130
Beltsville, MD 20705

J. Mulkey
1619 Garner Field Rd
Uvalde, TX 78801

Chris Mundt
Dept. of Botany & Plant Pathology
Oregon State University
Corvallis, OR 97331-2902
(503)754-3451

Aage Munk
Landbrugents Kornforaedling
Noerremarksveg 67 Sejet
Dk 8700 Horsens
DENMARK

Kouj Murai
Takarazuka Res. Center
4-2-1 Takatsukasa
Takarazuka, Hyogo, 665
JAPAN
0797-85-2045

Dr. Charles F. Murphy
USDA, ARS, NPS
Bldg. 005, BARC-W
Beltsville, MD 20705
(301)344-1560

Paul Murphy
Crop Science Dept.
North Carolina State Univ.
Raleigh, NC 27695-7620

Manuel Navarro-Franco
INIFAP-CIAMEC
Apdo Postal No 10
56230 Chapingo, Mex
MEXICO

L. R. Nelson
Soil & Crop Sciences Dept
Texas A & M Univ, Drawer E
Overton, TX 75684

J. J. Nielsen
Agriculture Canada
Res Sta, 195 Dafoe Road
Winnipeg, Manitoba
Canada R3T 2M9
(204)269-2100

W. C. Niemans-Verdriee
Instituut Voor Plantenveredeling
PostBus 386
6700 AJ Wageningen
NETHERLANDS

Ichizo Nishiyama
18-Hazamacho, Shugaku-in
Sakyoku Kyoto 606
JAPAN

J. D. Oates, Off. in Charge
Pl. Brd. Inst. P O Box 180
Castle Hill - Univ of Sydney
N.S.W. 2154 AUSTRALIA

Dr. H. W. Ohm
Agronomy Dept.
Purdue University
W. Lafayette, IN 47907

W. H. Oliver
P. O. Box 148
Lindfield 2070
NSW, AUSTRALIA
02/46-4785

Edward S. Oplinger
Agronomy Dept.
363 Moore Hall
University of Wisconsin
Madison, WI 53706

Yukio Ozeki
Hokkaido Nat. Agr. Exp. Sta.
Hitsujigaoka, Toyohira
Sapporo 004, JAPAN

K. W. Pakendorf
Small Grain Centre
Private Bag X29
Bethlehem 9700
Republic of South Africa

Andras Palagyi
Cereal Research Institute
Szeged
P O Box 391
HUNGARY 6701
62-54-555

Y. C. Paliwal
Chem & Biology Res Inst.
Research Branch, Canada Agric.
Ottawa, Ontario
Canada K1A 0C6

Brian Palmer
Ralston Purina Co
P. O. Box 3588
Davenport, IA 52808

R. S. Paroda
Dept. of Plant Breeding
Haryana Agricultural University
Hissar
INDIA 12500-4

Anna L. Parry
Plant Pathology Dept.
Walsh Plant Breeding Station
Plas Goggerddan Near Aberystwyth
S&23-3EB Wales, U.K.

H. Pass
Agronomy Dept.
Oklahoma State University
Stillwater, OK 74074

F. L. Patterson
Agronomy Dept.
Purdue University
W. Lafayette, IN 47907

B. D. Patil
Indian Grassland & Fodder Res.Inst.
Pahuj Dam, Jhansi-Gwalior Rd
Jhansi-284003 (U P)
INDIA

George Patrick
Agronomy Dept.
Iowa State University
Ames, Iowa 50011-1010

Thomas S. Payne
Dept. of Agronomy
279 Plant Sciences
University of Nebraska
Lincoln, NE 68583

Bill Pederson
Atwood-Larson Co.
876 Grain Exchange
Minneapolis, MN 55415

Robert E. Perdue
ARS, USDA
Room 366, Bldg. 001
BARC-West
Beltsville, MD 20705

Dr. Federico Cuevas Perez
Instituto Superior de Agricultura
Apartado de Correos 166
La Herradura Santiago
Dominican Republic

D. M. Peterson
Agronomy Dept.
University of Wisconsin
Madison, WI 53706

P. L. Pfahler
Agronomy Dept.
304 Newell Hall
University of Florida
Gainesville, FL 32611

Ariane Plourde
Universite Laval
Dept. Phytologie
FSAA, Quebec
Canada G1K 7P4

J. M. Poehlman
Dept. of Agronomy
109 Curtiss Hall
University of Missouri
Columbia, MO 65211
(314)882-7709

Gary Pomeranke
Dept. of Agron. & Pl. Genetics
University of Minnesota
St. Paul, MN 55108
(612)625-5220

Y. Pomeranz
1515 College Ave.
USDA/ARS Grain Mkt Res Cen.
Manhattan, KS 66502

K. B. Porter
Soil & Crop Sciences
Texas A & M University
College Station, TX 77843

Peter Portmann
Dept. of Agriculture
Jarrah Road
South Perth
AUSTRALIA WA 61S 1

J. Postoyko
Dept. of Biological Sciences
John Dalton Building
Manchester Polytechnic
Oxford Road, Manchester, U.K.

R. Prasad
G. B. Pant Univ Agr & Tech.
Pantnagar 263 145 Dist
Nainital (U P)
INDIA

M N Premachandran
Indian Grassland & Fodder Res Inst.
Pahuj Dam
Jhansi-Gwalior Road
UP INDIA 284 003

Dr. C. O. Qualset
Assoc. Dean Plant Science
Univ. of California-Davis
Agricultural Experiment Station
Davis, CA 95616

Dr. Alfredo Carballo Quiroz
Centro de Genetica
Colegio de Postgraduados
Apdo Postal 1
Chapingo, MEXICO CP 56230

Ignacio Ramirez A.
Instituto de Investigaciones
Agropecuarieas
Casilla 5427 / La Platina
Santiago, CHILE

Mark Ramsland
Burdick Grain Co.
730 2nd Ave. S.
Minneapolis, MN 55402

M. V. Rao
Wheat Project Director
IARI
New Delhi, INDIA 11001-2

Dale L. Reeves
Plant Science Dept.
South Dakota State University
Brookings, SD 57006
(605)688-5121

Dr. V. H. Reich
Agronomy Dept.
University of Tennessee
Knoxville, TN 37901

E. Reinbergs
Crop Science Dept.
University of Guelph
Guelph, Ontario
Canada N1G 2W1
(519)824-4120 X3388

Lars Reitan
Statens Forskingsstasjon Kvithamar
7500 Stjordal
NORWAY

Matti Rekunen
Hankkija Plant Breeding Inst.
SF-04300 Hyryla
FINLAND

Lucas Reyes
R R 2 Box 589
Corpus Christi, TX 78410
(512)265-9201

Clarence Richardson
USDA-ARS
P. O. Box 6112
Temple, TX 76503-6112

W. G. Richardson
20 Hill Rise
Woodstock, Oxford
OX7 1AB
ENGLAND

Howard W. Rines
Agron & Plant Genetics Dept.
303 Agronomy Bldg.
University of Minnesota
St. Paul, MN 55108

G. Roberts
Temora Agric. Research Sta.
P O Box 304
Temora, N S W 2666
AUSTRALIA

H. W. Roderick
Welsh Plant Breeding Station
Plas Gogerddan
Aberystwyth SY23 3EB
Dyfed, WALES

Alan P Roelfs, USDA
Cereal Rust Laboratory
University of Minnesota
St. Paul, MN 55108
(612)625-7295

W. J. Rogers
Cytology Dept. W.P.B.S.
Plas Gogerddan Near Aberystwyth
SY23-3EB Wales
UNITED KINGDOM

Magnus Roland
Weibullsholm Pl Breed Inst.
Bjertorp
535 00 Kvanum,
SWEDEN

A. Bruce Roskens
The Quaker Oats Company
418 2nd St. N.E.
Box 1848
Cedar Rapids, IA 52405

Dr. Brian Rossnagel
Crop Development Centre
Univ. of Saskatchewan
Saskatoon, Sask. Canada S7N OWO
(306)966-4976

Dr. P. G. Rothman
Cereal Rust Lab.
Univ. of Minnesota
St. Paul, MN 55108

Paul Rowoth
106 Curtiss Hall
University of Missouri
Columbia, MO 65211

Marketta Saastamoinen
Dept. of Plant Breeding
Agricultural Research Center
31600 Jokionen
FINLAND

Jaime Sahagun
Agronomy Dept.
Iowa State University
Ames, IA 50011

Dr. Warren Sahs
Rm 107 Agric. Hall
East Campus, UNL
Lincoln, NE 68583

Dr. Jose Juan Salmeron-Zamora
APDO. Postal No. 554
CD. Cuauhtemoc, Chic.
MEXICO

David J. Sammons
Dept. of Agronomy
University of Maryland
College Park, MD 20742
(301)454-3715

Laurent Saur
I.N.R.A.
Station d Amelioration des plantes
B.P. 29
35650 LE RHEU, FRANCE

Jack Scanlan
National Oats Company
1515 H. Avenue N.E.
Cedar Rapids, IA 52402
(319)364-9161 X163

John F. Schafer
Cereal Rust Laboratory
University of Minnesota
St. Paul, MN 55108

Dr. C. W. Schaller
Agron/Range Sci. Dept.
University of California
Davis, CA 95616

John W. Schmidt
322 Keim Hall - East Campus
University of Nebraska
Lincoln, NE 68583

Donald J. Schrickel
2502 E. Shaw Butte Dr.
Phoenix, AZ 85028
(602)482-7566

Grace Schuler
312 Bessey Hall
Iowa State University
Ames, Iowa 50011-1020
(515)294-9694

Josef Sebesta
Ripp-Plant Protection Div.
161 06 Prague 6 Ruzyne 507
CZECHOSLOVAKIA

Dr. Dale Sechler
Dept. of Agronomy
University of Missouri
Columbia, MO 65201

Adrian Segal
Tel Aviv University
Faculty of Life Sciences
Institute for Cereal Crops Impr.
Ramat Aviv, ISRAEL

Larry M. Seitz
1515 College Ave.
USDA Grain Mkt Res Center
Manhattan, KS 66502
(913)776-2735

Jayne T. Semple
Station De Recherche
5, rue de l'Ega lite
CHARTAINVILLERS
28130 MAINTENON FRANCE
37-323292

Dr. M. M. Shah
Division of Agric. Sci. & Tech.
Shalimar Campus 191121
Srinager Kashmir
INDIA

Dr. H. L. Shands
Agronomy Dept.
Univ. of Wisconsin
Madison, WI 53706

Henry L. Shands
Rm 140, Bldg. 005
BARC-West
Beltsville, MD 20705

G. E. Shaner
Botany & Pl. Pathology Dept.
Purdue University
W. Lafayette, IN 47907

Leslie Shugar
Cereal Research
W. G. Thompson & Sons Ltd.
Box 250
Blenheim, Ontario, Canada

Jose A. Sierra
Malteries, De Columbia
S. A. Calle 31 No. 13B-79
Bogata, Columbia
SOUTH AMERICA

R. Simmons
Dept. of Agron. & Pl. Genetics
University of Minnesota
St. Paul, MN 55108
(612)625-5220

Marr D. Simons
18013 Willowbrook Drive
Sun City, AZ 85373

E. Simpson
Twyford Seeds Ltd
Scott's Farm
Kings Sutton, NB.Banbury
Oxon, OX17 3WQ UNITED KINGDOM
0295-811677

H. J. Sims
21 Morwell Avenue
Watsonia
Victoria 3087
AUSTRALIA

H. Singh
Dept. of Plant Breeding
Haryana Agri Univ.
Hissar-125004
INDIA

Ron Skrdla
10 Agronomy
Iowa State University
Ames, IA 50011-1010

A. E. Slinkard
Crop Science Dept.
University of Saskatchewan
Saskatoon, Sask.
Canada S7N OWO

Dr. D. H. Smith
USDA-ARS
Bldg. 046 BARC-W
Beltsville, MD 20705

E. L. Smith
Agronomy Dept.
Oklahoma State University
Stillwater, OK 74074

Dr. G. S. Smith
Agronomy Dept.
North Dakota State University
Fargo, ND 58105

Gordon Smith
Quaker Oats Limited
P O Box 24, Bridge Road
Southall, Middlesex UB24AG
ENGLAND

Harry J. Smith
Quaker Oats Co. of Canada
Quaker Park
Peterborough, Ontario
Canada K3J 7B2

W. Smyth
Speedicook Ltd., Scarva Road
Tandragee
Co. Armagh BT62 2BY
IRELAND

Dr. Siegfried V. Soledad
c/o Vals Stylistics
Tagum, North Davao
Phillipines 9401

Manuel Somoza
Juan Mata Ortiz No 303
C P 31700
Nuevo Casas Grandes Chih
MEXICO

Dr. M. E. Sorrells
Plant Breeding Dept.
252 Emerson
Cornell University
Ithaca, NY 14853
(607)255-1665

Edward Souza
515 S. Albany St.
Ithaca, NY 14850

James Stage
Dept. of Agronomy & Plant Genetics
University of Minnesota
St. Paul, MN 55108

Dr. T. M. Starling
Dept. of Agronomy
Virginia Polytechnic Inst.
Blacksburg, VA 24061
(703)961-6483

J. B. Stevens
Agronomy Dept.
University of Wisconsin
Madison, WI 53706
(608)262-1650

D. Stoyanov
Institute of Introduction & Plant
Genetic Resources
4122 Sadovo Near Polvdiv
BULGARIA
225 2221 2256

C. A. St. Pierre
Agriculture Canada
2560 Boul Hochelaya
Sainte-Foy
Quebec, Canada

Margaret H. Streutker
Small Grain Center
Private Bag X29
Bethlehem 9700
REPUBLIC OF SOUTH AFRICA

Dr. D. D. Stuthman
Dept. of Agron. & Pl. Genetics
University of Minnesota
St. Paul, MN 55108

Seiji Tabata
Agronomy Dept.
Hokkaido Nat Agr Exp Sta
Hitsujigaoka Toyohira
Sapporo 004 JAPAN

Akitoshi Tajimi
Hokkaido National Agric.Exp. Sta.
Hitsujigaoka Toyohira-Ku
Sapporo 061-01
JAPAN

Hiroyuki Takada
Agronomy Dept.
Hokkaido Nat. Agr. Exp. Sta.
Hitsujigaoka, Toyohira
Sapporo 004, JAPAN

K. D. Taneja
Dept. of Forage Research
Haryana Agric. University
Hissar-125004
INDIA

Eldon E. Taylor
Plant Variety Protection Office
L & S Division, AMS, USDA
Natl. Agric. Library, Rm 500
Beltsville, MD 20705

Dr. G. Allan Taylor
Dept. of Agronomy
Montana State University
Bozeman, MT 59715

H. F. Taylor
Long Ashton Research Division
Weed Research Division
Yarnton, Oxford OX5 1PF
UNITED KINGDOM

M. Taylor
Speedicook Ltd
Scarva Road, Tandragee
Co. Armagh, BT62 2BY
IRELAND

Roscoe Taylor, Agronomimst
Agr. Exp. Station
533 East Fireweed
Palmer, AK 99645
(907)745-3257

Technische Universitat Munchen
Lehrstuhl fur Pflanzenbau und
Pflanzenzuchtung
805 Freising-Weihenstephan
WEST GERMANY

Hugh Thomas
Welsh Plant Breeding Station
Plas Gogerddan
Aberystwyth, DYFED
Wales, UNITED KINGDOM

Ronald C. Thomason
Plant Science Dept.
W.T. Box 998
Canyon, TX 79016
(806)656-3742

Christine Tibelius
3 Grantham Bank
Barcome Near Lewes
E. Sussex BN85DJ
ENGLAND

Juan Carlos Tomaso
I.N.T.A. Estacion Experimental
Agro Pecuaria
8187 Bordenave
Prov. De Buenos Aires, ARGENTINA

Walter Tonelli
Corso Statuto 26
12084 Mondovi (Cuneo)
ITALY

J. Truter
Winter Rainfall Region
Private Bag
Elsenburg 7607
REPUBLIC OF SOUTH AFRICA

Mrs. C. Tustain
Twyford Seeds Limited
Scotts Farm, Kings Sutton
Banbury, Oxon, ENGLAND

Dr. Cetin Tuten
Aegean Regional Agric. Inst. (ARARI)
P. O. Box 9
Menemen/IZMIR
TURKEY

Koichpiro Tsunewaki
Faculty of Agtriculture
Kyoto University
Kitashira Kawa, Sakyo-ku
Kyoto 606 JAPAN

Dr. Cetin Tuten
Aegean Regional Agricultural Institute (ARAR
P. O. Box 9
Menemen/IZMIR
TURKEY

Dr. J. Valentine
University College of Wales
Welsh Plant Breeding Station
Plas Gogerddan Near Aberystwyth
Wales, UNITED KINGDOM

J. Van Der Mey
Small Grain Centre
Private Bag X29
Bethlehem 9700
REPUBLIC OF SOUTH AFRICA

Willem H. Van Der Vliet
Caixa Postal 892
Pontagrossa, PR
84100 BRASIL

H. A. Van Niekert
Private Bag X29
Bethlehem 9700
REPUBLIC OF SOUTH AFRICA

M. Vanselow
Institut fur Angewandte Genet.
Universitat Hannover
Hannover
WEST GERMANY

J. S. Verma
Dept. of Plant Breeding
G. B. Pant University of Agric. & Tech.
Pantnagar, Nainital-263 145
INDIA 26314-5

Mary Jo Vivian
1 Agronomy Dept.
Iowa State University
Ames, Iowa 50011-1010

Ric Vogel
Fruen Milling Co.
301 Thomas Ave.
Minneapolis, MN 55406

I. Wahl
Dept. of Botany
Tel Aviv University
Tel Aviv Ramat-Aviv
69978 ISRAEL
03-420028

Harold Walter
Muhlenwerke am Hafen
d-2200 Elmshorn
WEST GERMANY

Ted Walter
Agronomy Dept.
Throckmorton Hall
Kansas State University
Manhattan, KS 66506
(913)532-7251

Dr. S. H. Weaver
The Quaker Oats Company
Merchandise Mart Bldg.
Chicago, IL 60654

Dr. J. A. Webster
USDA-ARS Plant Science Res. Lab.
P. O. Box 1029
Stillwater, OK 74076
(405)624-4200

R. W. Welch
Biology Department
15G09, Univ. of Ulster
Jordanstown, Newtownabbey, BT370QB
UNITED KINGDOM

Dr. D. M. Wesenberg
Research & Extension Center
P O Box AA
Aberdeen, ID 83210

D. E. Western
3365 Spring Mill Circle
Sarasota, FL 33579

Donna L. Whiting
Acquisitions Divisions
Albert R Mann Library
Cornell University
Ithaca, NY 14853

Gerhard Wilbert
Cabec Intl Corp.
1607 - 116th Ave. N.E., Suite 105
Bellevue, WA 98004

Dr. Roy Wilcoxson
Dept. of Plant Pathology
University of Minnesota
St. Paul, MN 55108

H. T. Williams
A & R Scott
Cupar
Fife SCOTLAND

David Wilson
Crop Improvement Division
Welsh Plant Breeding Stn
Plas Gogerddan NEar Aberystwyth
SY23-3EB Wales, UNITED KINGDOM

Richard L. Wilson
Plant Introduction Station
Ames, Iowa 50011-1170

Ralph Woodhull
617 W. Main St.
Barrington, IL 60010

David Worrall
P. O. Box 1658
Texas Ag. Experiment Station
Vernon, TX 76384

Ing. K. P. Wouda
Semundo B.V. Postbus 2
9970 AA Ulrum (Gr.)
HOLLAND
05956-1377

D. S. C. Wright
Crop Research Div., Cereal Section
D S I R Private Bag
Christchurch, NEW ZEALAND
252511

D. J. Wright
Colney Lane
Food Research Institute
Norwich, Norfolk NR47 7UA
UNITED KINGDOM

G. M. Wright
33 Harakeke St.
Christchurch, NEW ZEALAND

Victor Wu
USDA
Northern Regional Research Center
1815 N. University
Peoria, IL 61604

Hirofumi Yamaguchi
Snow Brand Seed Co. Ltd.
Chiba Research Station
631 Naganumahara-cho
Chiba City, Chiba Pref. 281
JAPAN
0472-59-2826

Lee R. Young
617 West Main St.
Barrington, IL 60010

Dr. V. L. Youngs
Dept. of Cereal Technology
North Dakota State University
Fargo, ND 58105

F. J. Zeller
Technische Universitat Munchen
805 Freising-Weihenstephan
WEST GERMANY

Kenneth E. Ziegler
108 Agronomy
Iowa State University
Ames, IA 50011

Ms Pam Zwer
Agronomy/Range Sci. Dept.
University of California
Davis, CA 95616

Dr. S. N. Zadoo
Div. of Plant Improvement
Indian Grassland & Fodder Res. Inst.
Jhansi (U.P.)
INDIA
Pin Code 284003

Linwood Hoffman
USDA Economic Resource Service
Rm 1034A 1301 N.Y. Ave. N.W.
Washington, DC 2005-4788

D. Stoyanov
Institute of Introduction &
Plant Genetic Resources
4122 Sadovo Near Polvdiv
BULGARIA