N. Jensen

1969

OAT NEWSLETTER

Vol. 20

July 1, 1970

Sponsored by the National Oat Conference

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Volume 20

Edited and multilithed by the Department of Botany and Plant Pathology, Iowa State University, Ames, Iowa 50010. Costs of preparation financed by the Quaker Oats Company, Chicago, Illinois.

July 1, 1970

Sponsored by the National Oat Conference

J. Artie Browning, Editor

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*Past Acting Chairman -	J. E. Grafius
*Secretary -	L. W. Briggle
*Editor Newsletter -	J. A. Browning

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North Central Region -	J. A. Browning, J. M. Poehlman, D. D. Stuthman
Northeastern Region -	N. F. Jensen, H. G. Marshall
Southern Region -	V. C. Finkner, C. F. Murphy
Western Region -	C. F. Konzak, D. M. Wesenberg
Cereal Crops Research Branch -	L. A. Tatum
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* Non-voting.

ANNOUNCEMENTS

It is with deep regret we announce the death 12 April 1970 of Mrs. Greta Murphy, wife of the late Dr. H. C. (Pat) Murphy and friend of many oat workers in the U.S.A. and around the world. Mrs. Murphy suffered a stroke early in the year and, after her release from the hospital in Silver Spring, Maryland, she was taken to a nursing home in Raleigh, N. C., to be near her son and his family. Committal services were held 14 April at Silver Spring, Md., where her late husband was buried in July, 1968. She is survived by her son, Charles F., Associate Professor of Crop Science and small grain breeder at the University of North Carolina, Raleigh, and one grandson.

Overseas contributions - Foreign contributors are urged to anticipate the annual call for material for the next Newsletter and to submit articles or notes to the editor at any time of the year.

Available back issues - Back issues of certain volumes are available on request. Please write the editor.

Variety descriptions - When you name or release a new variety, in addition to your account in the State report section, please submit a separate description to be included under "New Varieties." We would like to make the "New Varieties" section as complete and useful as possible.

PLEASE DO NOT CITE THE OAT NEWSLETTER IN PUBLISHED BIBLIOGRAPHIES

Citation of articles or reports of Newsletter items apparently is causing some concern. The policy of the Newsletter, as laid down by the oat workers themselves and later reiterated, 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. Just as definitely, no material is wanted which is of a nature that fits a normal journal pattern. Each year's call for material emphasizes this point. Unless there has been a change of thinking the oat workers do not aspire to a newsletter that would in any way discourage informality, the expression of opinions, preliminary reports, and so forth.

Citing the Newsletter creates a demand for it outside the oat workers' group. For example, libraries send several requests a year for it and we refuse them (if the Newsletter were made available to libraries it could not be produced as we now do it because the mailing list would approximately triple in number). So why cite it in a bibliography?

Certain agencies require approval of material before it is published. Their approval of material which goes into the Newsletter is a different evaluation from approval for publishing. Abuse of this informal relationship by secondary citation could well choke off the submission of information.

One suggestion which may help: If there is material in the Newsletter which 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."

PROGRAM FOR NATIONAL OAT CONFERENCE
NORTH CAROLINA STATE UNIVERSITY
January 26, 27, 28, 1970

Monday Morning - January 26

8:00 Registration

Presiding - C. F. Murphy

8:30 Business Meeting - J. E. Grafius
Report of Secretary - F. L. Patterson
Report of Editor of Newsletter - J. A. Browning
Report on the H. C. Murphy Memorial Library - J. A. Browning
Report of Committee on Genetic Nomenclature in Oats - M. D. Simons
Appointment of Committees
Preliminary Planning for Next Meeting

9:15 Welcome - Dean H. Brooks James, North Carolina State University

9:30 Uniform Oat Nurseries - L. W. Briggle, D. M. Wesenberg, H. G. Marshall, M. D. Simons, P. G. Rothman, ARS-USDA

10:00 Recess

10:15 Uniform Oat Nurseries (Continued)

10:50 The crown rust race situation - M. D. Simons, ARS and Iowa State University

11:00 Distribution and prevalence of oat stem rust races in USA in 1969 - P. G. Rothman and D. M. Stewart, ARS and University of Minnesota

11:15 The Colombian oat cultivar and oat rust race situation - Elkin Bustamante and Jesus Arias, Iowa State University

11:30 Discussion and Announcements

Monday Afternoon - January 26

Presiding - T. T. Hebert

1:15 On resistance to crown rust - M. B. Moore and D. Stuthman, University of Minnesota

1:30 Researching the indigenous populations of small grains and pathogens in Israel - J. A. Browning, Iowa State University

1:50 The evaluation of crown rust resistance from *Avena sterilis* - G. Fleischmann, Canada Department of Agriculture, Winnipeg

2:05 The utilization of rust resistance genes - R.I.H. McKenzie, Canada Department of Agriculture, Winnipeg

2:20 Discussion

2:45 Recess

3:00 Regional deployment for conservation of oat crown rust resistance genes - J. A. Browning, Iowa State University

3:15 Discussion panel -
J. W. Martins, Canada Department of Agriculture, Winnipeg
M. B. Moore, University of Minnesota
H. L. Shands, University of Wisconsin
M. E. McDaniel, Texas A & M University
L. W. Briggle, ARS, Beltsville, Maryland

4:30 Discussion and Announcements

Monday Evening, January 26 - Hilton Inn

7:00 Regional Committee Meetings - NCR-15 - H. L. Shands, presiding
Varieties being released
Election of Officers
Meeting site for 1972

Tuesday Morning - January 27

Presiding - J. A. Browning

8:15 Effect of crown rust infection on current oat varieties - L. J. Michel and M. D. Simons, Iowa State University and ARS

8:30 Observations on the late rusting phenomenon in Red Rustproof oats - H. H. Luke and W. H. Chapman, University of Florida

8:45 Discussion

9:00 Tolerance to the Septoria disease of oats - R. V. Clark and H. W. Johnston, Canada Department of Agriculture, Ottawa, Ontario and Charlottetown, P.E.I.

9:15 Some evidence for non-specific resistance to oat smuts - M. B. Moore, University of Minnesota

9:30 Systemic fungicides for control of oat smuts - E. D. Hansing, Kansas State University

9:45 Discussion

10:00 Recess

10:15 Inheritance of reaction to toxaphene in oats - J. H. Gardenhire and M. E. McDaniel, Texas A & M University

10:30 Effect of parathion on crown rust reactions of oat varieties - M. D. Simons and J. A. Browning, ARS and Iowa State University

10:40 Discussion

10:45 Specific virulences of races of Puccinia graminis f. sp. avenae near barberry at University Park, Pennsylvania in 1968-69 - D. M. Stewart, P. G. Rothman, W. O. Keim and R. P. Pfeifer, ARS, University of Minnesota and Pennsylvania State University

11:00 Stabilizing selection with respect to virulence in Puccinia graminis f. sp. avenae - K. J. Leonard, ARS and North Carolina State University.

11:15 Combining seedling and adult plant resistance to Puccinia graminis f. sp. avenae - P. G. Rothman, ARS and University of Minnesota.

11:30 Discussion and Announcements.

Tuesday Afternoon - January 27

Presiding - D. E. Western

1:15 Oat protein research at Aberdeen - D. M. Wesenberg, R. M. Hayes, and R. M. Wise, ARS, and University of Idaho, Aberdeen, Idaho.

1:30 Screening cereal selections for protein quality and quantity with weanling voles - F. C. Elliott and L. W. Briggle, Michigan State University and ARS

1:45 Oat groat protein content as influenced by breeding selection and cultural practices - H. L. Shands, R. A. Forsberg and R. Duerst, University of Wisconsin

2:15 Status of the Oat Quality Laboratory - D. E. Western, The Quaker Oats Co., Chicago

2:30 Future oat protein research tentative plans - L. W. Briggle, ARS, Beltsville, Md.

2:45 Discussion topics
(1) How can the Oat Protein Laboratory help us most?
(2) Will higher protein oats command higher prices?
(3) What sources of germplasm for high protein are being used?

3:15 Recess

3:30 Transfer of genes from Colombian tetraploid oats to hexaploid oats - Jesus Arias, Iowa State University

3:45 Agronomic and cytologic behavior of progenies in 6X-amphiploid X Avena sativa backcross generations - R. A. Forsberg and F. Wun, University of Wisconsin

4:00 Discussion

4:15 DNA synthesis in root tips of Avena sativa L. - K. Sadanaga, ARS and Iowa State University

4:30 Discussion

Tuesday Evening - January 27

6:30 Social Hour, Faculty Club

7:30 Dinner, Faculty Club. Address - J. B. Rhine, Duke University

Wednesday Morning, January 28

Presiding - H. L. Shands

8:15 Accelerating varietal releases - D. C. Ebeltoft, North Dakota State University

8:30 Response of stiff-strawed oat genotypes to nitrogen - D. Graham, Jr. and W. P. Byrd, Clemson University

8:45 Yield and yield components of seven oat hybrids - B. R. Hathcock and M. E. McDaniel, Texas A&M University

9:00 Discussion

9:15 Dormoats - Potentially a new oat crop for northern areas - V. D. Burrows, Canada Department of Agriculture, Ottawa

9:30 Genetic changes in winter oat populations in response to natural selection - H. G. Marshall, ARS and Pennsylvania State University

9:45 Discussion

10:00 Recess

10:15 The Iowa oat multiline cultivar development program - K. J. Frey and and J. A. Browning

10:30 The strategy of deployment of environmental resources by successful and unsuccessful oat varieties - J. E. Grafius, Michigan State University

10:45 Let's update cereal breeding methods - N. F. Jensen, Cornell University

11:00 Oat improvement in the 1970's - L. W. Briggle, ARS, Beltsville, Maryland

11:15 Discussion topics

1) Do we have an ideotype plant to produce 200 bushels of oats?
2) What level of oat yields must we have to compete?
3) Are we adequately sampling our germplasm?

Wednesday Afternoon, January 28

Presiding - J. E. Grafius

1:15 International registration authority for oat cultivars - B. R. Baum, Canada Department of Agriculture, Ottawa (Paper to be read by J. W. Morrison)

1:30 National Small Grain Variety Certification Review Board - F. W. McLaughlin, North Carolina State University

1:40 Variety and germplasm registration by the Crop Science Society - L. W. Briggle, Chairman Oat Subcommittee CSSA

1:50 Discussion

2:00 Business Meeting

2:30 Adjourn

The financial support of the conference by the North Carolina Crop Improvement Association is gratefully acknowledged.

MINUTES OF THE BUSINESS MEETINGS OF THE NATIONAL OAT CONFERENCE

J. E. Grafius, presiding

The National Oat Conference was held at North Carolina State University, January 26-28, 1970, with about 60 persons from Canada, Colombia and the United States in attendance.

The Conference was opened with the observation of a few minutes of silent thought in honor of the late H. C. Murphy and his great contributions to oat improvement and to the Conference.

A motion was made and passed that the National Oat Conference continue as in the past with the Leader of Oat Investigations, ARS, USDA, as permanent secretary.

Acting Chairman J. E. Grafius appointed a nomination committee, consisting of J. A. Browning, N. F. Jensen, and C. F. Murphy, to make nominations for Chairman of the National Oat Conference. The selection will be made by mail ballot by the representatives of the National Oat Conference.

The title of the next conference was discussed relative to the problem of travel approval to National and International Conferences. A motion was made and passed that the National Oat Conference organize an American Oat Workers Conference for 1974. Dr. J. A. Browning extended an invitation which was accepted for the American Oat Workers Conference to meet at Iowa State University in January or February, 1974.

Secretary's report (F. L. Patterson)

Secretary Patterson thanked the program participants for their cooperation in providing volunteer papers and in leading discussions on special topics. The program included 37 papers, 7 topic discussions, and 12 general discussion periods.

Report of the Editor of the Oat Newsletter (J. A. Browning)

My role of Editor of the Oat Newsletter is an easy one. I simply arrange your contributions into the format established by my predecessor, Dr. Neal Jensen, and send the bill for producing and distribution of the Newsletter to Dallas Western of Quaker Oats. Therefore, the key figures in production of the Oat Newsletter are you, the contributors, and Quaker Oats, and both are to be thanked for any success the current volumes of the Newsletter may have. Additionally, Neal Jensen should receive our special thanks for his 17 years of yoeman service as editor. As editor, I have initiated one new section--on equipment and techniques. So far, I feel this has been well received. Also, with the 1968 Newsletter, pictures and line drawings were published for the first time. The latter are especially appropriate for the techniques section, and with present printing methods they cost nothing extra. The Newsletter should go to all people interested in oat improvement, and help of project leaders is solicited in maintaining mailing lists. Currently, we print 450 copies for a mailing list of about 400. Cost of these is about $700 for printing, binding, and distributing. About 50 copies of volumes 18 and 19 are on hand in Ames, and a few copies of earlier volumes are available in Beltsville. Your suggestions for improving the Oat Newsletter are always appreciated.

Report on the H. C. (Pat) Murphy Memorial Library (J. A. Browning)

The family and friends of Dr. H. C. (Pat) Murphy, in seeking a suitable memorial, decided to establish a memorial library of journals and books related to plant pathology for graduate students in the Department of Botany and Plant Pathology at Iowa State University. Dr. Murphy's personal set of Phytopathology and Review of Applied Mycology, with other books on plant pathology, were kindly contributed by Dr. Charles F. Murphy and Mrs. Greta Murphy, to form the nucleus of the Library. It was hoped that contributions by friends would provide an endowment, the interest from which would continue Dr. Murphy's journals in perpetuity, subscribe to additional journals, and purchase additional works on plant diseases as they are published. The response has been good. To date, the library has received: Review of Applied Mycology volumes 1-35 bound and 36-43 (1964) unbound; Phytopathology volumes 18-42 bound and 43-58 (1968) unbound; miscellaneous books; and cash contributions totaling $3,295.00. Additional books may be sent to me, or cash contributions can be made payable to the Alumni Achievement Fund credit to the H. C. (Pat) Murphy Memorial Library and sent to the Alumni Achievement Fund, 242 Memorial Union, Ames, Iowa 50010. Receipts will be mailed, even for books, and all contributions are, of course, tax deductible.

Report of Committee on Oat Gene Nomenclature (M.D. Simons and N. F. Jensen)

The abstract of this committee report is included in the section on "Abstracts of Conference Papers."

Report of Resolutions Committee (K. J. Frey, C. M. Brown)

A resolution was presented by K. J. Frey and passed- We who are attending the National Oat Conference wish to express our gratitude and deep appreciation to our hosts, and especially to Professors Murphy, Herbert, and Cline, for the excellent hospitality they have accorded us during the 3-day meeting. The accommodations have been superb and have gone a long way to make the meeting so successful. Whether they had an "in" with the weather man we don't know, but we'll give our hosts credit for the fine weather also. Anyway from us non-North Carolinians we say sincere "thanks again."

Conference adjourned 2:00 P.M. January 28, 1970.

ABSTRACTS

Objectives of the Uniform Oat Performance Nurseries

L. W. Briggle, ARS, Beltsville

The long-range objectives of both the spring and winter Oat Performance Nurseries include the following:

1. Test potential and recent releases for adaptation, yield, and disease resistance over the entire region.
    a. The originator can get regional evaluation of his new line.
    b. Cooperators who grow the Performance Nursery can observe and collect data on a particular entry as a basis for future recommendations.
    c. Comparison of each entry with long-time standards furnishes a measure of breeding progress.
2. Provide a source of seed for quality or other tests.
3. Facilitate exchange of breeding material.

Any entry in either a spring or a winter Oat Performance Nursery should have adequate State evaluation before it is accepted. Size of a Nursery becomes important to many cooperators, particularly those who grow Uniform Nurseries of other crops as well as oats. Several questions can be posed concerning the Nurseries:

1. Is an unofficial maximum of 30 entries realistic?
2. Do we have too many checks?
    a. Checks in the 1969 Uniform Midseason Oat Nursery were: Andrew, Gopher, Mo. 0-205, Orbit, Clintland 64, Garland and Lodi (7). Additional released varieties grown were: Jaycee, Clintford, and Multiline M70.
    b. Checks in the 1969 Uniform Early Oat Nursery were: Andrew, Mo. 0-205, and Nodaway (3). Additional released varieties grown were: Jaycee, Multiline E70, Pettis, Nodaway 70, Clintford, and Clintland 64.
3. What do we mean by date headed? Different people use different criteria for determining heading date.
    a. All plants in the plot are fully headed.
    b. One-half of the plants in the plot are fully headed.
    c. Panicles just emerging from the boot in a specified percent of the plants in the plot.
4. Is it fair to use treated seed of some entries and not others?
    a. This is particularly a problem in the Smut Nursery. Seed sent for a Performance Nursery is used for the Smut Nursery.

International and Uniform Oat Rust Nurseries

Beginning with the 1970 Uniform and International Oat Rust Nurseries, the data will be processed in cooperation with Biometrical Services at Beltsville. Printed data sheets for both Nurseries will be sent to cooperators shortly. Data will be recorded just as it has been in years previous, but on a different form. Special coding will be for Biometrical Services use only.

There are 72 entries in the 1970 Uniform Oat Rust Nursery. This Nursery should not be considered for screening varieties or lines for reaction to rust, but rather for more intensive study of known sources of resistance. A reduction in number of entries would be appropriate.

The 1970 International Oat Rust Nursery has 129 entries. It will be grown at 41 locations and is designed to serve as a means for screening for rust resistance. This Nursery can be expanded. It automatically includes all entries in the Uniform Oat Rust Nursery.

American varieties or lines comprised 84% of all entries in the 1969 International Oat Rust Nursery.

American varieties or lines comprised 38% of all entries in the 1969 International Wheat Rust Nursery.

American varieties or lines comprised 22% of all entries in the 1969 International Barley Rust Nursery.

Plans for Future Oat Protein Research

L. W. Briggle, ARS, Beltsville

Oats have the highest protein content and perhaps the best quality protein of all the cereal grains. Preliminary analyses of oat groats have shown that our commercially grown _Avena sativa_ varieties range from approximately 15 to 20% protein. _A. sterilis_ collections from Israel contain from 15 to 30% protein. Total protein in oat grain (including hulls) among 3,000 entries in the active Oat World Collection maintained at Beltsville ranged from 7.8% to 21.9%. Practically all of those tested were _A. sativa_ or _A. byzantina_.

Avena sterilis as a source of high protein

The wild hexaploid species _A. sterilis_ has been considered the initial source for high protein in oats. Difficulties have been encountered, however, in attempts to transfer this characteristic to our common varieties. The two species seem to be fully compatible--crosses can be readily made. In the Beltsville program selection pressure has been applied on _A. sativa_ x _A. sterilis_ derivatives according to two criteria, 1) protein, and 2) agronomic type. When progenies were selected on the basis of protein content only, the high protein lines more closely resembled _A. sterilis_ in plant and kernel characteristics. When progenies were selected for agronomic type, they were either low or moderate in protein content.

In general, within our _A. sativa_ x _A. sterilis_ program there has been a negative relationship between yield and protein content. Another association we noted is that high protein _A. sativa_ x _A. sterilis_ lines have slender and usually long kernels. Those selections with shorter, more plump kernels are lower in protein. These observations cause us to wonder if we are confronted with a high bran/endosperm ratio in A. sterilis and in the high protein A. sativa x A. sterilis derivatives. We intend to pay much more attention to kernel configuration in the future.

The most advanced high protein lines in the Beltsville program were grown in a 4-rep yield test at Aberdeen, Idaho, in 1969. Data are listed in Table 1. The correlation coefficient for yield and protein content was -0.28. Three A. sativa x A. sterilis lines were significantly higher in yield and protein content than Garland, but not desirable in agronomic type. The most promising line in the Beltsville program is OA 123-33 from Canada. It was highest in yield in the test, was high (but not highest) in protein content, and had short and strong straw. It is now being used in many crosses. This is a selection from A. $strigosa^2$ x Victory. (Table 1 is on page 15).

Virtually all A. sativa x A. sterilis lines in the Beltsville program are derived from two collections of A. sterilis. Other genotypes of this species could be better protein donor parents. Individual collections of A. sterilis will be further screened and selected on the basis of kernel configuration as well as for high protein. Several hundred new accessions of A. sterilis are yet to be increased prior to initial screening for any character.

Sources other than Avena sterilis for High Protein

The following possible sources other than A. sterilis should be exploited for increasing protein content and/or protein quality:

1. Other Avena species such as A. strigosa, A. barbata, A. fatua, etc.
2. Varieties or lines of A. sativa higher in protein than average.
3. Use of radiation or chemical mutagens on A. sativa or other Avena species.

We plan to screen as many entries as possible of the Avena species World Collection, and will continue with varieties and lines of A. sativa. All lines found to be high in protein (or unusually low) will be retested and those consistently high or low will be intensively studied.

We have recently made intercrosses involving high protein F_1's, or high protein plants from two different early generation crosses. We plan to continue the procedure of intercrossing high protein materials from any source in an effort to accumulate either major or minor genes for high protein, if such entities do exist. Some parents used in the intercrosses are A. sativa, some are A. sativa x A. sterilis derivatives, and some trace back to A. sativa x other species.

Results from protein studies in wheat

Considerable effort has been expended in wheat to increase protein content and to improve the amino acid balance of the protein. A total of 10,500 common wheats from the World Collection have now been analyzed for protein content and lysine. In general, the high lysine wheats were low in total protein. One notable exception to this was a line which exhibited high protein and high lysine at several sites in a location/protein/lysine trial. In the wheat kernel, size appeared to exert little effect on either protein or lysine, but kernel configuration strongly affected protein content. It had little effect on percent lysine of the protein.

Kernel characteristics associated with protein content

The aforementioned findings in wheat have a bearing on the importance of kernel shape in common oats and in A. sterilis in relation to protein content. The fact that most of our high protein A. sativa x A. sterilis derivatives have slender kernels has already been referred to. Two additional examples of this phenomenon can be mentioned:

1. Early developed Triticale lines were reported to be very high in protein --higher than wheat. Each of these stocks had shrunken kernels. As kernel quality was improved through further breeding and selection (kernels were more plump), such lines only equalled or approached wheat varieties in percent protein.

2. Protein content of Saia (A. strigosa), CI 7010, was determined to be 20.3% while tetraploid Saia, CI 8089, was 25.2% in the same test. In another series Saia had 18.1% protein and tetraploid Saia had 22.4% protein. Examination of the groats revealed that those of the tetraploid were shrunken and wrinkled, while those of the diploid were normal. Groats of the tetraploid were slightly larger than those of the diploid.

Genetic high protein in wheat

There is only one confirmed instance of genetic high protein in wheat. Protein content of Atlas 66 and many of its derivatives will produce about 2% more protein than other wheats at a comparative yield level. Five other possible sources are being investigated.

Amino acid analyses in oats

Amino acid analyses of oats and related species will be a high priority item in the program of the USDA Oat Quality Laboratory when it becomes established. We have partial analyses on a few oat varieties, one A. barbata, one A. byzantina, a few A. sterilis lines, and five A. sativa x A. sterilis derivatives, through the courtesy of Dallas Western and the Quaker Oats Company (Table 2). Oats are higher in lysine than corn and wheat. In fact, lysine may not be of major concern in oats. Nevertheless, we plan to screen for lysine as well as for the other essential amino acids. In comparing values for the seven amino acids listed in Table 2 with the FAO recommended values, one can see that valine, leucine, threonine, and phenylalanine occur in oats in adequate quantity. Isoleucine and lysine tend to be near the recommended values, while methionine is low, except for two A. sativa x A. sterilis derivatives. In a study in Guatemala conducted by the Quaker Oats Company, in which oats provided the complete diet for humans, three amino acids had to be supplemented in order to provide a diet up to 92% as effective as milk. Those supplemented were lysine, methionine, and threonine. The report stated that threonine in oats is not completely available, so even though chemical analyses show comparatively high values, it still may be limiting. The information on amino acid balance in oats is limited, therefore, we are very anxious to begin intensive study and screening of material. (Table 2 is on page 16).

Guidelines have been set up for establishing some sort of priority on items to be analyzed for amino acid profile at the Oat Quality Laboratory. We will not be able to accept plant breeders' samples until current oat varieties and some available germ plasm have been evaluated. Guidelines have been established so that the following materials will be analyzed:

1. Current commercial oat varieties and those formerly released but no longer of commercial importance (we are using the Crop Science Registration List for most of these). The best current varieties form the base of germ plasm now being used by oat breeders. If any of these are particularly promising they are already available in virtually unlimited quantity.

2. The most promising advanced selections which are potential varieties. Most selections in this category are in various Uniform Performance or Disease Nurseries.

3. Other available germ plasm:
   a. Selected lines from the Oat World Collection, based upon their representation of different protein levels, possibly oil percent levels, or other quality criteria.
   b. Selected lines from the Oat World Collection, based upon area of geographical origin, or for agronomic characters.
   c. Selected related species of *Avena*. Within *A. sterilis*, where large numbers are involved, samples representative of different protein levels and kernel characteristics (shape and size) will be tested first.

4. Progenies from special studies such as genetic or cultural experiments involving rate and time of application of fertilizer, as well as formulation.

5. Plant breeders' samples.

As we learn more about genetic and environmental variability in protein content and amino acid balance, our ideas and priorities for testing may change.

Protein in forage oats

Considerable interest has been expressed in the possibility of testing oat varieties and lines in an early stage of growth for differences in protein content of plant parts. The Quaker Oats Company conducted an extensive study a few years ago and found that oat plants were highest in protein content when at the early jointing stage (about the time the first node is exposed). Most of the vitamins, crude fat, and chlorophyll also reach a peak in concentration at or near the jointing stage. From that time on the stem elongates and the plant contains more structural constituents. To my knowledge, no information exists concerning the amino acid balance of protein in oat plant parts at any stage of growth. It may or may not be similar to that in oat groats. We plan to conduct experiments to provide such information.

Most oats that is grazed is at or near the high protein stage. Protein content is not a limiting factor, in fact it is in excess, and presumably even the limiting amino acids are present in quantity. We do not know this to be a fact, but we intend to find out. What is really needed, therefore, in a forage oat, is total energy or TDN--not more protein--just more yield. Another factor to be considered is that 90 to 95% of all oats grazed is grazed by ruminants. Amino acid balance is of little consequence to these animals.

What is perhaps most needed in forage oats is more winterhardiness, disease resistance, and yield (vigorous growth). Selection for a good forage oat would be based on these characters plus late maturity and production of large leaves.

Protein content of a forage oat may be of consequence if fed at a much later stage of growth than that normally grazed. If genetic differences occur, this could be of importance. Protein can be very limiting in mature grass forage--it could be down to 2 or 3% in dry, mature plants.

Effect of culture on oat protein

Protein content can be increased by fertility and management practices, but available information does not permit a realistic estimate of the magnitude and value of the increase. In preliminary research conducted by D. M. Wesenberg at Aberdeen, Idaho, the average yield of five oat varieties was increased from 98 bushels per acre with no supplemental Nitrogen to 127 bushels per acre with 135 pounds of actual N per acre. Protein content of the grain was increased from 17.5% to 19.1%. One-third of the N was applied at the seedling stage and two-thirds at the heading stage. Dr. Wesenberg is planning more extensive research in this area.

Uniform Protein Nursery

A 15 entry, 2 rep Uniform Oat Protein Nursery was grown at several locations in 1969. Because of delays encountered through our Industrial Laboratory Contract, grain samples have not been analyzed for protein. These will be done under our Industrial Laboratory Contract, but not until breeders' samples have been completed.

We do not plan to grow a similar Uniform Protein Nursery in 1970, but do consider the possibility of such a Nursery in the future when support warrants it. Perhaps a Protein Nursery should be limited to two or three locations where disease is not a factor. Entries could be grown under high fertility conditions and irrigation in Idaho, where disease on oats is virtually non-existant, except for occasional infection with yellow dwarf. It would be desirable to have a low, a moderate, and a high protein entry, each of which would yield at as near a common level as possible, as checks. Plans will be made to establish such a Nursery.

Oat Improvement in the 1970's

L. W. Briggle, ARS, Beltsville

Objectives for a research program in oats during the 1970's would certainly include the following:

1. markedly increase the yield level (whether for grain or for forage)
2. improve grain quality
3. stabilize oat production

Most oat workers will agree that a major breakthrough from the so-called yield barrier is necessary. Perhaps the major limiting factor for increased yield is lack of response to high fertility conditions. Current varieties tend to respond with increased plant height and more lodging, with no real gain in yield of grain. Certainly oats will be grown under more optimum fertility conditions during the 1970's than in the past.

Table 1. Yield test of high protein oat lines, Aberdeen, Idaho, 1969

Line			Yield* g/plot	Groats g/100	% Protein, Udy Analysis 1969	% Protein, Udy Analysis 1968	Height in inches	Straw Score 1 strong 10 = flat
PA 12	401	OA 123-33	672.5	2.37	24.4	24.0	38	4.8
	415	Portal x *A sl* F_4	584.0	2.22	22.1	22.4	41	6.8
	421	*A sl* x Diana F_5	576.8	2.06	24.4	23.2	54	7.0
	404	Garland x *A sl* F_4	572.3	2.02	24.9	25.7	50	8.3 early
	405	Garland x *A sl* F_4	568.0	2.05	23.0	22.9	40	6.0
	402	Garland	557.0	2.35	20.8	20.6	38	4.5
	403	Garland x *A sl* F_4	553.8	2.11	24.5	24.3	45	6.8
	424	CI 7920 x *A sl* F_5	552.3	2.11	23.0	23.1	47	8.8
	425	CI 7920 x *A sl* F_4	516.5	2.18	22.2	25.1	57	9.5
	423	CI 7920 x *A sl* F_5	506.5	2.13	24.2	23.9	53	8.3
	409	Garland x *A sl* F_4	466.5	2.21	23.1	24.8	48	8.3
	413	*A sl* x Fla. 500 F_4	462.8	2.08	25.2	26.4	54	10.0
	414	*A sl* x Fla. 500 F_4	447.5	2.29	23.9	24.1	52	9.0
	411	*A sl* x Fla. 500 F_4	432.8	2.24	26.2	26.8	54	9.0
	418	*A sl* x Diana F_5	432.8	2.03	24.4	24.6	56	7.8
	422	CI 7920 x *A sl* F_4	424.5	1.94	23.0	21.2	52	8.8
	408	Garland x *A sl* F_4	418.5	2.22	24.7	25.9	47	7.3 early
	410	Garland x *A sl* F_4	393.5	2.25	25.6	24.4	47	8.5
PA 6	412	*A sl* x Fla. 500 F_4	388.3	2.31	26.3	26.1	50	9.5
	416	Portal x *A sl* F_4	381.0	2.25	25.7	23.5	54	7.0
PA 9	420	*A sl* x Diana F_4	372.8	2.06	26.6	24.4	55	8.5
	419	*A sl* x Diana F_5	354.3	2.08	25.6	25.8	52	8.8
	406	Garland x *A sl* F_4	346.5	2.16	24.4	25.5	38	9.3 early
	407	Garland x *A sl* F_5	341.3	2.19	23.4	22.8	36	7.0 early
	417	*A sl* x Diana F_5	311.3	2.03	25.6	23.8	55	9.5

*LSD (.05) 11.2

Table 2. Essential amino acid content of *Avena* species, *A. sativa* x *A. sterilis* progenies, and oat varieties

	Valine	Leucine	Isoleu-cine	Threo-nine	Lysine	Methio-nine	Phenyl-alanine	Trypto-phan
Garland	5.5	7.9	3.7	3.4	4.8	1.4	4.3	
Florida 500	6.2	9.1	4.4	3.8	5.1	1.4	5.0	
A sl x Fla. 500 (PA 6)	5.3	7.5	4.0	3.4	3.8	2.6	6.2	
A sl x Diana (PA 9)	5.5	7.7	4.0	3.6	3.4	1.5	6.3	
A sl x Diana	5.2	7.6	3.8	5.4	4.3	3.3	5.9	
Portal x A sl	5.0	7.9	3.8	3.7	3.7	1.4	5.9	
CI 7920 x A sl	5.0	7.7	4.0	3.5	3.4	1.4	6.5	
Garland	5.8	8.1	4.3	3.3	3.9	1.6	5.5	
A sl CI 2318	5.4	7.3	4.0	3.0	3.6	1.5	5.3	
A bz PI 182487	5.8	8.0	4.3	3.3	4.0	1.7	5.5	
A sl CI 1780	5.4	7.7	4.1	3.5	3.8	1.6	5.4	
A sl PI 282735	5.7	7.8	4.5	3.3	3.8	1.4	5.5	
A sl CI 2518	5.6	7.6	4.3	3.4	3.7	1.4	5.7	
A sl PI 287210	5.5	7.8	4.1	3.3	3.6	1.1	5.4	
A sl PI 287228	5.8	8.1	4.3	3.3	3.8	1.3	5.5	
A sl PI 287223	5.7	7.7	4.3	3.1	3.7	1.6	5.5	
A sl PI 282737	5.5	7.5	4.2	3.1	3.6	1.5	5.3	
A sl CI 2321	5.5	7.5	4.3	3.3	3.7	1.5	5.4	
A sl CI 5255	5.7	7.8	4.2	3.2	3.7	1.6	5.4	
A b PI 268214	5.7	7.6	4.3	3.4	4.0	1.5	5.4	
A sl PI 267989 (CI 8081)	5.8	7.8	4.1	3.2	3.8	1.6	5.4	
A sl CI 8077 (Wahl #6)	5.6	7.8	4.4	3.6	3.9	1.5	5.4	
FAO Recommendation	4.3	4.9	4.3	2.9	4.3	2.3	2.9	1.4

Seed of first group was grown at Aberdeen, Idaho, in 1968.

Seed of second group was grown at Aberdeen, Idaho, in 1964.

FAO Recommendation--Essential amino acid content for an ideal protein for human consumption as defined by the World Health Organization and FAO.

Primary emphasis over the past one-quarter century has been directed toward development of disease resistant oat varieties. Although some significant gains have been achieved in straw strength, grain quality, and yield, more progress is imperative in order to place oats in a favorable competitive position with other crops. We cannot abandon efforts to keep ahead in the vicious race to provide resistant varieties to the grower, but perhaps now is the time to re-direct some of our research effort. In the future, oats will have to meet the requirements for combine harvesting of maximum yields under optimum cultural conditions.

Straw strength and height

We need shorter oat varieties which have stronger straw for the 1970's. Unfortunately, there are not enough centers for oat research in the U.S., nor are there enough individuals with the facilities or financial support to undertake an intensive study on morphology of the oat culm and/or roots, or genetics of straw strength and/or height. Such basic work needs to be done, but until research support is strengthened, individual workers will have to do for themselves whatever is possible. We, within the Crops Research Division, will do our best to coordinate efforts and aid in exchange of germ plasm. When or if funds become available, we would consider research on the basic aspects of straw height and strength.

As oat varieties become shorter and are grown under higher fertility conditions, weeds and some diseases now considered minor are destined to plague the grower. If progress in increasing yield in oats parallels that in wheat, an entire new array of production problems will evolve. "Foot" or root rot diseases and foliar diseases such as powdery mildew and Septoria are bound to be more apparent. Some breeding efforts may have to be changed to cope with new problems.

We considered establishment of a Uniform Strong Straw Nursery, but had to abandon this plan. An alternative may be the collection of stiff-straw lines (from all oat workers and from the Oat World Collection) for an observation Nursery grown at high fertility levels under irrigation at Aberdeen, Idaho. Winter oats can be included if the Nursery is planted in early spring.

Root characteristics

The root system of oats has long been ignored, or at best has been under very limited investigation, primarily because of obvious difficulty encountered in evaluation. The structure of the root system may be equal in importance to culm structure in effect on lodging. Morphological development and/or structure of both roots and culms of weak straw varieties should be compared to that of strong varieties, to see if specific characteristics can be related to lodging resistance.

Are there inadequacies of oat root systems compared to wheat root systems? Oats do not fare as well as wheat under drouth conditions. Is this because of an inherent physiologic weakness? Failure to make dramatic increases in yield in oats may in part be due to lack of improvement in the root system.

Research in the 1970's could well be directed toward development of some simple screening test to measure early root growth. Perhaps oat seedlings could be grown in hydroponic solution or possibly in sand for a limited period. To my knowledge, neither vigor of root growth nor number of roots has been selected for, except in association with freezing tests where regrowth of roots is a selection criterion for winterhardiness.

Basic studies concerned with oat root systems would at this time fit into the same category as studies on straw height and strength. We have no established center for such research.

Physiology

Of all the scientific disciplines involved with research on oats during the 1970's, we will perhaps be more in need of basic information relating to Plant Physiology than any other. Results from such research may be our only hope of breaking the yield barrier, or of gaining protection from obligate parasites that would approach permanence.

Much has been accomplished in improving the oat plant, but little is actually known about physiological processes which affect growth, photoperiodism, metabolism, winter injury, heat and drouth damage, stress on a plant caused by disease, etc. Fundamental research of this nature requires the full time effort of scientists with extensive (and expensive) laboratory, greenhouse, and growth chamber facilities in which environmental conditions can be rigidly controlled. Such a single facility for physiologic research on cereals does not exist, but we hope that it will within the decade.

Theoretically the maximum possible efficiency of photosynthesis is about 8% of total incident radiation (Monteith, J. L. 1966. Agr. Prog. 41: 9-23). The highest net photosynthesis recorded for experimental plots is, with existing genotypes, less than 4%, while in commercial farming it is about 1% or less (Holliday, R. 1966. Agr. Prog. 41:24-34). Some very preliminary work has been done on evaluating wheat varieties for photosynthetic efficiency. In one test Gaines had a higher rate of uptake of CO_2 than did Hadden, when flag leaves and spikes of each were tested within a closed chamber. Is it within the realm of possibility to develop a screening test which would differentiate the most efficient genotypes of oats from the intermediate or less desirable--if, indeed, differences do exist? If such a test did become available, could it supplement or even replace part of our yield testing procedure?

In work with rice, it was reported that light intensity is most crucial during the period three weeks before heading to three weeks after heading. At least three factors influence the amount of light a plant receives when grown in the field: daylength, light intensity (cloud cover or lack of it), and mutual shading (one plant shades another; upper leaves shade lower leaves). Research with oats should include experiments on each of these factors.

Genetics and Cytogenetics

Our research on genetics and cytogenetics of *Avena* species should be strengthened in the 1970's. More information is needed on genome relationship, linkage groups, possible methods of gene transfer, and establishment of aneuploid series (monosomics, nullisomics, tetrasomics). One has to have only a cursory acquaintance with monosomics of wheat to realize their tremendous potential as a genetic tool. Genes can be located on specific chromosomes through use of monosomics, nullisomics, or substitution lines. By using telocentrics, somewhat more sophisticated aneuploid stocks, genes can be located on one arm or the other of a chromosome, and can even be positioned on that arm in respect to the centromere. Part of the monosomic series in hexaploid oats has been established. We need to complete the task and then develop other aneuploid stocks in addition to useful sets of substitution lines.

The search for male sterility in oats should be intensified. Either cytoplasmic or genetic male sterility, or both, would be extremely useful. The possibility of chemically induced male sterility should not be overlooked. This characteristic could be used to advantage in effecting large scale genetic recombination in bulk populations, composite crosses, and other heterogeneous stocks, and in production of large numbers of F_1 seeds. Hybrid oats on a commercial scale could be attempted if satisfactory cytoplasmic male sterility and an effective restorer gene(s) exists.

Our cytogenetic work is centered at Ames, Iowa, and some degree of genetic investigation is conducted at several locations. One possibility for expansion of cytogenetic work is associated with the Oat World Collection and the Avena Species World Collection, both of which are maintained at Beltsville. Opportunity exists here for almost unlimited genetic and cytogenetic research directed toward isolating, identifying, and exploiting genes for various characters.

Germ plasm collection and preservation

Approximately 7,500 cultivated oats (*A. sativa* and *A. byzantina*) are presently in the Oat World Collection. About 200 new introductions are added each year, so that by the end of this decade the Collection should contain about 9,500 cultivated entries, assuming a consistent rate of increase.

There are approximately 1,800 entries in the *Avena* Species World Collection, of which about 75% are *A. sterilis*. In addition, Dr. Craddock has 3,600 more *A. sterilis* collections which have not been grown under detention nor increased, so are not yet a part of the Species World Collection. That makes a total of nearly 5,000 individual collections of *A. sterilis* which will become available. Increase in numbers within the Species World Collection is infinitely more difficult to predict.

A. sterilis entries are particularly useful because the species is hexaploid and crosses readily with *A. sativa* or *A. byzantina*. Some of those tested possess promising resistance to one or more of the major oat diseases. These sources of resistance need to be identified and fully evaluated. They may or may not represent new genes.

The cultivated oat entries in the World Collection will be grown at Aberdeen, Idaho, in 1970 and 1971. Those CI's from the lowest up to about 7,000 will be grown this summer (1970). This includes entries which were assigned CI numbers up through the year 1955. The remainder of the CI's and all of the cultivated entries with PI numbers will be increased at Aberdeen in 1971.

Success in oat breeding is limited by germ plasm at our disposal. Oat breeders have an enviable record of success in developing resistant varieties (even though most are short-lived), but new pests and new races of old pests are sure to make the battle long and difficult. Invaluable germ plasm is continually being destroyed or replaced under the onslaught of ever increasing agricultural and population pressures.

An example of this is the shrinking indigenous population of *Avena* species in Israel. There is tremendous genetic potential here and in other Mediterranean areas where weedy oats abound. These populations can be looked upon as genetic raw material in abundance--but time is running out. This great wealth of oat germ plasm is in danger of being lost. Centers of diversity are being replaced by modern, uniform varieties. It behooves us to collect and thereafter maintain all germ plasm that we can handle, including old "land varieties." We have a recurring need for genetic variability--the "stuff" that plant breeding progress depends upon.

Diseases

Most of the U.S. oat crop is grown where the warm, humid conditions are highly favorable for disease development. A recent estimate of annual loss due to oat diseases was $200 million.

We will have a continuous need for basic information on the effects of fungus, viral, and bacterial diseases on winter survival, yield, and quality of oats, and on the effect of environmental factors on disease development.

Our primary approach to control in the past has been through breeding resistant varieties. This has been productive, but only a partial solution. In the 1970's we need to work even harder on this approach, and in addition, attempt to learn more about chemical control which may be used as a supplement.

Use of multilines (composed of near-isogenic lines--each possessing a single gene for resistance) and geographical deployment of resistance genes in commercial oat varieties have been discussed by others as means for more effective control of rusts, so will not be included here.

Special emphasis has been and will continue to be directed toward genetic control of oat diseases. Genetic resistance has several advantages over chemical control:

1. Resistant varieties prevent or restrict production of inoculum which could infect local or distant susceptible varieties.
2. Resistant varieties are far more economical for the grower.
3. Resistant varieties are protected throughout the life of the plant (except in the case of adult-plant or the very rare seedling-only types of resistance).
4. Resistant varieties are protected under all weather conditions conducive to survival of the oat plant.
5. Resistant varieties eliminate danger from injurious residues.

The disadvantage of genetic resistance has been its ephemeral nature.

There is much interest but little knowledge concerning the relative value of different kinds of genetic resistance. We hope that critical experiments can be conducted during the 1970's to learn the relative values of immunity, hypersensitivity, slow rusting, late rusting, and tolerance to infection. Some of these may represent the same phenomenon under different labels. F. J. Gough has indicated that cereal pathologists and breeders are interested in some form of non-specific resistance for two reasons:

1. They have become pessimistic about ever producing varieties with permanently effective specific resistance since repeatedly witnessing their cherished creations succumb to new virulent races of the organism.
2. Elucidation of the gene-for-gene interactions of rusts and their hosts, and the several mechanisms of variation in rust populations has reinforced their pessimism.

If non-specific resistance does occur, what is its physiologic nature? Does it represent some form of morphologic or chemical barrier in the host which may inhibit penetration by the parasite, cause suppressed sporulation, or result in early telia formation? It may even result from the accumulative effect of a number of minor specific genes for resistance. At any rate, a concerted effort will be made, first, to establish the validity of non-specific resistance. If such a phenomenon can be shown to exist, then methods of transfer from one genotype to another must be established if it is to be of value as a means of disease control.

Work dealing with genetic control of oat diseases will be conducted at virtually every location involved in oat improvement. Research on some form of nonspecific genetic resistance, primarily to crown or stem rust, will be underway in the 1970's at the Cooperative Rust Laboratory in St. Paul, Minnesota; Gainesville, Florida; Beltsville, Maryland; Ames, Iowa; and in Israel under a PL 480 research contract.

More precise identification and the isolation and transfer of genes for resistance to crown rust into a susceptible common genetic background is needed in oats. Such a program is already underway for stem rust at the Cooperative Rust Laboratory in St. Paul. A more definitive system for assignment of symbols to genes for crown rust is likewise necessary. This has been started for stem rust. A set of near-isogenic lines, each with a different gene for resistance, can be used as differentials to classify genotypes of the pathogen. Such lines function essentially as a set of gene differentials. If the background donor variety has no genes for resistance, it serves merely as a "carrier" for the introduced genes. Use of such a set of differentials circumvents difficulties encountered through the masking effect of minor or modifying genes and/or the presence of more than one major gene which so often occur in standard differential varieties. Combining any two or more of the isolated genes for resistance in this same genetic background allows for more precise genetic evaluation. The near-isogenic lines can be used as tester lines for identification of unknown genes for resistance. A program for establishment of near-isogenic lines possessing crown rust resistance genes has been initiated at Beltsville, Maryland; and Ames, Iowa.

Barley yellow dwarf virus (BYDV) research involves use of a unique plant-virus-vector system in attempting to answer basic questions such as:

1. How does infection by one virus affect multiplication and transmissibility of another?
2. What is unique about vector-dependent viruses?
3. What is the basis of vector specificity?
4. What role does phenotypic mixing (incorporation of nucleic acid of one virus with the protein capsid of another virus) play in plant viruses?
5. Does resistance to BYDV involve failure of aphid vectors to introduce virus into the plant, or is it failure of the introduced virus to reproduce within the plant tissues, or is it a result of lack of mobility of the virus within the plant?

BYDV represents an important group of viruses--those characterized as circulative aphid-transmitted viruses that are not mechanically transmitted--whose properties and nature are poorly known.

There is considerable fluctuation in degree of BYDV damage to oat fields from one location to another, and from one year to another. We need more information on aphid population dynamics and chemical control of aphids. Very good progress has been made in developing oat stocks with resistance to BYDV, and it looks like even greater progress is in the offing.

Research on BYDV in oats is conducted at Ithaca, New York; Urbana, Illinois; and Brookings, South Dakota.

Helminthosporium victoriae is one disease organism that has been held under complete control by a specific gene for resistance for a long period (over 20 years). Damage to the oat plant is caused by a toxin, victorin, which is produced by the fungus. Victorin is presently being used as a model system in the study of wilt inducing pathogens. Many such organisms occur which are parasitic on other species. Basic knowledge gained from research on *H. victoriae* and the effect of victorin on its host, the oat plant, can be invaluable in its broader application.

Basic research on mode of action indicated that the cell plasmalemma was the site of action of victorin. The toxin may or may not act directly on the plasmalemma, but data clearly showed that the integrity of that membrane was disrupted by victorin. Disruption of the physiochemical function of the plasmalemma resulted in loss of cell turgor and eventual cell death in a susceptible variety. Work on *H. victoriae* and on selection for resistance to *H. avenae* is conducted at Gainesville, Florida.

Oat Variety Classification

A new Oat Variety Classification Bulletin will be published in the early 1970's. This Bulletin is sorely needed. The last one, published in 1955, included oat varieties released up to 1940 or 1941. Only one Bond derivative was included. Not even Clinton made the bulletin. More than 200 oat varieties have been released in the 30-year interim (1940-1970). About one-fourth of these are winter varieties.

Mr. F. A. Coffman, who is writing the bulletin, requests that any Bulletins or descriptive information on new varieties be forwarded to him immediately at: 4327 Woodberry Street, University Park, Hyattsville, Maryland 20782.

Regional Deployment for Conservation of Oat Crown-Rust Resistance Genes

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Widespread production in North America of oat cultivars with the same resistance genes has resulted in a rapid turnover of oat cultivars and rust races. Central North America is an epidemiological unit for wind-disseminated continental pathogens such as the cereal rusts. These fungi overwinter in the South and move north into the upper Mississippi River Valley and Canada in the spring. Barberry and buckthorn eradication unified this vast area epidemiologically for stem and crown rust. In theory, the logical step sequential to eradication of the alternate hosts, therefore, is to deploy rust resistance genes so that those utilized in commercial cultivars in the northern USA and Canada differ from those utilized in the southern USA and northern Mexico. This should block the successful seasonal interregional movement of rust spores that has jeopardized crops in both the North and the South. Interregional movement of spores would still occur, but the spores should be of races avirulent on crops in the other region, forcing the fungi to recycle between incompatible hosts.

Only effective, uncommitted resistance genes are subject to deployment. There is an adequate number of such genes for oat crown rust on hand or on the horizon. Used wisely as part of an integrated continental control program, these should last indefinitely. Therefore, intra- and interregional research should be undertaken to test the validity of this theory. If valid, an integrated continental program for conservation of resistance genes while using them to control crown rust of oats could be developed through work and agreement of small-grain workers.

"Dormoats" - Potentially a New Oat Crop for Northern Areas

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"Dormoats" are cultivars derived from crosses between _A. fatua_ L. and _A. sativa_ L. and possess, at least in part, the dormancy and frost resistance characteristics of the wild oat seed and the seed morphology of the cultivated oat. They were bred to be sown in the fall and to emerge in spring thus avoiding seeding difficulties in spring. Yield increases of 10-24 percent have been obtained with fall-sown compared with spring-sown "dormoats". "Dormoat" strains are characteristically free of rust and septoria infection because of early maturity. They are quite resistant to lodging because the short, condensed, lower internodes develop under cool conditions. Low spring emergence (1-10 percent) of fall-sown seed is the major obstacle to solve before "dormoats" can become commercially acceptable. Spring emergence values have been dramatically increased (40-60 percent) by storing the newly harvested, partially imbibed, seed outdoors on the surface of soil for 4-6 weeks instead of indoors in a dry state. This treatment prevents germination, allows the seeds to after-ripen and "sets the germination clock" for spring emergence.

Tolerance to the Septoria Disease of Oats

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A cooperative study on tolerance to the septoria disease (_Septoria avenae_ f. sp. _avenae_) of oats was carried out at Ottawa, Ontario and Charlottetown, P.E.I. in 1969. A group of septoria resistant strains from the world oat collection was grown in a duplicate arrangement at both locations and in each case one set of plots was sprayed with the fungicide maneb regularly while the other set was left unsprayed. Four commercial varieties were similarly compared at both locations. Disease notes and seed yields were obtained on the various entries. Several diseases were prevalent at Ottawa while practically only septoria occurred at Charlottetown. However, average seed yields were higher at Ottawa than Charlottetown. Experimental variability was high at Ottawa and spraying with maneb only increased the yields of 22 of a total of 49 entries. At Charlottetown on the other hand experimental variability was low and spraying with maneb increased the yields of 43 of the entries. Control of the septoria disease by maneb was only fair at Ottawa but reasonably good at Charlottetown. In terms of crop loss an average 3% reduction in yield resulted from spraying with maneb at Ottawa while a 16% increase in yield was obtained at Charlottetown. Several entries showed good tolerance at Ottawa and Charlottetown but only one showed well at both locations. The entries showing the good tolerance were generally low in yield and high in septoria rating.

Accelerating Varietal Releases

David C. Ebeltoft, North Dakota State University, Fargo

Historically the development of new germplasm and the ultimate release of a new variety therefrom have taken many years, ten to twelve years being the average. The plant breeders have shortened this time by growing two generations per year in the greenhouse during the winter months. In addition to the early generation increases in the greenhouse, North Dakota has further hastened the release of a variety by making winter field increases in Arizona. These increases have been from November to May with the harvest being in time for spring planting in North Dakota. To further accelerate increase of potential varieties, trials were conducted in California to determine if an additional field increase could be made between an early harvest in North Dakota and a November planting in Arizona. Trials in California since 1966 have now located an environment that will successfully produce a good increase of daylength insensitive cereals between August 1 and November 15. On the basis of these studies, an increase of barley made in the fall of 1969 in California is now being further increased in Arizona for North Dakota plantings in May, 1970.

Screening Oat Selections for Protein Quality with Weanling Voles

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Preliminary nutrition studies, using high protein oats as the only source of protein in a diet fed to meadow voles, revealed extremely interesting information. The oats used were common oats, *Avena sativa*; derivatives from crosses involving *A. sativa* and *A. sterilis*, a wild hexaploid species from Israel; and derivatives from *A. sativa* x *A. strigosa*, a diploid species. The experimental lines were selected primarily for protein content, and most in their present form are unsatisfactory as oat varieties.

The voles were fed for a 7 day period in each test. The diet was prepared so that it furnished more than adequate energy, vitamins, and minerals, but the only source of protein was the oat line tested. Amount of protein in the diet was restricted to 7%.

Protein content and protein efficiency ratio (PER), which is a value derived from comparing the amount of protein consumed with gain in weight of the voles, are listed for each variety or line bioassayed. Table 1 includes 12 entries tested in 1968. One can readily see that PA 5, PA 6, and PA 9 had high PER's; PA 4 and PA 12 had moderately high PER's; while PA 3 and PA 8 had low PER's. All 7, however, were similar in protein content. This indicates that protein quality may be much more important than protein quantity, provided a certain minimal amount of protein is present. Varieties and lines tested in 1969 are listed in Table 2. Entry numbers 2, 3, and 4 were repeated from the 1968 test. PA 6 again had a high PER, and PA 12 again was moderately high, at comparable protein levels. A Diana x Roanoke F4, entry 9, at a similar protein level was high. The variety Roanoke had an exceptionally high PER but was considerably lower in percent protein. Garland 2 x Sauk x Simcoe likewise had a high PER but was relatively low in protein content. Such examples lend emphasis to the statement that protein quality in oats could be more critical than quantity.

A point to be stressed concerning these data is that they are only preliminary. Further such bioassays, supplemented by protein and amino acid analyses are urgently needed, and are planned in future work.

Table 1. Percent protein and PER values with weanling voles, 1968.

	Line	Percent Protein	PER value
PA 1	Garland	14.9	0.95
PA 2	Garland x A sl	21.5	1.26
PA 3	Garland x A sl	23.5	1.48
PA 4	A sl parent	24.6	2.07
PA 5	A sl x Florida 500	24.9	2.50
PA 6	A sl x Florida 500	24.1	2.67
PA 7	Florida 500	16.5	1.59
PA 8	A sl x Diana	24.3	1.36
PA 9	A sl x Diana	23.4	2.69
PA 10	Diana	21.3	2.09
PA 11	F_2 Composite of A sl x Diana crosses	20.8	2.24
PA 12	OA 123-33	23.4	2.08

All Avena sterilis crosses except PA 11 involve Israel Sel. 6-76-4-10. PA 11 involves Israel Sel. 6-174-5 (higher in protein and a better agronomic type than 6-76-4-10).

Table 2. PER values with weanling voles on 7% protein diets, 1969.

Entry	Rep I	Rep II	Rep III	Rep IV	Rep V	$\bar{X}$	Protein content
1. Garland selection	1.29	3.40	3.09	1.29	1.65	2.14ab 2/	16.5
2. PA 6 A sl x Fla. 500	4.00	3.42	5.11	1.29	3.74	3.51a	21.1
3. PA 9 A sl x Diana	0.18	3.92	1.30	2.00	0.63	1.61 b	22.4
4. PA 12 OA 123-33	3.45	2.84	2.57	2.34	2.84	2.81ab	19.6
5. OA 123.70	2.65	3.13	1.91	0.80	2.87	2.27ab	14.8
7% Casein Control	3.63	3.47	3.19	3.69	1.20	3.04ab	
6. Garland 2 x Sauk x Simcoe	3.14	3.54	3.00	3.13	3.35	3.23a 2/	16.7
7. Diana CI 7921	2.37	2.80	2.03 1/	1.33	2.18	2.17 b	17.4
8. Roanoke CI 7413	4.31	3.35	3.43	3.95	3.24	3.66a	16.0
9. Diana x Roanoke F_4	3.97	2.70	3.00	4.10	2.60	3.27a	19.9
10. Diana x Roanoke F_4	2.68	2.94	2.91	3.86	2.29	2.94a	17.1
7% Casein Control	2.94	3.47	3.35	2.34	3.63	3.15a	

1/ Missing plot, computed value.
2/ Values followed by the same letter are not significantly different (Duncan's Multiple Range Test).

The Evaluation of Crown Rust Resistance from *Avena sterilis*

G. Fleischmann, Canada Department of Agriculture, Winnipeg

The purpose of evaluating *Avena sterilis* collections for crown rust resistance is to provide the oat breeder or geneticist with the most promising material from which to identify and isolate effective crown rust resistance genes. The broadest possible spectrum of testing should be undertaken, both in terms of reactions to different races of the pathogen, and in terms of tests at several different stages in host development. Evaluation of the material should actually commence at the collection site, if crown rust infection is evident.

One third of the A. sterilis material showing field resistance at the collection site in Israel in 1966 was also found to resist the more virulent biotypes of crown rust prevalent in Western Canada. A far lower proportion of randomly-collected A. sterilis lines showed resistance to these isolates, thus indicating the merit of field evaluation, where possible.

Single-panicle collections of Avena sterilis were initially evaluated by testing groups of 3 to 5 seedling leaves to 4 or 5 key races of the pathogen, usually those representing a wide virulence spectrum. Collections showing effective resistance were grown out and retested in the adult stage to the same races.

In addition to greenhouse tests, the wild oats were subjected to naturally-occurring and artificially-induced epidemics of crown rust in the field. We tested the performance of this material in artificial epidemics at rust nurseries in Winnipeg and at Mayaguez, Puerto Rico, and under natural epidemic conditions at Winnipeg.

Usually it is possible to make some decisions about the wild oats being tested even before subjecting them to crossing and genetic tests. While genetic testing is required to determine whether the resistance encountered is the function of one or more genes, any differences in the reaction of different collections to the initial races tested, would indicate that we are dealing with more than one resistance source. Different types of resistance can sometimes also be differentiated phenotypically, both in the seedling and adult plant reactions. Differential reactions to races and varying resistant phenotypic response are important, in that the initial differentiation of resistances they point to, are the basis on which we decide which material to investigate genetically.

When certain Avena sterilis collections have been chosen for genetic analysis of resistance, it is useful to incorporate seed of these collections as supplementary differentials in the annual crown rust survey. By testing them to a wide range of field isolates we get an idea of the resistance spectrum, and we can also come up with various combinations of pathogenic virulence which might be useful in the subsequent genetic studies.

Agronomic and Cytologic Behavior of Progenies in 6x-amphiploid x Avena sativa backcross generations

R. A. Forsberg and S. Wang Wuu, University of Wisconsin, Madison

A perplexing problem which has existed in an interspecific gene transfer program is that plants in 6x-amphiploid x A. sativa backcrossed-derived lines have not been true breeding. Regardless of the number of backcrosses or number of selfed generations, a crown rust resistant plant always had both resistant and susceptible progenies. A stabilization program was initiated by irradiating BC_3F_4 seeds with thermal neutrons prior to planting, and then using the plants as male parents in crosses with Holden. The resulting F_1 hybrids were screened cytologically for the presence of multivalent configurations which would indicate that a translocation had occurred. Attention was focused on one specific cross in which F_1 plants had 2n=42 chromosomes including a quadrivalent. The F_2 populalation of 1,232 plants was screened for reaction to crown rust and resistant plants were progeny tested. F_3 lines homogeneous-resistant to crown rust were observed for the first time in a 1969 field nursery. The one plant examined cytologically in each of five different resistant F_3 lines contained 21 bivalents. Seedling tests with race 264, race 294, and a composite of field-collected races indicate continued stability for resistance within F_4 lines and within F_3-derived F_4 families. Verification of homozygosity in F_4 and F_5 populations will be undertaken.

Present Status of Multiline Oats

K. J. Frey and J. A. Browning, Iowa State University, Ames

Two series of multiline oats have been released from the Iowa station. One of these, MULTILINE M, is mid-season and the other, MULTILINE E, is early. New multilines in these series have been released in 1968, 1969, and 1970 as M68, M69, and M70 and E68, E69 and E70, respectively. In each new release the numbers and proportions of the several isogenic lines have been different.

A multiline of oats is formed by mixing together an appropriate array of isogenic lines, each of which carries a unique type of crown rust resistance. All lines used in a given multiline are essentially identical for agronomic appearance. The most current multilines, i.e., MULTILINE M70 and MULTILINE E70, have 7 and 11 isogenic components, respectively.

We currently have available 18 and 19 isolines of the M and E series, respectively, in quantities of 5 bushels of seed or more.

We have changed the recurrent parent in the mid-season series to Clintford, and in the next series of crosses for an early multiline, a strain designated C237-93-2 (from Clintland x Garry-5) will be used as the early recurrent parent. Presently, we are in backcross four to add 8 new sources of crown rust resistance from *Avena sterilis* into the new mid-season and early backgrounds.

Inheritance of Reaction to Toxaphene in Oats

James H. Gardenhire and Milton E. McDaniel,

Texas A&M University, Denton and College Station

Two resistant and three susceptible oats were crossed in all possible combinations (reciprocals excluded) for a study of the inheritance of reactions to Toxaphene. F_2 plants from the 10 crosses were studied in both greenhouse and field experiments. The reaction of oats to Toxaphene spray was found to be controlled by a single major gene, with susceptibility conditioned by the dominant allele.

The effect of Toxaphene appeared to be localized, and caused eventual death of leaf tissue contacted by the spray material. New growth appeared normal. Technical Toxaphene (solvent free) and a commercial Toxaphene formulation produced the same visual symptoms on susceptible oats. It appears that the insecticide chemical is responsible for this damage.

Table 1. Reaction of parents and F_2 populations to Toxaphene spray.

Parent or Cross	Number of Plants		
	Resistant	Susceptible	P
New Nortex	37	0	
Moregrain	37	0	
Fairfax	0	36	
Sel. 270-59-12	0	35	
Sel. 59C60	0	34	
New Nortex X Sel. 270-59-12	39	101	.30-.50
New Nortex X Fairfax	40	108	.50-.70
New Nortex X Sel. 59C60	42	105	.30-.50
New Nortex X Moregrain	149	0	
Fairfax X Sel. 59C60	0	138	
Fairfax X Moregrain	44	103	.10-.20
Fairfax X Sel. 270-59-12	0	156	
Sel. 270-59-12 X Sel. 59C60	0	100	
Sel. 270-59-12 X Moregrain	45	106	.20-.30
Moregrain X Sel. 59C60	42	107	.30-.50

Table 2. Classification for reaction to Toxaphene spray of F_3 families from resistant x susceptible crosses.

Cross	Number of Plants			P
	Res.	Seg.	Sus.	
Sel. 59C60 x Moregrain	13	21	16	.30-.50
Moregrain X Sel. 59C60	6	13	6	.98-.99
Fairfax X Moregrain	8	27	15	.30-.50

The Strategy of Deployment of Environmental Resources by Successful and Unsuccessful Oat Varieties

J. E. Grafius and R. L. Thomas,

Michigan State University, East Lansing

We have attempted to give a general description of the nature of the interrelationship of a series of traits in any developmental sequence.

Solution of the recursion formula $x_{n+2} + bx_{n+1} + Cx_n = 0$ (where the various x_n = different traits in the sequence) permits a general statement regarding the nature of any developmental sequence, providing n is small.

If the solution indicates an oscillatory form, and b and c are significant, direct genetic control of the more remote traits in the sequence can become very weak. In some cases the variation in last trait is largely controlled by the magnitude of the first traits in the series.

In an example, it was found that direct genetic control of x_3 was very weak, the size of x_3 being largely under control of prior events x_1 and x_2. Apparently starting at the same x_1 value, success (high yield) or failure of a variety depended on whether it elected high or low x_2 as the next move. This choice was largely under genetic control. But once x_2 was determined, x_3 was largely determined by the rules of the game, the oscillatory wave pattery. The strategy of a successful variety in this experiment called for it to elect for high x_2. The decision, it is assumed, is written in the genetic code, although this too may be subject to the strategies of other games played earlier in metabolic developmental processes.

Response of Stiff-Strawed Oat Genotypes to Nitrogen

Doyce Graham, Jr. and W. P. Byrd, Clemson University, Clemson, S. C.

Oat genotypes from Coker Pedigreed Seed Company with stiff-strawed derived from CI 7922, a Milford derivative, were evaluated for response to nitrogen fertilization. Three other genotypes representing presently available straw strength were included for comparison. The CI 7922 derived genotypes were Coker 68C165, Coker 68C61, Coker 69-27, and Coker 68-26. Check genotypes were Sumter 3, NC 2469, and Coker 68-14. Nitrogen rates were 50, 75, 100 and 125 pounds of nitrogen per acre applied as ammonium nitrate in the spring plus a preplant application of 700 pounds of 6-12-12. Results are one year's data from Florence and Clemson, S.C. plantings.

Objectives were (1) to evaluate the yield potential of the stiff-strawed genotypes under increasing rates of nitrogen and (2) determine their lodging response to nitrogen fertilization.

The stiff-strawed genotypes were significantly shorter than the normal strawed genotypes. Differential lodging was not discernible. The period from middle April to early June was unseasonably dry. There were no overall effects of nitrogen. However upon further examination it was found that some varieties were responsive to nitrogen. Average yields at the two locations had Sumter 3, NC 2469, and 2 stiff-strawed genotypes, Coker 68-26 and 69-27, included in the top yield range. On the basis of these data there was no yield advantage to the stiff-strawed. Genotype x nitrogen (linear) and genotype x nitrogen (cubic) responses were significant due to the fact that different genotypes had different responses to nitrogen.

The relationship between stiff-straw and nitrogen fertilization as it affects yield response is not a simple one as evidenced by the cubic responses of some genotypes. It would appear that for genotypes to respond favorably to nitrogen fertilization that a complete complement of plant characters must be available and ability to stand is only one of these traits.

Genotype	Clemson Ht. (cm)	Florence Ht (cm)	Clemson - Florence $\bar{X}$
Coker 68C165	74 c	67 c	70 c
Coker 68-14	86 ab	83 b	84 ab
Sumter 3	91 a	89 a	90 a
Coker 68C61	65 d	62 d	63 c
Coker 69-27	75 cd	69 cd	72 c
NC 2469	82 b	82 b	82 b
Coker 68-26	63 d	64 cd	63 c

Genotype	Grain Yield: Clemson - Florence KG/HA	BU/Acre
Coker 68C165	2163	64 b
Coker 68-14	2404	65 b
Sumter 3	3172	85 a
Coker 68C61	2278	61 b
Coker 69-27	2640	69 ab
NC 2469	2642	73 ab
Coker 68-26	2649	72 ab

Source	DF	Mean squares
Nitrogen	(3)	
Linear	1	
Quadratic	1	
Cubic	1	
Genotype	(6)	**
Genotype x Nitrogen	(18)	**
Genotype x N_L	6	*
Genotype x N_Q	6	
Genotype x N_C	6	**

		Mean squares		
Genotype	DF	Linear	Quadratic	Cubic
Coker 68C165	1			
Coker 68-14	1			
Sumter 3	1	**		**
Coker 68C61	1			
Coker 69-27	1			*
NC 2469	1			
Coker 68-26	1			*

Systemic Fungicides for Control of Oat Smuts

Earl D. Hansing, Kansas State University, Manhattan

An oat selection was inoculated by the partial vacuum method with a suspension of teliospores of loose smut (*Ustilago avenae*) and covered smut (*U. kolleri*). After the seed was dried 500 ml lots were treated with the systemic fungicides Benlate (50% benomyl) at 1 and 2 oz/bu, Vitavax (75% 5,6-Dihydro-2-methyl-1, 4-oxathiin-3-carboxanilide) at 0.67 and 1.33 oz/bu, UNI G-696 (75% 2, 4-Dimethyl-5-carboxanilido thiazole) at 0.67 and 1.33 oz/bu, and HOE 2988 (Identity not available) at 1 and 2 oz/bu, and HOE 2989 (Identity not available) at 1 and 2 oz/bu. Seed treated with Spergon (96% chloranil) at 2.08 oz/bu was included as a nonvolatile-nonsystemic check, and Ceresan L at 0.5 oz/bu and Panogen 15 at 0.75 oz/bu were included as volatile-nonsystemic mercurial checks. During 1968 (except HOE 2988 and HOE 2989) and 1969 nontreated seed and treated seed of each entry were planted each year on 2 different dates in 3 replicated 12-foot rows. Data were taken on smutted panicles during June of each year.

During 1968 when the seed was not treated 67% and 70% smutted panicles developed. When the seed had been treated with the fungicide checks the smutted panicles occurred as follows: Spergon, 9% and 11%, Ceresan L, 6% and 8%, and Panogen 15, 5% and 6%. Complete control of oat smut was obtained with Vitavax at both 0.67 and 1.33 oz/bu. Good control was obtained from seed treated with Benlate at 1 oz/bu, 6% and 5%, and at 2 oz/bu, 2% and 1%, and with UNI G-696 at 0.67 oz/bu, 2% and trace, and at 1.33 oz/bu, 0% and 0%.

During 1969 when the seed was not treated 81% and 73% smutted panicles developed. When the seed was treated with Spergon 53% and 50% smutted panicles developed which indicated that a high level of infection took place under the lemmas and paleas. For Ceresan L, 7% and 7%, and Panogen 15, 9% and 8% smutted panicles occurred. Smutted panicles from seed treated with the systemic fungicides were as follows: Vitavax at 0.67 oz/bu, trace and 1%, and at 1.33 oz/bu, 0% and 1%; Benlate at 1 oz/bu, 2% and 2%, and at 2 oz/bu, 1% and 1%; UNI G-696 at 1 oz/bu, 1% and 1%; HOE 2988 at 1 oz/bu, 4% and 5%, and at 2 oz/bu, 1% and 2%; and HOE 2989 at 1 oz/bu, 3% and 4%, and at 2 oz/bu, 1% and 3% smutted panicles.

Systemic fungicides, compared with mercurial fungicides at their recommended rates, have given equal or better control of the oat smuts during every year tested: Vitavax 4 years, Benlate 3 years, Plantvax 2 years, UNI G-696 2 years, and HOE 2988 and 2989 1 year.

Yield and Yield Components of Seven Oat Hybrids

B. R. Hathcock and M. E. McDaniel, Texas A&M University, College Station

Six of seven F_1 oat hybrids grown at Temple, Texas in the 1967-68 season yielded more than their respective higher yielding parents. Yield increases ranged from 19 to 105%, with 4 hybrids yielding at least 40% more than their parents. Most of the yield increases appeared to be associated with increases in the number of seed per panicle. The number of functional tillers produced by F_1 hybrids tended to be intermediate to that of the parents, and there was little indication of any increase in the weight per seed of hybrids.

Six of the seven F_1 hybrids also yielded more than the best pure line in the entire test. One of the yield increases was negligible, three fell between 13 and 18%, and two exceeded 30%.

Stabilizing selection with Respect to Virulence in Puccinia graminis f. sp. avenae

K. J. Leonard, ARS, Raleigh, N. C.

The use of major genes for oat stem rust resistance in America has resulted in the increase of virulent races of the pathogen which previously occurred only in extremely low frequencies in the pathogen population. Two explanations of the initial low frequencies of virulent races are offered. The low frequencies may indicate that the virulent races resulted from relatively recent mutations for virulence which will eventually replace their respective alleles for avirulence. A second explanation is that the relative frequencies of genes for virulence and their alleles for avirulence are determined by two opposing forces, directional selection which favors genes for virulence and stabilizing selection which favors genes for avirulence. According to this theory, directional selection is greater when genes for resistance are common in the host population, whereas stabilizing selection is stronger when resistance is rare in the host population.

If selection occurs only in the direction of virulence, then the changes that have been observed in the oat stem rust population in America should be irreversible. If stabilizing selection occurs, removal of resistant plants from the host population should result in a resurgence of simple races with few genes for virulence and a corresponding decline of complex races. To determine whether stabilizing selection does operate with respect to genes for virulence, we cultured a heterogeneous population of Puccinia graminis f. sp. avenae on susceptible oat varieties for eight successive uredial generations. After each generation a sample was tested for virulence on the standard oat stem rust differential varieties. Statistically significant decreases in proportions of virulent biotypes indicated that genes for virulence on varieties with the A, B, or D genes for resistance were reduced in frequency by culture of the population on susceptible plants. Stabilizing selection with respect to genes for virulence on varieties with the E or F genes was not conclusively demonstrated.

Average percentage resistant type pustules on differential varieties

	Craig population Generations		Clintland A population Generations	
Variety	1-4	5-8	1-4	5-8
A	10	13*	6	9
B	6	26**	6	23**
D	29	59**	27	69**
E	43	55	42	61
F	96	98	92	96
AB	7	17*	7	16
AD	19	59**	20	74**
ABD	22	57**	22	68**
BD	35	65**	35	77**
BF	88	96*	92	99**

* Increase significance at 95% level.
** Increase significance at 99% level.

National Certified Small Grain Review Board

Foil W. McLaughlin
N. C. Crop Improvement Association, Raleigh

The basic function of the National Certified Small Grain Review Board is to determine whether a candidate variety is suitable for certification (is new and unique and is reproducible as described) and whether a seed maintenance program is being followed that will insure a reasonable degree of genetic stability. The board will base its evaluation largely on information furnished by the applicant on the following points: (1) specific distinguishing characteristics (how it differs from other varieties); (2) origin and breeding procedures; (3) region of adaptation and primary use; (4) morphological and physiological characteristics including yield and disease and insect reaction; (5) methods for producing and maintaining breeders seed; and (6) a statement on limitation of generations eligible for certification.

The Board is composed of individuals appointed from the following organizations and agencies: Association of Official Seed Certifying Agencies, American Seed Trade Association, National Council of Commercial Plant Breeders, Crops Science Society of America, and a representative from the USDA who serves as Chairman.

Applications are to be submitted to the Chairman. The report of the Board's recommendations are to be made to the President of the Association of Official Seed Certifying Agencies, the Administrator of ARS, and the breeder or agency requesting an opinion on the variety for certification. The Board serves in an advisory capacity to certifying agencies on the eligibility of varieties for certification, thus providing a standardized and uniform review of applications.

The following paragraphs state PURPOSE, RESPONSIBILITY, etc. and present a copy of the "Application for Review of Small Grain Varieties for Certification" which were approved December 1, 1969.

PURPOSE: The main purpose of the Board is to review credentials of proposed new small grain varieties for suitability for certification.

RESPONSIBILITY: The Board is officially recognized as an advisory body by ARS and the Association of Official Seed Certifying Agencies. It provides an opinion on the basis of data made available but assumes no financial or other responsibility for the consequences of its recommendations.

MANNER OF APPOINTMENT AND COMPOSITION: The Board is composed of five members (including the Chairman) and five alternates as follows:

Chairman - appointed by the Administrator of ARS. The Chairman names his own alternate.

Members and Alternates - these are appointed by the President of AOSCA from nominations solicited from experiment stations, trade and professional organizations, and other groups.

Tenure - appointments expire 2 years from date of acceptance but more terms may be served.

REPORTS: All actions of the Board are reported to the President of AOSCA, the Administrator of ARS, and the breeder or agency requesting an opinion on a variety for certification. All information supplied to the Board about a candidate variety is privileged information, not to be divulged without written consent from the applicant.

STANDARDS: Nomenclature will follow the "International Code of Nomenclature for Cultivated Plants", 1969 edition. The minimum standards for certification will be those of the AOSCA. (Publication 22, Minimum Genetic Certification Standards). The Board observes the ESCOP guidelines in "A Statement of Responsibilities and Policies Relating to Seeds and Other Propagation Materials of Field Crops" approved February 28, 1967, the Federal Seed Act, and other pertinent controls.

APPLICATIONS: Submission of applications to the Chairman may be made at any time. Five copies are desired. All applications must be made using currently valid forms available from any Board member. Supplemental information deemed by the applicant to be useful to the Board is solicited. Such information is for Board use only, not to be divulged without written consent from the applicant.

PROCEDURE:

Meetings - The Board meets annually to consider applications and other business, generally in November, unless there is no item for deliberation, in which case there will be no meeting. Alternates are always welcome. On invitation, visitors may attend.

Interim Work - Consideration of applications by mail may be given at the discretion of the Chairman.

Voting - Four members or their alternates constitute a quorum. Three favorable votes are required to approve an application. The Chairman or his alternate may vote in case of a tie.

"Application for Review of Small Grain Varieties for Certification"--five copies of this application and supplemental documents to be submitted to L. P. Reitz, Crops Research Division, Plant Industry Station, Beltsville, Maryland 20705 (dated December 1969).

Applicant's Name ________________________________ Date ____________
Address ____
Sponsoring Institution ____
Breeder's Name (if other than applicant) ________________________
Variety Name Proposed ______________ Experimental Designation __________

The breeder or sponsoring institution must describe and DOCUMENT in this application the characteristics of the variety and designate those which give it DISTINCTIVENESS.

I. State how the variety differs from all prior varieties of public knowledge. List specific distinguishing characteristics. See also Item IV.

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____
____

II. Describe origin, breeding procedure, and time sequence used to develop the variety.

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____
____

III. State area of probable adaptation, primary use of the variety, and market subclass.

____
____
____

IV. Information required to establish identity and uniqueness including information of value to certification agencies.

A. Plant and seed characteristics and colors (seed samples and plant specimens may be submitted):

____

B. Variations and their frequency which are characteristic of the variety:

____

C. Growth Habit:

____

D. Adaptation (maturity, winterhardiness, day length sensitivity, etc.):

____

E. Special Markers:

____

F. Disease Reactions:

____

G. Insect Resistances:

____

H. Yield:

I. Quality:

J. Any Other Characteristics:

V. Describe methods for producing and maintaining breeder's seed including isolation and roguing schedule:

VI. State limitations of generations eligible for certification and other requirements necessary to maintain varietal characteristics:

VII. If this variety is accepted by official certifying agencies, when will seed first be offered for sale and what certified class will it be?

SIGNATURE OF APPLICANT

The Utilization of Rust Resistance Genes

R. I. H. McKenzie, Canada Department of Agriculture, Winnipeg

In our oat breeding program at Winnipeg we are trying to make considerable improvements in the oat plant. However, rust resistance is essential in eastern Manitoba. In order to learn more about sources of resistance we initiate a number of genetic studies and in collaboration with J. W. Martens and G. Fleischmann have assessed the potential usefulness of resistance genes.

Three methods of using these genes in plant populations appear possible.

1. Varieties could be released with single host resistance genes. In the past this has led to a rapid breakdown of the resistance.
2. Multiline varieties consisting of a number of sublines each with a different gene for resistance could be released. A good variety for use as a recurrent parent is required. A new virulent combination of the rust pathogen is possible by means of stepwise mutations.
3. Resistance genes could be pyramided in a single strain. To produce such a multigene variety requires a lot of background knowledge.
   (a) The genes to be used must be known to be not closely linked in repulsion. One couldn't use alleles.
   (b) Furthermore methods of distinguishing between single resistance genes must be available. Thus if there are 3 crown rust resistance genes conferring a high level of resistance one would have to
   (i) look for rare races that distinguish between them,

(ii) find some other physiological technique such as differential temperature, light or chemical breakdown of resistance to distinguish them

(iii) or as a last resort we might have to cross advanced lines to a susceptible variety and observe the segregation ratios. Lines with all the required genes present could be considered for release. A multigene oat should prove to be a very stable form of rust resistance. From the point of view of the gene for gene theory a stepwise mutation process would be unlikely to overcome this resistance. In fact only a mutation at a number of virulence loci almost simultaneously could overcome it.

However this pyramid could be toppled easily if the genes present in it are released singly in conventional varieties elsewhere.

At Winnipeg we will attempt to combine a number of resistance genes into one variety. Ideally a minimum of 3 good resistance genes against each of stem rust and crown rust are required.

Genetic Changes in Winter Oat Populations in Response to Natural Selection

H. G. Marshall, ARS, University Park, Pennsylvania

The F_3 and F_7 generations of 58 winter oat bulk populations were compared to determine the effect of natural selection on certain characteristics and to ascertain whether early testing can be used to identify those populations with the greatest selection potential. A positive increase in freezing resistance occurred in most populations, and 34 of the increases were statistically significant. Little change in freezing resistance occurred in populations that were initially high in survival, whereas large changes occurred in most initially low populations. Winterkilling was not severe enough to differentiate the more hardy populations, but survival in the initially low populations supported the conclusions based on freezing experiments. Populations with decumbent growth habits in the F_3 did not change in winter hardiness while all upright populations made positive changes. The growth habits of decumbent or semidecumbent populations did not change significantly, but all intermediate or upright populations became more decumbent.

In addition to the above bulk tests, 76 spaced plants were grown in each of the F_3 and F_8 generations of 12 of the populations and classified for growth habit, plant height, and maturity. Fifty lines per generation from 6 of these populations were then classified for freezing resistance. Examination of the data and frequency distribution curves led to the following conclusions:

1. The frequency of genes for upright growth habit decreased rapidly under natural selection.

2. All populations were significantly later in maturity after five generations of natural selection. There was a rapid accumulation of genes conditioning late maturity, and the two earliest maturity classes were not recovered in the F_8 of most populations.

3. The frequency of tall plants increased in 6 out of 12 populations. In most cases, the shortest classes were not recovered from the F_8 while the upper limit of the range had increased.

4. The increased freezing resistance of initially low populations generally resulted from a decrease in the frequency of individuals in the lower classes, and in only one case were individuals recovered in the F_8 that exceeded the upper range of freezing resistance in the F_3. In contrast, populations that did not change in freezing resistance had almost identical distribution curves in the F_3 and F_8 with a high frequency of individuals in the most resistant classes. Although bulk populations with a high selection potential were identified by early testing, the procedure is of questionable value because of subsequent changes in the low populations in response to natural selection.

5. Because of the undesirable natural genetic shift to late, tall plant types, the bulk method may lead to frustration in programs to improve the winter hardiness of oats.

Pedigrees of populations used in a study of genetic changes in winter oat populations in response to natural selection.

Population No.	Pedigree
1	Dubois x CI 6904 2x Nysel 3x Milford x Wintok
2	Ballard 2x CI 6904 x Dubois 3x Dubois x CI 7317
3	Ballard x Clintland 60 3x Milford 2x Wintok Selection x Hairy Culberson
4	Selection 5991 x LeConte 2x CI 7128 3x Wintok x Aa 676
5	LeConte x Selection 4977 2x Ballard x Nysel
6	Selection 4833 x LeConte 2x Nysel 3x Wintok x Aa 676
7	Milford 2x Wintok Selection x Hairy Culberson 3x Ballard x Nysel
8	Nysel 2x Hairy Culberson x Milford
9	Dubois x CI 6903 2x Nysel 3x Milford x Wintok
10	Selection 4833 x LeConte 2x VIII97X51DM 3x CI 7128 x Nysel
11	Ballard 2x Tennex Red Rustproof x Selection 5152 3x Ballard x Clinton 59
12	Milford 2x Wintok Selection x Hairy Culberson 3x Ballard x Nysel

Average changes in certain characteristics of 12 bulk populations in response to natural selection[1/]

Pop. No.	Growth habit[2/]			Maturity[3/]			Plant height (cm)			Freezing resistance (%)		
	F_3	F_8	Change	F_3	F_8	Change	F_3	F_8	Change	F_3	F_8	Change
1	3.3	2.4	-0.9**	3.9	5.4	1.5**	89.9	104.6	14.7**	91.4	96.2	4.8
2	1.9	1.7	-0.2	4.5	5.5	1.0**	71.4	99.1	27.7**	86.5	95.0	8.5
3	3.1	1.9	-1.2**	4.2	5.5	1.3**	85.9	84.8	-1.1	89.5	90.3	0.8
4	1.9	1.5	-0.4**	5.5	6.1	0.6**	81.2	83.1	1.9	84.7	96.2	11.5
5	2.9	2.5	-0.4**	4.8	5.3	0.5**	85.3	93.7	8.4**	82.5	91.3	8.8
6	3.3	1.8	-1.5**	4.0	6.0	2.0**	89.7	91.4	1.7	24.4	89.9	65.5**
7	4.0	2.8	-1.2**	4.5	5.5	1.0**	102.1	107.7	5.6**	29.9	68.1	38.2**
8	3.7	2.4	-1.3**	4.0	5.5	1.5**	112.0	108.0	-4.0	17.0	68.1	51.1**
9	3.4	3.0	-0.4**	3.8	4.6	0.8**	90.9	93.2	2.3	25.1	59.5	34.4**
10	1.8	1.6	-0.2	6.3	6.5	0.2*	106.7	106.7	0.0	45.6	72.8	27.2
11	4.3	3.0	-1.3**	3.9	5.0	1.1**	106.7	112.8	6.1**	19.6	87.6	68.0**
12	3.6	1.3	-2.3**	4.9	6.3	1.4**	105.7	82.0	-23.7**	74.9	78.5	3.6

* Significant at the .05 level; ** significant at the .01 level.

1/ Growth habit, maturity, and plant height values are averages of approximately 75 plants; freezing resistance values are the averages of 50 lines.

2/ Based on a scale: 1 = decumbent to 7 = upright.

3/ Based on a scale; 1 = early to 7 = late.

Tolerance of Current Oat Varieties to Crown Rust Race 326

L. J. Michel and M. D. Simons, ARS, Ames, Iowa

During the mid 1960's, race 326 became the dominant crown rust race in the United States. Since that time, there have been no major epiphytotics, and consequently there has been little opportunity to determine the potential effect of this race on the oat varieties that are currently being grown or developed. We subjected about 100 such oat varieties and selections to severe, artificially initiated epiphytotics of race 326 in 1967, 1968 and 1969. The varieties that were rated as susceptible for infection type varied greatly in ability to tolerate infection. Some, such as Tyler, were damaged as severely as was the old, highly susceptible Clinton. Others, such as Kota and Nodaway, showed only a little greater loss of yield due to infection than did resistant check varieties.

Resistance to Crown Rust

M. B. Moore, Deon Stuthman and Olin Smith, University of Minnesota, St. Paul

Testing lines of oats in the presence of a pathogenically diverse population of crown rust propagated repeatedly on buckthorns has permitted selection of lines and varieties that have an unusually broad base of resistance to the rust. Many lines have specific resistance and some apparently have a significant level of non-specific resistance. Selected lines have remained resistant in the buckthorn plot for 6 years and in the 1966-1968 International Oat Rust Nurseries have been among those with the lowest coefficients of infection. In the 1967 I.O.R.N. of 17 lines 6 were resistant at all stations, 1 was susceptible at 1 station, 8 at 2, 1 at 3, and 1 at 5 stations. These last 11 lines differentiated 11 different "station races" suggesting a great diversity for virulence in the rust and for resistance in the host. Resistance in the Minnesota lines appears to be multigenic since in crosses of resistant x resistant lines progeny vary from HR to MS with none fully S, and in crosses of resistant lines with commercial varieties segregation is similar but with a shift in distribution toward greater susceptibility. Non-specific resistance seems to be present in some Minnesota breeding lines and in the varieties Portage, Portal, Minhafer, Ajax, Kelsey, Kota, Roxton, and Rodney.

Combining Seedling and Adult Plant Resistance to *Puccinia graminis* f. sp. *avenae*

P. G. Rothman, ARS, St. Paul, Minn.

Recessive gene pg 12 confers a high degree of resistance in the seedling stage to all the present prevalent races of oat stem rust as well as the virulent race 6 AFH. The recessive gene pg 11 confers adult plant resistance to these same races. The combination of these two recessive genes could give the type and degree of resistance needed for protection against those races for which no source of combined resistance is known.

Four F_0 seeds were obtained in the cross C.I. 3034 (pg 11) by Kyto (pg 12). The four F_1 plants were highly sterile. The limited number of F_2 plants, in both the seedling and adult stage, were tested in the greenhouse with the virulent race 6 AFH. Four classes were obtained, indicating the two genes were independent (Table 1). The F_2 progeny, likewise, exhibited a high degree of sterility.

Seed, obtained from each class, was spaced planted in the field in F_3 blocks and inoculated with race 6AF and 6 AH. Adult reactions were made on individual plants within each class (Table 2).

Eighty-one resistant plants were harvested. Fertility of these plants varied from complete sterility to full fertility.

Seedling tests on the 81 resistant F_4 lines were conducted in the greenhouse with race 6 AFH. The classification of the F_4 lines is presented in Table 3. The eight resistant lines in Class 1 have been resistant as F_3 adults and as F_2 seedlings and adults.

The success of combining both the seedling and adult type resistance to our potentially dangerous races of oat stem rust at present seems encouraging.

Table 1.

	Reaction		
Class	Seed-ling	Adult	Number F_2 plants
1	R	R	17
2	R	S	7
3	S	R	8
4	S	S	6

Table 2.

	Adult reaction	
Class	Res.	Susc.
1	36	217
2	11	85
3	20	106
4	14	75

Table 3.

	Seedling reaction		
Class	Res.	Susc.	Seg.
1	8	18	0
2	4	1	4
3	8	12	0
4	5	3	5

Distribution and Prevalence of Oat Stem Rust Races in the USA in 1969

P. G. Rothman and D. M. Stewart, ARS, St. Paul, Minnesota

There was little change in the number of races of stem rust identified in collections received from the 1969 UORN over those of 1968 (Table 1). Race 6AF was the most prevalent race. Percentagewise, it increased from 60% in 1968 to 73% in 1969. Race 6F, once the most prevalent race in the U.S., continued to decline from 14% in 1968 to 5% in 1969.

Comparisons of uredial collections received from the Uniform Oat Rust Nursery planting with those received from other nurseries and commercial fields were made. Races and number of isolates identified from these latter sources are presented in Table 2. Prevalence of races found within the UORN collections and those collections from the other sources are compared in Table 3. Of the 14 physiological races identified in 1969, six were common to uredial collections from the UORN and other nurseries and commercial fields, one was found only in the UORN collections, while seven were found only in the collections from other nurseries and commercial fields. Race 6AF was found in 73% of all isolates identified both within the UORN collections and collections from other nurseries and commercial fields. (Tables 1, 2 and 3 appear on page 42).

DNA Synthesis in Root Tips of *Avena sativa* L.

K. Sadanaga, ARS, Ames, Iowa

Root tips of *Avena sativa* L. germinated at 27°C. were pulse labeled for 30 minutes in a solution of tritiated thymidine (concentration 3 uc/ml) to determine the cell cycle. A cell cycle of about 8 hours consisted of the G_1 phase of 1 hour, S phase of 4 hours, G_2 phase of about 2.3 hours, and Mitosis of about 0.7 hours. Pulse labeling experiments to study time of replication of chromosomes

Table 1. Physiological races of *Puccinia graminis* var. *avenae* identified from uredial collections made in the Uniform Oat Rust Nurseries grown in the United States from 1964-1969.

	Races and Percentages of Isolates Identified													
Race	1AH, 1H, 1	2H, 2	4A	5H, 5	6A	6F	6AF	6AH	6AFH	7F, 7A, 7	7AH, 7AF	12AF, 12A	13A	13AH, 13AF
1964	-	1	1	2	1	54	32	-	-	7	-	T	T	-
1965	-	1	T	1	8	37	40	-	1	5	-	3	2	-
1966	T	9	-	T	3	17	58	2	3	T	1	T	3	4
1967	-	-	-	-	-	20	68	8	-	-	-	-	-	3
1968	10	-	-	2	-	14	60	-	-	12	2	2	-	-
1969	6	5	-	5	-	5	73	5	-	-	2	-	-	-

Table 2. Physiological races of *Puccinia graminis* var. *avenae* identified from uredial collections received from sources other than the Uniform Oat Rust Nurseries, 1969.

	Races and Number of Isolates Identified													No. of	
Location	1H	2F	2H	2AF	6A	6F	6AF	6AH	7A	7F	7AF	7AH	8A	Iso.	Coll.
Ill.	2	-	-	-	-	2	-	-	-	-	-	-	-	4	3
Iowa	-	-	-	-	1	27	133	2	-	7	2	1	1	174	92
Minn.	-	1	-	-	2	1	48	2	1	-	-	-	-	55	31
N.Dak.	-	-	-	-	-	1	6	-	-	-	-	-	-	7	4
Ohio	-	-	-	-	-	-	3	-	-	-	-	-	-	3	1
Okla.	-	-	-	1	1	-	1	-	-	-	-	-	-	3	3
S.Dak.	-	-	-	-	-	-	5	-	-	-	-	-	-	5	5
Texas	-	-	14	-	-	5	20	-	3	2	2	4	-	50	32
Wis.	-	-	-	-	-	-	5	-	-	-	-	-	-	5	3
No. isolates	2	1	14	1	4	36	221	4	4	9	4	5	1	306	174
% isolates	0.6	0.3	4.5	0.3	1.3	11.9	72.8	1.3	1.3	2.9	1.3	1.6	0.3		

Table 3. Comparison of race identification data from collections received out of the Uniform Oat Rust Nursery with that received from other sources.

	Races and Number of Isolates Identified in 1969														No. of	
	1H	2F	2H	2AF	5H	6A	6F	6AF	6AH	7A	7F	7AF	7AH	8A	Iso.	Coll.
	Number of Isolates															
UORN	4	-	3	-	3	-	3	47	3	-	-	-	1	-	64	35
Other	2	1	14	1	-	4	36	221	4	4	9	4	5	1	306	174
	Percent Isolates															
UORN	6.3	-	4.7	-	4.7	-	4.7	73.4	4.7	-	-	-	1.6	-		
Other	0.6	0.3	4.5	0.3	-	1.3	11.9	72.8	1.3	1.3	2.9	1.3	1.6	0.3		

disclosed lightly, moderately, and heavily labeled metaphase cells in single root tip preparations. Differential labeling of individual metaphase chromsomes was observed in lightly and moderately labeled cells but differences were not clear-cut. This technique, therefore, appears to have limited application, if any, to identify chromosomes in the monosomics of oats.

Oat Groat Protein Under Different Cultural Practices, and Protein Content of Certain Breeding Selections

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This is a preliminary report of oat groat protein observations made at the University of Wisconsin. The protein contents (Nx6.25) have been determined by the Kjeldahl procedure at three industrial laboratories, largely on a single determination basis, and without reference to moisture which is presumed to have been near 10-12 percent.

Hull percentage has been determined by separating groats by the "wringer" method and by the Quaker impact dehuller. Often groats are bruised by dehuller impact. In a small dehulling methods experiment, it appeared that protein was lowest when prepared by use of the wringer. Samples of 2 grams, 5 grams, and 20 grams were dehulled by impaction followed by blowing away hulls gave similar protein percentages. When smaller and broken particles after 2 passes through the dehuller were analyzed, their protein content was greater.

Garland and Lodi have been produced in the nursery under eight cultural treatment combinations.[1/] Oats followed corn or alfalfa, seeded at two rates and were given nitrogen fertilization, or none, at planting time. Usually oats after alfalfa had higher protein, and usually Lodi had lower protein than Garland; but Lodi gave much higher protein on corn land in 1969 than in 1967 and 1968. This indicates genotype interaction with culture method or season. Protein content of six varieties grown at five locations for 4 years has been determined. Beedee and Clintland 64 have the highest average; Garland and Holden were intermediate, and Lodi and Portal were lowest. Hancock, a sand land station, had the highest average of five locations. Stations changed rank between years.

Workers at the Wisconsin Experiment Station are cooperating with members of the Crops Research Division of the U. S. Department of Agriculture and personnel of the Quaker Oats Company in developing agronomically usable oats that will have higher groat protein than now available. This work has been in progress for nearly three years. H. C. Murphy supplied some of the original breeding stocks and enthusiasm for the project of increasing protein content of oats.

A moderately large population of F_2 spaced plants from hybrids of _A. sativa_ x _A. sterilis_ was grown in 1967 and as many as 546 individual plants were examined for oat groat grade (0-100), groat percent and protein percent. Of this group, 346 were continued in the F_3 generation test in 1968. Of the 346 grown in 1968, more than 95 were harvested and were used for determining groat grade, groat percent, and protein percent.

Heritability of Protein Percent

Of the 95 F_3's evaluated after the 1968 harvest and compared with their F_2 percent protein of 1967, the correlation is +0.548. This means that there is considerable unaccounted for variation in protein content. After the 1969 grow-

1/ J. J. Schreck assistance is acknowledged.

ing season, groat protein content of 75 F_4 lines (some bc F_3 or dc F_3) was determined and compared with F_3 (some bc F_2 and dc F_2) protein percentages. There were 20 lines whose F_2 plants had protein percents determined, and followed through in F_3 (1968) and F_4 (1969). Some comparison and r values were as follows:

N	Comparisons	r	Mean values	
95	F_2 (1967) - F_3 (1968) protein	+0.548	16.88	17.56
17	F_2 (1967) - F_4 (1969) protein	+0.250	18.28	20.35
20	F_3 (1968) - F_4 (1969) protein	+0.684	18.85	20.27
75	F_3 (1968) - F_4 (1969) protein	+0.561 2/	18.50	19.45
20	F_4 (1969) groat % and protein	-0.125	62.0	20.27
20	F_4 (1969) groat grade & protein	+0.154	82.7	20.27

Outlook

The grain quality and agronomic characteristics from interspecific crosses of *A. sativa* x *A. sterilis* are not as good as intra-*A. sativa* crosses. Some of the interspecific cross derivatives may be useful parents since they may donate higher protein, and likely will donate better crown rust resistance.

Certain *A. sativa* lines may approach agronomic and crown rust resistance acceptability and offer 2 to 3 percent increase (added to 17 percent base) in protein content.

2/ Some bc and dc F_2, and bc and dc F_3.

The Crown Rust Race Situation

M. D. Simons, ARS, Ames, Iowa

During the last two or three years races 264B and 325 (which are similar except for the virulence of 264B on Ukraine) have shown a rapid increase in prevalence, and now are the most common of all races. They differ from the previously most common race 326 by their ability to induce moderately susceptible to susceptible reactions in Trispernia. The reactions of the other differential varieties and of supplementary differentials are similar. Nevertheless, there is some reason to think that races 264B and 325, under field conditions, may be more damaging in general than is race 326. None of these races seems to be closely related to race 264.

Differential Sensitivity to Parathion of Certain Crown Rust-Oat Variety Interactions

M. D. Simons and J. A. Browning, ARS and Iowa State University, Ames

Crown rust of oats is highly sensitive to parathion fumigation in the greenhouse. The fungus was completely suppressed, without apparent host injury, when plants were subjected to standard dosages before or after inoculation. Crown rust that developed on plants in rooms adjacent to or a distance from the fumigated rooms showed lesser degrees of damage. There were striking differences in the sensitivity of the host-parasite interaction on different oat varieties at very low differential concentrations of the fumigant in non-fumigated rooms.

Landhafer, Ukraine and Trispernia were among the cultivars on which the host-parasite interaction was most sensitive to parathion; Santa Fe and P.I. 174513 were among those least sensitive. Sensitivity was manifested in the form of fewer uredia, development of pin-point uredia lacking a surrounding chlorotic area, and/or a relative paucity of uredia on the distal portion of the leaf. Sufficient parathion persisted even in non-fumigated rooms to adversely affect crown rust development for at least 2 weeks after fumigation. The effects of parathion were more pronounced if inoculated plants were held at low than at high temperatures.

Report of Committee on Oat Gene Nomenclature

M. D. Simons and N.F. Jensen, ARS, Ames, Iowa and Cornell University, Ithaca, N.Y.

The committee is functioning, and requests the cooperation of all investigators in furnishing information on all new genes in oats. Information on genes governing reactions to disease organisms should be sent to M.D. Simons, and information on genes governing all other characters to N. F. Jensen.

Genes recorded since publication of the original list in 1966, and the references for them, are shown below.

fl; (floretless) Dyck, 1968.
mg; (multiglumes) Dyck, 1968.
Pc-36; Simons, 1965.
Pc-37; Dyck, 1966.
Pc-38, Pc-39, Pc-40, Pc-41, Pc-42, Pc-43; Fleischmann and McKenzie, 1968.
Pc-44; Martens, McKenzie, and Fleischmann, 1968.
pg-11; McKenzie and Martens, 1968.
pg-12; Martens, McKenzie, and Fleischmann, 1968.
pg-13; Martens, 1969.
Psc-2, Psc-3; (resistance to halo blight) Cheng, 1968.
pt-5; (cluster panicle) Dyck, 1968.

Cheng, Chien-pan, and C. W. Roane. 1968. Sources of resistance and inheritance of reaction to Pseudomonas coronafaciens in oats. Phytopathology 58: 1402-1405.

Dyck, P. L. 1966. Inheritance of stem rust resistance and other characteristics in diploid oats, Avena strigosa. Can. J. Gen. Cytol. 8: 444-450.

Dyck, P. L. 1968. Three morphological mutants in Avena strigosa. Can. J. Bot. 46: 867-868.

Fleischmann, G. and R. I. H. McKenzie. 1968. Inheritance of crown rust resistance in Avena sterilis. Crop Sci. 8: 710-713.

Martens, J. W. 1969. Letter dated July 23, 1969.

Martens, J. W., R. I. H. McKenzie, and G. Fleischmann. 1968. The inheritance of resistance to stem and crown rust in Kyto oats. Can. J. Genet. Cytol. 10: 808-812.

McKenzie, R. I. H. and J. W. Martens. 1968. Inheritance in the oat strain C.I. 3034 of adult plant resistance to race C10 of stem rust. Crop Sci. 8: 625-627.

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Specific Virulences among Races of Puccinia graminis f. sp. avenae near Barberry at University Park, Pennsylvania in 1968-69

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University of Minnesota and Pennsylvania State University

Race 6AFH of Puccinia graminis f. sp. avenae was first identified near barberry in the Oat Uniform Rust Nursery at University Park, Pennsylvania in 1965. This race attacks all commercial oat varieties with resistance conditioned by genes A, B, D, E, F, and H. The following year, race 6AH was detected for the first time in the same nursery. The implication of barberry in the hybridization of the rust and the potential danger of these races lead to a special study of the rust population at University Park in 1968 and 1969. In addition to screening for resistance genes among the host entries, more information was needed on the prevalence, competition, survival, and specific virulences associated with races in this local geographical area.

In these studies, rust observations and evaluation of host varieties and lines were recorded by W. O. Keim and R. P. Pfeifer at University Park. Rusted oat stems collected from various entries were sent to the Cooperative Rust Laboratory in St. Paul, Minnesota, for race determinations.

From 86 rusted samples collected in 1968, 14 races were found among 166 isolates. Race 6AH predominated with 40% of the isolates; 6AFH, 24%; 13AH, 11%; 6AF, 7%; 13A, 5%; and 13AFH, 4% (Table 1). The remaining 9% included races 4H, 4AH, 6A, 6F, 7AF, 7AH, 7F, and 13AF. Races 4H, 4AH, 6AFH, 13A, 13AF, and 13AFH were not found in other parts of the USA in 1968.

In 1969, 16 races were identified among 184 isolates from 109 rusted samples. Race 6AH comprised 59% of the isolates; 13AH, 8%; 4AH, 6A, 6AFH, and 13AFH, 5% each; 6AF, 4%; and 4AFH, 2%. Races 4A, 6H, 7F, 7AH, 8AH, 11H, 11AH, and 13A were found among the remaining 7% of the isolates. Races 4A, 4AH, 4AFH, 6H, 6AFH, 8AH, 11H, 11AH, 13A, 13AH, and 13AFH were not found elsewhere in the USA in 1969.

Table 1. Prevalent races identified at University Park Nursery in 1968-69.

Race	% of isolates 1968	% of isolates 1969	Shift in %
6AH	40	59	+ 19
6AFH	24	5	- 19
13AH	11	8	- 3
6AF	7	4	- 3
13A	5	Trace	- 5
13AFH	4	3	- 1
Other	9	21	
TOTAL	100	100	

Oat Protein Research At Aberdeen

D. M. Wesenberg, R. M. Hayes, and R. M. Wise, ARS and University of Idaho

Protein determinations by the Kjeldahl procedure were completed for advanced selections from several crosses included in irrigated oat yield trials during 1967-69. Dehulled samples were used for the determinations. Correlations between yield and protein content were calculated based on selection averages for several trials. The trials referred to here were composed of 20 to 40 selections and only progeny from one cross per trial. Yield - protein content correlations for eight of nine trials grown in 1967-69 were nonsignificant. Correlations for protein content between years for three trials were significant and ranged from 0.54 to 0.64. Comparable yield correlations between years ranged from .20 to .56 and two of the three correlations were not significant.

Protein determinations for varieties and selections included in the Uniform Northwestern States Oat Nursery were completed for two irrigated and two nonirrigated stations in 1968 and 1969. The average protein content for 23 entries at four stations in 1968 was 16.7%. Twenty entries averaged 17.4% at four stations in 1969. Clinton 59 was highest in protein in both years, averaging 19.1%. The four-station averages for each entry were used to determine the association of protein content with yield, bushel weight, kernel weight, and groat percentage. Yield was not significantly correlated with protein content in 1968, but a significant negative correlation of -0.68 was obtained in 1969. Protein content was not significantly correlated with bushel weight, kernel weight, or groat percentage in 1969, but a significant negative correlation of -0.42 was obtained between protein content and kernel weight in 1968.

Yield-protein content correlations for Uniform entries were also calculated based on individual station averages. All yield-protein content correlations were negative for individual stations in 1968, but significance was reached at only one station. Significant negative yield-protein content correlations were obtained at three of four stations in 1969.

F_1's and parents for a number of crosses between high and low protein oat varieties and selections were grown under irrigation at Aberdeen in 1969. The F_1's and parents were space-planted at 12-inch intervals in adjacent rows. The parents averaged from 12.9 to 24.1% protein. Eleven F_1's and their parents have been evaluated to date. Four of the crosses involve *A. sterilis* x *A. sativa* derivatives. *A. strigosa* and *A. fatua* are represented in the background of the parents of three other crosses with the remainder of the parents being *A. sativa* types. The F_1 protein content closely approximated the parental means for most of the eleven crosses, averaging 97.3% of the mid-parent value. The data suggest that the factors which influence protein content are primarily additive in nature.

A number of selections have been used as sources of high protein. *A. sterilis* x *A. sativa* derivatives from the Beltsville program and *A. sativa* selections from the Wisconsin program have been used in crosses with varieties and selections adapted to the northwestern States. A few advanced Aberdeen selections have good yield records and relatively high protein content. A selection from the cross Garland x 59Ab7140 (Sauk x Simcoe), for example, has a two-year average yield of 169.0 bushels per acre and 21.6% protein under irrigation at Aberdeen. This selection averaged 195.6 bushels per acre with 20.6% protein in 1969.

Protein content, yield, and other characteristics of five varieties and selections were evaluated in 1968 in irrigated trials with (a) no supplemental nitrogen and (b) 135 pounds of nitrogen per acre in the form of ammonium nitrate. The nitrogen application was split with 45 pounds applied at the seedling stage and 90 pounds at heading. Protein content averaged 19.1% with supplemental nitrogen and 17.5% for check plots. Yields averaged 126.8 bushels per acre for the five entries following application of additional nitrogen. Check plots averaged 98.0 bushels per acre. Test weights were similar for both treatments; however, there was a slight reduction in average kernel weight at the high nitrogen level. Similar expanded studies involving rates and times of nitrogen application were conducted in 1969.

II. SPECIAL REPORTS

Oat Variety Classification in the USDA

Franklin A. Coffman

Oat workers are familiar with the publication prepared by the late Dr. T. R. Stanton, "Oat Identification and Classification," USDA Tech. Bull. 1100, that was published in 1955. Few, however, realize that his "cut off" date for varieties included was 1940-41, nearly 30 years ago. Hundreds of oat varieties released since 1940-41 in the USA are not covered in Stanton's publication. Nonetheless, the publication is extremely valuable as a history of oats and oat varieties and is of special interest to oat workers.

Although presumably never officially so designated, J. B. Norton was the first man in charge of oat work in the USDA (1902-1907). If he was interested in classifying oats, no records remain which indicate this.

The late Dr. C. W. Warburton was the first officially designated leader of the oat project in the USDA and served from 1907-1923. Warburton started on oat variety classification early in his period of service with the Department.

T. R. Stanton joined the USDA in 1911-12, and later became Warburton's assistant on oats. He, too, became involved in oat variety classification efforts. Their work together continued for several years. In October 1916, the late W. C. Etheridge of Cornell University published his oat classification, Cornell Univ. Agr. Exp. Sta. Memoir 10.

With the start of World War I in 1917, Warburton became deeply involved in other duties in addition to the oat project work and apparently thereafter ceased his oat classification efforts. Stanton also was forced to curtail his work in that field for a period of years.

When Warburton left Oat Investigations in 1922, Stanton was placed in charge. On January 1, 1924, F. A. Coffman was assigned as assistant to Dr. Stanton in Washington, D. C. Shortly thereafter Stanton renewed his efforts to classify oats. Numerous varieties had been released in the USA since Etheridge's publication.

Stanton believed that more than one individual in the USDA should be familiar with the oat varieties grown and so in the early 1930's, at his request, F. A. Coffman also started working on oat classification. This classification work was continued through 1940. In 1941, when World War II started, there was a cutback of technical work and efforts to classify oats practically ceased.

Following the war and through Stanton's retirement in 1953, oat classification work was almost at a standstill due to financial limitations. Neither Stanton nor Coffman had been able to do much on oat classification for over a decade. Only after Stanton's retirement was he able to prepare for print the mass of data he had assembled on the classification of oats.

In the early 1950's, Dallas E. Western of Quaker Oats Company, with the encouragement of such men as the late Dr. George Wilds of Coker's Pedigreed Seed Company, gave significant support toward obtaining funds for oat research in the USDA. When the additional funds were made available, new oat research positions were established and work that had been delayed was initiated again in oat classification. Thus Stanton was able to publish his extensive oat manuscript.

In 1954, at the request of the late Dr. H. C. Murphy, who succeeded Stanton as Leader of Oat Investigations, F. A. Coffman renewed efforts in classifying oat varieties, keeping in mind the necessity to update and extend Stanton's work. Large nurseries were seeded at Aberdeen, Idaho, for 8 years (1955-1962), and notes on morphological characters were compiled. It was from these extensive plantings that information was gained on varieties that had been released in the U. S. since Stanton closed off his work. Seed for these varieties was assembled by Murphy, and valuable assistance was given by Harland Stevens and Frank Petr in planting the nurseries at Aberdeen. Petr also assisted in taking notes on the plants for several years.

Since his retirement on December 31, 1962, F. A. Coffman has continued to work on a new oat classification bulletin. Encouragement and information from many sources were provided by Dr. H. C. Murphy and by his recent successor, Dr. L. W. Briggle. Requests were made to people known to be involved in oat improvement in order to make the information as complete as possible. Most responded with seed of new varieties and published materials, for which thanks are due. Numerous detailed varietal descriptions and histories have now been prepared. Much of the material has been typed in final form.

Included in the new classification bulletin will be the necessary keys, tables, individual descriptions, and histories of more than 200 varieties as well as illustrations and literature citations. Writing a manuscript of more than 500 pages is an assignment one does not quickly cope with. This writer no longer wonders why one person has never published more than one oat classification bulletin in either Europe or America in the last 150 years!

Oat Variety Names

L. W. Briggle

Crop variety names must now be cleared with the U. S. Patent Office prior to assignment and general use. We will be glad to do this for anyone considering release of a new variety of oats. Kindly send a letter listing the proposed name(s), well ahead of the planned release date, and we will clear it with the Patent Office. We will also check the new name against our World Collection List, the Oat Classification Bulletin List, the Crop Science Registration List, and the Oat Variety Name Abbreviation List. In this way duplication in use of names should be avoided.

Progress Report on Studies Toward Increased International Standardization in Crop Research Data Recording and Toward a World Plant Germ Plasm Records System [1]

C. F. Konzak

Significant steps toward greater standardization in crop research data recording were made as the result of the successful application of a uniform data recording and processing system by cooperators in the Western Wheat Regional Research program, coordinated by Dr. F. H. McNeal, USDA, Agronomy Department, Montana State University, Bozeman, Montana. Plans are being made to extend the use of the system to other regions and a descriptive manual "A Uniform Data Recording and Processing System for Cereals" has been prepared and is in pre-publication review. In this manual procedures are described and methods defined and illustrated to aid in the recording of comparable research data.

Among the procedures described, for which are methods of recording data on the cereal rust diseases and a standardized approach to recording of data on all other diseases, a measure of agreement on an international scale appears to be in prospect. The principles involved in the standardized recording of disease data are essentially similar to those proposed by W. Q. Loegering as indicated in the 1968 Wheat Newsletter. Improvements in the diagrammatic description of cereal rust infection types and illustrations of other host-parasite interactions should soon be forthcoming.

Systematic management procedures during early generation progeny testing in a plant breeding program are described in a report by C. J. Peterson, USDA Wheat Investigations, Pullman, Washington, proposed for publication in Crop Science. The management methods described would appear to have broad application and offer increased efficiency conducive to standardization.

International coordination of activities related to the exploration, evaluation and conservation of genetic resources, as well as the development of an information center, and provisions for plant material exchange are functions of the Crop Ecology and Genetic Resources Branch at FAO, Rome. This new Branch of FAO was established in July 1968. The Branch Chief is Mr. R. J. Pichel.

A meeting of a part of the FAO/IAEA Working Group on International Standardization in Crop Research Data Recording was held in Vienna during March 1969. At this meeting the title of Genetics Resources Information System, acronym GRIS, was recommended as a designation for the computerized information network being developed. Revised documentary information formats were reviewed and it was recommended that practical experiments be undertaken utilizing available documentation of collections of genetic and breeding stocks.

Studies conducted at Washington State University to aid in this effort have included the transfer of documentary information on the USDA Plant Introduction Service collections of wheats (*Triticum* sp.) and beans (*Phaseolus* sp.). Records on wheats already on the tape were obtained through the cooperation of Dr. J. C. Craddock in charge of the USDA World Collection of Cereals. These records were used to prepare lists of accessions by country of origin. Utilizing these lists as a guide documentary information was transferred to computer cards from the

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1/ College of Agriculture, Washington State University Projects 1980 and 4068. A part of the research described here was supported by funds provided for information retrieval studies on induced mutant stocks under U. S. Atomic Energy Commission Contract AT-(45-1)-353. The research supervised by Dr. Devecioglu was conducted while at Washington State University under an FAO Special Training Fellowship.

published USDA plant inventory. FAO trainee, Dr. Basri Devecioglu, jointly supervised and assisted with the transfer of the records, and he and Mrs. Devecioglu established the approximate location by latitude and longitude of the actual collection sites of wheats from Turkey and Afghanistan that were traceable to the collection site. Records on wheats from several other Near East countries also were transferred to machine readable form. However, the work of correcting and standardizing the records has not yet been completed and additional records are being transferred as the study continues. Some preliminary impressions of the composition of the USDA collection of Turkish wheats are being described in a separate report.

In the case of the Phaseolus collection, the Devecioglu's worked with Mr. L. W. Hudson and Dr. S. M. Dietz to computerize both the documentation on the Turkish beans and the available description records on the USDA Phaseolus collection. The Phaseolus collection was selected for study partly because of its modest size and because of the availability of considerable descriptive information. These records were transferred to machine readable form for studies on the use of the computer to aid in the management of this genetic resource collection. This collection is maintained by the USDA Regional Plant Introduction Station at Pullman. For these studies the TAXIR information retrieval system developed by the Taximetrics group directed by Dr. David Rogers at Colorado State University, Boulder, was obtained. Through a cost-sharing arrangement the program was converted for use on the Washington State University computer by Mr. R. D. Dutton and Miss Mary Massara under the direction of Dr. W. E. Walden, Director of the Washington State University Computing Center. A part of the Phaseolus records and the computer program were ready in time for demonstrations of remote access capability of the system during July and August of 1969. These demonstrations were made at two international meetings--the Second International Barley Genetics Symposium and the FAO/IAEA Symposium on the Nature, Induction and Utilization of Mutations in Plants, both held in Pullman during July--and at two national meetings, the American Horticultural Society held at Pullman and the American Phytopathology Society Meeting held in Spokane, Washington. Queries to the system could be completed in less than one minute, depending on access to the computer.

The information bank on the Phaseolus collection now includes almost 3600 entries on which some 36 descriptive characteristics are recorded. Nearly 2000 additional entries are awaiting evaluation and descriptive data. Tests made so far utilize the information retrieval system for answering questions about the collection, including the compilation of frequency distribution information and for correcting errors in the descriptive and other records. In addition, the information retrieval system was used for instructional exercises in an Agronomy Advanced Plant Breeding course with an enthusiastic response from the students.

Studies on methods of summarizing and classifying data for integration into a typical genetic resources information system are currently in progress. Studies on the use of the estimated map coordinates for the collection sites to show the geographic distribution of sites of collection, by species and by character are also in progress using the computer mapping program. To date, maps have been made of the traceable USDA collections of wheats and Phaseolus from Turkey.

Plans are to make these machine readable records generally available and it is hoped that these studies will contribute to the development of a coordinated system of international, national and local information banks.

Oats in Ethiopia: Report on a Field Trip

G. Ladizinsky and D. Zohary

A collection trip to Ethiopia was undertaken in December 1969. Field data on distribution and ecology of oats in central and northern Ethiopia were gathered. Supplementary data came from examination of agricultural products that are sold in village markets. The information obtained is summed up in the following.

Ecologically, the oats in Ethiopia are confined exclusively to cultivated land and occur in cereal fields either as noxious weeds or as semi-cultivated "tolerated" weeds that grow in mixtures with barley or wheat. In no locality did we find oats outside segetal habitats. All Avena species are more or less confined to elevated basaltic plateaux at altitudes above 2,200 m, i.e., to the typical barley and wheat growing areas in Ethiopia.

1. Avena sterilis: This is a relatively rare species in Ethiopia with a disjunct, scattered distribution. We encountered A. sterilis in several localities in the provinces of Eritrea, Tigre, and Shoa, on heavy basaltic soil and at elevations of 2,200-2,400 m.

2. Avena sativa: We came across no pure fields of cultivated A. sativa. However, this cultivated oat was occasionally found as a contaminant in fields of bread wheat, i.e., among recently introduced wheat varieties.

3. Series Eubarbatae: This is the predominant group of oats in Ethiopia. On a basis of seed dispersal biology three types could be distinguished.

   (i) A completely brittle type: resembling the Mediterranean A. barbata in the general morphology of the spikelet and its mode of disarticulation. This type was encountered in the provinces of Shoa, Tigre, and Eritrea. It grows as a weed among cultivated cereals and shatters its seeds when the panicles are still half-green.

   (ii) A semi-brittle type: This is the most common of all oats in the Ethiopian Plateau. Characteristically only the upper part of the spikelet is brittle and the upper floret disarticulates upon maturation, while the lower floret of most spikelets persists on the dry panicle. The abscission layer at the base of lower florets is apparently poorly developed, so that such florets can be separated from their glumes only by force. We repeatedly watched local farmers harvest and thrash such dry oat panicles with intact lower florets together with the barleys and wheats among which they had matured. We refer to these endemic, semi-brittle forms as A. vaviloviana, although the description of Malzew is based primarily on lemma dentation and not on mode of disarticulation.

   (iii) A non-shattering type: This has a compact panicle and non-shattering spikelets. It is usually referred to as A. abyssinica Hochst. We encountered it in the provinces of Shoa, Gojjam, Begemder, Tigre, and Wolle, mainly in barley fields at altitudes above 2,400 m. Although farmers can eradicate this form successfully by weeding, we were told that this non-brittle oat is regarded as a "tolerated weed." We frequently found it left in barley fields which had been weeded of other pests. We also saw it harvested--together with the barley--and were told that this is the practice, particularly in drier years. A. abyssinica is thus a half-weed half-cultivated cereal in Ethiopia. Its

> ecology and its association with barley culture is very reminiscent of the relationship between Secale cereale and wheat in Turkey. We were also able to confirm our field observation by visits to several rural markets. Local barley sold in these markets was frequently "contaminated" by scattered A. abyssinica spikelets. Furthermore, we were repeatedly told that this is a tolerated (but not appreciated) contaminant.

Semi-brittle and non-shattering Eubarbatae types were frequently encountered together in the same cereal fields. Less frequently all three types grew side by side.

A first check on chromosome numbers performed on several samples of the above mentioned three types of Eubarbatae oats show them all to be tetraploid (2n = 28).

Observations on the Late-Rusting Phenomenon in Red Rustproof Oats

H. H. Luke and W. H. Chapman

Some cultivars of Red Rustproof oats (Avena byzantina C. Koch) exhibit signs of crown rust infection under field conditions two weeks later than other cultivars. They exhibit a lower percentage of infection (maximum of about 40%) than other susceptible cultivars. These characteristics probably explain why certain Red Rustproof types have been grown in the southern USA for more than 100 years. Late rusting and a low percentage of infection result in less damage from crown rust regardless of the race or races involved. Studies were initiated in 1958 to determine why Red Rustproof types exhibit signs of rust infection later than other cultivars, and to incorporate the late-rusting character into agronomically improved cultivars.

Observations revealed a range of maturity dates among different cultivars of Red Rustproof oats. The late maturing cultivars (Red Rustproof, Appler, Nortex, etc.) exhibited the late-rusting character, but the early maturing types did not. Additional observations indicated that late rusting was conditioned by host physiology or by environment.

When late-rusting types were artificially inoculated at different stages of development under greenhouse, growth chamber, and field conditions, all varieties at all stages of growth became heavily infected. When plants in different stages of growth were present in the field during March and April when crown rust occurred naturally, it was observed that plants in the juvenile stage exhibited about the same percentage of infection as plants in the heading phases. These two lines of evidence indicate that physiological changes during the heading phases of development are not an important factor in conditioning the late-rust character.

When late-rusting cultivars were artificially inoculated in a growth chamber at 18, 24, or 30 C, a high degree of infection was obtained. Thus, temperature does not appear to trigger the late-rusting character, or a temperature lower than 18 C is required to trigger the late-rusting character.

In further studies, growth chambers were programmed to simulate the temperatures and day lengths of the climatic weeks of March 8 and April 12. These periods were chosen because late-rusting Red Rustproof types do not exhibit signs of rust infection during early March, but usually become infected by mid April. Under the conditions of March 8, a late-rusting cultivar (Red Rustproof) exhibited a crown rust infection of 20% whereas an early-rusting cultivar (Fulghum) exhibited an infection of 80%. Rust also developed more slowly on Red Rustproof than on Fulghum. Under conditions of April 12, late-, intermediate-, and early-rusting cultivars exhibited an infection of 80%. These, as well as other observations, indicate that environment (temperature, and/or light intensity, and day length) is an important factor in conditioning the late-rust character. Perhaps this tolerance is conditioned by night temperatures that do not exceed 10 C. Nevertheless, observations indicate an intricate interaction between host physiology and environment that retards rust development, and also results in a low percentage of infection.

Under field conditions, the following observations concerning the late rusting or "tolerance" of certain Red Rustproof cultivars to crown rust have been made: (1) They exhibit signs of rust infection about two weeks later than other cultivars; (2) they exhibit a lower percentage of infection (maximum of about 40%) than other cultivars; and (3) they tolerate rust infection - i.e., there appears to be a compatible relation between host and parasite. Thus, Red Rustproof types do not exhibit severe necrosis or desiccation that is common to other cultivars. Our data show that temperature and/or day length are very important in conditioning the low percentage of infection.

In an effort to transfer the late-rusting character to an agronomically improved cultivar, Red Rustproof selections were crossed with Florad and with Indio. Advanced selections from these crosses are now in yield and crown rust trials. There is considerable variation in plant type, strength of straw, kernel type, and other agronomic characteristics. Some have leaf and plant growth habits similar to Red Rustproof cultivars but much stronger straw and improved kernel quality. There was not sufficient crown rust to make readings in 1968 and infection was spotted in 1969. However, rust reaction on some of the selections was similar to that of Red Rustproof with strength of straw and kernel quality much improved.

It appears that lines from RRP x Indio and Florad x RRP combine the late-rusting characteristic of Red Rustproof types with improved straw strength and good kernel type. Percentage of infection on some of these lines were also similar to Red Rustproof under severe rust conditions at Beeville, Texas. Additional observations are necessary to determine if these selections have the Red Rustproof type of crown rust tolerance, or if it is due to a combination of genes from the parents.

Blooming Time of *Avena* Species

I. Nishiyama

The blooming time of flowers in 12 species of *Avena* was recorded in Kyoto from April 20 to June 1, 1969. Plants were grown in pots under outdoor conditions. The time of blooming--spikelets begin to open their lemma and palea--was daily observed every 30 minutes. The results are summarized in the following table.

The 12 species are grouped into four types, afternoon, evening, night and early morning (of the next day) by their blooming times. In the evening and night types, flowers occasionally bloomed as late as early morning of the next day when the temperature dropped rapidly or extraordinarily at their proper flowering time.

From these results it can be stated that the blooming time is closely related to the genome constitution of *Avena* species.

Species		No. of days for observation	Time of Blooming Range	Mean (m ±)
A. pilosa (CW.45)	2x	17	3:00-5:30 pm	4:25 ± 9.74 min.
A. clauda (CW. 4)	"	23	3:00-5:30 "	4:20 ± 9.13
" (CW.16)	"	23	3:00-6:00 "	4:26 ± 10.15
" (CW. 5)	"	23	3:00-5:30 "	4:27 ± 9.16
A. ventricosa (CW.50)	"	15	3:00-5:30 "	4:40 ± 11.89
A. magna	4x	18	3:30-5:30 "	4:12 ± 7.50
A. fatua	6x	14	3:30-5:30 "	4:04 ± 9.02
A. byzantina	"	18	3:00-5:30 "	4:25 ± 8.58
A. sterilis	"	18	3:30-5:30 "	4:20 ± 7.81
A. hirtula (14-1)	2x	30+(2)*	6:00-10:30 pm	7:52 ± 8.48
" (14-2)	"	28+(5)*	6:30-10:30 "	8:42 ± 11.07
A. wiestii	"	31+(4)*	6:30-11:30 "	8:51 ± 12.26
A. strigosa	"	15	5:30- 8:30 "	7:12 ± 12.90
A. barbata	4x	15+(7)*	9:00-12:00 "	10:18 ± 16.69
A. longiglumis	2x	11	4:00- 5:00 am	4:16 ± 5.92

*Exceptional blooming of flowers in the early morning of the next day; omitted from the computation of the mean.

Protein Content of Entries in the Oat World Collection

R. T. Smith

A total of 5,000 oat varieties or lines was analyzed in 1968 for groat protein content (N x 6.25), through the efforts of the late Dr. H. C. Murphy. All, except for checks, were entries in the Oat World Collection maintained by the Crops Research Division, ARS, USDA, Beltsville, Maryland. Interspersed throughout the series were the check varieties Florida 500 and Garland.

Seed analyzed were harvested from an increase plot grown at Aberdeen, Idaho, in 1965, and subsequently stored at Beltsville. Moisture content at time of analysis was not determined, but was assumed to be near 11%.

Entries with protein content of 20% or higher numbered 72. Twenty-two had less than 11.5% protein. Entries in both categories are listed below. Seed are available from Dr. J. C. Craddock, Crops Research Division, Plant Industry Station, Beltsville, Maryland 20705.

High Protein Entries in the Oat World Collection

CI or PI Number	Source	Protein Content
CI 8089	Idaho (Autotet. Saia)	22.4
CI 6596	Florida	22.2
CI 7741	Idaho (Florida sel.)	22.0
CI 7394	Missouri	21.9
CI 8273	Iowa	21.9
CI 7787	USDA	21.8
CI 3675	Florida	21.8
CI 2001	Canada	21.6
PI 197647	France	21.6
PI 197835	Sweden	21.5
PI 183106	Africa	21.5
CI 7340	Georgia	21.5
CI 7108	Wisconsin	21.4
CI 2531	East Africa	21.3
CI 2338	Alaska	21.2
CI 8195	Kentucky	21.2
CI 4120	Australia	21.1
CI 4445	Georgia	21.1
CI 5923	Florida	21.1
CI 6716	Iowa	21.1
CI 7420	Florida	21.1
PI 197703	Germany	21.1
CI 1311	Indiana	20.9
CI 2912	USDA	20.9
CI 3329	Iowa	20.9
CI 7337	Indiana	20.9
CI 7730	Idaho	20.9
CI 7744	Idaho	20.9
PI 174566	France	20.9
PI 197724	Sweden	20.9
CI 1382	Pennsylvania	20.8
CI 1386	Ohio	20.8
CI 1412	Minnesota	20.8
CI 1535	Illinois	20.8
CI 2243	Canada	20.8
CI 4639	Minnesota	20.8
CI 7739	Idaho	20.8
CI 8183	Oklahoma	20.8
CI 8194	Kentucky	20.8
CI 8233	Mississippi	20.8
PI 193027	Scotland	20.8
PI 198222	Argentina	20.8
CI 2832	Ireland	20.6
CI 4744	Wales	20.6
CI 7182	Mississippi	20.6
CI 7743	Idaho	20.6
CI 1788	China	20.5
CI 1928	Washington	20.5
CI 6960	Iowa	20.5
CI 7742	Idaho	20.5
CI 3035	Africa	20.4

CI or PI Number	Source	Protein Content
CI 7676	Illinois	20.4
PI 198223	Argentina	20.4
CI 1507	New York	20.3
CI 5188	India	20.3
CI 6801	Wisconsin	20.3
CI 7685	Illinois	20.3
CI 8204	Kentucky	20.3
PI 198225	Argentina	20.3
CI 1287	Indiana	20.2
CI 2165	France	20.2
CI 2185	Michigan	20.2
CI 3435	Brazil	20.2
CI 4652	Arkansas	20.2
CI 6810	Iowa	20.2
CI 8280	Kentucky	20.2
CI 1891	Missouri	20.1
CI 3448	India	20.1
CI 4137	Canada	20.1
CI 7537	Nebraska	20.1
CI 7697	Idaho	20.1
CI 8231	Mississippi	20.1
CI 4547	Maryland	11.4
CI 5090	Sweden	11.4
CI 5161	Holland	11.4
CI 6834	Iowa	11.4
CI 8006	Massachusetts	11.4
PI 177780	Turkey	11.4
PI 203063	Finland	11.4
PI 258679	Russia	11.4
PI 262209	France	11.4
CI 2137	Russia	11.3
CI 3861	Idaho	11.3
CI 4134	Canada	11.3
CI 4795	Alaska	11.3
PI 197705	Germany	11.3
CI 8283	USDA	11.1
PI 266972	Turkey	11.1
PI 264429	Greece	10.9
PI 185324	Portugal	10.9
PI 185654	Austria	10.9
CI 7222	New York	10.8
PI 252008	Turkey	10.8
PI 264851	Greece	10.3

A Revisitation of the Area in Morocco Where *Avena magna* was first Collected

Frank J. Zillinsky

In the summer of 1969 I had an opportunity to visit Morocco to observe the effects of a very severe epiphytotic of *Septoria* spp. (*tritici* mostly), particularly on the Mexican wheats being used in their new wheat acceleration program.

While I was there I took the opportunity to locate the areas where I originally found the new tetraploid species A. magna and make some observations on the naturally occuring populations. When this was first collected I thought it was just another A. sterilis and only after Dr. H. C. Murphy and I observed the F_1 hybrids in 1966 did we discover that it was not A. sterilis at all. At that time we did not find another A. magna in any of our collections and had no idea how large the natural population was or what variability was present among plants in the population.

Populations of A. magna were found along the road sides and growing as weeds in crops south and west of the Tiflet-Khimisset road scattered throughout the area almost to the town of Romani about 75 kilometers southwest. Although Avena sterilis, A. barbata, was observed throughout most of the areas travelled in western Morocco, north of Marrakech, the only area in which A. magna was observed was in a radius of 40 kilometers from Maaziz (between Tiflet and Romani). Other areas could quite possibly have A. magna populations, since this was a relatively superficial survey of the area involving only five days in a half-ton truck and spending considerably more time on wheat than wild oats species.

Avena longiglumis was common on the sandy soils particularly among Eucalyptis groves. Associations of Avena pilasa, and A. clauda with or without A. barbata, were common at higher elevations along the lower Atlas Mountains from Beni-Mellal to Sefrou.

There appeared to be considerable variability in the A. magna populations. The roadside populations growing in competition with grasses and perennial weeds on dark fertile soil were short and seldom more than 2½ feet in height. Those found as weeds in cultivated crops were usually taller than the crop and plants over 7 feet in height were observed in one field. Plants displaying resistance to the local forms of leaf rust, stem rust, and Septoria were observed.

One of the puzzling things about this species is why is it so restricted in its habitat? The fact that it occurs as a weed in cultivated crops such as durum and bread wheat poses the question of why hasn't it spread throughout more of Morocco and north Africa?

Editor's Note: The above report was extracted, with minimum changes, from a letter to the editor.

III. CONTRIBUTIONS FROM OTHER COUNTRIES

Two New High-Yielding Oats for New South Wales

P. Guerin

Two very promising lines have emerged from a 1957 cross, namely (Fulghum x Garry) x (Victoria-Richland x Algerian x Fulghum) x (Victoria-Richland x Sunrise x Fulghum) . Below is a summary of 1961-1967 trials, carried out in most regions of the state under a wide range of management conditions:

One is an early line, P4315, and intended as a replacement for the popular oat Cooba to which it is 15% superior under heavy grazing, 17% superior under light grazing and 21% under very heavy grazing, in terms of grazing dry matter. It is 36% superior in grain recovery yield after grazing. In straight-out grain trials, P4315 was 21% higher yielding.

The other is a late line, P4319, and intended to replace Klein 69B, the popular coastal grazing oat, at least in the central and southern parts of the coast and in all Tableland areas. It is only 3% better than Klein 69B under heavy grazing but is 7% better for grain recovery after heavy grazing. For light grazing, P4319 is 2% inferior to Klein 69B but 31% superior to Klein 69B in grain recovery after light grazing.

There is not yet enough seed of satisfactory uniformity for release to growers.

Oat Production and Diseases in Canada in 1969

G. Fleischmann, J. W. Martens, and R. I. H. McKenzie

The acreage devoted to oats in 1969 was up by about 5% in the three Prairie Provinces to 5,600,000 acres. Very good yields of 51 bu/acre were obtained in both Saskatchewan and Alberta, while in Manitoba the crop yielded 45 bushels per acre. Total prairie production amounted to 276 million bu, about 11% above 1968. Extremely difficult harvesting conditions were experienced in many areas of Alberta. In eastern portions of Manitoba the oat crop suffered from severe flooding in July followed by extreme heat in August. These combined with losses from crown rust, Septoria and yellow dwarf, reduced yield and quality of the oat crop.

Considerable crown rust damage occurred in late-sown fields of oats in Manitoba in 1969. In excess of 4 million bushels of oats were lost due to this disease. Yield reductions due to oat crown rust in late-sown experimental plots of Eagle and Kelsey oats at Winnipeg were even more severe than estimates of loss in farmers' fields.

Races 264, 295, and 326 comprised nearly 60% of the isolates identified from western Canada. As in previous years, most of the western isolates attacked Landhafer and Santa Fe.

Crown rust resistance gene Pc 39 provided resistance to all 213 western isolates of crown rust to which it was tested, and Pc 38 was attacked by only one of these isolates. Two other collections of _Avena sterilis_ were also found to be highly resistant of oat crown rust.

Oat stem rust infections were very light or absent on most uniform rust nurseries grown across Canada in 1969. Rust was first found in western Canada on July 29. By the end of August very light infections were general in Manitoba and eastern Saskatchewan but there were no crop losses except in the Red River Valley of Manitoba where infections of 30% or more developed in a few late fields.

In western Canada physiologic race C10 (6AF) has almost completely (over 80% in 1969) displaced the previously dominant races C3 (7A) and C5 (6F). In Eastern Canada race C9 (6A) and C8 (4A) continued to predominate. A race not previously described, C23, (avirulent on Pg 2, 4, 9; virulent on Pg 1, 3, 8) was found in Manitoba, Saskatchewan and Ontario. This race may be similar to the old race 7 that was common from 1953 to 1959 but no such isolate has been found in Canada since the present differential set was first used in 1964. About 90% of all isolates identified in Canada were virulent on varieties carrying Pg 2 and Pg 4 resistance. Since these are the only types of resistance present in commercial oat varieties, conditions favoring rust development could result in serious crop losses.

Fodder Oat Improvement Work at Indian Grassland and Fodder Research Institute, Jhansi, U. P., India

K. L. Mehra, Bhag Mal, D. S. Katiyar and U. S. Misra

In India, oats is grown during the winter season for use as a fodder crop. It is cultivated on a large scale in Punjab and Uttar Pradesh and to a limited extent, in some parts of Maharastra, Gujrat, Madhya Pradesh, Orissa, Bihar and West Bengal. It provides a very nutritious fodder (13-15% protein) especially suited to horses and milk animals. The cultivation of fodder oats has gained importance in recent years due to expansion of the dairy industry in the country. In this context, the breeding of widely adapted, high yielding, fertilizer responsive and nutritive varieties deserves special attention. In view of these objectives, the fodder oat improvement program was initiated at this Institute in 1968 and the following work is in progress:

1. Testing of large number of varieties and lines from both indigenous and exotic sources;
2. Selection of the most promising materials based on desirable attributes, viz., plant height, tillering, leafiness, stem thickness, green fodder yield, dry matter and protein content, and low nitrate content;
3. Building up of selection indices based on genetic parameters;
4. Hybridization to incorporate disease resistance and other desirable attributes in otherwise high yielding varieties;
5. Determination of variety x year x location interactions;
6. Classification and grouping of the available material using various devices such as Vector analysis, D^2-statistic, metroglyph, and other numerical taxonomic procedures.

Collection and evaluation of germplasm. Ninety-five cultivars of oats from both indigenous and exotic sources were sown under uniform conditions in Federer's Augmented Incomplete Block design during 1968 at Jhansi (78°E long., 25°N lat. and 275 m alt.), using five released varieties as controls. Data on several plant characters were scored on three randomly selected plants in each cultivar and their averages were calculated. A wide range of variability was observed in all the characters, viz., 50% flowering (89-177 days), plant height (77.3-176.7 cm.), tiller number (14.1-66.0), leaf number (5.1-12.7), leaf length (28.2-59.5 cm.), leaf breadth (1.6-3.0 cm.), stem girth (0.5-1.0 cm.), leaf/stem ratio (0.17-0.39) and green fodder yield per plant (0.438-1.788 kg.).

Analysis of association of characters, using Anderson's metroglyph method, revealed that none of the collections had high values for all the characters studied. The high fodder yielding cultivars in our collection had more than 47 tillers/plant with a medium number of leaves and a medium-to-high leaf/stem ratio. Mostly the cultivars with high values of some characters had low values of other characters. It is felt that the hybridization program aimed at combining suitable attributes in a single strain needs to be attempted. Based on metroglyph analysis data, suitable types have been selected for use as parents in the hybridization program.

Testing of varieties. In a replicated trial, 25 varieties of oats were tested for their yield potential under Jhansi conditions. Although some of the varieties outyielded the control variety 'Kent', none of them was significantly superior in total green fodder yield. However, a few varieties with specific desirable attributes, viz., earliness, leafiness and tillering, etc., were marked for use as parents in the breeding program. During this year, 12 early and 18 medium-late types selected from the germplasm material are being further tested in replicated trials, using Kent and Brunker as controls.

Study of genetic parameters. Genetic parameters, viz., genetic coefficient of variation, heritability, and genetic advance were studied in 25 oat varieties. Heritability estimates of different characters ranged from 61.4 to 98.2% and the genetic advance varied from 13.4 to 45.9. Tiller number, leaf number, and stem girth showed high heritability followed by high genetic advance suggesting a scope for further improvement of these characters.

Correlations between different characters were also worked out. Plant height, stem girth, leaf length, and leaf width were found significantly positively correlated with fodder yield. Tiller number and leaf number were found to be negatively associated with fodder yield.

Internode patterns in oats. Internode patterns were studied in oats by the ideograph technique. Analysis of the lengths of successive internodes revealed that they either showed accelerated growth, retarded growth, uniform growth or a combination of two or more of these phases. Four internode patterns could be recognized in the material studied.

Internode pattern I. There was a progressive increase in the lengths of the successive internodes from the base upwards. Cultivars differed in the rate of increase in the lengths of the successive internodes.

Internode pattern II. Two growth phases, e.g., accelerated and retarded, could be recognized. This differs from pattern I due to the fact that its last internode was longer than the peduncle. In all other patterns, the peduncle was longer than the longest culm internode.

Internode pattern III. In this pattern, three growth phases, e.g., accelerated, retarded and again accelerated, were observed.

Internode pattern IV. Two growth phases, e.g., accelerated and almost uniform could be recognized.

It was noticed that the leaves on the successive internodes showing retarded growth overlapped and heavily shaded each other, while those on the internodes showing uniform growth slightly shaded each other. Leaves borne on the internodes showing accelerated growth had no overlapping or shading effects over each other. The type of internode pattern of a plant has a bearing on its leaf disposition and it could be used as an additional criterion for grouping the material.

Hybridization. A planned hybridization program to introduce desirable characters such as earliness, leafiness, and high tillering has been undertaken. F_1 and F_2 material of a few crosses are being further evaluated.

Oat Research in Japan

T. Kumagai and S. Tabata

Oat acreage in Hokkaido remains in a downward trend. The 31,000 hectars harvested in 1969 was a decrease of 20% below the figure for 1968. The 1969 season was an excellent one for oat growing in Hokkaido, though the period in May and early June was followed by an extended cool period. Grain yield in our nursery was 405 kg/hectare compared with 386 kg/hectare in 1968. The top variety grown still is Zenshin, but the new varieties, Ōtsuku and Honami, continue to increase.

Hybridization of 44 combinations was carried out in the greenhouse for the purpose of introducing excellent lodging resistance genes existing in foreign varieties, such as Flamande Desprez, into our varieties or experimental strains.

The performance test of F_8 selected lines showed that 4 strains had higher yielding ability than Zenshin, a check variety. The experimental lines Honkei No. 281 and No. 284, selected from the cross of (S. 84 x Milford) x Zenshin, had high yielding ability, 6-9% above the yield of Zenshin.

A population of F_3-F_5 was classed on the basis of grain size into three groups and was selected in successive generations. The yield and kernel size of three populations in F_5 were:

	Yield kg/hectare	Wt. g. 1000 Kernels
Small grain group	350	36.1
Medium grain group	373	36.0
Large grain group	401	37.6

The results showed that there was some tendency toward the change in the grain yield as well as grain size through the consecutive selection for grain size.

We have continued a test program for the development of excellent varieties with early maturity. Numerous oat varieties with various germ plasm were included in the test. Below is given the performance of promising varieties.

Variety	Head date July	Date ripe August	Culm height cm	Yield kg/hectare
Golden Clydesdale	3	4	112	468
Columbia	2	6	112	452
Wase Enbaku No. 2	6	6	113	439
Red Algerian	5	9	112	427
Bond	7	6	118	421
Fulghum 14538	11	10	108	417

Oats in Southeastern Yugoslavia

A. Popovic, B. Kostic, and T. Tesic

The oat improvement program at our Institute involves crossing different varieties of winter and spring oats. Since oats are self-fertilized, appropriate breeding methods have been employed. Some winter varieties from the USA were included in the crosses, such as Wintoc CI 3424, Winter Oat, Red Rustproof, etc.

Spring oats are more important because they cover large areas, especially in the mountainous part of Yugoslavia. Some spring oat lines reached high yields under mountain conditions (higher than 1000 m above sea level). The average yield in micro trials under this condition was about 6000 kg/ha.

In Yugoslavia, we grow very successfully some high yielding varieties introduced from the Netherlands, such as Condor, Astor, etc. On Zlatibor experimental field (mountain area in western Serbia) in 1968, they gave a yield of 7000 kg/ha. The variety Astor, with its short straw and good yielding capacity, is especially well adapted for growing under intensive agrotechnique and with the application of high doses of mineral fertilizers.

We brought to an end a program of crossing some cultivated and wild oat forms (Avena sativa x Avena sterilis). The result was the creation of strains with higher shattering resistance.

The collection of different forms of native autochthonous varieties is also in progress.

Work on oats in the Plant Protection Department of the Institute was related to the following points:

- The oat disease and pest survey in the southeastern part of the country,
- The stem rust race identification, and
- Testing of oats varieties to stem rust.

Survey trips were taken in the first half of July 1968 and 1969 to inventory the diseases and pests causing losses in yield and quality.

In 1968, the diseases were caused by: Puccinia graminis avenae, P. coronata avenae, Ustilago levis, U. avenae and Erysiphe graminis avenae.

In 1969 the same pathogens were detected in the inspected regions of the country.

The severity of attack varied from region to region and from plot to plot. In 1968, serious occurrence of covered smut in some plots has warned the growers to apply seed treatment more diligently.

Stem and crown rust attacks varied from trace to 100 (according to Cobb's scale). Luxurious crops and even those bad-looking crops grown in low terrain, and especially on plots not far from river banks, were extremely heavily infected.

Three insect pests found in the two years on oat crops are worth mentioning: Aphid (Rhopalosiphon graminum), Cereal leaf beetle (Oulema melanopa), and Frit fly (Oscinella frit).

The Aphid was very common in western Serbia. Immense colonies of the species have stopped crop growth. Large patches in the crop were easily recognized from a far distance. The plants were stunted, yellow and reddish in color, until finally death occurred.

The cereal leaf beetle was very common too, but the infestation varied from field to field and most exactly from region to region.

The infestation of oats by the Frit fly was investigated in two mutually far distant places. Two hundred ten oat varieties are sown every spring on Zlatibor and Rudnik. At the time of harvest, the samples are collected and the percentage of damaged seeds counted. The results for 1967 and 1968 are shown below:

Location	Frit Fly Infestation %	Year
Zlatibor	0.3-49.4	1967
Zlatibor	2.1-56.6	1968
Rudnik	0.7-56.1	1967
Rudnik	2.1-29.6	1968

During the inspection trip in 1968, the samples of Puccinia graminis avenae were collected and analyzed in the greenhouse. They originated from 17 locations in the southeastern part of the country. The races and isolates belonging to them are given below:

Race	Number of Isolates	Per cent
2	6	14.2
6	23	54.8
6A	3	7.2
7	4	9.6
8	6	14.2

In the seedling stage, 160 oat varieties were tested under greenhouse conditions using races 2, 6, 7, and 8. Thirty-five varieties were susceptible to race 2, 19 to race 6, 41 to race 7, and 39 varieties were susceptible to race 8. The prevailing number was shown to be immune or moderately resistant.

IV. CONTRIBUTIONS FROM THE UNITED STATES

Florida

W. H. Chapman and H. H. Luke

Several selections of oats produced over 100 bu/acre in the 1969 nursery. Florida 500 and Florida 501 continue to produce excellent grain and forage yields in commercial production but were damaged by crown rust in the nurseries at Quincy. Races involved were apparently 326 and 327 and appeared naturally rather late in the season. Because of cooler than average weather, infection was spotted, but excellent differential readings were obtained.

Several breeding lines from crosses involving *A. sterilis*, and Red Rustproof x Indio or Florad were highly resistant to crown rust at Quincy, Florida, and Beeville, Texas. An unexpected source of resistance was from crosses involving a selection (Southland x Minn. 19-11) Silva. The pedigree for Minn. 19-11 is Landhafer x Mindo-Hajira-Joanette. Some of these lines from Florida 500 x (Southland x 19-11) Silva were highly resistant to crown rust with excellent agronomic type and significantly higher yields than Florida 500.

Georgia

D. D. More, R. H. Littrell, A. R. Brown and M. J. Bitzer

The total oat acreage in Georgia in 1969 was 86,000 acres with an average yield of 47 bu/acre and a total production of 4,230,000 bu.

Oats are being tested at 8 locations throughout Georgia. Panicles have been selected from the winter oat bulk composite at three northern locations. Major emphasis is on winter hardiness at Blairsville and Athens. A soil-borne mosaic virus nursery is grown at Experiment and most attention is given to crown rust at Tifton, Georgia.

Two promising oat selections are in the final stages of testing before possible release to growers. A selection from the cross Fairfax x Florida 500 (T-5199), made by Dr. U. R. Gore, shows promise as a superior forage oat for Georgia. This selection has the good forage production and hardiness of Fairfax combined with the disease resistance of Florida 500. Another selection, (T-6161), from the cross Suregrain/LMHJA/2/Coker 57-11/3/Florida 500, has short strong straw and good grain yields. This selection also has reasonably good cold hardiness and forage yields. Earliness and disease resistance will tend to make T-6161 oats adapted to South Georgia conditions.

Idaho

Darrell M. Wesenberg and Ralph M. Hayes

Idaho's oat production was estimated at 5.5 million bu for 1969--a marked increase compared to the previous year and well above the 1962-66 average of 4.7 million bu. The 1969 harvested acreage was estimated at 100,000 acres by the Idaho Crop and Livestock Reporting Service.

The Uniform Northwestern States Oat Nursery averaged 167.6 bu/acre under irrigation at Aberdeen. Kelsey ranked first for yield at Aberdeen, averaging 201.3 bu/acre. CI 2874 (Minn. II-22-220) was first for yield at Twin Falls and Cayuse was first at Tetonia. Entries which averaged 170.0 bu/acre or more in the Aberdeen Uniform Nursery include Cayuse, Kelsey, Markton, Park, Sierra, CI 2874, CI 8304 (Minn. II-54-109), and 63Ab5100-1. The highest average yield in a four-replicate nursery was 215.0 bu/acre for 63Ab5280-7 (CI 5345 x Zanster).

The more promising advanced selections from Aberdeen include 65Ab4547 and 65Ab4602--selections from Park x Russell. 65Ab4547 has been superior to Park in yield, test weight, and lodging resistance although it averages three to four inches taller than Park. In 18 station-years of testing (1968-69) at irrigated stations, 65Ab4547 averaged 123.2 bu/acre and ranked second among 16 entries in the Uniform Northwestern States Oat Nursery. Cayuse averaged 129.5 bu/acre and Park averaged 118.3. 65Ab4547 averaged 3.3 bu/acre more than Cayuse at 15 non-irrigated stations in 1969.

65Ab4602 was entered in the Uniform Northwestern States Oat Nursery in 1969. It ranked first for yield at four locations and second and third overall at eight irrigated and 15 nonirrigated stations, respectively. Cayuse was first for yield at the irrigated stations, averaging 144.7 bu/acre. Fraser was first at the non-irrigated stations in 1969, averaging 95.1 bu/acre.

Indiana

F. L. Patterson, R. M. Caldwell, G. E. Shaner, J. J. Roberts, R. E. Finney, R. D. Barnett, H. W. Ohm (Breeding, Pathology, and Genetics), Kelly Day and O. W. Luetkemeier (Variety Testing), and W. D. Reiss and M. L. Swearingin (Extension).

Diana Distributed. Diana oats, released in 1966 and distributed in germ plasm amounts in the USA was multiplied in 1969 for distribution in Indiana in 1971. About 300 bu of breeders seed were offered to North Central States in February, 1970.

The 1969 Season. The 1969 season was generally favorable for oat production in Indiana. Yields in nursery plots at Lafayette ranged from 106 to 146 bu/acre for 190 entries. State average yields were estimated 59 bu/acre on 334,000 acres.

Cooler than normal May and early June temperatures were unfavorable for rust multiplication and crown and stem rusts developed slowly. Rust tolerance studies in the field were unsuccessful due to slow rust development.

Varieties Certified. Oat varieties certified in 1969 were Clintford, Clintland 64, Jaycee, Newton, Tippecanoe, and Norline (Winter). The average certified in Indiana, was 2800 in 1969, continuing a downward trend.

High Protein from Avena sterilis. Six lines were chosen from the group of about 20 A. sterilis lines distributed by the late H. C. Murphy in 1968. They are CI 8326, CI 8327, CI 8329, CI 8336, CI 8338, and CI 8339. These were intercrossed in a diallel fashion and parents, F_1, and check varieties were grown in replicated hill plots and compared for protein level. The A. sterilis lines ranged from 23 to 28% protein, the F_1's from 23 to 32% (some significantly above parents) and with 16 and 19% for the check varieties Clintford and Diana. It is hoped that this technique may help identify different sources of factors for high protein which may be combined in a breeding program.

Resistance to Cereal Leaf Beetle. Initial breeding work has been with 5 semiwinter lines: CI 4042, CI 4051, CI 4121, CI 4706, and CI 4795. In these lines partial resistance is due to non-preference for oviposition and larval feeding. However, the resistance may be associated with growth habit. Resistance will need to be confirmed in progeny lines with spring habit in comparison to check varieties.

Recently we have observed leaf pubescence in some A. sterilis lines which may be useful for resistance as it has been demonstrated for wheat. CI 8336 and F_2 selections in crosses of Clintford x CI 8336 have pubescence levels at about half that found on resistant wheat CI 8529. Effectiveness of this pubescence for resistance will be tested soon. We are anxious to receive samples of any oats with leaf pubescence. We believe A. sterilis may be an important source.

In wheat in crosses of Arthur x CI 9321 or CI 8529 we have been able to nearly double the pubescence density level of the original pubescent parent by plant selection in various backcross generations.

Kansas

E. G. Heyne and E. D. Hansing

Oat production per acre in 1969 equaled the highest average yield on record, equaling the yield per acre of 38 bushels obtained in 1883. However, the total production is down because of the small acreage, about 160,000 acres, and consequently a total yield of about 6,000,000 bushels. Wet fields in March delayed farm seedings and also reduced the number of acres sown.

Experimental plots were seeded at five locations in eastern Kansas at optimum time and yields up to 90 bu/acre were obtained in northeastern Kansas. Crown rust was prevalent and did some damage in this test, as indicated by the better performance of lines with some crown rust resistance, especially Multiline E68.

The oat breeding activities have been greatly reduced. At the present time only composites of several crosses involving the high protein Avena sterilis types crossed with spring types are being grown at Manhattan. Several winter oat composite crosses are being grown at Hutchinson and Parsons.

A small increase of CI 7698, Improved Garry/5/Landhafer/3/Mindo//Hijara/Joanette/4/Andrew was produced in 1969. This seed will be further increased in 1970.

Methyl mercurial fungicides effectively controlled the oat smuts in 1969 experiments. Systemic fungicides, compared with mercurial fungicides at their recommended rates, have given equal or better control of oat smuts in every year tested: Vitavax 1966 to 1969, and Benlate 1967 to 1969.

Michigan

J. E. Grafius, David H. Smith and A. H. Ellingboe

The Michigan oat picture is much the same as for 1968. We had an excellent crop in spite of local storm damage. Foliar diseases caused very little damage.

We have been interested in optimum shape of the yield parallelepiped and on the basis of three years data we have been able to draw some fairly definite conclusions. These were presented at the Raleigh Conference in January 1970 and an abstract of our findings will be found in this issue of the Oat Newsletter.

No real resistance to cereal leaf beetle has been found in oats. The beetle continues to spread but research in the areas of chemical control, biological control and host resistance will eventually pay off. There are reports by Dr. Fred Patterson of pubescence in one line of oats (resistance in wheat is related to pubescence) and a systemic seed treatment shows some promise of control.

Minnesota

D. D. Stuthman, O. D. Smith and M. B. Moore

The harvested oat acreage in Minnesota for 1969 was nearly 3.5 million acres, largest since 1961. The average yield was estimated to be 56 bu/acre. The recommended varieties for 1970 are Garland, Portal, Sioux, and Lodi. CI 8304 was released as Otter and is described in the New Varieties Section.

The use of VHO fluorescent bulbs as a source of light in the greenhouse was reported in the 1968 Newsletter. Using these lights (16 hours day-length) and temperatures of 60-70 F, approximately 50% seed set was obtained on 2,000 florets emasculated during November and early December of 1969. Pollinations were made by hand transfer of pollen.

Several lines have been selected from the Mexican breeding program for evaluation under Minnesota conditions. Preliminary observations suggest the lines would be valuable germ plasm for short, stiff straw, kernel plumpness, and possibly yield potential. They are, however, susceptible to crown rust in the Buckthorn plot and to race 6AF of stem rust. Seed of these lines are available upon request.

We now have growing at the Obregon, Mexico, station a number of F_2 populations from crosses in which one parent was classified as daylength insensitive. "Insensitive" segregates will be selected and grown in Minnesota in the summer of 1970. Rapida and two selections from F. J. Zillinsky are the "insensitive" parents.

Personnel Notes: O. D. Smith completed the Ph.D. requirements; his research dealt with inter-genotypic competition in hill plots. He is remaining on our staff and is responsible for the exploitation of *A. sterilis* germ plasm. Dr. Bob Romig is now associated with Northrup-King.

Missouri

Dale Sechler, J. M. Poehlman, P. Weerapat, Shu-Ten Tseng and Leo Duclos

Adverse weather conditions persisting from planting to harvest contributed not only to a reduction in oat acreage but relatively low yields. Production in 1969 declined 42% from that of 1968 when the season was quite favorable. Average yields of 37 bu/acre were reported as compared to 45 bu/acre in 1968 and 39 bu/acre in 1967.

Yellow dwarf was observed in many areas of the state causing rather severe injury to susceptible varieties. Crown rust was generally present and stem rust appeared late in the season. Loose smut also was rather abundant in oat fields.

Pettis, which was added to the 1969 recommended variety list, continued to show good resistance to BYDV and yielded well. Lodging problems were accentuated by the cloudy, rainy season. Jaycee led the varieties in most yield tests and appears well adapted to Missouri conditions.

New York

N. F. Jensen

Orbit. Perhaps it is coincidence but the introduction of Orbit has been followed by two years of record state average yields per acre: 1968, 59 bushels and 1969, 56 bushels.

General resistance to crown rust. The second harvest from the special project described in the 1968 Newsletter was taken in 1969. Approximately 15 bushels from the 1969 crop has been reduced through several seed processing procedures to about 3 bushels. This heavy seed will be used to plant the 1970 crop (however, each year we add a small amount of newly-obtained stock to this planting in order to continually broaden the germplasm base for natural selection).

Egdolon. The Cornell Egdolon series oats are the center peg around which our newer oat breeding efforts turn. We think this basic plant type can serve as the prototype for better varieties.

Quality. We are paying more attention to kernel quality and nutritional quality than in previous years. Our processing techniques (a form of mass selection) on bulk populations have given test weights as high as 46 pounds per bu. Nutritional interest centers around higher and better protein content of kernel.

North Dakota

Off-Station Variety Testing is Worthwhile Addition to Research in Southwestern North Dakota

Thomas J. Conlon

One aspect of crops research that has always had an important place in the work at Dickinson is small grain variety testing. This has been expanded in recent years to include an off-station testing program at five locations in southwestern North Dakota.

Off-station testing programs certainly are not something that originated at Dickinson. Some of our neighboring states have had off-station or what sometimes is called out-state testing programs for many years. Even in North Dakota, formal off-station variety trials were first tried by the Williston Branch Station.

The purpose of this presentation is not to claim credit for originating off-station testing, but rather, to point out some of the advantages and benefits derived from its use.

The Dickinson station's off-station sites are located at Beach, Bowman, Hettinger, Killdeer, and Glen Ullin. All of these sites, with the exception of the Killdeer site, are about 60 miles from Dickinson. Killdeer is about 35 miles from Dickinson.

This extends the area covered by our small grain variety testing program immensely, and provides a much wider base for interpretation of yield data as related to the growing conditions in southwestern North Dakota.

Trials on the off-station sites are conducted with the same care and diligence given these at the Station and the data collected has been very satisfactory, as is indicated by the coefficients of variability for the various trials. Farmers living some distance in any direction from the Dickinson station find the combined results of two or more stations located in the general vicinity of their farming operation more palatable than just the results from Dickinson.

Field days are held at each off-station site as well as at the main station. These are arranged for by the County Extension Agents and have been held either in the evening or on Sunday at the off-station sites. Response has been excellent at every location.

Five different soil types are represented at the six locations. These include Vebar, Morton, Regent, Arnegard, and Sen soils. It is very advantageous to have this variety of soil types because there are large acreages of each type in southwestern North Dakota. While the soils at Dickinson represent a large percentage of southwestern North Dakota soils, they are by no means representative of all the soil types being used for crop production in the area.

The off-station trials provide a hedge against loss of all variety yield data to hailstorms or other violent weather conditions. Hailstorms destroyed all crop trials at Dickinson in 1962 and again in 1966. This was before we began off-station work, and no data were available for those years to help provide variety recommendations for this region.

In 1969 the trials at Bowman were destroyed by hail, but the results from all other stations help greatly to minimize this loss.

Small but important local climatic differences are also being measured. This is most noticeable in the work being done with winter wheat. Trials with winter wheat have been conducted at the Station for more than 40 years, but results here were not impressive. Results from these tests were not very meaningful to growers in Golden Valley county and Bowman county where a considerable acreage of winter wheat was being successfully grown. Our winter wheat trials, now being grown at Dickinson, Bowman, and Beach, provide a much improved test and are far more acceptable to the growers in these locations.

The cost of conducting the off-station trials is small. A small lease or rental payment is made to each operator who owns the land where the trials are located. There is practically no increase in either machinery or labor costs. The benefits derived from the program far outweigh the minor expense for travel and effort necessary to get the job done. Present plans are to continue this work, and to improve upon it when the opportunities present themselves.

Oat Variety Trials - Dickinson and Off-Station Sites 1969.

Variety	Yields in bushels per acre						5-Station Average
	Dickinson	Beach	Bowman	Hettinger	Glen Ullin	Kildeer	
Holden	97.2	115.7	Hailed out	82.0	73.8	46.9	83.1
Kelsey	114.5	136.8		111.9	100.1	59.8	104.6
Burnett	106.8	108.2		88.2	75.3	38.4	83.4
Brave	97.0	96.0		81.3	72.7	31.5	75.7
Lodi	111.9	97.3		100.8	86.7	54.4	90.2
Portal	97.5	92.6		83.3	70.2	50.8	78.9
Harmon	101.0	108.9		93.4	81.0	52.3	87.3
Russell	98.6	113.1		104.2	87.7	44.7	89.7
Sioux	109.9	115.0		97.5	89.7	59.7	94.4
Garry	107.3	108.0		90.8	80.0	59.8	89.2
C.V.	6.04	8.56		8.70	6.22	8.26	
L.S.D.@5%	9.1	13.7		11.8	7.4	6.0	

Ohio

Dale A. Ray

1969 Production. After considerable increase in oat acreage and production in 1968, the trend was reversed in 1969 following heavy winter precipitation and poor seeding conditions in early spring. The 560,000 acres of oats harvested in 1969 was a reduction of about 22% below the 1968 acreage but did maintain an increase over the 1967 figure. The state average yield of 58.0 bu/acre was one of the highest yield averages for Ohio but was 8 bu under the record set in 1968. Some extension in area infested and increased damage from the cereal leaf beetle was noted; however, oat diseases again were light and did not appear to have a serious influence on yields.

Oat Varieties. The varieties currently recommended in Ohio are Clintford, Clintland 60, Garland, and Jaycee for grain, and Rodney for forage use. About two-thirds of the 1969 certified seed oats acreage in Ohio was seeded to Clintford and Clintland 60, oat varieties that also lead in popularity for production. The recommended varieties and Orbit continued to be the outstanding varieties for performance in the state-wide oat variety trial grown at eight locations.

Oat Breeding Studies. The selections with most promise in preliminary yield tests are from crosses of Clintland 60 x Rodney 2x Putnam 61. Exhibiting good straw strength, medium-early maturity and good grain yields, these lines will be compared further for decision on multiplication. Interesting data on the availability of high-protein selections from the bulked crosses of *Avena sterilis* x common oat varieties were obtained. Studies also were initiated on the possible association of morphological characteristics with protein and amino acid content. With adverse, open winter conditions, the winter oat nurseries had near complete loss of stands. The few surviving selections in the winter oat breeding nursery will be evaluated further for evidence of winterhardiness.

Oklahoma

L. H. Edwards, E. L. Smith, H. C. Young, Jr., E. A. Wood, Jr., H. Pass, and L. L. Singleton

Production. Oklahoma oat production increased again in 1969. A total of 6.5 million bushels was harvested from 158,000 acres. This compares with 4.5 million bushels from 132,000 acres in 1968 and 3.4 million bushels from 112,000 acres in 1967. Average yield was 41 bu/acre in 1969, an increase of 7 bu/acre over the 1968 average.

Oat Varieties. Checota was released by the Oklahoma Agricultural Experiment Station in 1969. Checota has averaged 15% more in yield than Cimarron in replicated tests. It also outyields other varieties currently grown in Oklahoma. Checota is mid-season in maturity and averages about 31 inches in height. Plants tiller heavily and have large culms with stiff straw. Checota is not as winterhardy as Cimarron.

Cimarron, Forkedeer, and Bronco are planted on most of the oat acreage in Oklahoma. Cimarron occupies by far the greatest acreage. Ora and Nora are becoming popular especially in Eastern Oklahoma. They are susceptible to winterkill almost every year in Western Oklahoma and in some years in Eastern Oklahoma. However, the average performance of Ora and Nora has been good.

Greenbug Resistance. Greenbug resistance from PI 186270 is being transferred to adapted types through a backcross procedure. Also, genetic studies to determine the genetics of greenbug resistance in oats have been initiated.

Pathology. Twenty-two lines or varieties of oats were tested for yield under a moderate epidemic of crown rust at College Station, Texas. Of the top ten varieties in yield seven varieties had over 30% severity of crown rust and three varieties had over 50% severity. The top yielding variety has 20% severity in contrast to varieties yielding less with only 1-15% severity. Since the severity of the epidemic was not as high as expected, there were 23 lines replanted at three locations: College Station, Beeville, and Denton, Texas, in order to increase the probability of obtaining the desired epidemic conditions. This work is being conducted in cooperation with Dr. M. E. McDaniels at College Station, Texas.

Personnel Notes: Dr. H. C. Young, Jr. is presently in Portugal. He is conducting research in cooperation with Professor B d'Olivera to determine the importance of the alternate host influence on wheat leaf rust race composition under natural conditions.

South Carolina

Doyce Graham, B. C. Morton, and G. C. Kingsland

SC 60-C16, CI 8351, was named 'Century' and released for fall planting in 1969. See Century in "New Varieties" section. Century is intended primarily for hay and silage. Considerable use is made of oats for hay and silage by dairy farmers in South Carolina particularly in the Piedmont. Oat clipping trials show oats yield somewhat less than rye over the full season.

Avena sterilis. The *Avena sterilis* elite nursery has germinated very poorly and survival has been low in our soil-borne oat mosaic virus plots for the past two years. A spring planting will be attempted this year.

South Dakota

R. S. Albrechtsen

1969 Season and Production. Seeding of the 1969 oat crop was delayed by a late spring in much of South Dakota. Cool, wet weather in May and June delayed development of the crop in early stages. Warmer temperatures and drier conditions in July resulted in a near-normal crop in most areas.

The South Dakota oat acreage remains steady, with an estimated 2,357,000 acres harvested in 1969. The average yield of 46.5 bushels per acre exceeded that obtained in 1968 and was equal to the 1967 figure. Total production in 1969 was estimated at 109,600,000 bushels, slightly above that of the preceding two years.

Stem rust and crown rust infections became established too late to do severe damage to the crop in most areas. An extremely severe epidemic of barley yellow dwarf occurred in some of the thinly planted breeding nurseries at Brookings; infection in commercial fields was negligible.

New Varieties. CI 8178 was named "Kota" and was released by the South Dakota Agricultural Experiment Station in January, 1969 (Described in the New Varieties section of the 1968 Newsletter). A sizeable acreage of Registered Kota was produced in 1969 with most growers realizing good performance from it as a variety.

Personnel Items. Dr. Rulon Albrechtsen, who has been responsible for oat and flax breeding in South Dakota, has assumed a plant breeding position at Utah State University. His replacement is Dr. Dale L. Reeves, now an instructor at Colorado State University. Dr. Reeves is a native of Kansas and received both his B. S. and M.S. degrees at Kansas State. He received the Ph.D. from Colorado State University in 1969.

Mr. LeRoy A. Spilde is progressing well with his thesis research involving the high protein *Avena sterilis* materials, on an assistantship supported by the Quaker Oats Company. He expects to complete requirements for the M.S. degree in the spring or summer of 1970.

Texas

M. E. McDaniel, F. J. Gough, K. B. Porter, Norris Daniels, K. A. Lahr, J. H. Gardenhire, M. J. Norris, Earl Burnett, and Lucas Reyes

The 1969 Texas Oat Crop was estimated to be 1,937,000 acres seeded and 670,000 acres harvested. Both seeded and harvested acreages were greater than those for the 1968 crop (increases of 19% and 11%, respectively). The average yield of 38 bu/acre for the harvested crop was one of the highest yields ever reported for the state.

South Texas - M.E.M., F.J.G., and L.R. Crown rust continued to be a serious problem in South Texas. At Beeville, nursery plots of Ora, Nora, Moregrain, and Coker 242 were killed by crown rust, which was very severe by mid-February. Coronado, Cortez, Florida 500, and Florida 501 were damaged appreciably. During the past 5 years, crown rust races 326, 325, and 264-B have increased rapidly. No presently available adapted commercial variety has high-level resistance to all components of this race complex.

Mild winter temperatures coupled with frequent heavy dew deposits provide optimum conditions for early development of rust epiphytotics in the Coastal Bend area of South Texas. Seedlings frequently become infected in the fall. Rust persists through the winter and "explodes" when the weather begins to moderate. Race changes occur very rapidly. Recently released varieties (including all those mentioned above) have had high-level specific (hypersensitive) resistance. However, new races historically have rendered the resistance useless after 3-5 years of production. This has occurred since the initation of oat improvement work in Texas, although some resistance genes (especially the Victoria resistance) were effective longer than those in recently released varieties.

We feel that a new approach to the rust problem is required. Since none of the varieties with single-gene specific resistance has "lasted", this type of resistance is not adequate to protect the oat crop from the changing genotypes of the crown rust pathogen. Although tolerance can be important in protecting the oat crop (especially in reducing forage losses from early infection), it does not appear that this mechanism can adequately protect the crop through maturity in South Texas. So-called "tolerant" winter oat cultivars, such as Appler and New Nortex, frequently do not produce much over half the amount of grain as varieties with effective specific resistance. Damage of these varieties by rust also is indicated by extremely poor test weights. It appears that varieties with the "slow rusting" characteristic are eventually overwhelmed by the pathogen--probably due to the extremely long period during which rust can be active in the area.

It also appears that multiline varieties would be subject to much damage in areas similar to South Texas and that the individual genes in the multiline would likely be rendered ineffective in much the same way (possibly even more rapidly) as those in pure-line varieties have in the past. The multiline concept undoubtedly is useful in areas where the period of active rust development is limited and occurs late in the growing season. Thus, a delay in the initial inoculum increase for a relatively short time can minimize rust damage. It seems likely that the effect of this initial retardation of rust development would be negligible in areas having long periods favoring active rust development.

We are planning to "pyramid" or combine previously unused specific genes (primarily from *Avena sterilis*) in pure-line varieties, as proposed by the Canadian workers. Theoretically, resistance of such varieties should be much harder to overcome, since simultaneous mutation at two loci would be necessary to permit successful parasitism. Since South Texas may well constitute a natural "band" as envisioned by Browning, *et al.*, we plan to cooperate with the Iowa and Canadian workers to implement regional deployment of crown rust genes.

Denton - J.H.G. Oat lines with tolerance to the greenbug aphid have been developed. Some greenbug tolerant lines with extremely large seed are being tested. An attempt is being made to combine resistance to the "tiger" greenbug from PI 186270 with the earlier-discovered (and apparently different) resistance of Russian 77 (CI 8298).

Personnel Notes: Dr. I. M. Atkins retired from Texas A&M University after a fruitful career of 40 years as a small grain and flax breeder. He is one of the few breeders who developed improved varieties in four crops--wheat, oats, barley and flax. Dr. Atkins has been given Professor Emeritus status, and is doing consulting work at present. He and Mrs. Atkins will continue to reside at 1215 Marsteller Street, College Station, Texas.

Washington

C. F. Konzak and E. Donaldson

Barley yellow dwarf was significant on oats in Eastern Washington during 1969. Although other activities prevented taking detailed notes on the reaction of varieties in the regional nurseries we were able to visually select for low disease presence among F_2 and F_3 progeny lines of Cayuse/CI 2874.

The effect of BYDV was apparent in the yields of the 1969 oat nurseries at Pullman especially and for the first time in several years Cayuse lost its lead position, though it still outperformed other varieties at outlying locations. Cayuse continues to be the most widely adapted variety among those tested in the area.

Eight winter oat selections obtained via Dr. H. G. Marshall were sown for the first time in eastern Washington to test their hardiness and agronomic characteristics under Northwest conditions.

V. NEW OAT VARIETIES

A. Alphabetical List

Name	CI No.	Origin	Described on page:
Century	8351	South Carolina	74
Checota	-	Oklahoma	71
Mapua 70		New Zealand	75
Nodaway 70	8442	Missouri	75
Otter	8304	Minnesota	75
Selma	-	Sweden	76

B. Descriptions

Century Oats

Century, CI 8351, was initially tested as SC 60-C16 in the Uniform Central Area Oat Nursery. It has outstanding tolerance to soil-borne oat mosaic virus making it ideal for the Piedmont areas where the virus is prevalent. Successful oat growing hinges on using tolerant varieties in such areas. Century is resistant to *Helminthosporium* seedling blight and culm rot; it is susceptible to prevalent races of crown rust. It is tall with strong straw and matures 10 to 14 days later than Bruce oats. The height, leafiness, and later maturity make Century an excellent hay or silage oat. Fall and early spring growth is more prostrate and Century is not as suitable as other varieties in this respect.

Century, tested as SC 60-C16, resulted from the composition of 16 oat lines that were superior for tolerance to soil-borne oat mosaic virus, had strong straw, and were resistant to *Helminthosporium* seedling blight and culm rot. These 16 lines were selected from a strong-strawed, heterogeneous line from the cross, Wintok/2/2*Clinton/Santa Fe///Lee/Victoria//Fulwin/4/2*Clinton/Santa Fe. Seed of the original line was obtained from the late R. L. Thurman, University of Arkansas.

The original cross was made by F. A. Coffman, USDA. All 16 lines were similar in height and maturity. Final selections were harvested from 1962-63 head rows. The individual lines were tested in 1963-64 and the composite made in 1964-65.

Performance of Century and other oat varieties on soil-borne oat mosaic virus infested soil at Clemson, S. C., in 1966-67 and 1967-68.

Variety	Yield (bu/acre)	Height (inches)
Century	55.9	32.8
Bruce	63.6	28.4
Coker 242	34.7	21.9
Nora	27.4	19.5
Carolee	40.1	21.8

Mapua 70

Mapua 70 was obtained as an atypical single-plant selection during the purification of the variety Mapua (Mapua 65: see description in 1966 Oat Newsletter, p. 70) at the Crop Research Division, D.S.I.R., New Zealand. In 19 replicated yield trials over 5 seasons it has averaged 8 bu/acre above Mapua 65. Certified Breeders seed will be released in 1970, and Mapua 65, which by 1968 had become the principal feed grain oat in New Zealand, is withdrawn from certification.

The two varieties are similar in growth habit and appearance, and in virus resistance. Mapua 70 has shorter straw and a thicker grain, but is slightly later in ear emergence and has a thicker husk. It is not so readily dehulled at harvest as Mapua 65, and should be more popular with millers.

Nodaway 70

The Nodaway selection, Mo. 04978 or CI 8442, was increased in 1969 and will be released in 1970 under the name Nodaway 70. Nodaway 70 originated as a panicle selection from Nodaway, CI 7272, derived from the cross (Columbia X Marion) X R.L. 2105. R.L. 2105 involved the parentage Victoria X (Hajira X Banner) X (Victory X Hajira) X Roxton . Nodaway 70, compared to Nodaway, is more uniform in height and maturity, higher in yield, one day earlier, one day shorter, and has heavier test weight. It is resistant to smut, has the AB genes for stem rust resistance and is possibly slightly more tolerant to BYDV than Nodaway but is susceptible to prevalent races of crown rust.

Otter

Otter, CI 8304, is a spring oat selection released by the Minnesota Agricultural Experiment Station in February, 1970. North and South Dakota also participated in the release. It is from a single F_6 plant from the cross Landhafer 3X Mindo 2X Hijara X Joanette $4X^2$ Andrew 5X Rodney. Otter was tested in Minnesota Oat Variety trials for 6 years and was originally identified as II-54-109. It was in the Uniform Midseason Oat Performance Nursery for three years, 1967-69, the Uniform Early Oat Nursery for two years, 1968-69, and in the Uniform Northwestern States Oat Nursery in 1969.

Otter yields very well (1st, 5th, and 6th in the Midseason Nursery for 1967, 1968 and 1969, respectively) and appears to have a large area of adaptation. It is similar to Garland in maturity and height and equal to Lodi in lodging resistance. The test weight of Otter has been inferior to that of Garland. Its groat percentage is better than the test weight would indicate. The seed is white and fluoresces under ultraviolet light. Otter is resistant to smut, has genes A, B, and D for stem rust resistance (but is not resistant to race 6AF) and has a S-MS crown rust reaction in the Minnesota Buckthorn Nursery.

Breeders and Foundation Seed Stocks will be maintained by the Foundation Seed Division of Minnesota Crop Improvement Association.

Weibull's Original Selma Oats

by N. O. Hagberth

Selma (WW 16412) is a new spring oat variety from Weibullsholm Plant Breeding Institute, Landskrona, Sweden. It is a sister line of Nina being derived from the same cross, Palu x Saxo (see Oat Newsletter, Vol. 17, page 71). Selma combines high yield of good quality grain with very stiff straw and a large area of adaptation.

Selma has been tested in trials in Scandinavia, Great Britain and some countries on the European continent. In Sweden, Denmark, the Netherlands, Luxemburg, France, England, and Scotland as a rule it has outyielded all other oat varieties. In all these countries it is entered on their recommended lists or corresponding registers.

Selma is a very stiff and rather short strawed oat of average maturity. It has good quality of grain. Test weight and kernel content is high and 1000-grain weight moderately high. Hull color is white.

Selma has no race-specific resistance to diseases and pests.

From the cross Palu x Saxo we have obtained further two varieties, Ponta (WW 16509) and Weikus (WW 16511). Both are high yielding and very stiff and short strawed. Weikus will be marketed in Austria in 1971.

VI. GERM PLASM MAINTENANCE

USDA Small Grains Collection

J. C. Craddock

The assigning of Cereal Investigations (C.I.) numbers to oat selections is the responsibility of the Small Grains Collection personnel. I urge you to review your breeding materials and to request C.I. numbers for outstanding lines so that they can be made available to other scientists. In order to assign a C.I. number the developer must submit a seed sample (up to 200 grams) to be added to the collection and a statement declaring the variety 'open stock.' This statement is required as all varieties in the USDA Oat Collection are distributed without restrictions for experimental use. To keep a complete record of your selection, the pedigree and description are also needed.

Approximately 5000 oat entries from the collection will be grown at Aberdeen, Idaho in 1970. These will be principally the old varieties up to C.I. 7000. The remainder of the collection will be grown in 1971. Oat workers are welcome to visit the nursery. This is an excellent way to observe the oat collection without having to grow it. Please remember that your excess seed from F_1 and F_2 plants is needed for the Oat Gene Bank. In 1969 there were no contributions to this bank. In order to continue this program your cooperation is requested. During 1969, C.I. numbers were assigned to 26 oat varieties that were developed in the United States. These entries are listed.

C.I. NUMBERS ASSIGNED IN 1969

C.I. Number	Name or Designation	Pedigree	Source
8419	MONTEZUMA	Selected from Composite Cross II	California
8420	YANCEY	Carolee x Fulgrain	N. Carolina
8421	CORTEZ	(Santa Fe x^2 Clinton 3x Sac 2x Hajira x Joanette) 4x New Nortex x Landhafer 5x (Black Mesdag x AB 101 (?))	Texas
8422	63C6875	(Fulwin-Lee-Victoria-Red Rustproof-Victoria Richland) x Bond-Rainbow-Hajira-Joanette x Landhafer	Texas
8423	62C955	Clintland x PI 174544 2x Suregrain	Texas
8424	OIR 113-116	Red Rustproof x Indio	Florida
8425	AB 113	Florida 500 x 61AB544	Florida
8426	OIR 125-28	Florida 500 x 61AB544	Florida
8427	AB 104	Florida 500 x Avena sterilis (PI 296266)	Florida
8428	AB 596	61AB544 x Coker C61-24	Florida
8429	66AB599	Red Rustproof x Indio	Florida
8430	2912-15	Red Rustproof x Indio	Florida
8431	67AB112	Florida 500 x 61AB544	Florida
8432	2764-67	X63-16, 61AB544 x Coker 61-24	Florida
8433	Egdolon 23	Alamo 5x Garry Sel. 5 4x Goldwin 3x Victoria 2x Rainbow x PI 193027	New York
8434	Egdolon 26	Alamo 5x Garry Sel. 5 4x Goldwin 3x Victoria 2x Rainbow x PI 193027	New York
8435	LANE	Grey Winter x Letoria	Oregon
8436	56-252	Grey Winter x Letoria	Oregon
8437	59-1571	Grey Winter x Milford	Oregon
8438	59-1861-2	Grey Winter x Milford	Oregon
8439	59-1861-3	Grey Winter x Milford	Oregon
8440	59-1861-10	Grey Winter x Milford	Oregon
8441	59-1861-15	Grey Winter x Milford	Oregon
8442	NODAWAY 70	Selection from Nodaway	Missouri
8443	ELAN	Suregrain x LMHJA 2x Coker 57-11 3x Florida 500	Georgia
8444	FROKER	Jaipur 3x Beacon 2x Hawkeye x Victoria 4x Clintland 3x Garry 2x Hawkeye x Victoria	Wisconsin

VII. EQUIPMENT AND TECHNIQUES

A Two-Wheeled Tractor of Unique Design

Donald Cameron

A small two-wheeled tractor has been developed at the Scottish Plant Breeding Station from the marriage of a Howard 700 rotovator engine and gear box to the front axle and steering of a Land Rover. This tractor, when ridgedly coupled to any two-wheeled agricultural implement or to a roller, which is provided with a standard 3-pin tractor linkage, converts such an implement into a self-propelled machine driven and steered by its front wheels. Articulation is provided around the central longitudinal axis of the machine to avoid strain to the frame on uneven ground.

Trimming and Spraying Experimental Plots

Doyce Graham, Jr., B. C. Morton, and G. C. Kingsland

As described in the 1968 Oat Newsletter, our yield plots are planted with a tractor-mounted seeder. Plots are overplanted in length and then trimmed back to harvest length. On the same Allis Chalmers G tractor, discs were mounted on a rectangular frame such that by driving down the alley perpendicular to plot rows, row ends are trimmed to the proper length. A sprayer is also mounted on the same rig and two operations can be done at once.

Production of Teliospores for Studies on Rust Genetics

A. Dinoor

Studies on rust genetics should be carried out with single spore cultures maintained and propagated as pure cultures under isolation. The production of teliospores by such cultures poses problems of keeping the cultures pure and producing teliospores as quickly as possible.

Propagation and maintenance of active rust cultures was adopted from Agr. J. Anikster working with barley leaf rusts. Oat seedlings are grown under glass chimneys covered with filter paper. Seedlings are inoculated and kept in these chimneys for about 10 days. When rust pustules burst, the leaves are excised and arranged in a glass petri plate on a filter paper sitting on a thin layer of cotton-wool soaked in 200 ppm benzimidazole. This procedure provides a fresh, handy, and pure inoculum.

For the production of teliospores, the excised leaves (in petri plates as above) are kept in controlled environment under a long-day regime, namely: 16 hr days at 26-28 C and 8 hr nights at 16 C. Teliospores are formed within 10 days, which means 3 weeks after inoculation. Kept on benzimidazole, the oat leaves are still green after 3 weeks when teliospores are harvested and this facilitates the germination of teliospores by alternate wetting and drying.

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