12
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64
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1979

OAT NEWSLETTER

Vol. 30

May 1980

Sponsored by the National Oat Conference

1979

OAT NEWSLETTER

Volume 30

Edited in the Department of Plant Pathology, Iowa State University, Ames, Iowa 50011. Costs of preparation financed by the Quaker Oats Company, Chicago, Illinois 60654.

May 1980

Sponsored by the National Oat Conference

Marr D. Simons, Editor

CONTENTS

PAGE

PAGE

J. E. Grafius
In Memory

John E. Grafius was born June 8, 1916 in Rochester, New York. He received his B.S. degree from Michigan State University and his M.S. and Ph.D. degrees from Iowa State University. After receiving the Ph.D. in 1942, he joined the staff at South Dakota State University, then moved to Michigan State University in 1953, where he served as Professor of Farm Crops until his retirement. He died January 19, 1980 after a short illness.

Dr. Grafius was a leader in research on small grains and in the development of improved small grain varieties. His oat varieties include James, a hulless type, Coachman, Menominee, Au Sable, Mariner, Korwood, and Mackinaw. He developed varieties of barley, winter wheat, and rye as well.

Dr. Grafius authored more than 60 technical articles in plant breeding and related subjects, and is perhaps best known for his monograph entitled "A Geometry of Plant Breeding" which describes his philosophy and strategy of plant breeding. He was instrumental in applying mathematics to many breeding problems. Also, he made significant contributions in development of plot equipment, namely a mechanical plot seeder and a self-propelled plot combine.

He was an excellent teacher, teaching both statistics and advanced plant breeding. During his career he advised a number of graduate students, both domestic and international.

He is a past Crop Science Achievement Award winner, a Guggenheim fellow and a Fellow in ASA. He was given the Award for Distinguished Service to Oat Improvement in 1978, and was given a Distinguished Faculty Award at Michigan State University just before his death. He is a member of Phi Kappa Phi, Sigma Xi, Alpha Zeta and the American Society of Agronomy and Crop Science Society of America. He has been active in university activities including service on the Academic Council of Michigan State University.

I. NOTES

NEWSLETTER ANNOUNCEMENTS AND INSTRUCTIONS

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

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

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

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

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

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

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

Marr D. Simons
Dept. Plant Pathology, ISU
Ames, Iowa 50011, USA

<u>Please Do Not Cite The Oat Newsletter In Published Bibliographies</u>

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

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

AMERICAN OAT WORKERS' CONFERENCE COMMITTEE, 1978-81

Executive Committee

R. A. Forsberg, Chairman
*C. F. Murphy, Past-chairman
*H. G. Marshall, Secretary
*M. D. Simons, Editor, Oat Newsletter

Representatives

M. Sorrels, Northeast Region, USA
H. W. Ohm, Central Region, USA
H. Harrison, Southern Region, USA
D. M. Wesenberg, Western Region, USA
H. G. Marshall, U. S. Department of Agriculture
H. T. Allen, Canada Department of Agriculture
V. D. Burrows, Eastern Canada
R.I.H. McKenzie, Western Canada
M. Navarro-Franco, Mexico
D. Schrickel, Representative at large
C. M. Brown, Representative at large
M. E. McDaniel, Representative at large

* Non-voting member unless also a representative

Minutes of National Oat Improvement Council Meeting
Madison, Wisc., Feb. 24, 1980

The meeting was called to order by Chairman R. A. Forsberg at 2:00 p.m.

As the first order of business Dr. D. M. Peterson reported on the status of the vacant Cereal Chemist position at the National Oat Quality Laboratory. Recruitment is underway but there is a shortage of candidates trained in cereal chemistry. Forsberg noted that the group and oat workers will want to write letters of gratitude to congressmen and other individuals who applied pressure to have the position refilled as soon as an appointment is finalized.

D. Wesenberg reported on the work of the GRIP Oat Technical Advisory Committee. He said that most comments were favorable on the list of descriptors that was circulated to oat workers. Most comments expressed concern about inadequacy of funding to evaluate the oat collection. A discussion of funding followed. Briggle reported that a 1980 budget item of $500,000 was submitted for the small grains germplasm collection but this was lost. The 1981 proposal was for $650,000. The total for all germplasm was about $2,000,000. However, the present amount is $400,000 and small grains may not get any. The 1982 budget request for small grains germplasm will be $750,000. Briggle feels administrative awareness and sympathy has improved and is optimistic about future funding. M. Tomes stated that some Regional Research Fund money might be earmarked for germplasm work for wheat and corn.

There was a discussion about who should receive a copy of the report by the GRIP Oat Technical Advisory Committee. Briggle indicated that copies should go to the Germplasm Resources Board (Dr. Bertrand is co-chairman), to the Germplasm Resources Committee (Dr. Foote is chairman), and to Mr. Edminister.

Discussion followed relative to the need for a resolution to support the above report and the $750,000 budget proposal for 1982. Stuthman, Briggle, and Wesenberg were designated to draft an appropriate resolution to be presented at the business meeting of the NCR-15 group on February 26.

Forsberg reported that a Title XII pre-proposal for improving oat germplasm in developing countries had been submitted to BIFAD in late 1977. Several universities and four USDA stations are involved. Forsberg named the Title XII projects approved so far. Frey reported that small grains proposals are not in the top priority group. Forsberg suggested that the NOIC might lobby for support of these proposals during the upcoming Washington visitations.

D. Schrickel reported on past Washington visits. Although requested funding increases have not materialized, he believes the visits have increased awareness of oat research needs and may have laid foundations for future support. For the March 1980 visitation, the committee will attempt to expand visits to include OMB and Under Secretary Williams to discuss oat research needs and research needs in agriculture in general. Frey stressed the importance of meeting with key staff people of appropriate congressmen. Stuthman suggested that NOIC members should visit their respective congressmen while in Washington. Tomes suggested that a few oat growers should be included in the Washington lobbying efforts.

Forsberg cited recent oat germplasm collection expeditions and indicated that Dr. George White is in charge of present efforts to make collection expeditions.

Frey reported for the International Oat Conference Study Committee. He reviewed results of a poll regarding the need for an international conference. Forty-three out of 55 returns were in favor of having such a meeting every 4 to 5 years. Most were in favor of holding the meeting in conjunction with other crops (e.g. barley or wheat or both). There was discussion regarding the possibility of making the next American Oat Workers' Conference an "experimental" International OWC. Marshall stated that if this is to be done, work must start soon to allow adequate time for potential participants to pursue authorization and funding to attend.

Forsberg discussed the Creech questionnaire regarding seed regulatory agencies and laws. He suggested that oat workers should have more input into the forms used for plant variety protection purposes.

Forsberg also expressed concern that no plant breeders participated in a recent major symposium in St. Louis on integrated pest management.

Forsberg indicated that formalization of the NOIC is needed. The present Committee is appointed. The group decided that the Executive Committee of the American Oat Workers' Conference should present a suggested system for constituting this committee. Marshall stated that the adopted system should become part of the AOWC charter.

The meeting was adjourned at approximately 4:50 p.m.

Respectfully submitted,

Harold G. Marshall, Secretary.

Minutes of Business Meeting of NCR-15
Oat Workers' Conference

University of Wisconsin
February 25-26, 1980

R. A. Forsberg, Chairman NCR-15, called the meeting to order (see attached program for NCR-15 conference).

Administrative Advisor Dr. Mark Tomes reported that NCR-15's official "charter" was nearing the end of the appointment period. It was moved that the Chairman of NCR-15 submit a Statement of Purpose to Dr. Tomes who in turn should take the steps necessary to formalize approval of NCR-15 as an active Committee for the next three years. Seconded and passed.

Howard Rines discussed the uniform early- and midseason oat performance nurseries. Copies of the completed 1979 early- and midseason nursery reports were distributed. Data processing for the uniform nurseries is now highly computerized and the system is working very smoothly. Subset data analyses are available for any cooperator interested.

F. L. Patterson moved that Lang be replaced with Ill. 73-2664 as a check entry in the UMOPN beginning with the 1980 season. Seconded. Carried. D. D. Stuthman suggested additional checks be included at certain locations for specific reasons.

Don Schrickel suggested that we need to enumerate the value of oats and then inform others. He also expressed concern over how average state oat yields are estimated. Chairman Forsberg suggested we find out how oat acreage and yield estimates are made in the various states. He also requested Don Schrickel to survey the methods of data collection. If problems appear to exist, we should work with proper individuals in our respective states to develop reliable production and cost/return estimates for oats.

The NCR-15 oat workers voiced unanimous support for the following resolution:

> Be it resolved that the National Oat Improvement Council and the NCR-15 Technical Committee strongly support the proposal for increased funding for evaluation of the small grains world germplasm collection, and urge the inclusion of such funds in the 1982 USDA SEA-AR budget.
>
> Be it further resolved that the National Oat Improvement Council and the NCR-15 Technical Committee strongly endorse in principle the report prepared by the Improved Utilization of Oat Germplasm Committee of the American Oat Workers' Conference. This report describes procedures for evaluation of the oat portion of the small grains world germplasm collection.

Dave Smith reported that a John E. Grafius memorial fund has been established. Contributions may be sent to Dr. Harpstead, Head, Department of Crop and Soil Sciences, Michigan State University, East Lansing, Michigan 48823. Marr Simons moved that we dedicate the 1979 Oat Newsletter to Dr. J. E. Grafius.

Seconded. Carried unanimously. The oat workers as a group expressed appreciation to the Quaker Oats Company for financial support for the Oat Newsletter.

Darrell Wesenberg reported that nearly all oat workers supported the report of the GRIP committee. If anyone has additional suggestions, see Drs. Wesenberg or Shaner.

Dr. Ken Frey reported results of the survey sent out by the International Oat Conference Committee to American and international oat workers. The majority of returns indicated that an international conference should be organized, that a conference should be organized every 4 or 5 years, that these should be held concurrently with other commodity groups, and that the meeting place should alternate between Europe and North America. Dr. Frey was asked to look into possibilities of organizing the 1982 American Oat Workers' Conference at Pennsylvania into an American and International Workshop.

D. D. Stuthman invited the NC oat workers to see the Minnesota oat breeding program sometime during mid-June to mid-July. More details will be forthcoming.

Plant Variety Protection, with Title V, has been applied for on the cultivars Moore and Benson (MN).

Dr. Rothman noted the occurrence of *H. victoriae* on certain oat lines in 1979.

C. M. Brown indicated that two oat lines from the Illinois program, 73-2664 and 73-2186, are being increased for release and seed is being shared with interested states.

K. J. Frey indicated a Lang-type multiline will be in the uniform nursery in 1980. He also has found that substitution of the *A. sativa* nucleus in *A. sterilis* cytoplasm results in 3 to 20% (7% average) heterosis.

F. L. Patterson indicated that P70408E1-3-25-2 is being increased for release.

R. A. Forsberg stated that Marathon will be available to commercial growers in 1980. The loose smut 'crisis' of 1976 and 1977 seems to have subsided.

A unanimous ballot was cast for Dr. Greg Shaner, Chairman, NCR-15 and for Dr. Mike McMullen, Secretary, NCR-15.

The NCR-15 oat workers expressed appreciation to all those responsible for the program, arrangements, and facilities for a very fine conference.

Appreciation was also expressed to all speakers, panel chairmen, and panel members for excellent presentations. It was a very productive conference!

Respectfully submitted,

H. W. Ohm
Secretary, NCR-15

Note of Appreciation

P.O. Box 559
Seabrook, MD 20801
April 8, 1980

Dear Oat Workers:

I want to take this opportunity to thank you, the Oat Workers, for your gifts --the surf casting fishing rod, spinning reel, and sheath knife. These are sincerely appreciated. As a matter of fact, I was just about to purchase a new rod and reel when your gifts arrived, but now only have to wait till the water warms up.

I do not know how to tell you what your thoughtfulness means to me. I am grateful for the time we worked together and all the support you gave the Oat Collection.

It is indeed gratifying to know I have made lifelong friends. To each of you my very best regards.

Gratefully yours,

Joseph C. Craddock

II. NORTH CENTRAL OAT WORKERS CONFERENCE

PARTICIPANTS IN NCR-15 OAT WORKERS' CONFERENCE,
University of Wisconsin
February 25-26, 1980

Arny, Deane
Briggle, L. W.
Brinkman, Marshall
Brown, C. M.
Brown, Douglas
Browning, J. A.
Burnett, Peter
Burrows, Vernon
Donhowe, Erik
Duerst, Ron
Fisher, Hal
Forsberg, Robert
Frank, Jim
Frey, Kenneth
Gould, Jack
Hall, Lon
Halstead, Richard
Hurt, David
Jedlinski, Henry
Jose, Alvin
Karow, Russ
Laskar, Bill
Lesar, Lucia
Luby, Jim
Luk, George
McDaniel, M. E.
McMullen, Mike
Marshall, Harold
Meyer, Dwaine
Michel, Leonard J.
Miller, Jan
Moore, Matt
Moser, Frank
Murphy, C. F.
Nielson, Bob
Ohm, Herb
Patterson, Fred
Peterson, Dave
Radtke, Jim
Rasmussen, Ole
Ray, Dale
Rho, Yeong
Rines, Howard
Rothman, Paul
Schmidt, John
Schrickel, Don
Sechler, Dale
Shands, Hazel
Shaner, Gregory
Simons, Marr
Skrdla, Ron
Smith, David H.
Stuthman, D. D.
Thro, Ann Marie
Tomes, Mark
Trommer, Dale
VanHorn, Mark
Wesenberg, Darrell
Wych, Bob
Youngs, Vern

ABSTRACTS OF PRESENTATIONS AT NORTH CENTRAL OAT WORKERS CONFERENCE

Realized Correlated Responses and Their Implication for Recurrent Selection

J. A. Radtke and D. D. Stuthman
University of Minnesota

Recurrent selection offers an opportunity to evaluate and utilize variability for multigenic traits such as yield in oats. At Minnesota, a recurrent F_6 selection program for yield alone is now about to enter it's third cycle after being initiated with crosses between high yielding, adapted parents in 1968. Yield improvement has been encouraging. A comparison between the original parents (C0) and the C1 progeny showed a 12.6% yield increase for the first cycle. Lines that were visually selected for kernel plumpness from the second cycle progeny increase rows did well in our 1979 preliminary yield trials. Twelve lines exceeded Benson, the highest yielding check variety, the best line being 15% higher yielding.

When selecting for yield alone, unselected traits showed correlated responses which are undesireable. Two such traits are heading date and height which increased an average of 2.2 days and 5.6 cm respectively, per cycle. To control these correlated responses three methods, a base index, regression adjustment, and truncation selection within populations, will be evaluated. A parallel recurrent selection scheme which controls the height and maturity of the selected parents will subsequently be initiated. Lines derived from the parallel scheme will be compared to those from the ongoing original scheme in regards to the quality and yield to determine if the gain per cycle has changed.

Finally, future plans will include opening up the recurrent selection program to incorporation of new germplasm. This is essential if recurrent selection is to be a basic part of a breeding program so that favorable alleles, absent in the original parents, may be added to the system over time. If acceptable methods to add new germplasm and control undesired correlated trait shifts can be found, recurrent selection may play a valuable part in future breeding of oats.

Effect of Nitrogen on Grain Yield and Growth Characteristics of Three Oat Varieties

Yeong Deok Rho and Marshall A. Brinkman
University of Wisconsin

Three oat varieties, Stout, Marathon and Lodi, were tested at 5 nitrogen levels, ranging from 0 to 112 kg/ha, at Madison and Arlington, Wisconsin, in 1979.

The grain yield response to nitrogen differed between the two locations due to differences in soil fertility and rainfall during the oat growing season. Stout, a short, early, high tillering variety, appeared to be less adaptable to stress, but it responded well to nitrogen and outyielded the two taller, later varieties in high fertility. Stout had thicker leaves and was high in leaf weight ratio and harvest index. Although it had less vegetative growth, it accumulated more dry matter during the ripening period, especially in high fertility.

The relationships between grain yield and other plant characteristics, measured in all N levels, are shown in Table 1. Among the yield components, number of kernels per panicle was highly correlated with grain yield at both locations. Total dry matter accumulated until maturity was strongly correlated with the grain yield, but vegetative growth (dry matter accumulated until heading or LAI at heading) was not. This implies that plants producing large amounts of photosynthetic tissue at heading may not necessarily produce high grain yields at maturity. However, dry matter accumulated from heading to maturity was highly correlated with grain yield. Results combined over both locations showed that the optimum LAI for the three varieties was approximately 5.

Table 1. Partial correlation coefficients between grain yield and other plant characteristics

	Grain Yield	
	Madison	Arlington
Dry Wt. at Heading (H)	0.177	0.168
Dry Wt. at Maturity (M)	0.902**	0.839**
Dry Wt. (M-H)	0.637**	0.668**
LAI	0.079	0.241
Harvest Index	0.310	0.415*
Panicles per Unit Area	0.113	0.181
Kernels per Panicle	0.708**	0.384*
100 kernel wt.	-0.244	0.314

* - significant at the 5% level.
** - significant at the 1% level.

"Phenotypic plasticity of biological and grain yield in wild (*A. sterilis*) and cultivated (*A. sativa*) oats"

(A. M. Thro and K. J. Frey, Iowa State University)

The wild oat species *A. sterilis* has contributed genes for disease resistance, high groat protein, and oil percentage and grain yield to *A. sativa* breeding programs. Because of the unpredictability of future climatic patterns and agricultural environments, we explored the possibility that *A. sterilis* may be a source of genes for agriculturally useful types of phenotypic plasticity for oat production.

Fourteen accessions of *A. sterilis* from six countries and seven *A. sativa* cultivars were evaluated for phenotypic plasticity in test environments which had varying sowing dates and levels of available nitrogen. Because recent Iowa studies implicate increase in biological yield as one cause of increased grain yield, both biological and grain yield were measured.

Positive phenotypic plasticity of biological yield was found to be associated with positive phenotypic plasticity of seed yield, indicating that harvest index did not change substantially in most entries. All variation for biological yield was found among *A. sterilis* entries. Three *A. sterilis* entries were identified which had high biological yield, greater stability than *A. sativa* entries for biological yield and seed yield over planting dates, and equal or greater response to nitrogen. Using such *A. sterilis* types, it should be possible to select introgression lines with high biological yields, stable biological yield toward uncontrollable environmental variation, and stable harvest index as fertility is improved. If the optimum harvest index of *A. sativa* parents can be recovered, these lines should have high grain yield.

GROWTH OF EXCISED OAT PANICLES IN LIQUID CULTURE

Lucia Lesar and David M. Peterson
SEA-AR, USDA, University of Wisconsin

Excised oat panicles (8 days after heading) were grown in liquid culture for 6, 9, and 12 days. The medium contained 2% sucrose, nutrients, vitamins, and different nitrogen sources at various levels. Some panicles were left intact so comparisons could be made between the groats from cultured panicles and the groats from intact panicles. Groat development in terms of dry weight was not significantly different between intact panicles or panicles cultured in media containing levels of nitrogen ranging from 0 to 0.15% as a complete mix of amino acid or 0 to 0.075% nitrogen as glutamine or as ammonium nitrate. Percent nitrogen of the groats increased with increasing levels supplied through the media; the differences were highly significant. Groat composition in terms of soluble amino-N, nitrate and total amino acid balance was similar across all treatments. The percent protein was higher in the groats from the panicles cultured on the highest levels of nitrogen supplied through the media. Differences among treatments were also found in terms of the percent protein laid down in the embryo and scutellum, endosperm and bran.

Potential For Oat Improvement Using Wild Oats

J. M. Reich, T. M. Luk, and M. A. Brinkman
University of Wisconsin

A program was initiated in 1975 at the University of Wisconsin to study the inheritance of protein, seed yield and its components, straw yield, and agronomic traits in crosses between *Avena sativa* L. and *Avena fatua* L. The program was also set forth to evaluate ten *A.fatua* collections with respect to their genetic potential in crosses with several *A.sativa* cultivars.

Twenty-one F_1 crosses and their 21 respective F_2 populations representing a 7x3 mating of 7 *A.sativa* varieties (as females) and 3 *A.fatua* collections (as males) were evaluated in Madison in 1979 as part of a larger program involving fifty-five crosses.

Preliminary results showed hybrid vigor above the high parent for seed yield, panicles per plant, and straw yield in 15 out of 21, 18 out of 21, and 21 out of 21 crosses, respectively. Heterosis expressed as a percentage of the high parent ranged from 105-165% for seed yield, 105-215% for panicles per plant, and 115-250% for straw yield.

The presence of transgressive segregation for these traits in some populations indicates that progress from selection could be made in those populations, provided that narrow-sense heritability is sufficiently large. One important limitation on the utility of *A.fatua* in oat improvement is its susceptibility to crown rust.

Grain and Straw Protein Percentage and Fibrous Constituents of Oat Straws as Influenced by Genotype

D. W. Meyer and M. S. McMullen
North Dakota State University

Grain and straw protein percentages were determined on 58, 48, and 53 entries of the Mid-season Regional Oat Nursery and variety trials in 1976, 1977, and 1978, respectively, to determine the relationships between grain and straw protein percentages among various genotypes. Groat and straw protein percentages averaged 18.1 and 8.4%, respectively, for 28 genotypes. OA-338 had the highest straw protein percentage at 10.1 while Spear was lowest with 7.3. Groat protein percentage was highest in Otee (20.8) and lowest in OA-338 (15.7). Genotypes were ranked for grain and straw protein percentage by the number of entries and on a unit of protein. Several genotypes were found that ranked high-high, low-low, high-low, and low-high for groat-straw protein percentage in each year and in the three-year average. Total plant protein in 1976 did not necessarily follow the groat-straw protein rankings, however. Kelsey, which ranked low-low, was 5th in total plant protein/acre out of 25 cultivars. Wright, which ranked high-low, and Dal, which ranked high-medium, also were high in total plant protein.

Forage quality (ADF, CWC, IVDMD, ADL, hemicellulose, ash, protein and P) was determined on the same experimental material to determine if the straw quality was affected by the genotype. Genotypic differences were found for all characters in all years except hemicellulose in 1976. Genotypic differences among the 28 genotypes common in the 3 years for protein, ADF, CWC, hemicellulose, and ash characters were found. However, genotype x environment interactions were significant for all quality characters except hemicellulose and P.

RECENT DEVELOPMENTS IN PATTERNS OF CROWN RUST VIRULENCE

L. J. Michel and M. D. Simons
SEA-AR, USDA and Iowa State University

Crown rust isolates obtained in 1979 were tested for pathogenicity toward 24 strains of oats. Most of these were either cultivars or lines with breeding potential that had been derived from crown rust resistant Avena sterilis. Five lines were outstanding for resistance, being resistant to all collections made in 1979. Several others were resistant to all but a few of these collections. The three cultivars representing the old standard ten differentials (Ukraine, Trispernia, and Bondvic) were susceptible to most of the collections, will probably be dropped from the survey in the future. The results of the survey for 1979 and the three previous years are summarized in Table 1.

The frequency of the different crown rust virulence patterns (or "races") in 1979 is shown in Table 2. The detection of 38 distinct virulence patterns in this material attests to the variability of the crown rust population in terms of pathogenicity toward currently promising sources of resistance.

Table 1. Pathogenicity of crown rust isolates in recent years.

Var. code no.	Var. or Line	1979 No. vir.	1979 No. avir.	1979 % vir.	1978 % vir.	1977 % vir.	1976 % vir.
1	Iowa Y345	0	358	0.0	0.3	-	-
2	H-544	27	347	7.2	14.6	-	-
3	H-561	9	352	2.5	4.9	-	3.2
4	H-548	0	358	0.0	0.8	-	-
5	H-547	0	358	0.0	0.0	0.0	2.6
6	H-676[a/]	7	354	1.9	-	-	-
7	Ukraine	352	26	93.1	84.0	77.3	73.1
8	Trispernia	327	37	89.8	85.2	86.9	89.4
9	Bondiv	334	30	91.8	87.6	91.3	89.4
10	TAM 0-312	112	275	28.9	20.7	12.3	5.8
11	Ascencao	12	352	3.3	12.1	4.3	3.5
12	Iowa X421	14	349	3.9	5.7	2.6	2.9
13	H-382	55	336	14.1	16.7	4.2	9.7
14	H-441	5	355	1.4	2.8	1.7	0.9
15	Iowa X475	263	154	63.1	48.6	34.4	33.5
16	Iowa X434	109	299	26.7	22.6	19.7	23.0
17	Canada PC 38	9	354	2.5	2.2	0.0	2.7
18	Canada PC 39	2	357	0.6	1.1	2.1	2.0
19	Coker 234	0	358	0.0	0.8	0.9	0.3
20	H-677[b/]	6	354	1.7	-	-	-
21	MN 5250	0	358	0.0	0.0	-	-
22	Canada PC 50	32	349	8.4	16.0	1.3	6.0
23	H 555	1	357	0.3	0.3	0.0	0.0
24	TAM 0-301	14	344	3.9	5.5	1.3	1.8

a/Derived from H-382 Ascencao

b/Derived from X421 x H382

Table 2. Frequency of crown rust virulence patterns, 1979

Code nos. of susc. lines	No. of isolates
2, 7, 8, 9, 13, 15, 16	2
3, 7, 8, 9, 12, 13, 15, 20	3
7, 8, 9, 10, 14, 15, 24	7
7, 8, 9, 10, 15, 16	4
7, 8, 9, 10, 15, 24	7
7, 8, 9, 10, 15	75
7, 8, 9, 10	2
7, 8, 9, 11, 15, 16	2
7, 8, 9, 11, 15	2
7, 8, 9, 13, 15	2
7, 8, 9, 15, 16, 22	2
7, 8, 9, 15, 16	21
7, 8, 9, 15	61
7, 8, 9	73
7, 9, 13, 15, 16	2
7, 9, 15	2
7, 15, 16	5
7, 15	2
8, 9, 15, 16, 17, 22	2
8, 9	4
13	2

No.	Line	No.	Line
1	Iowa Y345	13	H-382
2	H-544	14	H-441
3	H-561	15	X475
4	H-548	16	X434
5	H-547	17	Can PC 38
6	H-676	18	Can PC 39
7	Ukraine	19	Coker 234
8	Trisp.	20	H-677
9	Bondiv	21	MN 5250
10	TAM 0-312	22	Can PC 50
11	Asc.	23	H-555
12	X421	24	TAM 0-301

There were 17 additional virulence patterns, each represented by a single isolate

Reliability of the Field Testing Method for Tolerance to Barley Yellow Dwarf Virus in Oats

H. Jedlinski, C. M. Brown, and P. A. Burnett[1/]

A visual scoring system for assessment of barley yellow dwarf (BYD) disease severity in spring oats was tested under field conditions at Urbana, Illinois. Included in the tests were the 1979 Uniform Early Oat Performance Nursery and the 1979 Uniform Midseason Oat Performance Nursery and five BYD differentials. The oat selections were planted in hills, (twelve seeds per hill) replicated four times in separate inoculated and uninoculated blocks. A moderately virulent, vector-nonspecific isolate of barley yellow dwarf virus (BYDV) and the vector *Rhopalosiphum padi* L. (approximately five aphids per plant) were used for controlled inoculations of the plants in an early tillering stage. The scores based on symptoms (degree of dwarfing, tillering, discoloration and sterility) were recorded using a scale of 0 = fully tolerant to 9 = intolerant. Independent scores taken by two observers were highly correlated (Table 1 and 2). The individual disease severity scores were also highly correlated with the depression in height, number of tillers and yield. The selections could be ranked within each of the categories. It is concluded that visual disease severity scoring is sufficiently accurate to permit screening of spring oats by this method for tolerance to BYDV.

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Table 1. Field reaction to the vector-nonspecific isolate of barley yellow dwarf virus (BYDV) of entries included in The 1979 Early Oat Performance Nursery and five BYD differentials at Urbana, Illinois in 1979.[a/]

ENTRY NO.	ABBR. NAME	Ranking as % of healthy control: Height Rank 1-25	Tillers Rank 1-25	Yield Rank 1-25	Means of BYDV disease severity scores by: Burnett	Jedlinski
1	Otee	6	8	2	6.7	4.2
2	IL 73-2186	7	11	13	7.0	6.2
3	IL 74-5667	5	5	8	7.0	5.0
4	IL 75-5667	8	9	4	6.2	6.2
5	IL 75-5743	13	6	10	6.7	5.5
6	IL 75-5681	2	10	3	6.2	4.0
7	Lang	15	19	21	8.2	8.2
8	Clintford	10	3	9	7.5	7.5
9	IA Y341-41	22	22	18	8.7	8.7
10	IA Y22-15-9	9	2	5	7.0	5.0
11	IA B525-2	18	21	22	9.0	9.0
12	IA Y286-53	23	23	24	9.0	9.0
13	Grundy	24	25	24	9.0	9.0
14	Andrew	20	20	19	9.0	8.7
15	MO 06637	21	18	20	8.2	8.7
16	MO 06553	16	1	17	7.7	8.5
17	MO 06767	14	15	12	7.5	7.2
18	MO 06528	4	4	6	7.0	5.2
19	MO 06806	12	13	14	7.7	7.7
20	Bates	11	12	11	7.2	7.2
	Differentials					
21	Saia	1	7	1	3.7	3.0
22	Albion	3	14	7	6.7	5.0
23	Newton	19	16	16	8.0	8.3
24	CI 5068	17	17	15	7.7	6.7
25	Clintland 64	25	24	24	9.0	9.0

CORRELATION COEFFICIENTS/PROB>/R/UNDER HO: RHO=0/N=25

	Score-Burnett	Score-Jedlinski
Height as % control vs. score	-0.815 0.0001	-0.836 0.0001
Tillers as % control vs. score	-0.733 0.0001	-0.741 0.0001
Yield as % control vs. score	-0.914 0.0001	-0.814 0.0001

Score-Burnett vs. Score-Jedlinski
0.912
0.0001

[a/] Ranking and severity data are based on four replications with 12 plants per replication growing in a hill; the scores are based on visual evaluation using the scale of 0=fully tolerant to 9=intolerant. BYDV inoculated and uninoculated hills were in two separate blocks in the same field. The disease severity was accentuated by a drought during an early part of the season.

Information on entries in the 1979 Uniform Early Oat Performance Nursery

1979 Entry No.	C.I. No.	Variety or State Sel. No.	Pedigree
1	9086	Otee	Albion X Newton 2X Minhafer 3X Jaycee
2	--	IL 73-2186	Tyler X Egdolon 2X Tyler X Orbit
3	--	IL 74-5667	CI 5068 X CI 6975 2X Brave 3X Egdolon 23 X Clintford
4	--	IL 75-5667	Coker 227 2X Clintford X Portal
5	--	IL 75-5743	Coker 227 3X CI 5068 X IL 3 0959 2X CI 6975 X CI 1915
6	--	IL 75-5681	Coker 227 2X Clintford X Portal
7	9257	Lang	Tyler X Orbit
8	7463	Clintford	Clinton 59^{7} X Landhafer 2X Milford
9	9273	IA Y341-41	Clintford^{6} X B443 (*A. sterilis*)
10	--	IA Y22-15-9	Garland X B 433 (*A. sterilis*) 2X Holden
11	--	IA B525-2	Selection from a bulk population
12	--	IA Y286-53	Grundy^{3} X CI 9170
13	8445	Grundy	Clintland X Garry Sel. 5
14	4170	Andrew	Bond X Rainbow
15	--	MO 06637	Nodaway 70 X CI 8238
16	--	MO 06553	Nodaway 70 X CI 8238
17	--	MO 06767	Pettis X Egdolon 26
18	--	MO 06528	Pettis X Jaycee
19	--	MO 06806	Albion X^{2} Clintland 60 2X Orbit 3X Pettis X Jaycee
20	9211	Bates	Pettis X Florida 500

Table 2. Field reaction to the vector-nonspecific isolate of barley yellow dwarf virus (BYDV) of entries included in The 1979 Uniform Midseason Oat Performance Nursery and five BYD differentials at Urbana, Illinois in 1979.[a/]

ENTRY NO.	ABBR. NAME	Ranking as % of healthy control: Height Rank 1-33	Tillers Rank 1-33	Yield Rank 1-33	Means of BYDV disease severity scores by: Burnett	Jedlinski
1	WI X3086-1	21	6	16	7.0	6.2
2	WI X2977-1	23	25	21	7.7	7.0
3	WI X2795-1	18	10	11	7.2	6.0
4	WI X3420-1	28	12	19	7.5	6.7
5	Dal	15	8	12	7.2	6.7
6	Lang	10	1	20	7.5	7.0
7	IL 73-2664	5	5	7	6.2	4.0
8	IL 75-1062	13	7	24	7.2	7.7
9	IL 75-1056	7	15	9	6.7	5.7
10	IL 75-5665	1	3	4	6.5	4.5
11	MI 64-152-47	17	18	17	6.7	5.2
12	MI 69-27-403	12	17	15	7.0	5.2
13	Orbit	29	26	30	8.0	8.2
14	OA 366	19	24	22	7.7	7.2
15	OA 424-1	32	32	32	9.0	9.0
16	OA 405-5	31	31	32	9.0	9.0
17	NY 6083-21	27	21	28	8.0	8.0
18	NY 5977-6-56	30	29	29	8.5	8.0
19	Otee	6	2	2	6.5	4.2
20	SD 743199	24	27	27	8.2	8.2
21	SD 740065	14	19	13	7.5	6.2
22	SD 760044	20	23	10	7.2	6.2
23	Clintland 64	22	30	26	8.7	8.2
24	MN 76161	4	4	5	6.5	4.2
25	Gopher	25	22	23	8.2	7.5
26	P 7135A1-1-8-4	9	11	6	6.7	4.2
27	P 70408D2-3-3-3-2	11	16	14	7.5	6.7
28	P 70408E1-3-25-2	8	9	3	5.7	3.7
	Differentials					
29	Saia	2	14	1	4.7	3.0
30	Albion	3	13	8	6.3	3.7
31	Newton	26	28	25	8.0	8.0
32	CI 5068	16	20	18	7.7	5.7
33	Clintland 64	33	33	32	9.0	9.0

CORRELATION COEFFICIENTS/PROB>/R/UNDER HO: RHO=0/N=33

	Score-Burnett	Score-Jedlinski
Height as % control vs. score	-0.874 0.0001	-0.862 0.0001
Tillers as % control vs. score	-0.774 0.0001	-0.736 0.0001
Yield as % control vs. score	-0.797 0.0001	-0.717 0.0001

Score-Burnett vs. Score-Jedlinski
0.912
0.0001

[a/] See Table 1.

Information on entries in the 1979 Uniform Midseason Oat Performance Nursery

1979 Entry No.	C.I. No.	Variety or State Sel. No.	Pedigree
1	--	WI X3086-1	Garland 3X Trispernia X Belar 2X Beedee 4X Garland
2	--	WI X2977-1	Lodi 3X Trispernia X Belar 2X Beedee
3	--	WI X2795-1	Garland X CI 8385
4	--	WI X3420-1	Garland ^{2}X CI 8077 4X CI 7677 2X^2 Beedee X Clintafe 3X Trispernia X Belar 2X Beedee
5	9159	Dal	Trispernia X Belar 2X Beedee
6	9257	Lang	Tyler X Orbit
7	--	IL 73-2664	Brave 2X Tyler X Edgolon 23
8	--	IL 75-1062	Coker 227 2X Clintford X Portal
9	--	IL 75-1056	Coker 227 2X Clintford X Portal
10	--	IL 75-5665	Coker 227 2X Clintford X Portal
11	--	MI 64-152-47	MI 56-22-1689 ^{2}X Marino
12	--	MI 69-27-403	MI 64-152-47 X MI 64-152-32
13	7811	Orbit	Alamo 4X Garry Sel. 5 3X Goldwin 2X Victoria X Rainbow
14	9361	OA 366	CAV 2700 X Gemini 2X Rodney 3X CAV 2700 X Gemini
15	9362	OA 424-1	*A. fatua* X Clintland 60 2X Gemini 3X CAV 2700 X Gemini 2X 5872-1
16	9363	OA 405-5	Dorval 3X CAV 2700 X Gemini 2X Rodney
17	--	NY 6083-21	Orbit 2X CI 6936 X Clintland 60
18	--	NY 5977-6-56	Astro X PI 193027
19	9086	Otee	Albion X Newton 2X Minhafer 3X Jaycee
20	--	SD 743199	Dal X Nodaway 70
21	--	SD 740065	Spear X Kelsey
22	--	SD 760044	Kelsey X Spear
23	7639	Clintland 64	Clintland^5 X LMHJA 3X Clintland 2X Clinton X Grey Algerian
24	--	MN 76161	Otee X Dal
25	2027	Gopher	Selection from Sixty-Day
26	--	P 7135A1-1-8-4	(CI 7684-Putnam-Albion) Sel. X Allen 2X Noble X Stout
27	--	P 70408D2-3-3-3-2	Stout X a Purdue line with complex parentage including Putnam, Albion and CI 7684-1-5
28	--	P 70408E1-3-25-2	Stout X a Purdue line with complex parentage including Putnam, Albion and CI 7684-1-5

Evaluation of Some Advanced Oat Selections with Barley Yellow Dwarf and Crown Rust Resistance from *Avena Sterilis*

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Avena sterilis has been used in the Illinois oat breeding program since 1966. Early interest in the species originated from its potential use as a source of high grain protein. Our early results were somewhat disappointing in that none of our selections combined high protein content with high yield and good agronomic type. However, we did observe that many of the selections derived from crosses with *A. sterilis* combined excellent resistance to crown rust and tolerance to Barley Yellow Dwarf (BYD). We thus became interested in using the *A. sterilis* derivatives in our breeding program for crown rust and BYD resistance.

Some advanced lines from the early crosses with *A. sterilis* do have fair agronomic type and yielding capacity and combine excellent resistance to crown rust and BYD. However, our most promising advanced selections to date have derived from crosses with two Coker lines (C227 and C234) that were obtained from Howard Harrison in 1972. Both C227 and C234 have excellent crown rust resistance derived from *A. sterilis*. They have also shown a fair degree of tolerance to BYD in tests at Urbana, Illinois.

Illinois selection numbers and parents of four advanced selections from crosses with C227 are presented in Table 1. Two of the selections (Il. 75-1056 and Il. 75-5665 were included in the 1979 Uniform Midseason Oat Nursery while the other two (Il. 75-5743 and Il. 75-5681) were included in the 1979 Early Uniform Oat Nursery. All four selections have excellent resistance to crown rust and BYD.

Midseason Uniform Nursery data for the two selections in that nursery along with comparable data for Lang, Otee and Il. 73-2664 are presented in Table 2, while data for the two selections included in the Uniform Early Nursery along with data for Lang, Otee, and Il. 73-2186 are presented in Table 3.

Data in Tables 2 and 3 clearly show that crown rust and BYD resistance from *A. sterilis* have been combined in advanced oat selections that compare quite favorably in other respects to some of the better varieties and selections from the Illinois oat breeding program. These or similar selections from the Illinois program may be released as varieties some time in the future, but for the time being they should provide excellent germplasm for use in oat breeding programs where crown rust and BYD are of major concern.

Table 1. Illinois Advanced Oat Selections with BYD and Crown Rust Resistance from _A_. _Sterilis_

Selection	Parents
Il. 75-5743	Coker 227 3X CI 5068 X Il.30959 2X CI 6975 X CI 1915
Il. 75-5681	Coker 227 2X Clintford X Portal
Il. 75-1056	Coker 227 2X Clintford X Portal
Il. 75-5665	Coker 227 2X Clintford X Portal

Table 2. Uniform Midseason Nursery Results -- 1979

	Yield Bu/A	T.W. Lb/Bu	Ht. In.	Lodge %	Date Headed	Groat %	Protein %
	(20)1/	(21)1/	(21)1/	(14)1/	(16)1/	(9)1/	(9)1/
Il. 75-1056	92	35	33	12	176	76	18
Il. 75-5665	84	35	32	10	173	73	18
Lang	87	34	35	10	172	74	17
Il. 73-2664	103	34	36	9	175	75	16
Otee	82	36	35	15	174	73	19

1/ Indicates number of test locations

Table 3. Uniform Early Nursery Results -- 1979

	Yield Bu/A	T.W. Lb/Bu	Ht. In.	Lodge %	Date Headed	Groat %	Protein %
	(14)1/	(14)1/	(14)1/	(6)1/	(11)1/	(7)1/	(7)1/
Il. 75-5743	84	33	30	9	168	75	17
Il. 75-5681	89	33	32	38	167	71	18
Lang	85	32	32	13	165	73	17
Otee	78	35	33	15	166	73	19
Il. 73-2186	86	34	30	6	167	71	16

1/ Indicates number of test locations

Status and Potential of Tissue and Anther Culture in Oats

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SEA-AR, USDA and University of Minnesota

Cell, tissue, and anther culture have received much attention in recent years as potentially valuable techniques in the genetic improvement of crop species and in basic plant science research. The objectives of our studies have been to develop culture techniques in oats and to explore their potential in oat improvement research.

Oat tissue cultures were initiated by placing immature embryos excised from groats at the late milk - early dough stage onto Murashige-Skoog basic salts medium containing 2 mg 2,4-D/l, 2% sucrose and 0.7% agar. Initiated cultures were maintained by subculturing every 4 to 5 weeks onto the same medium. Plants were regenerated by transfer of cultures to medium with 0.5 mg 2,4-D/l for about one month and then to hormone-free medium for an additional month. Regenerated plants were transplanted to soil for growth to maturity.

Oat genotypes differed greatly in their ability to initiate cultures from which plants could be regenerated. The cultivars 'Lodi' and 'Lyon' were the most responsive of 40 _Avena sativa_ lines tried, with 40 to 80% of embryos plated giving rise to regenerable cultures in various experiments. Of 21 _A. fatua_ lines tested, lines 381, 415, and 429 were also highly responsive. Of 16 _A. sterilis_ lines, only 3 produced regenerable cultures and then only at low frequency. Selection among segregating populations is being made to identify lines with improved culture initiation and plant regeneration capacities.

Only cultures which retained tissue organization had plant regeneration capacity. These complex cultures may have a restricted number of growth centers. The potential and efficiency of such organized tissue cultures in _in vitro_ mutant selection is being studied by attempting selection for resistance to _Helminthosporium victoriae_ toxin in cultures initiated from _H. victoriae_-sensitive oat lines.

Cytogenetic variability arising in cultures was investigated by meiotic analysis of regenerated plants. Various cytogenetic alterations, including monosomics, trisomics, heteromorphic pairs, and interchanges have been observed. Of 331 regenerated plants of Lodi, 207 had one or more chromosomal alterations. Examination of 319 regenerated plants of Tippecanoe showed that 101 were cytogenetically abnormal. The frequency of cytogenetic alterations increased with time in culture. The results suggest that an array of useful cytogenetic stocks in a common genetic background may be obtained through tissue culture.

Haploid oats would have potential value in more efficient selection of mutants and in the generation of doubled haploids for breeding and genetic purposes. Oat anthers were placed onto culture medium to attempt to initiation haploid cultures and/or plants from developing microspores. The optimal treatment involved harvesting plants just post-meiosis (2 to 5 cm of flag leaf collar exposed) by cutting the stems near ground level, placing them in water, and holding the plants at about 8 C for 6 to 10 days. Anthers were then excised onto MS medium containing 10% sucrose, 2 mg 2,4-D/l, 0.2% activated charcoal, and 0.7% agar. Among over 32,000 anthers plated, 668 have produced callus from anthers, but no haploid plants have been produced. Almost all of the callus-forming anthers were from the cultivars 'Stout' and 'Clintford'. Segregating populations are presently being screened for genotypes more responsive to anther culture.

Oat tissue and anther culture holds promise as a useful tool for oat improvement, but the required technology is still in the developmental stage.

Nitrogen Accumulation and Partitioning in Oats

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University of Minnesota

Enhanced translocation of nitrogen from stems and leaves to the developing grain has been suggested as a desirable component of improved fertilizer nitrogen use by small grains. A field experiment was conducted to survey a group of 20 oat genotypes, chosen to represent a wide range of percentage groat protein, for variability in nitrogen uptake and partitioning.

The twenty genotypes were compared for total above-ground N content and N concentration in leaves and stems at heading and maturity, N harvest index (NHI), grain yield, harvest index (HI), groat %, groat protein %, and groat protein yield. Genotypes differed significantly in all these characters. NHI ranged from 0.64 to 0.80, was positively correlated (p=0.01) with HI, and was negatively correlated (p=0.01) with total N accumulation. Groat protein % ranged from 15.9 to 22.7, was not correlated with NHI, and was negatively correlated (p=0.01) with grain yield.

Further study of the physiology of N uptake and translocation in relation to groat dry matter and protein accumulation seems warranted. Data from this experiment will be used to select a few genotypes best suited for such future studies.

EFFECT OF BYDV INFECTION ON GRAIN YIELD, PROTEIN, AND LIPIDS IN OATS

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Oat Quality Laboratory, University of Wisconsin

The cultivars and lines Dal, Stout, Noble, Otee, Ill. 70-1468, and Ill. 70-1297 (in order of increasing resistance to barley yellow dwarf virus) were infested with viruliferous *Rhopalosiphum padi* in the field at Lafayette, Indiana, in 1976, 1977, and 1978.

Barley yellow dwarf virus (BYDV) infection in the one to three leaf stage significantly reduced grain yield of all cultivars and lines. Yield was reduced to the greatest degree for Dal and least for Ill. 70-1297. Seed weight was significantly reduced with BYDV infection.

Cultivars differed with respect to percentage protein and percentage of the various amino acids, but these constituents were not significantly altered in any of the cultivars by infection with BYDV. Cultivars also differed in percentage total lipid and percentage palmitic, stearic, oleic, linoleic, and linolenic acids, but BYDV infection did not significantly alter these constituents.

Relationships Between Grain Morphological Characteristics and Milling Yield in Oats (*Avena sativa* L.)

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Six grain-quality traits (bushel weight, kernel weight, groat percentage, groat-protein percentage, protein weight per groat, and milling yield) and 18 kernel and groat morphological traits including primary kernel and primary groat length, width, and weight, a grain-filling index, and a groat-crease index were determined for seven oat genotypes grown in large drill plots, (three replicates) in 1976 (Madison) and 1977 (Arlington). The seven genotypes were Dal, Froker, Lodi, Spear, Wright, X1839-1 (a Lodi-type kernel), and X2221-2 (a Wright-type kernel). Milling yield is defined as the amount of whole-kerneled oats required to produce 100 pounds of rolled oats.

Selection X2221-2 had the best milling-yield value (156.7 pounds) in conjunction with a test weight of 40.3 pounds per bushel, a groat percentage of 71.2, a primary kernel length of 11.2 mm, a primary kernel width of 2.9 mm, and a 1,000 kernel weight of 27.4 grams. Selection X1839-1, a large-kerneled type, had the poorest milling yield (171.9 pounds), with a test weight of 36.7 pounds per bushel, a groat percentage of 66.7, a primary kernel length of 12.5 mm, a primary kernel width of 3.2 mm, and a 1,000 kernel weight of 31.9 grams.

Higher bushel weight and higher groat percentage had favorable (negative) effects on milling yield. The R^2 value for each of these two traits as singular predictors of milling yield was above 60%. In multiple regression, bushel weight, groat percentage, and 1,000 kernel weight predicted milling-yield values with an R^2 of 80.3%.

Regression of milling yield on the eight kernel and groat morphological traits listed above indicated that well-filled kernels of less weight with wider and shorter, well-filled groats were the most desirable for lower (better) milling-yield. The R^2 value was 54.6% for this regression.

ABSTRACTS OF DISCUSSION SESSIONS AT NORTH CENTRAL OAT WORKERS CONFERENCE

THE FUNCTION OF THE OAT QUALITY LAB IN PROTEIN QUALITY IMPROVEMENT

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The Oat Quality Lab was established in 1970 and staffed with a cereal chemist, a plant physiologist, and two physical science technicians. The mission of the laboratory is "to perform research leading to improved nutritional and milling quality of oats for food and feed". This mission is being accomplished by protein analysis service for plant breeders and by basic research.

From the 1973 through the 1978 crop year we have analyzed an average of 27,500 samples annually. These are now being done by infrared reflectance using Kjeldahl as a backup for checks and special material. More than 95% of our samples are from the north central region. This year we began reporting moistures in addition to protein percentages.

Basic research is being conducted in several areas. Protein characterization work has led to the possibility of using electrofocusing of oat groat globulin as a tool for varietal identification. Protein bodies are being isolated and studied from the aleurone layer and the starchy endosperm. The effect of nutrient supply on grain composition was studied by culturing excised culms. The protein synthesis system in developing groats is being further defined. The effects of the inhibitor methionine sulfoximine and the toxin produced by the oat halo blight pathogen on nitrogen metabolism in seedling leaves are being investigated.

Future projections for the service work involve accurate lipid measurement with the infrared reflectance analyzer and computer processing of the data.

I believe that more emphasis should be given to quality aspects other than protein percentage. In this regard, some data on protein digestibilities as measured by an *in vitro* test showed significant differences among oat cultivars although the range was narrow. Other possible important quality aspects are metabolizable energy, fiber, lipids, and anti-nutritional factors. Research is needed on these aspects to define genetic and environmental variability and heritability.

Biofunctional Properties of Oats

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Quaker Oats Company

Preliminary studies indicate that oats possess some physiological properties which may have implications to man, and appear to be unique to oats among the cereal grains. These studies suggest that oats may be useful in the treatment of hypercholesterolemia and diabetes mellitus.

Four subjects suffering from hypercholesterolemia consumed a high carbohydrate fiber diet containing 100 grams of a coarse oat fraction daily. Significant reductions in serum cholesterol, low density and very low density lipoprotein cholesterol were observed. High density lipoprotein cholesterol was elevated by this diet. This effect is thought to be beneficial. Similar diets using primarily wheat bran as the cereal fiber source, while effective, were not as effective, and did not show the shift toward high density lipoprotein cholesterol.

One of the four subjects had diabetes mellitus and was taking 20 units of insulin per day. By the end of 10 days on the HCF-coarse oat diet, his insulin dosage had been reduced to zero and his plasma glucose was in a normal stage.

These preliminary studies are difficult to interpret because of the basic differences between the control and the HCF diets. The HCF diets are lower in total fat, saturated fat, and cholesterol, and are higher in starch and plant fiber than the control diets. Thus, the specific contribution of coarse oat fraction is confounded by these other factors.

These preliminary studies have encouraged further studies to examine the influence of coarse oat ingestion in individuals where the diets are kept as constant as possible except for the addition of oat bran. The protein, carbohydrate, simple carbohydrate, complex carbohydrate, total fat, fatty acids and cholesterol content of the coarse oat diet is virtually identical to that of the control diet. However, the oat bran diet contains approximately 50% more plant fiber than contained in the control diet. This study is being completed now and will be subsequently reported.

Progress to Date and Future Research for Oat Protein Improvement

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The biological value of oat protein is the highest among the cereal grains because it is low to medium (5 to 20%) in prolamine content. The distribution of amino acids in the oat protein is similar for all genotypes of oats, irrespective of the total nitrogen content of the grain, and it is quite similar to the array in opaque-2 corn. Correlations between lysine content in oat protein and protein content in the oat kernels tend to be slightly negative. Generally, it appears that there is little opportunity or need for making oat protein nutritionally better.

A number of oat varieties with high protein percentage as exemplified by Dal, Goodland, Otee, Wright, Marathon, and Spear, have been developed and released. Each contains from one to four percent higher protein percentage than normal varieties. The genes responsible for the high protein percentage in these varieties are from *Avena sativa*. The protein content of the seed of *A. sterilis* has been variously reported from 17 to 35%. Studies in Iowa and Indiana have shown that the genes for high protein content from *A. sterilis* and *A. sativa* are complementary, which suggests that they can be combined to give a protein percentage higher than present in either of the species alone. Generally, in oats as in all cereal grains, there is a negative phenotypic relationship between grain protein content and grain yield. However, exceptions to this general negative relationship do exist, as shown by the high protein oat varieties that have satisfactory grain yield, by the $r\hat{g} = 0$ found by Frey between protein percentage and grain yield when soil nitrogen was readily available, and the case of Lancota variety of wheat, which has both increased protein percentage and improved yield.

Probably the most important factor in protein of cereals to be considered is protein yield per hectare. Currently, the easiest way to increase protein yield is through increased grain yield. Before really significant advances can be made in increasing protein yield via protein percentage, however, more basic research is necessary on the nitrogen metabolism of oats, especially as it relates to nitrogen uptake from soil and distribution to the various plant parts.

Priorities for Future Oat Research

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University of Minnesota

The responses to a recent survey indicate that just over 21 SYE's (scientist year equivalent) are now devoted to oat research in the U.S. Approximately 9 SYE's (including 1 vacancy) are USDA-SEA-AR positions. Another 7.5 are state funded positions in the North Central region and the remainder (about 5) are state supported positions in the Northeast, Southern and Western regions. By discipline, the major areas of oat research are breeding and genetics (11.5 SYE's), pathology (7 SYE's), and physiology (1.55 SYE's). In addition to the full time personnel, there are approximately 40 graduate students with research problems on oats. Just over 30 of these are in the North Central region.

Research areas which were listed for future consideration include:

Oat Quality Lab -- protein and utilization,
Germplasm development -- World Collection evaluation,
Bolstering ongoing breeding efforts -- team approach and increasing yield potential,
Oat production -- making the crop more competitive by improving profitability,
Diseases -- particularly BYDV and crown rust, and
Forage and/or straw production.

Because this list is long and because the resources are meager, oat researchers need to develop priority rankings of these items. Relevant comments are solicited and should be directed to Dr. R. A. Forsberg, Chairman, American Oat Workers Conference.

SLOW RUSTING IN OATS AND OTHER CEREALS

M.B. Moore
University of Minnesota

Rust resistance designated as "slow rusting" of one cultivar obviously is defined by comparison with faster or "normal" rusting of another cultivar. To be useful it must offer practical protection against crop loss. Its greatest promise lies in the probability that in some cases at least, it may be general, i.e., effective against all races of a given rust. A slow rusting cultivar retards rust development and sporulation at any or all stages of repetitive disease cycles, with the result that an ensuing epidemic is limited. Many researches attest to the existence of various components of slow rusting in cereal hosts. Evidence of its general effectiveness against all races is more limited, but not lacking. The non-race-specific resistance of corn to rust is often cited, and the continued resistance of wheat varieties to stem rust in Mexico, and of other wheat varieties in Northern United States and Canada may well be due to slow rusting abilities along with major genes for specific resistance. Exposure of breeding materials to a diversity of virulences and races of a rust permits the selection of those lines which are most likely to have general and hence lasting resistance. The Minnesota buckthorn plot and the international rust nurseries provide such a diversity, and various oat selections have remained resistant to these dynamic rust populations for many years. Similar selective pressure could be provided by inoculation of selection nurseries with a multiplicity of races but at considerably more effort. Amidst the plethora of recent publications on slow rusting the dearth of yield tests is notable. Very limited tests at Minnesota suggest that an only moderate degree of resistance will provide substantial field protection against crown rust and against stem rust. While slow rusting appears to be polygenic, the relative roles of major and minor genes is not yet clear. Some evidence points to the independence of the two systems. Certain lines that are moderately resistant in the field to the entire crown rust population of the buckthorn plot were susceptible as seedlings to all but one or two of 54 pathogenicly different rust isolates from that plot. Similarly certain oat selections which have no major genes for resistance to stem rust races 6AF and 6AH (NA27 and NA26) are moderately resistant to them in the field. Breeding for slow rusting resistance should be no more difficult than for any other polygenic character, but only requires an adequate screening population of the appropriate rust. It also requires that the eye be trained to distinguish moderately rusted from more heavily rusted plants. In this it is a great aid to have plenty of both susceptible and resistant checks throughout the nursery. It should be realized that all of the slow rusting lines and cultivars of whatever cereal crop, that have been studied as slow rusters were first discovered simply by visual observation in the field without any of the detailed, impossibly time consuming tests suggested by those studies. Very simply one sees in the field, fewer pustules, usually smaller pustules, and overall less rust on a slow rusting cultivar than on a comparatively more susceptible cultivar. With a sufficiently diverse rust population, major resistance genes may be carried along in various progenies, though the breeder will not likely be able to specify which genes they are. Suggested general references: Johnson, R-1978. Euphytica 27:529-540. Parlevliet, J.E. 1979. An. Rev. Phytopathology 17:203-222.

USE OF RACE-SPECIFIC RESISTANCE GENES AND THE RELATION OF HYPERSENSITIVITY TO SLOW-RUSTING AND PARTIAL RESISTANCE

J. Artie Browning
Iowa State University

My subject requires me to consider terms and definitions and, secondarily, breeding strategies. This is because the terms and concepts I have been asked to consider cannot be compared directly. "Race-specific" is a genetic concept; "hypersensitivity" is a cytological or mechanistic concept, describing how death of host and pathogen cells occurs; and "slow-rusting" is an epidemiological concept--the rate of rust development. "Partial resistance" should never be used. Most plant pathologists agree that immunity is absolute, but that resistance and susceptibility are on a continuum and are different degrees of the same thing. Thus, all resistance is partial and the term "partial resistance" adds nothing. Pringle and Scheffer (1964) stated that "The state of our knowledge of plant pathology is reflected by the terms we use." Surely the state of our knowledge of genetic and epidemiologic concepts of resistance justifies more precise terms and definitions and our use of them.

Hypersensitivity expresses itself in death of the host cell(s) and of the attacking pathogen, often the haustorial mother cell. Commonly this is recognized as immunity, either host or non-host. Generally it is oligogenically controlled. "Hypersensitivity" is a good term that is especially meaningful in biochemical and ultrastructure studies of host-parasite interactions. But it never should be used as synonymous with high resistance, major gene resistance, vertical resistance, specific resistance, etc. that express genetic concepts.

If hypersensitivity occurs, death occurs. Thus, immunity expresses a "whether" interaction, i.e., whether the pathogen can unlock the door of the host. If a "stop" order is received, that is it. If "go" permission is received, then a separate "resistance-susceptibility" mechanism takes over. This determines the extent that the door is opened and the rate and extent that the room is occupied.

High resistance, like immunity, commonly is oligogenic and dominant. Frequently this is referred to as vertical resistance (Vanderplank 1968) or specific resistance. Vanderplank (1978), however, stated that specificity is not necessarily associated with vertical resistance and redefined it as "correlated variation in host and pathogen." Specific resistance has the right of priority to express genetic concepts (Browning, Simons, and Torres 1977), but incompatibility-compatibility expresses current concepts still better.

Moderate resistance, slow rusting, etc. may be controlled oligogenically but probably involves recessive polygenes. Frequently this does not show the presence of pathogenic races so dramatically as specific resistance. Vanderplank (1968) coined the name "horizontal resistance" for that resistance effective against all races, although general resistance has the right of priority to express genetic concepts (Browning, Simons, and Torres 1977). Vanderplank (1978) redefined horizontal resistance as "uncorrelated variation in host and pathogen" and emphasized that it may involve great specificity.

Epidemiologic concepts also must be described. Vanderplank (1968) stated that horizontal resistance influences the epidemic by reducing the rate of increase of the pathogen. Vanderplank (1978), however, concluded that vertical resistance that does not involve host-pathogen specificity also may reduce the infection rate. Nelson (1978) concluded correctly that Vanderplank's genetic definition of horizontal resistance was invalid for several reasons. For instance, combining vertical and horizontal resistance is precluded by Vanderplank's definition of horizontal resistance, although Vanderplank (1968) himself does so. That is, a resistance effective against all races cannot be combined with that effective against some but not other races although, of course, the genes conditioning the resistance could be combined. Nelson's solution was to redefine horizontal resistance as a rate-reducing resistance, an epidemiological concept, while retaining the term "horizontal resistance" itself. Nelson's goal was to clarify, but having one term with two or more meanings can only confuse further. One now is forced to specify the term "horizontal resistance sense Vanderplank 1968 or 1978" (specifying which) or "horizontal resistance sensu Nelson" to use the term at all.

Browning, Simons, and Torres (1977) earlier had concluded that genetic and epidemiologic concepts should be separated. They retained the terms specific and general resistance to express genetic concepts, and coined the term "dilatory resistance" for the epidemiological concept of the resistance that delays the epidemic.

Vanderplank (1968) stated that vertical resistance (which expresses a genetic concept) affects the epidemic by reducing the amount of incoming inoculum, i.e., by making inoculum of avirulent races ineffective. Browning, Simons, and Torres (1977) retained the term specific resistance to express genetic concepts (but incompatibility/compatibility now is considered preferable) and coined a new term, "discriminatory resistance", to express the epidemiologic effect of specific resistance, i.e., reducing incoming inoculum. "Discriminatory resistance/susceptibility can discriminate in favor of virulent races or against avirulent ones.

Reducing r, the apparent rate of infection, is a natural means of pathogen control. It is effective in both natural and agricultural ecosystems. Reducing incoming inoculum, however, is an artifact of agricultural systems. In wild systems there are not normally large, homogeneous populations to give rise to large amounts of outgoing inoculum or to receive it, as in agricultural systems. Incompatibility genes are used in nature only in diverse populations where, along with polygenic dilatory resistance, they are very effective in removing the threat of destructive epidemics from natural systems almost completely. This very effective use of genes for incompatibility can be simulated in breeding programs by developing multiline cultivars (Frey, Browning, and Simons 1973) or by using variety mixtures (Wolfe and Barrett 1980). Such diversity is the surest, easiest, most predictable means of approaching the goal of "durable resistance".

Nature uses one epidemiological concept--dilatory resistance--in removing the threat of epidemics, but it uses different genetic controls and population structures for achieving it. So must man.

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RUST TOLERANCE

M. D. Simons
SEA-AR, USDA and Iowa State University

The idea that certain cultivars of small grains tolerate disease better than others was spelled out before 1900, and numerical examples had been published by the late 1920's. Tolerance is based on the idea of equivalent severity of disease without equivalent damage or loss. A working definition is that tolerance is that quality of a susceptible plant that enables it to endure severe attack by a rust fungus without sustaining severe losses in yield or quality. Or, more rigorously: "tolerance is that capacity of a cultivar resulting in less yield or quality loss relative to disease severity or pathogen development when compared with other cultivars or crops". One of the theoretical advantages of tolerance over resistance is that tolerance should be more stable than resistance. This is because a new strain of the pathogen capable of severely damaging a previously tolerant cultivar would have no compensating advantage in reproduction over other strains of the pathogen in the general population. Thus, the new strain would not be expected to show the rapid increase characteristic of a new strain of rust that is able to parasitize previously resistant cultivars. There is some question whether tolerance actually exists, or is merely a form of resistance that is difficult to detect or measure. Current research on such pathogen traits as length of latent period, duration of sporulation, and quantity of spores produced should help to answer this question. Unfortunately, tolerance must be handled as a quantitative trait, and thus is much more difficult and expensive to work with than is resistance. Heritability, however, is relatively high.

Breeding Strategy for Rust Resistance in Oats

Summary of Panel Discussion

Gregory Shaner
Purdue University

Experience with many crops and diseases clearly indicates that highly resistant or immune reactions to infection are often circumvented by genetic variants of pathogens, especially when resistance is simply inherited. Resistance in oats against Puccinia coronata is perhaps one of the most notorious examples of the emphemeral quality of this type of resistance. Time and again genes for resistance to crown rust have been added to commercial oat varieties only to be quickly rendered ineffective by new strains of the pathogen. The continued use of monogenic crown rust resistance will expose the oat crop to the danger of explosive epidemics. The alternative is to find and employ more durable crown rust resistance. Even if the durable resistance conditioned by a certain group of genes proves not to be permanent, the probability of a sudden and disastrous "breakdown" of resistance is greatly reduced. A corollary to this is that a productive oat variety will not have its useful lifetime cut short through loss of resistance. More durable resistance will also give the oat breeder more time for improving oats in other traits because he can devote less time to transferring rust resistance genes from poorly adapted varieties or other Avena species into A. sativa.

Unfortunately, durable resistance cannot be defined in such a way that it is immediately recognized whenever it is found. Durable resistance is only unequivocally recognized in hindsight. It is resistance that has remained effective during widespread and longterm testing, for perhaps 20 to 30 years in the case of crown rust. Professor Moore presented some examples of oat varieties whose crown rust resistance has endured. They are slow rusting rather than immune. "Slow rusting" describes the behavior of an oat variety in the field under epidemic conditions rather than any specific phenotypic response to infection by P. coronata. Slow rusting arises from the cumulative effect of several components of resistance discussed by Professor Moore. The degree of expression of each component may vary among oat varieties that all show slow rusting in the field. Identification and measurement of components in parental lines allows the oat breeder to combine parents in such a way as to obtain transgressive segregrants for slow rusting.

Dr. Browning has pointed out that durable resistance can also be achieved with the same resistance genes that give only ephemeral control when used singly. Regional gene deployment, varietal (and resistance gene) diversity within a region, and resistance gene mixtures within fields through multilines or varietal blends all interfere with the explosive spread of new virulent strains of P. recondita. Although there are apparently many genes for resistance to crown rust that breeders can retrieve from A. sterilis whenever currently used genes succumb to new pathogen biotypes, breeders would be more prudent and efficient to use these genes in the above ways rather than singly.

It is still not clear whether tolerance to crown rust is entirely distinct from low levels of slow rusting. Even without a clear answer to this question, oat breeders can add selection of tolerance, based on yield reduction studies, to selection for slow rusting. When dealing with resistance that does not completely inhibit rust development, it is not sufficient to show that disease develops more slowly compared to a susceptible check variety. It must be shown that the degree of slow rusting is adequate to prevent significant yield reduction. In doing the yield reduction studies necessary to prove this point it may be possible to add tolerance to slow rusting.

Finally, Dr. Forsberg has pointed out that crown rust pressure varies greatly from one region to another in North America. The strategy of control chosen should take this pressure into account. Where disease is sporadic, simpler approaches of control, such as combining two genes for resistance or alternating the genes used with each variety released, would be adequate. Where crown rust is chronic, the more elaborate methods of control such as slow rusting, tolerance, or multilines are called for.

U.S. COMMERCIAL OATS SITUATION

Donald J. Schrickel
Quaker Oats Company

Oats production continues to decline in the U.S. and in the four major commercial oats producing states. The primary reason for this decline is the low net return per acre to producers. Much of this low return is attributed to the lack of demand for oats as a feed grain. Demand for oats by the milling industry remains rather stable, and is expected to increase slightly in the 1980's.

Oats demand can be increased by identifying the unique values of oats for livestock feed and human food. This increased demand will improve returns to the producer and result in greater production.

Production and Demand

United States oats production has been declining rapidly from 1.1 billion bushels in 1960 to 534 million bushels in 1979. The major production area of oats for grain is concentrated in the North Central states. Of the 534 million bushels produced in 1979, the four leading states will contribute over half of this total. (South Dakota - 99 million, Minnesota - 85 million, Iowa - 63 million, Wisconsin - 56 million). Although Wisconsin is one of the leading states in the production of oats for grain, it is not considered a commercial origin area as essentially all the oats are used for local feeding purposes. North Dakota produced 37 million bushels in 1979 and is considered a source of commercial oats.

Production in the four leading commercial oats producing states - Iowa, Minnesota, North Dakota, and South Dakota - has declined at almost the same rate as the U.S. total. In 1960, these four states produced 600 million bushels and in 1979 284 million bushels.

Oats are grown primarily as a livestock feed in the United States. Even in the four major commercial production states, only 40% of the oats are sold off the farm. It is from this 40% (114 million bushels in 1979) that the milling industry acquires its needs. The needs of the milling industry are approximately 45 million bushels annually.

The primary reason for the declining production of oats for grain is the low net return per acre to producers. In recent years, the net return per acre in the four commercial oats producing states has been lower for oats than any of the competing crops. The primary reason for this low return is the lack of demand for oats as a feed grain compared to corn.

Figure 1 and Table 1 show how the demand for oats as livestock feed has declined, while demand for corn has grown.

Figure 1

U.S. Grain Fed to Livestock

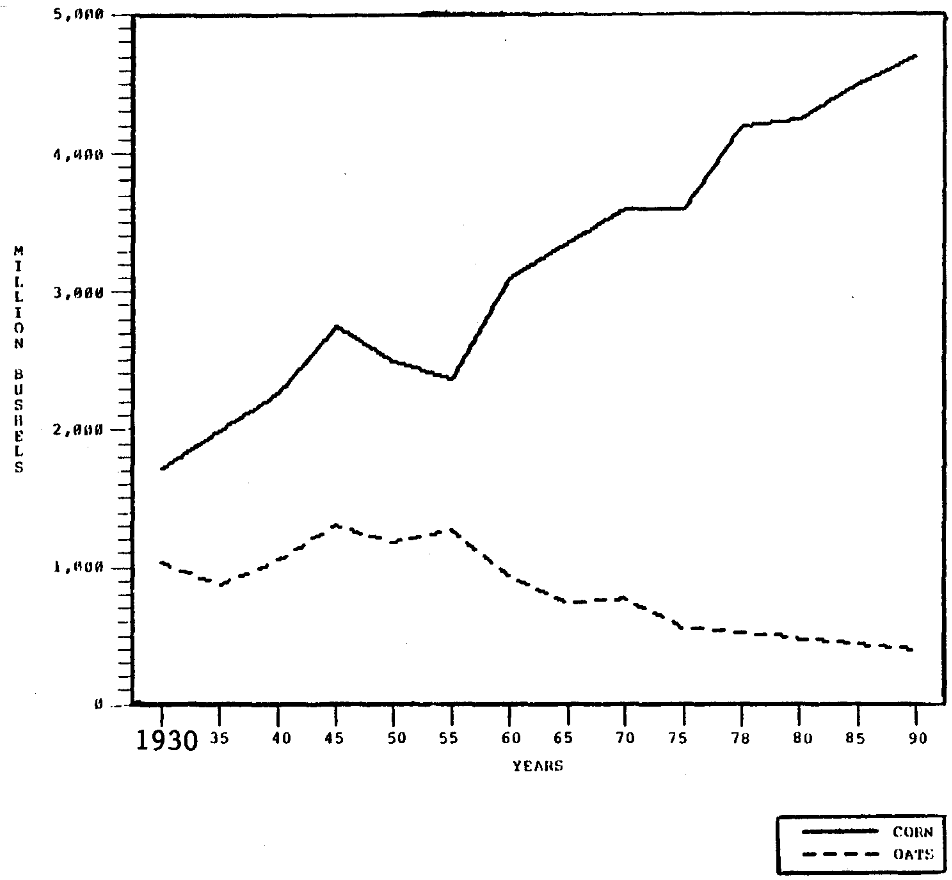

Table 1

	Corn Fed	Oats Fed
	(million bushels)	
1930	1,712	1,037
1935	1,991	880
1940	2,258	1,052
1945	2,747	1,315
1950	2,482	1,182
1955	2,366	1,281
1960	3,092	943
1965	3,362	742
1970	3,592	778
1975	3,592	562
1978	4,194	528

The export demand for oats as compared to corn presents a similar picture:

Figure 2

U.S. Corn and Oat Exports

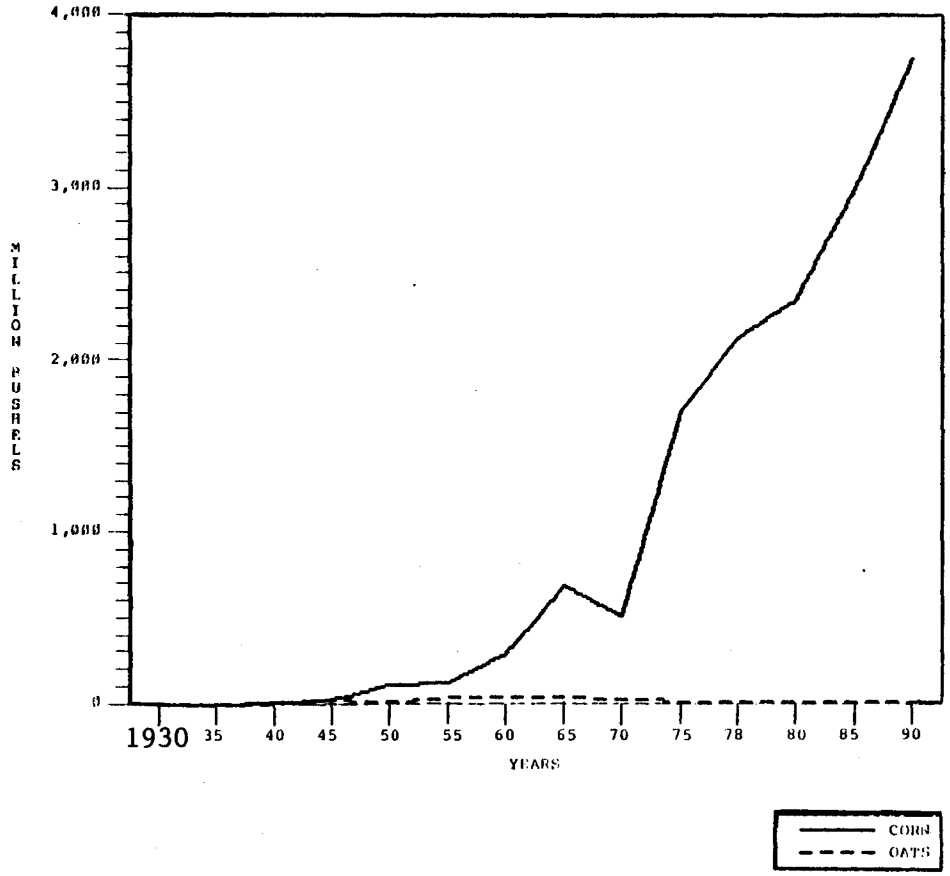

Table 2

	Corn Exports	Oats Exports
	(million bushels)	
1930	2	2
1935	-	-
1940	15	-
1945	20	18
1950	117	7
1955	120	29
1960	292	29
1965	687	34
1970	517	19
1975	1,711	14
1978	2,133	13

There has been no target price established for oats by the U.S. Department of Agriculture as has been the case for corn, barley, and other major feed grains. By not having a target price for price insurance, growers have another reason for cutting back on oats production.

Reasons for Growing Oats

The question may well be asked "Why do producers continue to grow oats at all, in view of the low net return per acre?" A survey was conducted in Minnesota recently and the reasons given by producers for growing oats were as follows -- in the order of importance:

1. As a nurse crop to establish seedings of small-seeded legumes.
2. As a rotation crop for controlling weeds, insects, and erosion.
3. For distribution of labor.
4. It is a dependable crop.
5. Net return per acre.

In the same survey, when asked what were the major uses of the crop, producers stated the number one use was as livestock feed, and the number two use was the need of oats straw for livestock bedding.

The Future of Oats Production - 1980 through 1990

It is obvious that one of the possibilities for increasing production is to have a major breakthrough to improve yields per acre. The possibility of a major genetic breakthrough which would dramatically increase yields of oats appears rather slight. Relative to trend, the current yields of approximately 54 bushels per acre for the U.S. are expected to reach 65 bushels per acre by 1990. However, this will be insufficient to prevent a continued decline in U.S. production which by 1990 is expected to be 400 million to 450 million bushels, and for the four commercial oats-producing states to be 225 million to 250 million bushels. By 1990, it is forecast that only 30% of the oats from the four commercial states will move to market, and this would mean that only 70 million to 75 million bushels of oats will be available to the milling industry whose annual needs will be 55 million to 65 million bushels by that time.

The position of the milling industry is that sufficient supplies of milling quality oats have been available at rather reasonable premiums over the price of feed oats. These premiums in recent years were in the area of 3% to 10%. It is projected that these premiums will rise to 15% to 20% over feed oats by 1990. It is possible that more oats will have to be grown under a form of contract program at that time in order to assure that the milling premiums are paid to the growers, thus assuring that they maintain production.

Quaker has been involved in two programs that deal directly with producers. One is an oats contract program in which premiums are paid directly to growers for furnishing milling quality oats, and the other is an oats improvement program with students of vocational agriculture. In both cases, it has been established that with the proper incentive - higher price in the case of the contract program or other reward in the case of the oats improvement program - higher yields are attainable than those generally reported in the commercial oats producing states. Many instances of 100 bushels per acre and higher are obtained. This reveals that current varieties have a yield capability much higher than is being reported. In order to reach this yield capability, it requires that higher quality soil be used than most growers are willing to allocate to oats under the present situation, and that a much higher degree of management can be applied if the rewards are sufficient. The overriding factor is that producers need more attractive marketing incentives, which in plain terms is the payment of sufficient premium for milling quality oats at the farm level. With this incentive, the milling industry can be assured of sufficient quantities of oats for the future.

In total, the question we face as Oatworkers is, "How can demand for oats be increased?" There is considerable evidence that oats have unique feeding value for certain classes of livestock - particularly dairy cattle and young hogs. The protein quality and quantity of oats are excellent; dietary fiber is present at reasonably good levels; the palatability of oats as forage or silage is superior. It seems rather obvious that a "selling job" has to be done to improve the image of oats. And who is better equipped to do this than members of the American Oatworkers?

I believe the milling industry will take positive steps to improve the image of oats and "sell" the nutritive values of oats for humans. I challenge the American Oatworkers to do their own "selling job", particularly on oats as livestock feed.

III. SPECIAL REPORTS

OATS IN TEXAS ACROSS THREE CENTURIES 1/ And Progress In Breeding Improved Varieties For Texas Conditions

Irvin M. Atkins, Professor Emeritus, TAMU

Oats and other small grains were brought into Mexico by the Spanish soon after Cortez forced the submission of the Indians in the Mexico City area and began settling the country. All crops and livestock were brought northward as the country was settled, wheat reaching Saltillo by 1575 and to the north side of the Rio Grande by 1581. Wheat and barley were important crops along the Rio Grande from El Paso, Presidio to the Gulf and in northern Mexico from 1684 to 1850.

The first recorded planting of oats in Texas, which has been found, was that by the Canary Islands immigrants, who reached San Antonio on March 9,1731. They immediately planted crops and vegetables and oats is one of the crops mentioned. All missions were planned to be self supporting and, as they were established, the statement is made that " corn and other grains were planted". The writer has found no record of harvesting of oats is this period so it seems that oats did not become established as a crop. The Spanish made many explorations into Texas in the 1600's and 1700's so it is possible that oats, even Red Rustproof and wild types, could have been introduced several times. (See 1977 Oat Newsletter, p.39, " Who sowed our wild oats".

Some 100 years after the Spanish settled at San Antonio, European immigrants settled in South Texas and the Edwards Plateau areas. Undoubtedly, all types of seed were brought to Texas by them but few records of varieties or types of the crops are found. There are statements that " all European cereal crops do well in the Edwards Plateau"., but in other areas there appear to be few success stories with any of the small grains. One Leon County rancher stated in 1837 that, " We grow no oats or barley, having no use for them. The cattle, sheep and horses can feed themselves on the range the year round".

Not until North Central Texas was settled did oats become an established crop. The major influz of immigrants came into this area from 1840 to 1880, into the Rolling Plains area from 1870 to 1900 and into the High Plains from 1890 to 1920. These immigrants were from the Southeastern, northeastern and Midwestern states, with their ancestors coming originally from Northern and Central Europe. The food grains, corn and wheat, were those needed immediately and oats were slower in becoming established. The first census of 1866 shows 40,000 acres of oats. The Red Rustproof oats were introduced after the Civil War and the acreage jumped to 300,000 in 1880 and to 847,000 by 1900.

1/ Taken from " A history of the small grain crops in Texas through five centuries, 1581-1976. Texas A&M University Historical Series Bulletin No. (In press). By I.M. Atkins.

Two early demonstations of the adaptation of oats in the Rolling Plains area were made by people attached to the early army posts established to protect the settlers from Indians. Jesse Stern, the Comanche Indian agent at Camp Cooper (Shackelford County) in 1853 broke the sod and successfully grew oats along the Clear Fork of the Brazos River. Also, in 1869, Colonel Whaley, who was stationed at Fort Sill, Oklahoma, saw an opportunity to make money supplying the Fort with grain. He resigned and settled in the bend of the Wichita River in Clay County Texas where he grew from 15,000 to 20,000 bushels of oats each year and received $1.25 per bushel from the Army. The Railroads set up demonstration plots and fields along their routes to promote the sale of land. These were located at Gainesville, Comanche, Baird, Stanton, Midland and other locations.

The first field of oats grown on the High Plains was in 1879. Ceasar Romaro used oats to help establish a stand of alfalfa at Old Tascosa (near Amarillo). The crop grew as tall as a man and were harvested for hay with hand sickles. A year earlier a field was seeded on the T-Anchor Ranch, near Canyon, but a herd of buffalo found and destroyed them before harvest time.

Production of oats reached a peak in 1919, when 62 million bushels were produced. Grain production has declined recently owing to more extensive use of the crop for winter and spring pasture. From an average production of 36 million bushels annually from 1916 to 1930, the average has dropped to only 16 million bushels for the period 1966-75. Drought, winterkilling, diseases, insects and use of the crop entirely for forage reduces the harvested acreage to less than one-half that seeded.

Early records in Texas mention the varieties Prince Edward Island, Black oats, Suprise, Henry, Black Tartarian, Egyptian and others. Egyptian oats were introduced from Scotland, Egypt and Europe. They were recommended for winter pasture. The Red Rustproof oats appeared in Texas after the Civil War and soon replaced most others. We were not able to come up with any additional information on their origin, than that reported some time ago by Coffman and Morey. From 1890 to 1930, a considerable industry developed in the Dallas-Sherman area to provide Red Rustproof oat seed to the Southeastern states. Cotton was King in that era and the horse or mule the power source on the farm. Oats were grown for feed and the oats were fed in the bundle so no seed for replanting was produced. These growers looked to Texas to supply oat planting seed.

The Winter Turf and Culberson oats are mentioned in literature from 1890 to 1920 but it appears that they never did occupy any substantial acreage in Texas.

<u>Research:</u> The Texas Agricultural Experiment Station was established in 1889 and soon began to test varieties of many crops. Seed was furnished to farmers for trial with a request that a report be made of the success or failure of crops or varieties.

Seed of crop varieties were obtained from adjoining states and the U.S. Department of Agriculture and introduced seeds and plants were available from the U.S. Patent Office at that period. The U.S. Department of Agriculture established field experiment stations at Amarillo, Channing, Chillicothe and San Antonio soon after 1900. Crop adaptation and variety testing studies were initiated. The Texas Agricultural Experiment Station established the Substations No. 5 and No. 6 at Temple and Denton in 1911. Variety testing and selection breeding were initiated at this time. From this work, the variety Nortex was released in 1926 and was the major variety grown in Texas for many years. The Ferguson Seed Farms, Howe, Texas developed and distributed Ferguson 71 oats in 1917 and Ferguson 922 oats in 1926, all strains of Red Rustpfoof.

Research work on oats was enlarged in 1930 and coordinated with the regional programs of the U.S. Department of Agriculture. I.M. Atkins was stationed at Denton and E.S. McFadden at College Station to work in cooperation with P.C. Mangelsdorf of TAMU. The crown rust resistant varieties Victoria, Bond, Santa Fe, Landhafer, Trispernia and others were introduced in this period and extensive breeding programs to transfer this resistance to the winter-type oats followed. The varieties Ranger, Rustler, Fultex and Alamo were released from this program, providing some protection from crown rust until Victoria blight reduced their usefulness. Alamo-X, developed by irradiation of Alamo, was an important improvement because of its leaf and stem rust resistance, resistance to blight and greater hardiness.

Severe winterkilling of oats occurred in 1928,1930,1933,1935, 1943 and 1947 stimulated the breeding of more winter hardy oats. Efforts from 1930 to 1950, utilizing cold tolerance of the Winter Fulghums, gave rise to the new varieties Mustang, Bronco, Norwin and Alamo-X. The Oklahoma varieties Wintok and Cimmaron were also distributed in Texas.

The Red Rustproof strains were weak strawed and not well adapted to combine harvesting. Slow but gradual improvement in plant type has come with all new strains released in Texas. The first improvement came in Fultex and Alamo and the Coker variety Victorgrain but all later succembed to Victoria blight. Plant type and grain size was improved in Alamo-X, Houston, Cortez, Coronado and TAM O-312. While some of these are perhaps too tall under some conditions, they generally will stand for direct combine harvesting. On the other hand, with modern hay-making machinery, there is considerable interest in tall varieties for the production of oat hay..

Progress in breeding oats: In plant breeding over a long perid of time, a breeder probably frequently asks, " Am I making progress"?. Fortunately in our work we have kept one measuring stick, that of the Red Rustproof almost universally grown in 1930, Nortex and New Nortex in this instance. Very recently it has been dropped from some yield trials. In Table 1 we have tried to measure the improvement by comparing the new variety with Red

Rustproof, as represented by New Nortex. Varieties have been grown for varying periods of time, but all can be compared for the same period with New Nortex, the type grown in Texas since 1875. The advantage of the new variety, or lack of advantage, then is shown in percentage of Red Rustproof.

Confession is good for the soul: We must confess that in many instances we cannot show a yield advantage for the new variety. We do feel that we improved the varieties in other ways. The first varieties released were Ranger, Rustler, Fultex and Alamo (all Victoria derivatives and all susceptible to Victoria blight). Suprisingly, these showed more advantage yield wise in the colder parts of the State than they did in the rust prevalent area. It is possible that Victoria blight may have influenced this. Ranger and Rustler provided good protection and high yields in South Texas for a time, plus improved forage yields,1938-50.

Severe winter killing during the late 1920's through the early 1940's pointed emphasis toward improving cold tolerance. Mustang, Bronco, Norwin and Alamo-X were developed in this program and we borrowed Wintok and Cimmaron from Oklahoma. These varieties were not adapted to South Texas but provided better forage producers for west Texas. Yields were better than Red Rustproof at several stations.

Not until the Coker varieties Suregrain and Moregrain; and, the Arkansas varieties Ora and Nora were available could we show significant advances in grain yield over New Nortex. Yet, with their specific resistance, when they became susceptible, they "went out like a light" and it was back to the drawing board for the breeder. Used for winter pasture under the long, mild winters of South Texas, such varieties may be killed in the seedling stage resulting in complete failure for the grower.

Combinations of genes for rust resistance, together with considerable tolerance reaction, was brought together by Paul Pawlisch, the writer and others in Cortez and Coronado. The best plant and grain type yet achieved in a Texas variety also made them satisfactory. These have shown significant yield increases over New Nortex at all locations and are still being grown on a considerable scale.

A high type of specific resistance, from Avena byzantina, or sterilis was utilized by Milton McDaniel in the development of TAMU 0-312 and by Coker's Howard Harrison in Coker 227 and 234. These have shown large increases in grain yield and also are superior forage varieties. However, already 0-312 has isolated a new race that in 1979 caused marked reduction in yield so perhaps we shall "go back to the drawing board", again.

So, while we have not made spectacular records in new varieties of oats in Texas, we feel that much as been accomplished. Varieties now available can be fall seeded with reasonable hope of survival and the production of winter pasture over all the State. Instead of growing oats for "horse-power", we grow them for forage and grain- with the grain minor under many instances. The average grain yield ranges from 30 to 40 bushels per acre most seasons, whereas 40 years ago it usually was 20 to 30 bushels. Our greatest acreage was in 1955 when 2,834,000 acres were sown. More than half the acreage is grazed to maturity most seasons. In 1971,less than 10 percent of the seeded acreage was harvested. A considerable acreage is used for hay.

<u>That amazing Red Rustproof oat</u>: Having worked with and around Red Rustproof since 1930, the writer continues to learn something. As Randy Dangerfield would say, " they don't get no respect". They have many faults, among them are weak straw, insufficnet cold tolerance, low forage production when planted late, heavy husks etc but, we have to admit, that it is still pitching after use by Texas farmers since 1875.

Red Rustproof has that tolerance, I call it that second catch on the door, which permits it to recover or ward off so many hazards. The writer has seen it thinned to 20 percent stand then yield more than Mustang that survived 100 percent. likewise, when a new race attacks a variety with specific resistance, it may be killed but Red Rustproof will rust very slowly and produce some yield. A study of root organisms on varieties of oats and other crops several years ago, showed that Red Rustproof was resistant to most of the soil fungi. So, no other variety has contributed so much to oat production in the South. It was the major variety in all Southern states from 1875 to 1940.

<u>Some Atkins philosophy</u> for what it is worth is that, if I were doing it over, we would not give so much emphasis to rust in the Central Blacklands and West Texas. For South Texas, yes. We still need some real improvements in standability of oats, increased nutritional value for livestock and humans and use for other special purposes. Unless we do make such improvements, oats will continue to decline in competition to corn, grain sorghum and soybeans. Good luck to you.

Note: A request form for the"History of small grains in Texas" will be sent to you soon. Return this if you want a copy. Others may order.

Table 1. Comparisons of improved oat varieties and New Nortex, long-time check variety, in bushels per acre and by percentage measure at Texas locations, 1931-79.

		Average yield, bushels per acre				
Item	Denton	Temple	College Station	Iowa Park	Chillicothe	Bushland
1938-54: No. tests	13	9	12	18	17	9
New Nortex check	62.2	56.0	63.8	66.5	53.1	47.8
New Var: Fultex	54.6	51.9	49.6	61.7	53.4	51.0
Adv.: Fultex	-14%	-8%	-16%	- 8%	16%	7%
1950-62: No. tests	10	16	15	10	10	13
New Nortex check	62.3	54.3	52.4	82.6	44.4	61.5
New Var: Alamo	59.4	44.7	56.6	75.4	46.9	66.5
Adv.: Alamo	- 5%	-22%	- 8%	-10%	6%	- 2%
1961-72: No. tests	8	9	7		10	
New Nortex check	69.3	62.1	44.1		24.1	
New var: Alamo-X	60.1	48.7	44.4		29.7	
Adv.: Alamo-X	-15%	-28%	1%		23%	
1943-65: No tests	19	20	10	18	22	13
New Nortex check	59.1	56.6	51.2	66.7	43.5	52.2
New var: Mustang	62.2	51.5	52.2	73.4	45.5	64.0
Adv. Mustang	5%	-10%	1%	10%	5%	23%
1952-75: No. tests	22	18		13	25	10
New Nortex check	65.1	59.1		68.0	33.7	64.1
New var: Bronco	66.2	48.9		75.2	37.2	54.8
Adv. Bronco	2%	-20%		11%	10%	-17%
1961-74: No. tests	12			3	13	10
New Nortex check	68.7			39.1	29.9	104.9
New var: Norwin	64.8			59.8	37.4	116.8
Adv. Norwin	6%			53%	25%	11%
1942-72: No. tests				18	30	15
New Nortex check				66.5	38.1	58.5
New var: Wintok				61.9	38.4	66.2
Adv. Wintok				-8%	7%	13%
1942-72: No. tests				11	21	12
New Nortex check				70.5	33.3	66.6
New var: Cimarron				77.5	34.7	77.5
Adv. Cimarron				10%	4%	16%
1942-68: No. tests				22	27	16
New Nortex check				64.9	40.3	62.3
New var: Fulwin				56.9	39.6	59.5
Adv. Fulwin				-14%	-2%	-5%

Table 1 continued.

Item	Denton	Temple	College Station	Bee-ville	Chilli-cothe	Bush-land
	Average yield, bushels per acre					
1937-58: No. tests		19	19	9		
New Nortex check		53.5	50.1	10.4		
New var: Ranger		45.7	57.8	23.9		
Advantage:Ranger		-17%	15%	130%		
1937-50: No. tests		8	8	2		
New Nortex check		53.5	42.6	4.0		
New var: Rustler		48.0	46.7	20.9		
Advantage: Rustler		-11%	10%	500%		
1958-68: No. tests	6	11	15	9		
New Nortex check	70.6	63.2	50.6	20.1		
New var: Suregrain	73.7	54.3	57.9	41.6		
Advantage: Suregrain	4%	-16%	14%	107%		
1958-69: No. tests	12	11	12	10	8	
New Nortex check	70.4	63.2	46.7	18.9	24.1	
New var: Moregrain	71.4	57.3	58.0	32.8	27.6	
Advantage: Moregrain	1%	-10%	24%	74%	15%	
1961-79: No. tests	6	11	15	9	10	
New Nortex check	68.7	54.9	34.8	22.0	23.5	
New var: Ora	78.7	67.8	45.7	25.2	27.8	
Advantage: Ora	15%	24%	31%	14%	18%	
1965-79: No. tests	11	10	4	4	13	7
New Nortex check	78.4	57.2	37.1	18.6	40.6	108.9
New var: Nora	87.2	69.2	39.2	13.0	59.2	149.5
Advantage: Nora	11%	21%	6%	-43%	46%	37%
1967-79: No. tests	12	11	10	8	9	
New Nortex check	78.4	54.3	33.8	17.8	36.8	
New var: Cortez	85.7	73.6	62.8	37.4	50.7	
Advantage: Cortez	9%	36%	86%	110%	38%	
1967-79: No. tests		10	9	8		
New Nortex check		59.6	32.3	17.8		
New var: Coronado		71.5	61.2	30.5		
Advantage: Coronado		20%	89%	71%		
1973-79: No. tests	5	6	3	6	6	
New Nortex check	72.4	48.3	38.8	14.9	52.1	
New var: TAM 0-312	102.1	76.1	61.5	40.1	77.9	
Advantage: TAM 0-312	41%	58%	41%	169%	49%	
1973-79: No tests	5	7	2	4	6	
New Nortex check	72.4	48.3	33.0	17.9	52.1	
New var: Coker 234	104.5	70.3	65.4	39.0	79.0	
Advantage: Coker 234	44%	46%	98%	118%	52%	

ULTRASTRUCTURE OF OAT ENDOSPERM

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SEA-AR, USDA

The structure of the endosperm of five oat cultivars was studied using light and electron microscopy and histo- and cyto-chemistry. The aleurone was typically composed of a single layer of cells and occasionally two layers of cells. Major organelles of the aleurone cells were; aleurone grains, lipid bodies, plastids, mitochondria, ER, and a centrally located nucleus. The subaleurone starchy endosperm region contained numerous protein bodies and a few small starch granules, whereas, the central starchy endosperm region was composed largely of starch with protein bodies interspersed. The protein bodies were apparently of one morphological type and were highly variable in both size and shape. They ranged in size from 0.3 µm to 5 µm in diameter and ranged in shape from round to angular to irregular masses. All the protein bodies shared a common characteristic, however; they stained medium electron-dense in the electron microscope and contained rounded electronlucent inclusions. The protein bodies, particularly those from the subaleurone region, were associated with densely stained regions containing ribosomes and ER. Two types of starch granules were observed in both regions of the starchy endosperm; compound granules composed of individual angular grana, and simple rounded granules composed of a single granum.

Greenbug Resistance in Oats

Norris E. Daniels and Louis Chedester*
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In 1979, 504 oat selections from the USDA World Collection were tested in the greenhouse for biotype C greenbug resistance. Of these, 14 had ratings of 3.1 to 3.8, table 1. Thirty to 40 seeds were planted per row in large flats. The plants, when about an inch tall, were infested with greenbugs. After the plants were heavily damaged, ratings of 1 through 6 were made. A rating of 1 = no damage; a rating of 6 = a dead plant.

Table 1. Greenbug resistant oat selections, Bushland, 1979.

P.I. Number	Designation	Source	Rating
290047		Hungary	3.1
290074	Lovaszpatonai-sa	Hungary	3.6
287475	Baerwalder	Germany	3.6
290086	Bellyei 1601	Hungary	3.5
290087	Eezterhazi 16	Hungary	3.5
290094	V.I.R. 1714	Hungary	3.5
290095	Schottischer Fah	Hungary	3.5
287340		Germany	3.5
287341		Germany	3.5
294673	Jezewski	Bulgaria	3.7
294679	Sowetskii	Bulgaria	3.7
294687	Mongolia	Bulgaria	3.8
294697	Bulgarien 5	Bulgaria	3.7
294698	Bulgarien 905	Bulgaria	3.7

*Respectively, Associate Professor and Research Associate, The Texas Agricultural Experiment Station, Bushland.

Oat Smut in Wisconsin - Update

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University of Wisconsin

The most unusual smut epidemic of 1977 has not repeated itself in the past two years - fortunately. However, it is evident that considerable shifts in the virulence of the smut organism have been developing.

The 1979 results for several cultivars are given in Table 1. Some, such as Froker, Lang, Lodi, Orbit, and Wright, were quite susceptible. Others like Marathon and Moore showed somewhat higher infection than in earlier tests. Bates, Goodland, Jaycee and Lyon continued to look resistant.

Lest we get too complacent, Table 2 suggests what can happen. Lyon and Moore developed considerable infection with the Lodi collection. Marathon, Moore, and Wright had rather high infections with the Wright collection. The Froker collection, as might be expected, gave especially high infection on Froker. Goodland and Jaycee held their own with these collections. As an indication of what used to be, there were many 0's with the "Older" collection, but even here Froker had some infection. The averages for all 14 collections tested indicate that Dal, Marathon, and Moore could have some problems in the future.

It is apparent that with a foundation and certification program that takes the smut threat into account, cultivars with other desirable characteristics can continue to be grown even after a virulent smut population has developed on them. Field inspection, and seed treatment, when indicated, should insure an adequate supply of smut free seed.

Table 1. Smut reaction of several oat cultivars in 1979.

Cultivar	% smut: Wright[a] smut	% smut: Mixed[b] smut	Cultivar	% smut: Wright smut	% smut: Mixed smut
Ajax	52	43	Lang	30	2
Bates	1	1	Lodi	58	12
Clintland 64	13	6	Lyon	2	0
Dal	17	3	Mackinaw	11	19
Froker	37	24	Marathon	29	3
Garry	33	9	Moore	20	3
Goodland	4	0	Orbit	33	6
Gopher	28	68	Otee	23	33
Holden	12	17	Rodney	51	2
Jaycee	2	0	Stout	20	53
Lancer	30	35	Wright	45	5

[a]Vacuum inoculation
[b]Blender inoculation

Table 2. Virulence of oat smut collections on selected cultivars in 1979.

Cultivar	Percent smut[a]				
	Lodi collection	Wright collection	Froker collection	Older collection[b]	Ave. from 14 collections
Ajax	58	43	75	64	49
Dal	27	38	8	0	11
Froker	40	65	85	15	38
Goodland	2	8	9	0	3
Jaycee	6	5	1	0	1
Lodi	78	66	17	0	28
Lyon	36	1	2	0	5
Marathon	22	39	10	0	11
Moore	45	38	6	0	14
Rodney	85	59	21	0	29
Wright	55	62	30	0	22

[a]Vacuum inoculation
[b]Maintained on States Pride

An Appearance of Victoria Blight

P. G. Rothman and M. B. Moore
SEA-AR, USDA and University of Minnesota

After an absence of some 16 years, Helminthosporium victoriae reappeared during the 1979 growing season on the St. Paul Campus and at the branch experiment station at Rosemount.

The disease had the usual devastating effects on susceptible lines and cultivars. These included sparce stands, death of plants at any stage of growth and lodging with accompanying root rot and the eventual blacking of the lower nodes by sporulation of the fungus. The fungus itself was identified only by the accompanying symptoms on lines and cultivars known to be susceptible or suspected of the possibility because of their parentage as well as by the presence of H. v. type spores on the affected plants.

The prime targets for the fungus were 2 stem rust resistant lines resulting from single plant selections from Wis.X1588-1 and Wisc.X1588-2. The pedigree of both lines is VICTORIA//HAJIRA/BANNER/3/FULTEX/4/CANUCK/5/ ILL.HULLESS/EARLY CHAMPION. They have been in the International Oat Rust Nursery since 1973 as MN 72001-65 and MN 72066-84.

Other susceptible cultivars and lines included: Vicland, Ascencao, Ark 674 (CI 4529), Cld/Garry-5^6/Magnifique 28 (X717), X-15-2-2/BMAB101, PUR61353//BADJA, DNLS/BMAB101 and X57BL (BMAB101). The last 4 lines are derived from previously untested lines for H. v. from Coffman's BLACK MESDAG/ AB101 (probably BLACK MESDAG/ASCENCAO) cross.

Whether there may be a linkage between the gene(s) for stem rust resistance and susceptibility to H. v., as reported for crown rust, it is not known.

The source of primary inoculum for this reoccurrence of H. v. cannot be accounted for except that it seems to be of local origin. H. v. was last used in the field in 1963 at St. Paul in testing for resistance. Since then the susceptible Ascencao, Victoria and occasionally Vicland have been grown without attack. The other above lines were first grown in the St. Paul nurseries around 1967 and also have been disease free until 1979. Seed of MN 72001-65 and MN 72066-84 increased in 1978 carried H. v. spores but that increased in 1976 did not. No 1977 seed increase was available for examination. Since all nursery lines are processed through the same threshing machine it is likely that any or all lines could be contaminated from only a single diseased line. That the original source of inoculum was probably local is suggested by the lack of H. v. in MN 72001-65, MN 72066-84 and Ascencao in the 1979 International Oat Rust Nursery grown at St. Paul. This seed was supplied by R. A. Kilpatrick from an increase at Aberdeen, Idaho.

The long and apparently complete absence of H. v. from the St. Paul nurseries, where from the late 1940's to the early 1960's it was so abundant, indicates the possibility that rather extensive breeding programs might be carried on for a considerable time with susceptible material before the advent of the disease, if occasional testing for resistance is not done.

Rusts of Oats in 1979

A. P. Roelfs, D. L. Long, and D. H. Casper
SEA-AR, USDA and University of Minnesota

In 1979, crown rust was more severe than in recent years throughout the Southern States. Overall losses in south Texas were limited because of the resistant cultivars grown in this area. Losses in late maturing fields in north central Texas were the most severe since 1975. The first crown rust infections in southern Minnesota were observed in late June, 15 days later than normal. Due to a lack of crown rust resistance in the commonly grown oat cultivars in the northern Great Plains, scattered late maturing fields became severely infected. Crown rust caused more yield loss in Minnesota and South Dakota oat fields in 1979 than did stem rust.

Oat stem rust was first observed during 1979 in a Beeville, Texas forage nursery on February 27. In this region, vast quantities of inoculum were produced and losses were moderate. A rapid increase in disease was anticipated in central and northern Texas, but the spring rainfall was less than normal, resulting in unfavorable conditions for disease increase. Also, a higher percentage than normal of the south Texas oat rust races were avirulent on genes Pg 2 or 4. These resistances are used in the commercial cultivars grown elsewhere. By mid-June, traces of oat stem rust were present from northern Kansas to southern Minnesota. The earliest centers of stem rust infection in Minnesota were caused by rust inoculum that arrived in late May. These centers were widely scattered, and secondary spreads indicated that they were as infrequent as one per county. Although the initial infection was 20 days earlier than normal, the low initial prevalence of the disease plus marginal environmental conditions in June offset the potential effect of early disease onset on the epidemic. Thus, moderate losses occurred in the initially infected fields and light to moderate losses occurred in the late planted fields in the Dakotas and Minnesota.

Oat stem rust race NA-27 was the most prevalent race identified from 1355 isolates obtained from 494 collections made in the U.S.A. NA-27 comprised 94% of all isolates (Table 1) and was the most commonly identified race in all states. The frequency of NA-16 was much less than 1978 and was similar to the epidemic year of 1977. As in previous years, races NA-1, 2, 3, 5, and 7 were only found in Texas.

Publications

1. Simons, M. D., P. G. Rothman, & L. J. Michel. 1979. Pathogenicity of Crown Rust Isolates from Buckthorn and from Oats Adjacent to and Distant from Buckthorn. Phytopathology 69:156-158.

2. Martens, J. W., A. P. Roelfs, R. I. H. McKenzie, P. G. Rothman, D. D. Stuthman, and P. D. Brown. 1979. System of Nomenclature for Races of Puccinia graminis f. sp. avenae. Phytopathology 69:293-294.

3. Roelfs, A. P., D. H. Casper, and D. L. Long. 1979. Races of Puccinia graminis f. sp. avenae in the U.S. during 1978. Plant Disease Reptr. 62:748-751.

Table 1. Physiological races of stem rust identified from 1979 collections made from oats.

State	Source	Number of Collec.	Number of Isol.	Percent of the isolates of each race[a/] NA-1	NA-2	NA-16	NA-26	NA-27	Others
CA	Wild Oats	1	3					100	
FL	Nursery	2	6					100	
IL	Nursery	2	6					100	
IA	Field	9	23					100	
	Nursery	16	43			9		91	
KS	Field	1	3					100	
	Nursery	3	5			20		80	
MN	Field	68	187			*[b/]		98	2
	Nursery	36	98			7		92	
	Wild Oats	9	24					100	
NE	Nursery	5	13				8	92	
ND	Field	29	83					100	
	Nursery	22	64			2		98	
	Wild Oats	53	148			4		95	1
OK	Field	1	2			100			
PA	Nursery	3	8					100	
SD	Field	34	89					100	
	Nursery	15	44					100	
	Wild Oats	12	31			6		94	
TX	Field	8	12	17				50	33
	Nursery	108	317	7	1	2		85	5
WI	Field	58	149					98	2
	Nursery	2	6					100	
USA	Field	208	548	*		*		97	2
	Nursery	214	610	4	*	3	*	90	3
	Wild Oats	75	206			4		96	*
	Total	497	1364	2	*	2	*	94	2
Mexico[c/]	Nursery	20	51			2		98	
	Wild Oats	9	24			21		75	4
Canada[d/]	Field	3	9				22		78
	Nursery	18	54				15	6	79

a/ = See Phytopathology 69:293-294 for description of races

b/ = * = less than .6%

c/ = Collections were from western Mexico in the spring and eastern Mexico in the fall.

d/ = Collections from Ontario, Canada.

IV. CONTRIBUTIONS FROM OTHER COUNTRIES

OAT BREEDING IN ARGENTINA

Hector Jose Martinuzzi and Hector Leopoldo Carbajo
Ministry of Rural Affairs, Argentina

The Experimental Farm of Barrow serves an area of 3,150,000 ha. Of this, 200,00 ha, or 6.6%, are sown with oats. In acreage, oats was exceeded only by bread wheat, which was sown in 22.4% of the area.

Varieties of *Avena sativa* were sown on 75% of the oat acreage, with varieties of *A. byzantina* occupying the remaining area. Most of the acreage was grazed to some extent before harvesting, but only 3% of the total acreage was completely utilized by grazing.

Adequate rain and a moderate winter resulted in generally favorable growing conditions during 1979. Some hail and late frost occurred but resulted in only minor damage.

Stem rust was very severe, averaging 33.4%. All varieties appeared equally susceptible. Crown rust was not as severe, showing an average infection of 10%. There were great differences in susceptibility between the two *Avena* species, with an infection mean for *Avena sativa* of 9.5% and for *Avena byzantina* of 24.1%. Other diseases that were not important, with levels below 5%, included *Erysiphe graminis*, *Ustilago*, and *Pseudomonas*.

Outbreaks of the yellow aphid (*Metopolophium dirhodum*) were moderately severe but the damage was not great. Significant, but less important attacks of green bug (*Schizaphis graminun*) and army worm (*Pseudaletia* sp.) also occurred but with less frequency.

On the basis of prior experience with specific growing conditions, and visual inspection, the average yield of oats that were not grazed was estimated to be 2,200-2,300 kg/ha. The average yield of oats that was grazed was 700 kg/ha.

The oat breeding program at Barrow has the following major objectives:

1. Higher grain yield
2. Higher forage yield
3. Resistance to the green bug (*Schizaphis graminun*)
4. Resistance to crown and stem rut (*P. coronata* and *P. graminis*)
5. Improved grain quality, including both increased protein percentage and increased groat percentage
6. Resistance to frost and to drought
7. Resistance to lodging

The first four of these objectives are regarded as the more important, and when the program was begun there was an abundance of diverse material available, both local and introduced. There are now two groups of test lines and segregating populations that have promising agronomic characteristics, very good disease resistance, and good grain quality. Currently, the New York Oat Composite I from N. Jensen and the Genetic Pool *A. sterilis* x *A. sativa* from K. J. Frey are being used to increase rust resistance. The 630 entries of the oat collection and introduced lines were tested for green bug resistance. Twenty varieties showed different degrees of resistance to the biotypes in Argentina. Of these, C.I. 1579 and P.I. 186270 were most promising and some crosses have been made with them.

Secondary lines of investigation presently being pursued include "1. Trials to determine levels of damage resulting from infection of crown and stem rust, 2. Trials to determine hay production of commercial varieties, 3. Preliminary investigations in the application of gameticides to increase the amount of hybrid seed and to thereby increase genetic recombination and selection.

INTERSTATE OAT VARIETY TRIAL SERIES FOR AUSTRALIA IN 1980

Andrew R. Barr
South Australian Department of Agriculture

Oat breeders from New South Wales (N.S.W.0, Victoria, South Australia (S.A.) and Western Australia (W.A.) met in Sydney in October 1979 to discuss the need for an interstate oat variety trial. All delegates were in favour of such a series with the result that the inaugural trials will be sown in the 1980 season. Researchers in Queensland and Tasmania have been approached and it appears likely that these states will also be involved in the trials albeit on a smaller scale than the above mentioned four states.

At present there are interstate trials in three field crops in Australia. The very comprehensive Interstate Wheat Trial, which was established in 1970, has been highly successful and now involves some eight breeders, 16 sites in five mainland states as well as back up from cereal chemists and plant pathologists. There are smaller programmes involving Oilseed rape and barley. The interstate oat trial will be modelled on the barley trial series.

The aims of the trial series are as follows:

1. To evaluate the potential of crossbreds outside of their state of origin prior to release in the state of development. As can be seen in the table below, varieties bred in any of the Southern mainland states of Australia may be well adapted to any other of those states. Traditionally, Western Australian bred varieties have dominated areas in South Australia and Victoria and have even contributed to production in southern N.S.W.

2. To promote exchange of germplasm and information between breeders. Lines to be submitted by breeders are to encompass not only possible releases but lines of some particular merit, e.g., disease resistance, dwarfness etc. that are not intended for registration.

3. To integrate the activities of the Plant Breeding Institute, University of Sydney in the sphere of stem and crown rust research more closely with the breeders in all states. It is of interest to note that crown rust is not considered a major problem in Western Australia or South Australia yet it is of concern in Victoria and southern N.S.W. and is severe in Northern N.S.W. and Queensland. On the other hand stem rust is considered a major problem in all states although to a lesser extent in W.A.

This trial series will therefore enable breeders to have material tested against pathogens encountered in their home state. The devastating nematode *Heterodera avenae* only causes severe damage in S.A. and Victoria and BYDV occurs mainly in southern Australia, high rainfall situations being especially severe in Tasmania.

Salient features of the 1980 oat trials are: (details to be finalized by April 1980 so use only as a guide)

1. There will be a check variety from each participating state.

State	Variety	State of Origin
New South Wales	Cooba	N.S.W.
Victoria	Avon	W.A.
Western Australia	West	W.A.
South Australia	Swan	W.A.
Queensland	Stout	Purdue Univ.
Tasmania	Esk	TAS.

2. Each state will have the following trials

State	No. trials	Type
Victoria	3	Grain
Western Australia	3	Grain
South Australia	3	Grain
New South Wales--southern	1	One grazing, recovery grain yield.
--Sydney		Determination of Crown and Stem Rust resistances.
Queensland	possible 1	
Tasmania	possible 1	

It is hoped that in future years the entries may be evaluated under grazing in States other than N.S.W. and for hay.

3. Entries in 1980 will be approximately 25 comprising the following:

6 check varieties - as above
6 crossbreds from W.A.
6 crossbreds from N.S.W.
6 crossbreds from Victoria
0 crossbreds from South Australia (Programme initiated in 1977 no material available)

Entries from Queensland and Tasmania have been invited but are not yet finalized.

NEW SOUTH WALES OAT CROP 1979-80

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The area sown to oats is estimated at 750,000 hectares of which 401,000 hectares were harvested for a grain production of 528,000 tonnes giving an average yield of 1.32 tonnes/hectare. This was a reduction on the previous year when 587,000 tonnes were harvested from an area of 428,000 hectares at a yield of 1.37 tonnes/hectare. However, the 1979-80 harvest was the third highest on record.

The 1979-80 season differed markedly from the previous one. The 1978-79 season was characterized by abundant rain during the previous summer and late autumn-winter resulting in ample storage of subsoil moisture. However, as oats is very much a dual purpose crop, a large proportion of the crop was sown in early autumn. The wet winter resulted in less grazing than usual. A moist spring with mild temperatures enabled crops to maximize grain setting and filling and kept disease incidence at a low level.

In contrast, for the 1979-80 season there was little rainfall during the previous summer to replenish subsoil moisture. Reasonable falls of rain in the autumn-early winter enabled crops to be sown on time but dry weather during the winter resulted in many crops being heavily grazed by stock reducing potential grain yields. Grain falls of rain in late spring enabled crops to recover reasonably well. Diseases throughout the season were at a fairly low level.

Large Seeded Hull-less Oats

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The relatively small seed size of hull-less oats is one of several factors preventing the acceptance of hull-less cultivars by producers. The latest Canadian hull-less oat Terra, bred by Dr. R.I.H. McKenzie, Research Station, Winnipeg, Agriculture Canada, represents a major advance in yield over older cultivars such as Vicar and Brighton but still Terra is not grown widely. The groat weight of Terra is equivalent to the groat weight of common hulled cultivars but, for some reason, farmers expect the seed size of a hull-less kernel to be equal to a hulled kernel. We have managed to achieve and even surpass this objective in the Ottawa Research Stations breeding program to improve hull-less oats (Table 1).

Table 1. Groat Yield and Groat Kernel Size of Large Seeded Hull-less Oats Grown in Replicated Trials at Ottawa (Ott.) and Inkerman (Ink.), Ontario in 1979

Cultivar	Groat Yield (Kg/Ha)			Groat Kernel Wt (mg)		
	Ott.	Ink.	Ave.	Ott.	Ink.	Ave.
OA504-5	2870	3113	2991	37.0	31.0	34.0
-6	2552	2739	2646	41.6	42.3	41.9
OA507-2	2287	2791	2539	41.2	29.2	35.2
-3	1848	2339	2094	44.2	31.8	38.0
Terra	2061	2130	2096	22.8	19.2	21.0
Scott[1]	2497	2839	2668	23.6	20.9	22.2

[1]Groat yield calculated using value of 30.1% hull.

This advance in seed size became possible by using a very large-seeded hulled strain OA348 which was isolated in our daylength insensitive program. Many of the daylength insensitive strains typically flower early, develop grain over a long period of time and mature at the same time as sensitive strains. OA348 has the parentage CAV2700/Gemini/2/Rodney/3/5811a1-8B. The strain 5811a1-8B is a winter-type oat obtained from Dr. N. Jensen at Cornell University.

OA504-5 and OA504-6 were derived from the hybrid between the hull-less strain OA287-4 and OA348. OA287-4 has the parentage Gemini/6/Alaska/Gold Rain/2/Legacy/Victoria/3/RL453/4/RL339/5/Laurel.

OA507-2 and OA507-3 were derived from the hybrid between Terra and OA348.

The groats of all these large-seeded strains possess many surface hairs, but a breeding program to solve this problem is in progress.

Hull-less Oat with Few Surface Hairs on Groat

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The hairs on the surface of groats represents another constraint in the adoption of hull-less oats by producers. During threshing and handling these hairs break off and are liberated into the air and act as skin and respiratory irritants to operators. The hairs on the kernel surface are also thought to collect dust and spores leading to unsightly appearance. Several years ago we began a small project to isolate glabrous or bald groats. Selection OA 503-1 has been isolated and the main body of the kernel, except for the brush end, has definitely fewer surface hairs than most standard cultivars. The agronomic performance of OA 503-1 compared to Terra was determined in 1979 (Table 1).

Table 1. Groat Yield, Measured Weight and Kernel Weight of OA 503-1 and Terra Grown in Replicated Plots at Ottawa (Ott.) and Inkerman (Ink.), Ontario

	Terra			OA 503-1		
	Ott.	Ink.	Ave.	Ott.	Ink.	Ave.
Groat Yield (Kg/Ha)	1913	2478	2196	1844	2826	2335
Kernel Weight (Gr/1000)	22.0	19.2	20.6	30.2	29.8	30.0
Measured Weight (Kg/Hl) (as is)	52.7	49.3	51.0	63.0	63.5	63.3
Measured Weight (Kg/Hl) (surface hairs removed)	61.0	57.5	59.2	69.2	68.7	69.0
Percent increase in Kg/Hl	15.7	16.6	16.1	9.8	8.2	9.0

Note that the yield of groats is at least equal to that of Terra but that the kernel size and the hectolitre weights are much higher than that of Terra. Hectolitre weight can be used as a measure of kernel hairiness; hairy kernels fail to pack sufficiently in the measuring cup, whereas, hairless kernels pack more closely and produce high readings. Removal of the surface hairs results in a great increase in

hectolitre weight of OA 503-1. This is due mainly to removal of the hairs at the brush end of the kernel rather than to the removal of surface hairs.

It is not possible at this time to determine the parental origin of the bald condition. The parentage of OA 503-1 is as follows: CAV2700/Gemini/2/Rodney/12/CI3834/Beacon/2/Beaver/9/Exeter/2/Garry/Klein 6B/4/Beaver/Garry/2/Clinton/3/Roxton/8/Bond/2/RL1692/M. Ukraine/7/Alaska/Gold Rain/2/Legacy/Victoria/3/RL453/4/RL339/5/Laurel L10/6/2105/10/Alaska/Gold Rain/2/Legacy/Victoria/3/RL453/4/RL339/5/Laurel L10/11/CI7987/6/Alaska/Gold Rain/2/Legacy/Victoria/3/RL453/4/RL339/5/Laurel L10. There is still some variation in the degree of hairiness of the groats of OA 503-1 but selections have been made to improve the strain further. OA 503-1 has been used as a parent and bald kernels have been found in the segregating generations. Seed of OA 503-1 is being increased for experimental purposes.

Irrigation and the Kernel Weight of Oats

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Sixty cultivars arranged in single row 3 m long plots with 2 similar rows of spring wheat on either side and replicated 4 times were grown in two duplicate blocks in 1979. The plants in one block were irrigated 4 times at 2 day intervals shortly after heading to promote disease and those in the other block were sprayed regularily with maneb fungicide from late tillering to maturity to control disease. Very little disease developed due to the dry season. However 45 of the cultivars responded positively to irrigation, as measured by an increase in 1000 kernel weight of harvested seed, 14 showed no response and 1 responded negatively. Cultivars showing no response and having a reasonable kernel weight may be of interest to plant breeders for their tolerance to hot, dry weather. They included OA 338, Clintland 64, Glen, Rodney, Victory and OA 276-1. Non-irrigated kernel weight ranged from 20.0 to 30.1 g/1000 seeds and irrigated from 20.8 to 33.5.

The Influence of Herbicide on Septoria Development

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A 1.5 ha area of "dormoats" was sprayed in early June with bromoxynil herbicide (Brominal 1.3 L/ha) to control weeds. The oat plants ranged from late tillering to early boot stage of growth which was past the optimum stage for spraying. Damage to the tips of the leaves and to the middle of bent over leaves occured and appeared as white bleached areas. At this time natural infection of septoria (S. avenae f. sp. Frank avenae) was beginning to develop in the crop and appeared as typical small purple-brown lesions on leaves uninjured by spray. On damaged leaves lesions were more plentiful, a lighter brown color, much larger and contained many sporulating pycnidia. Thus the increased inoculum potential for secondary spread of the fungus was substantial in this damaged crop. Fortunately the weather remained dry at Ottawa in 1979 until maturity and the disease did not become severe. A few plants were noted with damaged areas with no increase in septoria indicating that plants may differ in their response. Thus the past summers experience is of interest because of the potential increase for septoria epidemics and the possible difference in response of oat plants. Septoria is a disease particularly important during the adult senescent phase of oat development leading to black stem but bromoxynil may prove useful in causing senescence in parts of young plants to permit screening for septoria resistance.

Trials for BYDV resistance of oats in Quebec, 1979.

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This year our BYDV resistance trials involved oats, barley, wheat, triticale and spring rye. It appears that BYDV resistance of our best oats is indeed approaching that of the "Yd_2" ethiopian barleys, but there is still a difference in favor of the Yd_2 barleys. Perhaps the next crosses will help us to get closer to our goal.

We have tested material obtained from a variety of locations this year, using a highly virulent BYDV isolate. It is noteworthy that many crosses with *Avena sterilis* originating from various research groups have produced lines with some BYDV tolerance or resistance, although *A. sterilis* also contains some parent lines which increase BYDV susceptibility. Reports on BYDV resistance in *Avena sterilis* will be issued in the near future.

The list below (Table 1) gives an approximate idea of the order of resistance of some of the most interesting oat lines:

Table 1. A list of interesting sources of BYDV tolerance in oats (*Avena* sp.)

From best to good	Other noteworthy lines (from best to good)
7 A 202.208	Ill 73-2664
AA 68-75 (= CN 1880)	C.I. 4492
78 AA 1435	O.T. 213
78 AA 1439	Q.O. 158.16 (= CN 1872)
78 AA 1447	Coker 227
78 AA 1448	X 2055-1
78 AA 1453	Coker 234
78 AA 1454	Y 248.32
78 AA 1475	72 C 3034
76 S 6-1454	72 C 3028
7 A 201.113	72 C 1246
7 A 200.33	72 C 1208
7 A 201.104	C.I. 8089
7 A 205.219	72 C 3035
NZ AA 300	72 C 1409
NZ AA 319	Irwin
and other material	Kent
derived mostly	Swan
from Illinois	O.T. 212
sources and from	C.I. 5068
C.I. 500 (Norway)	TAMO 312
	Noire de Moyencourt
	Mapua
	Y 247.2

It is noteworthy that Mapua, which definitely has some virus resistance, is used as a "susceptible check" in New Zealand.

Some recent canadian commercial cultivars have shown some level of field tolerance, although they would not necessarily be recommended as parents when breeding for resistance to BYDV. These include Sentinel, Manic and Cascade (Table 2).

Table 2. Yields (Kg/ha) of some canadian oats submitted to a heavy inoculation with BYDV on the 28th day of growth

		Straw	Grain
Susceptible	Dorval	1396	0
	Lamar	1619	15
	Hudson	2008	187
Moderately Tolerant	Sentinel	2195	435
	Manic	3020	243
	Cascade	3151	971
Tolerant	QO 158.16 (CN 1872)	5276	2261
Very Tolerant	AA 68-75 (CN 1880)	5716	3895

We feel that the incorporation of high BYDV resistance into agronomic types is a major undertaking, and we would agree that this work would be accelerated by setting up international BYDV nurseries similar to the rust nurseries already existing. The 1979 data have been put together as a report on cereal resistance to BYDV, available on special request.

Thanks are extended to the many contributors who sent us lines and germplasm for testing.

OATS IN WESTERN CANADA 1979

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The oat hectarage sown in Western Canada was down considerably in 1979 to 1,355,000 according to Statistics Canada. Of this 1,113,000 hectares were harvested for grain and a yield of 1.89 tonnes per hectare obtained, down 6% from 1978. Yields were down in Manitoba and Saskatchewan, but up in Alberta and British Columbia. Seeding was quite late on the eastern prairies and in northern areas due to a very long winter that just wouldn't quit. A mid-August frost caused some damage but general frosts didn't occur until early October allowing the late sown oats to mature in many areas.

Barley Yellow Dwarf

Aphid populations were low through much of the season but later in August and September became extremely high. Thus, except for a few very late seeded fields there was not too much damage from BYD in 1979.

Oat Stem Rust

Oat stem rust was first observed in southern Manitoba on July 30. The rust was common throughout Manitoba and eastern Saskatchewan by late August but infections were light, causing little or no damage except in the western part of the Red River Valley. In this area, infections of up to 70% had developed by the early dough stage of crop development causing heavy losses. A total of seven different avirulence/virulence combinations of stem rust were identified from Western Canada in the physiologic race survey but two of these, NA27 (9,13,15,16,a/1,2,3,4,8) and NA16 (2,4,9,13,15,16,a/1,3,8) comprised 97% of all field isolates. Races NA25 (8,13,16,a/1,2,3,4,9,15) and NA12 (1,8,13,16,a/2,3,4,9,15) predominated in Eastern Canada.

Oat Crown Rust

Oat crown rust was generally light across Western Canada except in the western regions of the Red River Valley. Crown rust infections were observed by mid-July, but further development was limited due to very dry conditions. In the western part of the Red River Valley local rain showers during the growing season resulted in heavy infections in some fields, causing significant yield losses, particularly in late-sown fields.

The crown rust virulence survey showed no indication of the development of new races which would threaten the currently used resistance gene combinations, *Pc38-Pc39* and *Pc55-Pc56*. As in past years virulence on genes *Pc35* and *Pc40* predominated, in fact there was a higher level of isolates which were avirulent on all of the *Pc* genes.

BREEDING OATS IN CZECHOSLOVAKIA

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Spring oats in Czechoslovakia occupied approximately 132,000 ha, i.e. 5% of the acreage sown to small grains in 1978. The average yield of grain was 3.45 t/ha in that year. The highest decrease of the acreage sown to oats had been recorded between the years 1965 and 1975, ranging from 416,000 ha to 221,000 ha. Now, the acreage sown to oats has been moderately increasing again, reaching 149,000 ha in 1979. Oats are grown mainly in higher regions for grain but also in more productive parts of the country as a valuable forage crop.

Recently, the importance of oats was emphasized again in Czechoslovakia. The oat grain has been in big demand as a component in feed mixtures for young and breeding livestock. When harvested in milky dough stage, oats give a high yield of digestible nutrients per ha. It is supposed that the acreage of oats, harvested, particularly for haylage, will be increased by 50,000 ha in the next few years. Moreover, the phytosanitary effect of oats in crop rotation systems with a high percentage of cereals has been emphasized, too.

Of the oat varieties grown, the variety Diadem, developed at the Krukanice Plant Breeding Station and licensed in 1969, has been the most widely distributed. It is characterized by a plasticity, being capable of giving stable grain yields in all production regions, and also under less favourable conditions. It has yellow grain of a high quality. Its disadvantage is less resistance to lodging.

The variety Hermes, licensed in 1978, when compared with Diadem, gives higher yields of grain and has stronger straw.

In 1979, the West German variety Flamingsnowa was released for its early maturity and high yield of grain.

Recently, the variety Saturn, bred especially for forage purposes, was released. This variety is characterized by a higher content of protein in both green matter and grain.

Of new oats, tested now in the State Varietal Trials, the line KR 356 possesses considerable resistance to lodging, has been found to be higher yielding and earlier than Diadem. Also the other new oats such as KR 396 and KR 245 show less lodging and are more productive than Diadem.

Recently, breeding of oats was concentrated into the Plant Breeding Station at Krukanice (KR oats) in Western Bohemia. Parental material used consists mainly of the European lodging resistant, adapted and high yielding oats which are crossed with oats resistant to disease or possessing a high protein content.

The main objectives in the oat breeding program in Czechoslovakia, which is concerned solely with production of spring varieties, are as follows:

1. a yield of grain higher by 20% than that in Diadem variety,
2. lodging resistance,
3. early maturity,
4. resistance to crown and stem rusts and powdery mildew,
5. lower percentage of hulls and
6. higher level of protein content in the grain.

The breeding of naked oats has been undertaken in a limited way as well. To be acceptable, a variety of naked oats should give the same grain yield as non-naked varieties after dehulling. Attention has also been devoted to breeding for high yield and quality of green matter.

Of donors of crown rust resistance the American varieties Dodge and Garland or their Czechoslovak derivatives are widely used. These resistance genes have been combined with Canadian oat line Pc-39 and others as a background for breeding of oats with multigenic resistance. Stem rust resistance breeding has been established on the combination of Pg-4 (B) and pg-9 (H) resistance genes conferring resistance to all stem rust strains isolated in Czechoslovakia and Austria up to now.

In powdery mildew resistance breeding, the Mostyn variety was demonstrated to be a good donor of resistance, being free of mildew infection in Czechoslovakia up to now. Last year powdery mildew field tests revealed a high degree of resistance in some other English varieties or entries such as Panema, S. 171, Cc4146, Cc4346 and Cc4761. Furthermore, low levels of mildew infection was recorded in varieties Maelor, Maldwyn, Padarn, Cc6490 and Roxton.

The international cooperation in breeding of oats with German Democratic Republic and Poland consists of a coordinated crossing program, exchange of breeding material and advanced selections, common performance trials, and tests for important characters.

PROTEIN, DRY MATTER DIGESTIBILITY AND YIELD OF SOME FORAGE OAT VARIETIES

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Oats is a rabi cereal fodder and its importance for this region is increasing as it is gaining popularity with the farmers as a good nutritive fodder. The research work for the development of improved varieties of forage oats is already in progress. The present experiment was conducted to evaluate the newly developed varieties for their quality attributes, mainly crude protein and *in vitro* dry matter digestibility. The *in vitro* technique is the only alternative short of expensive and time consuming feeding trials.

The samples have been taken at 50% flowering from the field trials conducted in a randomized block design using three replications during 1977-78 and 1978-79 with twenty single cut varieties. These were ground to pass through a 1 mm sieve. Protein content (N x 6.25%) was estimated by the conventional Kjeldahl method whereas *in vitro* dry matter digestibility was assayed using the two stage Tilley and Terry method. The results are reported in Table 1.

Total dry matter yields ranged from 42.9 to 110.9 q/ha during 1977-78 season and 47.9 to 138.2 q/ha during 1978-79. On the basis of the data of both the years varieties OS 6 and OS 7 ranked first followed by OS 8. Variety OS 15 was at third rank.

Protein percentage varied from 3.50 to 6.75 during the year 1977-78 but ranged from 5.90 to 9.84 in 1978-79 season. Variation for *in vitro* dry matter digestibility was from 50.80 to 67.40 and 48.80 to 67.40 percent during 1977-78 and 1978-79 seasons. The results show that varieties behave differently due to the seasonal differences.

During 1977-78 crude protein yield varied from 2.06 to 6.24 q/ha and digestible dry matter ranged between 28.91 and 61.09 q/ha. In the year 1978-79 the variation observed for crude protein yield was from 3.88 to 12.61 q/ha whereas digestible dry matter yields were from 31.71 to 90.65 q/ha. The variety OS 8 ranked first in crude protein as well as in digestible dry matter yields during both the years.

On the basis of overall performance for quality characters in the two years, the varieties are in the order OS 8, OS 7 and OS 6 and all are most promising for cultivation as single cut varieties.

Table 1. Dry matter, protein and digestibility of oat varieties.

S. No.	Variety	Dry matter yield (q/ha)		Crude protein %		In vitro dry matter digestibility %		Crude protein yield (q/ha)		Digestible dry matter yield (q/ha)	
		77-78	78-79	77-78	78-79	77-78	78-79	77-78	78-79	77-78	78-79
1.	UPO - 50	75.9	94.4	3.50	6.99	59.40	58.20	2.65	6.60	45.08	54.93
2.	UPO - 121	101.7	97.5	5.46	7.87	51.50	59.40	5.55	7.68	52.37	57.94
3.	UPO - 125	64.9	73.7	4.37	7.44	53.00	57.10	2.84	5.48	34.40	42.09
4.	UPO - 130	42.9	47.9	4.80	8.09	67.40	66.20	2.06	3.88	28.91	31.71
5.	UPO - 136	81.0	67.8	5.68	7.00	64.40	60.00	4.60	4.74	52.16	40.69
6.	Chauri Patti	92.8	66.5	6.56	7.00	55.40	56.40	6.09	4.65	51.41	37.47
7.	P.O. 1	73.1	116.4	5.68	6.78	57.00	56.60	4.15	7.89	41.67	65.91
8.	P.O. 2	93.7	123.4	4.59	7.87	60.70	55.40	4.30	9.72	56.87	68.39
9.	Palumpur-1	76.5	111.7	6.75	7.44	60.60	56.40	5.16	8.30	46.36	63.00
10.	OS 6	101.4	138.2	3.50	8.53	56.80	65.60	3.55	11.78	57.59	90.65
11.	OS 7	107.5	132.1	4.81	9.18	54.80	61.00	5.17	12.13	58.91	80.59
12.	OS 8	105.7	128.1	5.90	9.84	57.80	67.40	6.24	12.61	61.09	86.35
13.	OS 10	81.9	106.0	5.03	6.99	57.20	58.90	2.46	7.41	46.85	62.41
14.	OS 15	110.9	109.0	4.86	6.12	54.60	60.00	5.39	6.67	60.55	65.38
15.	OS 46	70.1	96.5	5.03	7.06	58.00	48.80	3.53	6.81	40.66	47.11
16.	2688	76.2	101.0	3.93	6.12	53.20	55.60	2.99	6.18	40.54	56.13
17.	3021	74.3	111.8	4.81	5.90	58.20	60.40	3.57	6.60	43.24	67.52
18.	NFO 114	93.7	107.9	4.59	6.78	51.80	64.60	4.30	7.31	48.54	69.68
19.	W - 11	90.7	104.8	5.90	5.90	50.80	55.80	5.35	6.19	46.07	58.47
20.	FOS1/29	96.5	92.6	4.86	7.22	58.40	62.40	4.69	6.68	56.36	57.80
	S.E.	8.27	8.03	1.01	0.80	4.19	3.55				
	CD (5%)	23.40	22.25	N.S.	2.32	N.S.	N.S.				

RAPIDA - AN EARLY MATURING GRAIN OAT

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An early maturing variety Rapida (C.I. 8303) was received from U.S. Department of Agriculture. Its grain is usable by the milling industry for the manufacture of oat flakes, where plump, heavy kernels with low husk and high protein percentage are preferred (Singh, Hardas and Singh, 1975).

For human consumption oats are today mainly marketed in the form of rolled oats or oat flakes, which have a higher energy value than rice or wheat flour. It is reported that 100 g of oat flakes will furnish 100 percent of the daily requirement for six out of eight essential amino acids, 33 percent of the daily requirement for essential fatty acid - linoleic acid, and 40 percent of the daily requirement for vitamin B 1, thiamine.

Agronomic Considerations:

Oats is primarily grown as an irrigated crop in India. Rapida, a medium tall (136-140 cm) variety, is sown by the end of October and matures in 120 days by mid-March, and gives an estimated grain yield of about 25 q/ha. Being early maturing, it requires only 4 irrigations as compared to NP101 and Kent, the other recommended grain varieties in India, which require 5-6 irrigations. Rapida being the earliest in oat germplasm collections maintained at this Bureau, vacates land for the multiple cropping system for summer crops such as cowpea, mung-bean or vegetable type of guar-bean (cluster bean).

A late sown crop can be sown as late as December or January. The December sown crop matures by the first week of April. The field is thus still available for a summer crop in a multiple cropping system.

Quality features:

Some work has been done on amino acid and protein content in improved varieties at the Central Food and Technological Research Institute, Mysore. The oat samples were supplied by the then Division of Plant Introduction, IARI (now National Bureau of Plant Genetic Resources).

Rapida, along with two other improved varieties: NP101 and Kent, and a 'Commercial' sample obtained from local Breakfast Food Manufacturers were analyzed at CFTRI, Mysore (Rao, Padma Rani, Srinivasan and ShurPalekar, 1974).

The data from their publication on protein content and amino acid make-up are reproduced in Tables 1 and 2.

Table 1. Approximate composition (g/100 g) of four oat varieties.

Constituents	Varieties			
	NP101	Rapida	Kent	Commercial
Moisture	8.0	7.7	7.4	7.7
Protein (N X 6.25)	11.8	14.2	11.6	7.8
Fat	4.8	4.4	4.7	5.7
Total ash	3.3	3.9	3.7	2.3
Crude fibre	9.0	9.8	9.3	8.5
Carbohydrate (by diff.)	63.1	60.0	63.3	68.0

Table 2. Essential amino acid composition (g/16gN) of four oat varieties.

Amino acids	Varieties			
	NP101	Rapida	Kent	Commercial
Lysine	3.4	2.6	3.1	3.6
Methionine	1.3	1.2	1.2	1.6
Histidine	1.9	1.6	1.6	1.9
Phenylalanine	4.0	3.7	4.2	3.9
Cystine	1.5	1.2	1.5	1.8
Leucine	5.5	5.2	6.8	7.6
Isoleucine	4.4	3.4	4.6	4.4
Valine	5.3	4.3	4.6	5.2
Threonine	3.3	2.8	3.4	3.6
Argenine	7.0	6.0	7.7	7.0
Tryptophan	1.3	1.5	1.4	1.2

Rapida variety, which has the highest protein content (14.2%, nearly double that of the commercial sample), has comparatively low lysine content (2.6%).

It is suggested by Rao et al. (1974) that Rapida in particular appears to be promising in view of its high protein content; and in combination with lysine-rich legumes, it can form good blends of protein achieved through mutual amino-acid supplementation.

Alternatively, in the manufacture of breakfast foods with lysine fortification, Rapida can offer a better source of raw material as compared to the other samples of low protein values.

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AVENA ABYSSINICA A POTENTIAL SOURCE FOR FODDER PRODUCTION DURING LEAN PERIOD

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In most parts of India, the farmers face two main lean periods. The first falls after rabi (winter season cultivation) from April to June and the second after kharif (rainy season cultivation) from October to December. During these period green fodder is unavailable for livestock, thereby adversely affecting livestock production. At the Indian Grassland and Fodder Research Institute, Jhansi (78°E long, 25°N lat., 275 m. alt.) under the fodder oat improvement program, Avena abyssinica (abyssinian oats) has been identified as a potential source of green fodder production during the lean period without disturbing the routine cropping sequence. The observed characters of this oat are: erect juvenile growth, 3-9 tillers, extremely early, and the seeds have no dormancy. It is a fast growing, single or multicut type, flowers between 40-44 days, and has a long sowing period. It can complete two crop cycles in one season, so when sown in October, it matures in January. If again sown immediately after harvest, it will be mature in April. It has low water requirements.

A. abyssinica when assessed in comparative yield trials with other promising oats 90 days after sowing, was found to be mature. Its green fodder yield was lowest, but it had the highest dry matter percentage

In a subsequent trial, it was sown in early October, mid October and late January. It was noted that the number of days taken by A. abyssinica to flower as well as the overall crop performance did not vary with planting date. The cultivars IG 2688, IG 3008 and Punjab local did not grow beyond the boot stage. It was also found suitable as a companion crop with slow growing legumes like lucerne and fast growing Brassicas during the winter season.

Cultivar	Sowing date	Sampling date	Flowering date	Green wt q/ha	Dry matter %
A. abyssinica	17.10.75	16.1.76	1.12.75	190	22.8
Curt	-do-	-do-	4.1.76	240	12.0
Gopher	-do-	-do-	23.1.76	290	11.1
IG 3026	-do-	-do-	19.1.76	325	11.4
IG 3021	-do-	-do-	2.1.76	310	12.0
Punjab local	-do-	-do-	24.1.76	225	9.3
Kent	-do-	-do-	22.1.76	410	13.8

CORRELATION BETWEEN STABILITY PARAMETERS FOR DIFFERENT CHARACTERS IN OATS (Avena sativa L.)

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In forage crops, which are often cultivated under varied environmental conditions, genotype x environment interactions pose a serious problem. Recently it has been possible to understand these interactions due to availability of statistical and genetical models given by Eberhart and Russell (1966) and Perkins and Jinks (1968). By using these models inferences can be drawn on the basis of mean response and stability. However, information on the relationship between these three parameters is rather scanty. In the present study an attempt has been made to study the association between these parameters in different characters of oats.

The experimental material consisted of 33 varieties. These varieties were sown at the Haryana Agricultural University Experimental Farm in eight different environments created by different dates of sowing and fertilizer doses during rabi, 1976-78. In each environment, an experiment was grown using a randomized block design with three replications. The data were recorded for five plants at 50 per cent flowering for the following characters: Green and dry fodder yield/plant, days to 50 per cent flowering, plant height, number of tiller/plant, leaf length, leaf breadth, stem girth, green leaf and stem weight/plant, dry leaf and stem weight/plant, crude protein and in vitro dry matter digestibility (IVDMD). The stability analysis was done according to Eberhart and Russell (1966) and Perkins and Jinks (1968). The correlation coefficients were worked out as per standard statistical procedure.

A perusal of Table 1 indicates that there was a significant and positive association between mean and response (b) for the characters days to 50 per cent flowering, leaf length, green and dry stem weight, dry fodder yield and crude protein. It revealed that increase in mean would be associated with an increase in responsiveness and thus the genotypes with higher mean would be suitable for the favorable environments. Significant and positive association between response and stability for the characters like number of tillers, leaf length, stem girth and crude protein indicated that an increase in responsiveness would lead to unstable genotypes and vice versa and therefore, breeding genotypes responsive to poor environments would be better for these characters. For the characters days to 50 per cent flowering, green stem weight and crude protein, significant and positive association between mean and stability were observed. The interesting observation was that by and large mean, response (b) and stability ($\overline{S}_d^2$) were not associated for the large number of characters and it appears that they are governed by different gene systems. It is, therefore, suggested that independent selection criteria for individual parameters should be applied. These findings are in agreement with earlier workers (Jhorar et. al., 1978; Hooda and Solanki, 1977 and Hooda et. al., 1978) Fripp and Caten (1973) have also established that both mean expression and linear sensitivity are governed by separate gene systems.

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Table 1. Correlation between different stability parameters.

Sr. No.	Characters	Correlation coefficient between Mean and b	s and $\bar{S}^2_d$	Mean and $\bar{S}^2_d$
1.	Days to 50% flowering	0.8475**	-0.0009	0.7089**
2.	Plant height	0.1193	0.0734	0.0853
3.	No. of tillers/plant	0.0807	0.9114**	0.0349
4.	Leaf length	0.4436**	0.5423**	0.0349
5.	Leaf breadth	0.2345	0.0581	0.0499
6.	Stem girth	0.1313	0.8033**	0.1320
7.	No. of leaves/plant	0.0582	0.1241	0.0720
8.	Green leaf weight/plant	0.1570	0.0282	0.4340**
9.	Green stem weight/plant	0.5668**	0.1856	0.2656
10.	Green fodder yield/plant	0.2194	0.1699	0.1340
11.	Dry leaf weight/plant	0.1014	0.0143	0.1586
12.	Dry stem weight/plant	0.3809*	0.2252	0.3292
13.	Dry matter yield/plant	0.4302*	0.0911	0.1959
14.	Crude protein	0.3743*	0.3447*	0.3431*
15.	IVDMD	0.0784	0.2566	0.0525

*Significant at 5 per cent level

**Significant at 1 per cent level

A STUDY OF BREEDING POPULATION IN OATS

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The 53 (F_6) strains derived from a cross of Kent and EC 4263 were evaluated for plant height, number of branches per inflorescence, number of grains per inflorescence, grain yield per plant, 100 seed weight per plant, dry matter yield per plant and harvest index (ratio of grain per plant and dry weight per plant).

On the basis of the different characters studied, these strains could be classified into two groups:

Group I : Dual purpose (high fodder and grain yield)
Group II: Fodder types (high fodder and average grain yield)

It has been found as shown in Table 1 that some strains, namely 7/1, 10/1, 10/2, 11/1, 11/5, 11/6 and 11/7 could be classified into Group I. All these strains had high dry matter production with much superior dry matter yield than either of the parents, i.e., Kent and EC 4263. These strains were equally superior in grain yield in comparison to high grain yielding parent, Kent. Besides very high fodder and grain yield, some of the cultures coupled with the large seeded character, namely strain No. 10/2, which had nearly double fodder yield, the same grain yield and larger seed (4.70 g/100 seed wt.), in comparison to the control (Kent) with dry matter yield (232 g/plant), grain yield (163.60 g/plant) and seed weight of 4.33 g/100 seeds. The other strain, 10/1 also gave double the fodder yield of Kent, whereas in respect to grain yield and seed size it is similar to Kent. In respect of other dual types, the fodder yield was much higher than Kent with same grain yield. A special reference may be made to strain No. 7/1, which had highest dry fodder yield (595 g/plant) with same grain yield (168 g/plant) as Kent.

In a second group (the strains with high fodder and medium grain yield) five strains had nearly double the fodder yield of Kent, ranging from 448 g/plant to 486 g/plant and grain yield of 134 g to 139 g/plant with medium to large seed. A special reference may be made to strain numbers 9/2 and 9/3 which had 448 g and 472 g per plant dry matter respectively but could be categorized among with largest seeded types (4.80 g and 4.40 g per 100 grains respectively). The other cultures in these groups were 7/5, 8/5 and 8/4. These five strains may be cultivated for fodder purposes with sufficient seed production.

Table 1. Mean performance for different characters in superior F_6 populations.

Plant No.	Height (cm)	No. of branches per inflorescence	No. of grain per inflorescence	Grain weight per plant (g)	100 seed weight (g)	Dry weight of plant (g)	Harvest index
7/1	81.25	36.00	459.75	168.00	4.00	595.00	0.28
7/5	97.00	49.60	347.40	137.60	3.80	486.00	0.28
8/5	89.00	37.20	473.60	139.20	3.70	460.00	0.30
8/4	82.20	51.00	338.40	134.40	3.90	456.00	0.29
9/2	101.80	66.60	456.80	135.80	4.80	448.00	0.30
9/3	108.60	67.40	437.80	138.60	4.40	472.00	0.29
10/1	71.60	47.80	489.40	160.80	4.30	462.00	0.35
10/2	74.20	49.60	236.00	159.60	4.70	450.00	0.35
11/1	92.60	50.40	398.20	161.40	3.30	404.00	0.40
11/5	93.80	47.60	250.00	173.60	3.50	408.00	0.43
11/6	102.20	47.80	290.20	160.80	3.50	408.00	0.39
11/7	102.60	51.60	376.60	152.20	3.70	426.00	0.36
Kent	94.00	38.60	210.80	163.60	4.33	232.00	0.71
EC 4263	102.40	63.20	181.60	35.60	2.56	300.00	0.12

USE OF *Avena sterilis* AND *Avena fatua* GENES FOR IMPROVEMENT OF CULTIVATED OATS

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The oat breeding program at Pantnagar started with the use of information obtained largely from crosses among lines and cultivars of *Avena sativa* L. Several hundred crosses have been made over the last seven year period and certain useful lines having excellent attributes including green forage and seed yields have been isolated. Some of these derived lines have shown outstanding performance over the varieties currently under cultivation. Certain inheritance studies on quantitative traits have also been done utilizing *Avena sativa* crosses and their derivatives.

After Frey and Browning (1971) and Lawrence and Frey (1975, 1976) demonstrated the usefulness of *Avena sterilis* genes from the Middle East for improving yield of adapted *Avena sativa*, I was encouraged to use the genes from two wild relatives of the cultivated oats namely *A. sterilis* and *A. fatua* obtained through the courtesy of Dr. R. A. Forsberg of the University of Wisconsin, Madison. These two species are being used extensively in the oat improvement program at Pantnagar with four major objectives: 1) to obtain information on the inheritance of quantitative traits including grain and green forage yields, 2) to isolate lines with high yield potential, 3) to improve resistance to crown rust, and 4) to increase protein content. The lines CI 8077, PI 292541, PI 292561, PI 295909, and PI 295932 of *A. sterilis* and 803 and 1033 of *A. fatua* are currently being used in our oat breeding program and certain crosses of these with the *A. sativa* lines have already been made and are under observation.

COMPARATIVE PERFORMANCE OF F_7 DERIVED LINES FOR KERNEL WEIGHT IN FOUR OAT CROSSES

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An observation nursery comprising of one adapted (Kent) and four unadapted (Rapida, Montezuma, Oribt, and Portal) and 75 F_7 derived lines of four crosses among them (Kent/Montezuma, Portal/Kent, Kent/Rapida, and Oribt/Kent) were planted in winter season of 1978-79. Kent has been regarded as one of the best adapted cultivar under Indian conditions having average level of forage and seed yields, resistance to crown rust and blight, and better kernel plumpness. The major objective in our breeding program is to develop lines better than Kent in yielding ability and other traits. The initial crosses involved two early parents (Rapida and Montezuma) and two very late parents (Oribt and Portal). In the selection criteria applied, plants having 75% heading in 85-100 days and kernel characteristics of Kent in Ken/Rapida and Kent/Montezuma, and plant type of Portal and Orbit in Portal/Kent and Orbit/Kent crosses were selected for further propagation and testing.

The results with regard to kernel weight (Table 1) of the F_7 progenies selected out of these four crosses indicated higher seed weight than their either parental lines or their average. With the increased kernel weight the F_7 derived lines also had earlier maturity than their parental lines Portal and Orbit in Portal/Kent and Orbit/Kent crosses and later maturity than Rapida and Montezuma in Kent/Rapida and Kent/Montezuma crosses. Among the crosses the best performing lines with regard to kernel weight and other plant traits were derived from the cross Orbit/Kent. It therefore seems possible that kernel weight might be regarded as a selection criterion for further improvement in seed yield.

Table 1. Performance of F_7 derived lines for 1000 kernel weight (KW) in four oat crosses.

Parent/Derived Line	Pedigree	1000 KW (g)	% Increase over best parent
Parental Lines:			
Kent		52.0	
Montezuma		50.5	
Portal		53.0	
Rapida		43.7	
Orbit		40.0	
F_7 Derived Lines:			
OX 1 F_7-6-14	Kent/Montezuma	54.0	3.85
-9-2	"	53.0	1.92
-9-6	"	58.0	11.54
-15-12	"	54.0	3.85
-16-2	"	54.4	4.62
-16-6	"	54.4	4.62
-17-7	"	55.0	5.77
-20-7	"	55.0	5.77
-36-13	"	58.0	11.54
OX 8 F_7-21-5	Portal/Kent	56.0	5.66
OX 9 F_7-47-3	Kent/Rapida	50.0	-3.85
-49-8	"	47.5	-8.65
-117-5	"	47.5	-8.65
-241-6	"	47.0	-9.62
-241-7	"	47.0	-9.62
OX 12 F_7-1-15	Orbit/Kent	55.0	5.77
-3-2	"	57.0	9.62
-3-8	"	53.5	2.88
-11-11	"	53.0	1.92
-13-13	"	53.0	1.92
-17-3	"	53.0	1.92
-18-4	"	53.8	3.46
-18-5	"	57.2	10.00
-24-5	"	57.8	11.15
-24-15	"	53.3	2.50
-33-8	"	54.2	4.23
-33-12	"	59.1	13.65

OS 6, A NEW PROMISING FORAGE VARIETY OF OAT

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Among winter crops, oats is considered to be a very nutritive forage because of high crude protein and digestible dry matter. It is generally grown for fodder in areas with limited irrigation facilities. The varieties recommended at present for cultivation in India are almost direct introductions or else direct selections. Research work for the development of improved varieties was intensified at the Haryana Agricultural University, Hissar during the year 1971. Many crosses were attempted and the single plant selections were made in the F_2 and advanced generations. As a result of this, homozygous plants from the cross HFO 10 x HFO 55 were bulked in F_5 during the year 1975 and a new entry namely OS 6 was tested against the approved varieties like Kent and HFO 114. The new OS 6 has been tested in the Final Evaluation Trial for the last three years. Variety OS 6 showed its superiority for both green as well as dry matter yield as compared to the released varieties Kent and HFO 114. OS 6 on an average gave 18% and 10% higher green fodder yield and 23.4 and 23.5% higher dry matter yield over Kent and HFO 114, respectively. The average green and dry fodder yield over the last three years was 508 q/ha and 110 q/ha as against 463 q/ha and 89 q/ha, respectively for the variety HFO 114 (Table 1).

OS 6 was also included for testing in the All India Coordinated Trials for forage oats during the years 1977-78 and 1978-79. The trial was conducted at 14 locations all over India. It gave the highest dry fodder yield (about 95 q/ha) and green fodder yield (about 420 q/ha) during both the years as compared to all other entries. This variety has been identified as a promising entry and is being considered for recommendation for release. Based on its consistent superior performance, OS 6 has also been identified by the Coordinated Project on Forage Crops this year as the most promising new entry for consideration for release at All India level by the Central Variety Release Committee. The new OS 6 oat has several distinct features which are summarized as follows:

Distinguishing characters of OS 6 as against HFO 114 and Kent

Characters	OS 6	HFO 114	Kent
Early vigor	Good	Good	Good
Days to 50% flowering	109.0	110.0	109.0
Plant height (cm)	109.0	93.0	93.0
No. of tillers/plant	10.5	9.4	9.6
Leaf length (cm)	45.0	49.7	50.3
Leaf breadth (cm)	2.96	2.48	2.39
Protein %	8.5	6.7	6.7

Characters	OS 6	HFO 114	Kent
IVDMD %	65.6	64.6	58.0
Green fodder yield/plant	289.6	260.6	250.5
Dry fodder yield/plant	51.5	44.8	46.8
Green fodder yield (q/ha)	508.1	462.8	430.5
Dry fodder yield (q/ha)	110.1	89.2	89.2

Other morphological characters: OS 6 grows erect, has early vigor and good plant type. Leaves are relatively broad and green in color as compared to the check varieties. The flag leaf remains erect at the time of emergence of the panicle. The panicle is open. OS 6 grows tall but is resistant to lodging, and is resistant to diseases. Seed is relatively less bold as compared to Kent and HFO 114. Accordingly, OS 6 holds promise in India as based on several desirable attributes that it possesses from the point of view of higher nutritious forage production per unit area per unit time.

Table 1. Performance of OS 6 against check varieties during the last three years.

Genotype		Yield (q/ha)								Percentage increase over	
		1976-77	R[1]	1977-78	R	1978-79	R	Mean	R	HFO 114	Kent
OS 6	GFY	483.3	4	508.6	3	532.6	1	508.10	3	9.78	18.02
	DMY	109.3	2	107.8	3	113.6	1	110.18	1	23.49	23.52
Check											
HFO 114	GFY	426.2	12	466.0	9	495.9	7	426.80	9		
	DMY	94.7	8	84.5	18	88.5	19	89.22	14		
Kent	GFY	365.0	19	443.5	18	483.2	11	430.5	17		
	DMY	78.1	20	94.2	9	95.4	12	89.20	15		
CD at 5%		86.75		42.50		16.30					
		18.43		14.81		19.28					
CV%		12.32		10.25		6.38					
		12.17		10.06		14.95					

GFY: Green fodder yield
DMY: Dry matter yield
R: Ranking is based on performance of varieties (24) in these trials.

ADAPTABILITY AND QUALITY TRAITS OF THE VARIETY CHAURI PATTI (FORAGE OAT)

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The variety Chauri Patti continued its superior performance in the multilocation departmental trials. The results based on the statistical analysis of trials conducted in twenty environments revealed that the variety "Chauri Patti" was at par with EC 4263, EC 34587, EC 13294, Kent and HFO-114. However, a comparison made with the first three promising strains for the quality traits shown in Table 1 makes it clear that compared to the variety Kent (an introduction from Australia) and HFO-114 (released for the State of Haryana) Chauri Patti has shown higher performance for per plant yield, percentage of leaf blades and crude protein percentage both in stem and leaves. Because of higher percentage of crude protein and higher proportion of leaves per plant, the variety has proved more digestible and nutritive. Large scale trials for *in vivo* digestibility are under progress.

Table 1. Comparison of quality traits in three promising varieties of forage oats in Haryana.

Trait (at full flowering)	Varieties		
	Chauri Patti	HFO-114	Kent
Total yield in grams per main tiller	69.6	54.8	48.7
Leaf blade yield in grams per tiller	17.2	10.6	10.0
Weight of per main stem along with leaf sheaths in grams	52.4	44.2	38.7
Percentage of leaf blades per main tiller	32.8	23.5	25.7
Crude protein percentage in leaf blades on dry matter basis	17.21	15.09	17.28
Crude protein percentage in stem with leaf sheaths on dry matter basis	7.07	5.11	5.83

A NEW DWARF OAT SELECTION

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While evaluating available *Avena* germplasm in the Division of Plant Introduction (now National Bureau of Plant Genetic Resources) at the Indian Agricultural Research Institute during October 1969-April 1970 season, an introduction with short, stiff-stem, compact panicles and reasonably good looking grain was identified. This variety had been received under the designation of Dwarf Palestine (EC 56175) in 1968 from Australia. Utilizing its unique characteristics mentioned above, it was intended to develop, through genetic manipulation, a grain variety which would respond to high levels of fertilizer application by showing greater productivity, unaccompanied by any lodging and consequential grain loss. Such a variety may meet the requirements of the Indian manufacturers of rolled oats.

With this objective in view, during 1971, a cross was attempted between Dwarf Palestine and the early grain variety, NP 101. The locally acclimatized variety NP 101, was originally received as a breeder's line designated, OX B6 Orient x (Mulga x Belar) in 1962 from Agricultural College, Roseworthy, South Australia. Because of its good performance as a grain variety, it was released as NP 101 by the Indian Agricultural Research Institute, New Delhi.

A wide spectrum of genetic variation emerged in a space-planted F_2 population. Sixty to seventy single plant progenies (per generation) were screened for desirable attributes in subsequent generations. Desirable attributes were fixed in one of these in F_6. Its seed is being increased for further evaluation. Comparative data on some 'descriptors' and 'descriptor states' of the selection and the two parents are given in Table 1.

Table 1. Comparative data on some descriptors of Dwarf Palestine, NP 101 and a selection from a cross between them.

No.	Descriptor	Dwarf Palestine	NP 101	Selection
1.	Initial plant growth and habit	Vigorous, erect	Vigorous, semierect	Slow, semierect
2.	Leaf:			
	Color	Dark green	Dark green	Green
	Length (Av. in cm.)	39.33	43.4	42.3
	Width (Av. in cm.)	1.8	2.02	1.83
3.	Flag leaf:			
	Length (Av. in cm.)	35.08	37.7	38.33
	Width (Av. in cm.)	3.83	2.36	2.33
4.	Culm:			
	Width (Av. in cm.)	0.95	0.86	1.15
	Node (No.) on the main stem	4.5	5-6	3
	Lowermost internode length (Av. in cm.)	3.0	15.74	4.13
5.	Tiller No./plant (Average)	8.9	10-12	8.66
6.	Plant height (Av. in cm.)	66.33	135	70.0
7.	Panicle:			
	Type	Compact	Equilateral	Compact
	Length (Av. in cm.)	10.0	45	15.7
	Average Spikelet (No.)/ panicle	45.0	60-65	61-66
8.	Spikelet:			
	Fertile floret No./ spikelet	3	3	2
	Outer glumes	Nil	2	1, present on secondary floret
	Hairs at the base of the floret	Dense tuft	Absent	Absent
	Hairs on palea:	Absent	Absent	Palea of primary floret is hairy
	Awn	1 or 2	1	Absent
9.	Days to initial flowering (range)	94-96	84-88	100-102
10.	Days to maturity (range)	142-145	135-140	150-152

The material is still segregating in the F_7 generation and from a 'genetic resource' point of view it constitutes of a 'rich pool of genes' for a number of other traits of interest to oat breeders.

PERFORMANCE OF SOME OAT VARIETIES FOR FODDER AND SEED YIELD

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In India, oats are grown as *rabi* fodder largely on military farms and to a limited extent in suburban areas of Punjab, Haryana, and U.P. Being less remunerative as compared to other grain crops, oat acreage is decreasing steadily. Recently, oats are gaining importance as a source of raw material for breakfast food industries. Hence a variety able to give good seed yield and high fodder yield may be more profitable than a variety grown for single purpose. Therefore, the identification of dual purpose genotypes is the most important task before the breeder. Accordingly, attempts have been made to identify promising varieties so that they may be tried as such or may be used in a further crossing program.

Twelve promising genotypes were selected out of the germplasm being maintained at the Haryana Agricultural University, Hissar. In *rabi*, 1974-75 all the 12 strains were grown in a randomized block design in 12 replications. The seeds were sown on October 17, 1974 in 20 square meter plots using a drill, with 30 cm between rows. The trial was divided into four experiments of three replications each. In one case, fodder was harvested at 60 and at 105 days following planting, after which the plants were allowed to mature for grain. In the second case, fodder was harvested 60 days after planting, and in the third, 80 days after planting. In all the experiments 40 kg N and 80 kg P_2O_5 were applied initially. Then 40 kg N were applied to all the experiments after one cutting. An additional dose of 40 kg N was applied to the experiments where a second cutting was harvested. No plant protection measures were applied. The seeds were harvested at different dates as the genotypes included in the trial varied in maturity (140-160 days). Observations were recorded on green fodder yield (q/ha), seed yield (q/ha) and straw yield (q/ha).

The mean performance of the 12 genotypes for green fodder yield, seed yield and straw yield is given in Table 1. The data showed that a considerable amount of variability was present for all the characters studied. In the first experiment, HFO 65 gave the highest green fodder yield, whereas HFO 168 gave the highest seed yield and straw yield. In the second experiment also genotype HFO 65 gave the highest green fodder and straw yield, whereas HFO 114 gave the highest seed yield (40 q/ha). In the third experiment, where one cut was taken after 80 days, genotype HFO 41 and HFO 235 gave significantly higher fodder yield, whereas HFO 114 gave the highest seed yield and FOS 1/29 gave the highest straw yield. In the last experiment where only seed yield was taken entries HFO 41 and HFO 78 gave the highest seed yield, whereas HFO 65, HFO 235 and HFO 163, in that order, gave significantly higher straw yield. Further it was revealed that seed yields, in general, were higher or equal when one additional cutting of forage was harvested after 60 days, which is indicated by a non-significant 't' test. Also, no variation in forage and seed yield was observed where one cutting was taken after 80 days and total yield after 105 days was considered. It is clear from these experiments that when seed yield is the main objective than the crop should be allowed to mature after one cutting made 60 days after sowing. When both green fodder and grain are important the crop should be cut over 80 days after sowing and then left to mature. Genotype HFO 114 appears to be the best cultivar when both fodder and grain are desired.

ACKNOWLEDGEMENT

The authors are thankful to Dr. Kanwar Singh, Additional Director of Research-cum-Head, Department of Forage Research for providing necessary facilities and encouragement.

Table 1. Mean performance of different strains for green fodder, grain and straw yield in different cutting management patterns.

Sr. No.	Genotypes	Cut at 60 and 105 days			Cut at 60 days			Cut at 80 days			Seed yield (q/ha) without cut	Straw yield (q/ha)
		Green fodder yield (q/ha)	Seed yield (q/ha)	Straw yield (q/ha)	Green fodder yield (q/ha)	Seed yield (q/ha)	Straw yield (q/ha)	Green fodder yield (q/ha)	Seed yield (q/ha)	Straw yield (q/ha)		
1.	HFO 41	178.7	19.4	56.0	55.0	38.5	101.5	180.6	26.6	90.0	36.6	102.5
2.	HFO 43	192.5	21.0	49.4	55.6	30.7	103.0	144.1	25.8	96.9	27.8	105.5
3.	HFO 54	151.2	15.7	65.2	65.0	29.2	99.5	149.1	22.0	93.0	27.1	101.1
4.	HFO 65	236.2	11.1	56.3	71.8	18.2	12.5	115.6	14.5	105.5	14.5	143.8
5.	HFO 78	165.0	8.5	71.5	66.2	23.7	111.2	147.5	19.3	104.0	36.3	101.3
6.	HFO 163	157.5	11.7	58.2	45.6	23.5	132.7	155.6	11.3	112.0	30.1	131.5
7.	HFO 168	93.7	33.5	89.0	38.1	30.5	107.0	105.5	27.3	114.3	29.5	107.1
8.	HFO 212 B	152.5	16.5	53.5	46.2	24.0	121.0	165.6	15.1	119.8	26.3	122.8
9.	HFO 235	150.0	16.7	67.0	79.3	30.7	105.5	169.1	19.8	99.3	13.3	137.0
10.	HFO 114	191.2	21.5	61.0	63.7	40.0	98.7	150.6	28.0	95.3	30.1	112.3
11.	W-11	192.5	12.1	60.3	45.0	29.0	87.2	132.5	26.8	99.8	24.0	106.0
12.	FOS1/29	136.2	24.6	85.3	47.5	26.0	108.7	102.7	18.0	139.5	30.6	112.8
	Mean (q/ha)	166.4	17.6	63.8	56.6	28.6	107.9	142.3	21.2	105.7	27.5	115.3
	C.D. (q/ha)	43.0	8.7	29.5	15.8	5.9	16.2	15.6	5.4	18.1	7.0	16.5
	C.V. (%)	12.2	22.4	21.1	19.6	9.3	6.9	12.5	15.2	10.1	15.0	8.5

V. CONTRIBUTIONS FROM THE UNITED STATES

ARKANSAS

F.C. Collins, J.P. Jones, and M.L. Fouts

According to the 1979 Arkansas Crop Statistics farmers planted 70,000 acres in the state but they only harvested 32,000 acres which had an average yield of 65 bu/A. Most of the oat acreage is in the Grand Prairie area of the state where oats are grown for seed purposes and the land is double cropped with soybeans. Nearly all of the acreage that was not harvested suffered severely from winter killing. Although no official surveys of varieties were made, most of the acreage was planted to Bob, Nora, Florida 501, Coker 227, Coker 716, and Tam 0-312. Among these Coker 716 reportedly had the least winter injury.

Relatively little disease was observed with barley yellow dwarf being the most prevalent disease. Results from our seed treatment tests indicated that several compounds were effective for covered smut control. Good to excellent control was obtained with the fungicides Bayleton, Baytan, Benlate, Ciba-Geigy CGA-64251, Olin OAC 3390-PENB, Orthocide- Vitavax WP, Orthocide-Vitavax HB, Sisthane, and Trivax with rates ranging from one-half to four ounces of active ingredient per hundred weight of seed. The use of acetone as a diluent did not appear to improve the effectiveness of the fungicides as was noted in previous year's tests.

GEORGIA

A. R. Brown (Athens), B. M. Cunfer, J. H. Massey,
J. W. Johnson (Experiment), and D. D. Morey (Tifton)

The Georgia Crop Reporting Service reports 59,000 acres of oats harvested in Georgia during 1979 at 54 bushels per acre for a total production of 3,186,000 bushels. Oat yields were good in nursery plantings in every region of Georgia. Salem, Brooks and Coker 716 yielded in the 90 bu. range in the Athens nursery. Salem was the highest yielding variety (132 bu/A) evaluated at Experiment where test weights were also excellent. Salem oats (78.8 bu/A) lead the test at Calhoun, Georgia. Coker 227 (71.5 bu/A) was the leading variety at Midville, Georgia.

Coker 227 (106.4 bu/A) was the leading variety at Tifton while Coker 76-14 (120 bu/A) gave the highest yield at Plains, Georgia. Coker 227 continues to do a good job for farmers in Georgia followed by Florida 501 and Elan which are known to be susceptible to prevalent races of crown rust. At present we are breeding oats for earliness and disease resistance when the need arises to replace Florida 501 and Elan. Early generation selections at Athens and Tifton are still under test and gray oats with poor grain quality prove to be one of the problems.

We have found 5 gallon plastic pails make useful and sturdy miniature greenhouses for field inoculations of spreader rows in South Georgia. The bottoms are cut out of these plastic pails, they are inverted over inoculated plants in the spreader row and a pane of greenhouse glass is placed on top and weighted down with a half brick or a flower pot. These miniature greenhouses are useful during cold weather and can be easily moved about to start new centers. They can be used to increase and spread centers of leaf rust, stem rust, crown rust, powdery mildew and probably other diseases.

Indiana

H. W. Ohm, F. L. Patterson, G. E. Shaner, J. J. Roberts (Breeding, Genetics and Pathology), J. E. Foster (Entomology), Kelly Day, O. W. Luetkemeier (Variety Testing), and K. L. Polizotto (Extension).

Production: Indiana oats production for 1979 was estimated by the Indiana Crop and Livestock Reporting Service at 8.84 million bushels--about the same as in 1978. Average yield was 61 bu/A--up from 54 in 1978, but acreage was down from 1978.

Most of the oat acreage in Indiana was seeded by early to mid-April. Unseasonably cool temperatures persisted until mid-May, which resulted in little vegetative growth early in the season. Short nights by the end of May caused the oats to head, and the early-flowering varieties, especially, were somewhat short and lacking in number of culms per plant. Temperatures remained cooler than normal throughout the season and moisture was adequate. Therefore, yields and test weight of oats were generally good. Crown rust was negligible. There was some but minor incidence of barley yellow dwarf.

Research: David Harper's M.S. thesis research shows large differences among Dal (most susceptible), Stout, Noble, Otee, CI9312, and Illinois 73-1297 (most resistant) for resistance to barley yellow dwarf (BYD). He has carefully characterized the effect of BYD infection in terms of leaf discoloration, yield, and reduction in plant height, number of tillers, and seed weight for each of the above lines and cultivars. Dave has also observed F_1, BCF_1, F_2 and F_3 populations from selected crosses between these cultivars and lines in different environments. Environmental factors, probably moisture stress and fertility, seem to significantly affect the distribution of phenotypes in the segregating populations. This has a drastic effect on conclusions about the inheritance of resistance to BYD in a given environment. His research indicates few major genes for resistance. In other studies in controlled environment chambers, we also find that moisture and fertility affect BYD symptom expression in oats and wheat.

Dr. J. E. Foster has identified some wheat and oat lines to which aphids seem to show some nonpreference. We will attempt to combine this nonpreference with resistance to the BYD virus.

Dr. R. M. Lister (virologist, Department of Botany and Plant Pathology), is working on refinement and efficiency of extraction procedures to isolate the virus from plant tissue. ELISA, enzyme-linked immunosorbent assay, appears promising as a quantitative test for virus concentration in plant tissue. The idea is that this will reflect the relative resistance of cultivars.

Research in cooperation with V. L. Youngs, oat quality laboratory, indicates that BYD infection has little effect on lipids and protein quality or quality in oat grain. A large effect of course, is reduction in grain yield.

We are continuing use of a greenhouse seedling test for BYD in oats and wheat (Ohm, H. W., and J. E. Foster, 1979. Agronomy Abstracts, p. 71). The test is simple, and many lines can be screened on a weekly basis throughout the winter months.

Breeding: The major thrust of our program continues to be the incorporation of resistance to BYD and crown rust into high yielding cultivars. Infestation of early-generation plant populations in the field with greenhouse-reared viruliferous aphids has proven very effective in the selection program for BYD resistance. We view high percent protein as an additional trait which we need to continue to select for.

IOWA

K. J. Frey, M. D. Simons, J. A. Browning, R. K. Skrdla
L. J. Michel, G. A. Patrick

The oat acreage harvested for grain in Iowa was one million acres. A record yield was recorded of 63 bushels per acre, so total productivity was 63 million bushels. The oat acreage in Iowa continues to decline slowly.

A recent analysis showed that little if any genetic variability exists for growth rate in the germplasm pool used by oat breeders in the midwest. Tippecanoe variety may have a differing set of genes for growth rate, but the most significant source of genetic variability for this trait is the weedy species, *Avena sterilis*. Genes for high growth rate have now been introgressed from *A. sterilis* into good *A. sativa* genotypes. Although not yet ready for release to midwestern farmers, one more cycle of breeding should provide varieties that utilize these genes for increased growth rate. Growth rate is polygenically inherited with an estimated effective number of factor pairs between six and eight. These genes are inherited additively and their presence in the parents of a mating result in significant transgressive segregation for the trait.

Utilizing data from many previous experiments, selection for yield (10% intensity) was carried out in two groups of random oat lines (Group T and Group G contained 200 and 480 lines, respectively) in each of three selection environments that represented conditions of low, medium, and high productivity. The samples of lines from all selection environments were tested for three production traits, mean, response, and stability of grain yield, in common evaluation experiments. Each evaluation experiment contained production environments ranging from low to high in productivity. Selection resulted in actual gains in grain yield of 16 and 7% in the T and G groups, respectively. The actual advances were 16, 13, and 18% of the population means in the low, medium, and high productivity environments, respectively, for Group T and 7, 5, and 8%, respectively, for Group G. In each group, the advances for the sample selected under high and low productivities were significantly superior to that for the sample for medium productivity. Mean response indexes for the selected samples of oat lines to improving environment ranged from 1.20 to 1.44 and all were significantly greater than 1.0. Generally, the mean stability indexes (r^2) for the selected samples were greater than those for the population as a whole; however, there was no superiority for one selection condition over another for selecting for either response or stability of production.

From 35 to 50 percent of the lines selected under low and high productivity had means in the upper 10% of yields in the evaluation environment, whereas only 23 to 25% of those in the medium productivity sample fell in this fraction. Lines selected _only_ under low- or medium-productivity conditions gave mean yields that were not significantly greater than the respective group mean, whereas those selected _only_ under high productivity gave significantly greater yield (average 13%) in the same evaluation experiments. The number of lines common to all selected samples (from low-, medium-, and high-productivity) were 3 for Group T and 6 for Group G. In the evaluation experiments, these lines averaged 20% higher than the group means for yield and they tended to be significantly superior at all three levels of productivity. Lines common to the samples selected under low and high productivity gave a mean yield increase of 18%, and generally, they were superior in all evaluation environments.

On the basis of comparisons among groups of selected lines, it appeared that low- and high-productivity conditions were equally satisfactory for selecting high-yielding lines of oats, and both were somewhat superior to medium-productivity as a selection environment. However, detailed analyses showed that high productivity tended to differentiate high-yielding lines best. The most superior lines for all conditions of production were those that were chosen in all three selection environments and those chosen in both low- and high-productivity selection environments. Our results suggest that a disruptive selection scheme with high-productivity conditions being used during the first stage of selection will be the best procedure for selecting high yielding, broadly adaptable lines.

In 1979, the following personnel changes occurred on the small grains project at Iowa State University. Susan Behizadeh, Urbano Vega, Sami Saad El-Din, Jimi Adegoke, and Diana Bloethe-Helsel completed their Ph.D. degrees. Stan Cox and Ann Marie Thro completed M.S. degrees. Urbano Vega returned to the Central University of Venezuela, Maracay, Venezuela, as a corn geneticist; Sami Saad El-Din returned to the University of Alexandria, Egypt, as assistant professor of plant breeding; Jimi Adegoke returned to the Cacao Research Foundation, Ibadan, Nigeria, as a cacao tree breeder; and Diana Bloethe-Helsel continued as corn breeder with DeKalb Ag Research at Mason, Michigan. Stan Cox and Ann Marie Thro are continuing their studies at Iowa State University toward Ph.D. degrees. New faces on the small grain project in 1979 are Bruce McBratney and Sandy Johnson, who are studying for M.S. degrees and Carrie Young, Darrell Cox, Linda Rust, Chris Mundt, and Jim Oard, who are studying on Ph.D. programs.

KANSAS

E. G. Heyne

The 1979 Kansas oat crop was seeded on 135,000 acres and harvested from 85,000 acres. The average yield was 44.0 bushels per acre for a total of 3,740,000 bushels. Only four smaller crops were harvested since Kansas records have been kept (since 1866). These were the years of 1866, 1867,1868, and 1972. Only since the 1970's has the average yield been over 40 bushels per acre and even 30 bushel yields were uncommon prior to that time. A 36 bushel per acre yield was recorded in 1866 and a 39 bushel average in 1883 and only twenty 30-bushel-per-acre crops till the late 1960's. The average increase in yield per acre in Kansas of oats has not been as good as for other crops. However, 1979 experimental yields in test plots were over 100 bushels per acre at Hutchinson and Parsons test sites. There appears to be a better demand for oats seed for seeding in 1980 than previous years, especially in central and south-central Kansas where wheat seeding problems occurred and where there is some wind (soil blowing) damage to seeded wheat.

Lang and Bates have given good performance in our tests since 1975 and are superior to other cultivars even in the absence of BYDV. In addition to these two cultivars, there were certified seed fields of Pettis, Russell, Spear, Stout, and Trio grown in Kansas in 1979.

There were no winter oat nurseries seeded in Kansas (1978-79). Trials in 1979 at Hutchinson with several of the hardy cultivars were abandoned because of winter killing due to the severe winter conditions experienced this past season.

Minnesota

D. D. Stuthman, H. W. Rines, P. G. Rothman & R. D. Wilcoxson

Production

Oat production in Minnesota totaled 85 million bushels from 1.5 million acres in 1979. The average yield was estimated to be 57 bushels per acre. The season was somewhat unfavorable in that seeding was delayed as much as one month in some areas. In addition, August was much wetter than normal, thereby delaying, and in numerous cases preventing, harvesting. For example, the state crop report dated August 26, 1979, indicated 42% of the acreage was combined compared to the 5 year average of 88%.

The intentions of Minnesota farmers for 1980, as of January 1, include 1.55 million acres of oats, a slight decline from that planted in 1979. Surprizingly, sunflower acreage is also expected to decline slightly, while there are large percentage increases for barley and spring wheat.

Varieties

Moore and Benson were planted on 4,900 and 2,500 acres respectively in Minnesota and surrounding states for Certified seed production. Minnesota growers expressed overall approval of both on a grower evaluation survey.

Personnel

Randy Jeppson, who is completing his Ph.D. requirements in the Agronomy and Plant Genetics Department, has been hired as Extension Specialist for small grains. He replaces Roy Thompson.

Tom McCoy will complete his Ph.D. requirements soon. His research dealt with the frequency and types of cytogenetic abnormalities in plants regenerated from tissue cultures of oats and corn.

Mark Van Horn began his graduate studies in September 1979 coming from the University of California-Davis. His research will compare pedigree selection and Single Seed Advance when high yielding crown rust resistant lines are the objective.

MISSOURI

Dale Sechler, J. M. Poehlman, Paul Rowoth,
Jeff Gellner, (Columbia) and Calvin Hoenshell (Mt. Vernon)

Production: Only 44,000 acres of oats were harvested in Missouri in 1979. Weather adversity, continuing throughout the spring, has contributed to record low acreages the past two years. Although adverse weather conditions in 1979 delayed seeding by about a month in most areas, we had a late, cool spring and yields were relatively good. The average yield for the state was only 45 bu/acre but yields in excess of 100 bu/acre were reported.

Diseases: Damage from diseases appeared to be minimal. Occasional symptoms of BYDV were observed in both winter and spring oats but damage was slight. The first leaf of oat plants often showed considerable damage from halo blight in the early spring but no symptoms were observed later in the season. Rarely are oats as free of disease as they were in 1979.

Varieties: Since we had a long, cool spring and diseases were almost nonexistant, the differences in variety performance that are normally observed were not seen. What are often late, disease susceptible varieties produced relatively good yields. Test weights often were in excess of 35 lbs/bu, very unusual for Missouri.

Breeding Effort: Emphasis continues to be placed on incorporating resistance to BYDV, crown rust and smut into short stature, early maturing, high yielding spring oat lines. We are concerned also with improving grain quality, both physical and chemical. The breeding and selection work with winter oats has been essentially discontinued and testing activity, although continuing, is minimal.

NEW YORK

Mark E. Sorrells

One of three New York selections will be chosen over the next two years for cultivar release. Two of the selections, NY 6083-21 and NY 5977-6-56 were entered in the Uniform Midseason Oat Performance Nursery in 1979 while the third, NY A-11, will be entered in 1980. NY A-11 is a selection from NY Composite I, a broad based composite that was mass selected for crown rust resistance under a buckthorn hedge. NY 5977-6-56 is a selection from the same cross (Astro/PI 193027) that gave rise to the Egdolon series, and NY 6083-21 is from the cross Orbit//C.I.6936/Clintland 60. All three selections are superior to Orbit and Astro in grain yield under New York conditions but only NY 5977-6-56 and NY A-11 have a heavier test weight. NY A-11 is above average in protein and oil content and seems to be highly resistant to prevailing crown rust races.

Demand for improved straw yield in oats remains high. We began taking straw yield data on 3 M x 1.5 M plots in 1979 using a Hege combine with the header set 15 cm high. We mounted a straw catcher apparatus with removable canvas on the rear of the combine. At the end of the plot, the full canvas is removed and weighed, and a moisture sample is collected. This operation requires one or two additional people. The data collected this past summer indicate that most cultivars recommended for New York yield 10 to 15% less straw than cultivars producing the highest straw yield in the tests.

NORTH CAROLINA

C. F. Murphy, T. T. Hebert and R. E. Jarrett

The 1978-79 growing season was the best in several years. Good growing conditions and improved varieties resulted in the production of 5,320,000 bushels from 95,000 harvested acres. The state average yield of 56 bu/acre equaled a record set in 1971.

The variety Carolee has been grown extensively in North Carolina for almost twenty years. While it still performs surprisingly well, a transition to more productive varieties is definitely occurring. It appears that both Brooks and Coker 716 will become popular varieties. Most of our oat production is used for livestock feed, and farmers seem to be especially interested in the potential of Brooks to produce protein.

Personnel: Mrs. Rebecca Rufty has completed her M.S. and has moved to the Plant Pathology department to complete her Ph.D. studies. Ms. Nancy Wiebe has joined the project in the three-quarter time position formerly occupied by Mrs. Rufty.

OHIO

Dale A. Ray

Production. Spring oat seedings were delayed two to four weeks by cold, rainy spring weather. After slow establishment of stands, the favorable midseason conditions helped recovery of vegetative development. Several fields of oats were damaged by a heavy infestation with cereal leaf beetles in mid-May. Only trace evidence of crown rust infection was found, however barley yellow dwarf virus damage increased in susceptible varieties as the season progressed. The harvest season was about two weeks behind the normal schedule. The 340,000 acres harvested represented a decline of about 60,000 acres in comparison with the 1978 crop. The estimated average yield of 70.0 bushels per acre was a new record high for Ohio.

Oat Varieties. Over 90 percent of the Certified Seed acreage consisted of Noble, Otee, and Clintford varieties. Lang, Noble and Astro were the highest yielding varieties in a 6-location performance trial. Clintford, Dal, Noble, and Otee varieties are currently recommended.

Oat Breeding. Four preliminary performance nurseries were grown to screen 165 new spring oat selections. These lines were obtained from single-panicle multiplications and represented advanced-generation material from bulked crosses with parentage including an *Avena sterilis* selection, Garland, Florida 500, Clintland 60, Putnam 61, and Rodney. The highest yielding selections that also exhibited adapted maturity, straw strength, good kernel quality, and tolerance to barley yellow dwarf virus will be entered in a more extensive testing program.

OKLAHOMA

H. Pass, R. L. Wilson, L. H. Edwards and E. L. Smith

Production: The Oklahoma state average oat yields and acreage fluctuate from year to year. The 1979 oat crop amounted to 4.6 million bushels and harvested from 95,000 acres with a yield of 48.0 bushels per acre. Harvested acreage was the same as 1978, however, total production was up 33 percent. This increase was due to a record breaking 48 bushels per acre state average yield. This was a two bushel increase over the previous record set in 1946.

Oat Varieties: Most of the oat acreage is seeded to winter oats. The popular varieties are Cimarron, Chilocco and Nora. Okay was released in 1978 and should find a place in the present acreage. Oats were relativity free from disease. This was the first year since 1974 that Barley Yellow Dwarf did not reduce Oat yields. However, some winter killing was noted, especially in the less winterhardy varieties like Nora.

Research: Work is continuing on the development of a greenbug resistant oat variety for Oklahoma. Resistant parents being used are P.I.186270 and C.I.1580. Susceptible cultivars involved in the crosses are 'Okay' and 'Nora.' F_3 plants were evaluated, by Dr. R. L. Wilson, this year and resistant selections were made for F_4 testing next year.

SOUTH DAKOTA

Lon Hall and Dale L. Reeves

Production: The 1979 oat acreage was 2,400,000 down from 1978 by 6.6% the average yield was up 3.5 bu/A from 1978. Oat production for 1979 was 98.5 million bushels down 4.2% from the previous year.

Disease: Crown rust infections were present at all our eastern locations with the highest reading in the northeast. Stem rust infection were also highest in the northeast while the other locations only had traces. Smut was almost nonexistent.

Varieties: Lancer's rank in yield in our eastern locations was 2nd our of 20 standard varieties being exceeded only by Moore. The line SD743358, a Dal x Nodaway 70, is being purified for increase.

Personnel: Dr. Reeves is in Botswana setting up an agricultural education program.

TEXAS

M.E. McDaniel, J.H. Gardenhire, L.R. Nelson, K.B. Porter, Norris Daniels, Earl Burnett, Lucas Reyes, E.C. Gilmore, and Charles Erickson

Production: The 1979 seeded acreage of oats in Texas decreased slightly to 1,700,000 acres. The seeded acreage remained below the 10-year average of 1,856,000 acres for the period 1969-1978. The proportion of the crop harvested for grain was 23.5% of the seeded acreage, also slightly below the 10-year average of 27.1% for 1969-1978. However, the 1979 statewide yield of 42.0 bushels per acre was the highest on record. Much of the traditional "seed oat" acreage in the Blacklands was badly damaged by a severe freeze early in January. New Nortex, Tam O-312, and Cortez suffered almost complete stand losses; Coker 234 and Four Twenty-Two survived relatively well. At Dallas, only Walken maintained satisfactory stands; most other varieties were completely killed by the severe January ice-storm freeze.

Good spring moisture enabled surviving stands to produce good yields; several counties in the San Antonio area produced yields of 55-62 bushels per acre. This area and the Edwards Plateau region west of San Antonio produced a much higher proportion of the state's oat grain crop than usual.

Research: We are continuing to emphasize crown rust and stem rust resistance in the breeding program. Crown rust cultures with strong virulence on TAM O-312 have become widespread in Texas. Fortunately, the Coker varieties are resistant to the new biotype. Excellent levels of seedling and adult-plant stem rust resistance have been recovered in a low frequency of plants in F_2 populations from BC_2 crosses (three "doses" of Texas-adapted oats) with C.I.9221. Further crosses with winter-type oats will be necessary to improve winterhardiness of this material; only 18 of approximately 400 F_2 populations from BC_2 stem rust crosses appeared to have adequate cold tolerance in 1979. Stem rust severity continued to increase in 1979; both Beeville and College Station nurseries had severely damaging natural infections, which allowed effective selection in segregating populations. An adapted oat variety with stem rust resistance is urgently needed for the South Texas area.

Crosses were made with the 10 lines having the lowest biotype C greenbug damage ratings among the 31 resistant lines reported by Daniels (see 1978 Oat Newsletter, pages 82-84). F_2 populations from these crosses have been tested; resistance appears to be rather simply inherited. Agronomic characteristics of all the oat lines exhibiting high-level resistance to biotype C are very poor; development of an agronomically suitable greenbug-resistant oat will probably require considerable effort.

Latin American Oat Research: A tour of oat research and production areas in Brazil, Argentina, Uruguay, and Chile was made by M.E. McDaniel, H.L. Shands, and Sam W. Weaver in November-December, 1979. Crown rust races completely virulent on Coker 227 and Coker 234 were found near Bage, Brazil and at La Estanzuela, Uruguay. Severe stem rust epidemics were seen in nurseries at Barrow, Argentina and La Estanzuela, Uruguay; BYDV was serious in the nursery at Castelar, Argentina. Greenbugs (and some other aphids) are a serious problem in many South American small grain production areas.

U T A H

R. S. Albrechtsen

Production. Utah's oat acreage is very small, but has remained constant for the last several years. The 1979 average per-acre yield was the highest recorded since 1967. Even so, state-average yields of oats are usually lower than those of barley, at least partially due to the poor conditions under which oats are generally produced. Losses from diseases are usually minimal in Utah, although smut is occasionally severe in isolated fields.

Herbicide Injury. Plants in some areas of our 1979 oat nursery sustained injury from residues of the herbicide "Nortron" utilized on sugar beets grown on the area the previous year. Areas of injury showed rather definite patterns and are believed to have occurred from excessively high levels of the herbicide resulting from overlap of application in parts of the field. Injury to the oats was not as severe as that on barley and spring wheat growing in the same area, indicating that the oats had a higher degree of tolerance to the herbicide than the other two crops. However, such injury could occur in commercial production fields from excessive application rates of this herbicide on the preceeding crop.

Breeding Program. We are not carrying on an active oat breeding program because of the small acreage of oats grown in the state. Improved cultivars developed elsewhere that are adapted to our conditions are identified by growing the Uniform Northwestern States Oat Nursery and by personal contact with individual breeders. Cayuse is presently the most widely grown cultivar in Utah; some of the newer releases and advanced breeding lines from Idaho and Washington show good promise for us.

WASHINGTON

C. F. Konzak

Yields of oats in 1979 were generally good, with yields at Pullman among the best ever. Diseases were negligible due to the dry late summer conditions. Appaloosa (CI9272) again showed its slight overall superiority in yield over Corbit and Cayuse, but likewise showed its slightly lower test weight. Of the new entries evaluated, WA6392, WA6393, and WA6394 continued to show promise. However, a new Idaho selection, 75Ab1170=Cayuse/Otana showed exceptional yield performance combined with high test weight. New crosses were made to combine larger kernel size and weight with shorter straw, BYDV tolerance, and high yield. WA6391, 72Ab1729, WA6392, WA6394 and all Cayuse/CI2874 derivatives were used as sources of BYDV tolerance and high yield; Aurora and 74Ab1929 were used for short straw and 63Ab7868 was used for large kernel size.

Canadian Sel. OT184D also appears to be a good source of short straw but our crosses with it were not successful and will be repeated.

Our objective is to develop a better oat for culture in irrigated Central Washington.

WISCONSIN

R. A. Forsberg, M. A. Brinkman, Z. M. Arawinko, R. D. Duerst,
E. S. Oplinger, H. L. Shands, and D. M. Peterson (Agronomy),
and D. C. Arny and C. R. Grau (Plant Pathology)

Oat grain yields in Wisconsin in 1979 averaged 57 bushels per acre, up 1 bushel from 1978. Late planting in the northern half of the State, below-normal temperatures in each month of the small grain season, and wet weather in August all contributed to lower grain yields. Although straw length was shorter than normal in most areas, strong winds and heavy rains lodged many oat fields, and frequent showers interfered with combining.

Wisconsin farmers seeded 1,100,000 acres of oats in 1979, a decline of 150,000 from 1978. Increased use of oats for silage and poor harvest conditions resulted in 980,000 acres harvested for grain, the first time since 1880 that less than 1 million acres of oats were harvested for grain.

Other than some severe crown rust infection in south central Wisconsin, oat diseases were of minor importance in 1979. For the second year in a row oat smut was low in prevalence, and stem rust infection was negligible.

Marathon oats. Certified seed of Marathon was produced in 1979 and it will be seeded for general farm production in 1980. Parents of Marathon are Holden and selection X1289-1, the latter a sister line of Dal.

Dr. M. A. Brinkman has assumed leadership of Wisconsin's section of the International Oats Program developed by Dr. H. L. Shands and supported by Quaker Oats. The primary site for germplasm development and selection has been shifted to College Station, Texas, under the direction of Dr. M. E. McDaniel, Texas A&M University.

Drought Tolerance in Oats. M. A. Brinkman is continuing to evaluate the association of a number of traits with drought tolerance in oats. Results of a study on seventeen oat genotypes indicate that low stomatal frequency is associated with high stomatal resistance to moisture diffusion, resulting in a low transpiration rate. A low transpiration rate should provide for efficient use of soil moisture.

The U.S.D.A. Oat Quality Laboratory is now under the leadership of David M. Peterson. Lucia Lesar completed her M.S. degree, presenting a thesis titled "Growth of Excised Oat Panicles in Liquid Culture." She presented her results at the North Central Oat Workers Conference held in Madison in February. Tom Frantz is continuing his M.S. project on physiological aspects of halo blight. Erik Donhowe is working on protein body characterization for his M.S. thesis. Chris Brinegar joined the project in September, with an M.S. in Food Chemistry from Cornell. He is working on regulation of protein synthesis for a Ph.D. thesis.

Thesis Research Projects

Oat kernel and groat conformation. Mr. Wesley R. Root completed his Ph.D study of the influence of oat kernel and groat morphological and conformation characteristics on grain- and milling-quality traits. (See Abstract elsewhere in this newsletter.) Dr. Root currently is a plant breeder affiliated with ICRISAT and is located at Ouagadougou, Upper Volta.

Avena translocation lines. Ms. R. Sherri Stern completed her MS program in February, 1980. Part of her thesis research involved studies of crown rust inheritance patterns in translocation line x translocation line F_2 populations and in translocation line x *Avena sativa* F_2 populations.

Fatty acid inheritance. Mr. Russell S. Karow (MS program) is currently assaying parents, F_1's, and F_2 progenies from certain crosses for three individual fatty acids, i.e., palmitic, oleic, and linoleic. The time-consuming assay procedure is limiting the scope of this work.

Interspecific transfer of genes for stem rust resistance. Mr. P. Douglas Brown is continuing his Ph.D. program at Wisconsin while maintaining employment with Agriculture Canada at Winnipeg. Mr. Brown is working with stem rust resistance derived from tetraploid *A. barbata* selection D203 in the program of Dr. R. I. H. McKenzie. Mr. Brown is concentrating on the use of monosomic alien substitution lines ($2N=20'+1'+1_A'$) as potential bridging types. Mr. Brown passed his preliminary oral exam in June, 1979, and is continuing his research at Winnipeg.

Effect of nitrogen on grain yield and growth characteristics of oats. Results of this research, which is part of the Ph.D. thesis research of Mr. Yeong D. Rho, are summarized in another section of this issue of the Oat Newsletter.

Potential for oat improvement using *Avena fatua*. Mr. Jonathan Reich is conducting this research as part of his MS program. Results of Mr. Reich's work are summarized in another section of this issue of the Oat Newsletter.

VI. NEW CULTIVARS AND RELATED MATERIAL

NASTA

O. Inkila

The spring oat variety Nasta, bred at the Institute of Plant Breeding, Agr. Res. Centre, Finland, was included on the Recommended List of the Board of Agriculture, 1979.

Nasta was selected from the cross Titus x Ryhti. It is well adapted to northern growing conditions. It is early, as early as Swedish Titus. Nasta has short, very stiff straw and grain size is small, similar to Pendek.

The grain yield of Nasta is greater than that of Pendek and Titus; it yields slightly better on organic and sandy soils than on clay soils.

Nasta has very good ability to yield protein, protein percentage is high, and protein yields (averages 639 kg/ha) are greater than on other varieties growing in Finland. Lysine yield is high and hull percentage is lower than in Pendek and Titus.

NEMA

B. Mattsson

Nema, is the first spring oat cultivar released from Svalof, Sweden with resistance to the cereal cyst nematode (*Heterodera avenae*). By back-crossing, Sigurd Anderson (in Denmark) transferred resistance from Avena sterilis to the Svalf Sun II oat and one selected line from this material was crossed with Svalof's Sorbo. In the F_5 pedigree the line Sv 71559 was selected and later named Nema.

Nema is resistant to the two common races of nematodes in Sweden and also to a newly discovered race. The yield is not as high as that of Weibull's Selma or Svalof's Sang and Nema is also less stiff. It has, however, a big kernel with good quality.

Nema has been granted Plant Breeder's Rights in 1978 and added to the Official Swedish List of Cultivars in 1979.

OS 6

R. S. Paroda, K. R. Solanki, C. Kishor,
and B. S. Chaudhary

A promising new forage variety, OS 6, has been developed at the Haryana Agricultural University. A detailed history and description appear elsewhere in this newsletter.

PUHTI

O. Inkila

The spring oat variety Puhti was bred at the Institute of Plant Breeding, Agr. Res. Centre, Finland. Puhti was selected from the cross Hannes x Ryhti.

Puhti is a high yielding variety; the yield is 9% better than that of Pendek, which was bred in the Netherlands. Puhti has averaged 1 day later in maturity than Pendek.

Puhti has very stiff straw and grain size is large, but it has very low hull percentage. The ability to produce protein is high, protein percentage is medium high, and protein yield high compared to Pendek. Lysine percentage is higher than in Pendek. The milling characteristics are good because of low hull percentage.

The performance of Puhti is slightly better on sandy and clay soils than on organic soils. Puhti has been succesful in variety trials under Swedish conditions, and it is at present rapidly spreading in Finland.

PLANT VARIETY PROTECTION PROGRESS REPORT

Larry W. Dosier
AMS, USDA

As of December 1, 1979, the Plant Variety Protection Office had received 14 applications for protection of oat varieties. Eleven certificates of protection have been issued, one was withdrawn, and one denied. Only one application is pending.

With the exception of 'Coker 234', all certificates specify that the variety be sold by variety name only as a class of certified seed. Three certificates of protection have been issued in addition to those listed in the 1977 _Oat Newsletter_:

'Firecracker' - 5/18/78
'Coker 716' - 12/28/78
'Four Twenty Two' - 4/12/79

Our office is soliciting descriptions of all released varieties. Furthermore, we have made provisions for publishing full descriptions of varieties in the _Official Journal of the Plant Variety Protection Office_, if requested. This is an excellent opportunity to record an accurate and detailed description of your variety. Availability of the originator's description will have a distinct influence on the interpretation of characters which show a range of expression. This will serve to benefit the breeder in any situation involving variety identity, including variety protection. The variety descriptions are recorded in our computer for comparison in determining novelty of new application varieties. We would also appreciate copies of any descriptions prepared for other organizations, such as the Small Grains Review Board of AOSCA. Review Board information cannot be used unless released by the applicant.

Breeders contemplating variety protection should review the suggestions in the 1976 and 1977 editions of the _Oat Newsletter_.

1979 North Central (NCR-15) Oat Workers Field Day

The 1979 Oatworkers Field Day was held July 22 and 23 at Fargo, ND. A gathering was held Sunday evening, July 22, at the home of Mike and Marcia McMullen providing an opportunity for informal interchange of ideas. The following morning the group met briefly in the oat workroom where Dr. Dwain Meyer discussed evaluation of oat straw forage quality. Dr. Meyer has observed significant genotypic differences in straw protein content even though the genotype X environment-interaction for this character is relatively large.

Methods of setting up seed for planting head-rows using "trays" were explained.

The group proceeded in a tour of field plots. A hill-plot barley yellow dwarf virus evaluation nursery was toured. One hill of paired hill-plots replicated twice is infected with viruliferous aphids and the other hill is protected with insecticide to serve as the uninfected control. The infected hill is evaluated visually for injury due to BYDV. All breeding lines which reach preliminary yield trials are evaluated in this nursery.

Yield trial nurseries were toured. Four 8' rows are used as plots for advanced trials and 2-8' rows are used in preliminary trials. A lattice design is used in nurseries with more than 30 entries to adjust for soil heterogeneity.

Hal Fisher explained his Master's thesis research investigating the effect of the 'Blunt' dwarfing gene on the agronomic performance of nearly isogenic lines. Frank Moser described a comparison of plot size an experimental design on the efficiency of selection for agronomic characters.

A lunch was sponsored by the Milling Oats Improvement Association during which a business meeting was conducted by Dr. R. A. Forsberg, chairman of NCR-15. During the meeting Dr. Vernon Youngs was honored for his service to oat improvement while in charge of the USDA Oat Quality Laboratory. Don Schrickel and Dale Trommers of the Quaker Oats Company explained factors considered to be important in determining milling oat quality.

The group continued the field tour observing F_2 populations which had been space-planted using an air planter. The air-planter and a 'Suzue' binder were available for examination by the group.

A severe thunderstorm interrupted the tour preventing the group from seeing early generation materials planted in head rows.

Submitted,

M. McMullen

M. S. McMullen
Secretary, NCR-15

VII. EQUIPMENT, METHODS, AND TECHNIQUES

A NEW 4-ROW CONE PLANTER WITH AUTOMATIC LEVELING

R. S. Albrechtsen
Utah State University

A new 4-row cone plot planter was designed and constructed in a cooperative effort with Dr. Wade G. Dewey. Our 1979 nurseries were seeded with this planter. The seed is distributed to the four rows via a single K.E.M. cone and spinner-distributor. This 4-row unit is removable by pulling four quick-release pins and is easily replaced with a 4-cone unit for seeding individual rows. A Zero-Max variable speed drive allows a continuous row length range from 4 to 100 feet. Three types of furrow openers (disc, deep furrow, or a narrow shoe opener) are easily interchangeable, as are three types of press wheels. The most unique feature of the drill is a self-leveling mechanism for maintaining the cone (cones) in a level position. Our nurseries are frequently located on undulating land, often sloping in two directions. This has seriously restricted our use of cone distributors. The leveling mechanism consists of a double frame connected on one end by a ball-joint and on the other end by two small screw jacks. The lower frame is fastened rigidly to the main drill frame. The upper frame, which carries the cone, is leveled by the two screw jacks. Two mercury switches (set at right angles to each other on the upper frame) activate small electric motors, which in turn operate the screw jacks. Leveling is continuous throughout the planting operation. Seed is poured into a holding cup in the cone while the preceeding plot is being planted, so planting is non-stop through the field.

The drill is relatively light and compact and is easily handled by a light tractor, with a standard 3-point hitch. We have kept the seed drop as short as possible in order to minimize alley width. The drill can be completely enclosed with a plexi-glass cover, in the event of inclement weather. The unit performed very satisfactorily during its first season as was evidenced by the speed and ease with which nurseries were seeded and the uniform stands obtained.

Viability of Oat Seeds Stored 15 to 16 Years At the National Seed Storage Laboratory, Fort Collins, Colorado

L. N. Bass
SEA-AR, USDA

The primary function of the National Seed Storage Laboratory is to preserve valuable plant germplasm as viable seeds. As part of that function, the Laboratory has acquired and stored samples of various oat cultivars. As there is little published data on the longevity of oat seeds under good storage conditions, we thought oat workers would be interested in the following data (Table 1). Oat samples stored in the National Seed Storage Laboratory at approximately 5 C and 35 to 40% RH for 15 to 16 years are included in the data. Germination tests were made at 20 C in either folded germination blotters or rolled germination toweling. Germination percentage was recorded 7 days after planting. Most of the samples were not treated, although a few samples were treated by the donor.

Because in most cases we have only one sample of a cultivar, we are not claiming that those cultivars which show the greatest percentage decline are necessarily shorter-lived than the other cultivars, because factors other than cultivar differences can cause differences in the rate of viability loss. Seeds of hull-less cultivars usually have a lower initial germination and lose viability more rapidly than do seeds of other cultivars.

Table 1: Percentage germination of seed of oat cultivars when stored and after 15 to 16 years storage at 5^{o} C and 35 to 40% RH.

	Germination Percentage		
Species/Cultivar	When Stored	After Storage (14-15 years)	Change %
Avena byzantina			
Appler	98	94	- 4
Brunker	97	96	- 1
California red	96	98	+ 2
Columbia	95	90	- 5
Delair	98	94	- 4
Delta Red 88	81	68	-13
DeSoto	92	89	- 3
Early Grain	94	92	- 2
Ferguson 560	98	99	+ 1
Forkedeer	95	96	+ 1
Frazier	95	96	+ 1
Fulgrain Strain 4	96	95	- 1
Fultex	78	66	- 8
Fulton	93	98	+ 5
Fulwin	96	92	- 4
Indio	97	96	- 1

(Table 1: Continued)

Species/Cultivar	Germination Percentage When Stored	After Storage (14-15 years)	Change %
Avena byzantina			
Kanota	98	99	+ 1
Mid South	86	92	+ 6
Moregrain	99	97	- 2
Neosho	79	72	- 7
New Nortex	97	96	- 1
Nortex	94	88	- 6
Palestine	98	99	+ 1
Palestine	99	99	0
Ranger	72	72	0
Red Rustproof 14	99	98	- 1
Tennex	99	98	- 1
Ventura	95	96	+ 1
Victorgrain	97	96	- 1
Victorgrain 48-93	97	98	+ 1
Wintok	98	97	- 1
	Range of Change		+6 to -13
	Mean Change		-1.48
Avena sativa			
AB 110	97	97	0
Advance	97	99	+ 2
Ajax	99	99	0
Alamo	95	96	+ 1
Alamo X	92	94	+ 2
Andrew	97	98	+ 1
Arkwin	95	91	- 4
Arlington	97	96	- 1
Atlantic	91	96	+ 5
Bannock	94	92	- 2
Basin	76	96	+20
Beedee	98	98	0
Blount	93	98	+ 5
Bonda	97	96	- 1
Bonham	94	92	- 2
Bonkee	96	84	-12
Branch	98	96	- 2
Bridger	95	98	+ 3
Bronco	78	90	+12
Burnett	98	96	- 2
Carleton	96	92	- 4
Carolee	96	95	- 1
Centore	93	99	+ 6
Cherokee	95	90	- 5
Cimarron	99	99	0
Clarion	98	96	- 2

(Table 1: Continued)

Species/Cultivar *Avena sativa*	When Stored	After Storage (15-16 years)	Change %
	Germination Percentage		
Clintland	98	99	+ 1
Clintland	91	72	-19
Clintland	99	99	0
Clintland 60	97	98	+ 1
Clintland 60	96	78	-18
Clintland 64	96	98	+ 2
Clinton 59	99	98	- 1
Clinton 59	94	94	0
Cody	94	91	- 3
Cody	99	95	- 4
Cody II	95	98	+ 3
Colo 37	95	86	- 9
Cornellian	98	99	+ 1
Craig	98	99	+ 1
Crater	94	98	+ 4
Curt	99	99	0
Dodge	99	96	- 3
DuBois	96	87	- 9
Dupree	99	99	0
Eagle	98	95	- 3
Eaton	98	96	- 2
Fairfax	92	88	- 4
Fayette	96	94	- 2
Florad	93	84	- 9
Floriland	86	92	+ 6
Forager	87	82	- 5
Fulwood	94	87	- 7
Garland	97	98	+ 1
Garry	99	98	- 1
Golden rain	99	94	- 5
Goldwin	99	98	- 1
Goodfield	98	94	- 4
Gopher	98	98	0
Grey Winter	95	99	+ 4
Houston	97	96	- 1
Ithacan	95	99	+ 4
Jackson	94	98	+ 4
James (Hulless)	82	62	-20
LeConte	65	68	+ 3
LeConte	89	91	+ 2
Lee Cold proof	94	94	0
Lee Cold proof	95	96	+ 1
Lenroc	98	99	+ 1
Lodi	99	99	0
Macon	97	98	+ 1
Mahaska	98	96	- 2
Marida	99	96	- 3

(Table 1: Continued)

Species/Cultivar	When Stored	After Storage (15-16 years)	Change %
	Germination Percentage		
Avena sativa			
Marion	94	99	+ 5
Markton	98	99	+ 1
Minhafer	99	98	- 1
Minland	94	92	- 2
Minton	98	96	- 2
Mission	96	96	0
MO 0-205	98	99	+ 1
Mohawk	97	99	+ 2
Mustang	90	90	0
Neal	99	98	- 1
Nehawka	93	99	+ 6
Nemaha	99	98	- 1
Newton	97	99	+ 2
Niagra	96	98	+ 2
Nip	96	96	0
Nodaway	94	96	+ 2
Nora	85	92	+ 7
Norline	99	99	0
Norline	99	98	- 1
Nysel	84	74	-10
Oneida	97	99	+ 2
Oneida	88	82	- 6
Ora	98	94	- 4
Orbit	99	99	0
Ortley	97	96	- 1
Osage	98	98	0
Overland	99	98	- 1
Park	99	99	0
Portage	99	98	- 1
Powys	94	98	+ 4
Putnam	96	96	0
Putnam 61	95	99	+ 4
Putnam 61	95	96	+ 1
Radar 1	84	98	+14
Radar 2	95	97	+ 2
Rainbow	95	94	- 1
Ransom	99	98	- 1
Roanoke	96	96	0
Rodney	93	99	+ 6
Rodney	95	96	+ 1
Russell	81	70	-11
Sauk	99	98	- 1
Seminole	86	86	0
Shasta	91	96	+ 5
Shield	97	99	+ 2

(Table 1: Continued)

Species/Cultivar	Germination Percentage When Stored	After Storage (15-16 years)	Change %
Avena sativa			
Sierra	95	99	+ 4
Simcoe	95	94	- 1
Southland	94	86	- 8
Sumter	96	99	+ 3
Suregrain	86	82	- 4
Taggart	96	99	+ 3
Terruf	98	99	+ 1
Tioga	98	99	+ 1
Tippecanoe	96	69	-27
Tonka	95	72	-23
Traveler	78	90	+12
Upright	98	99	+ 1
Uton	99	96	- 3
Vicar	76	66	-10
Vicland	99	99	0
Victory	91	99	+ 6
Waubay	99	99	0
Winema	90	99	+ 9
Woodgrain	87	94	+ 7
		Range of Change	+20 to -27
		Mean Change	-.62

Routine Use of Gibberellic Acid to Break the Dormancy of Freshly Harvested Oat Seeds

V.D. Burrows and C.J. Andrews
Research Branch, Agriculture Canada

Oat breeders who experience difficulty in encouraging the germination of freshly harvested oat seed might find it useful to adopt the technique we use to stimulate the germination of "dormoat" seed. Dormoat seed (derived from hybrids between *Avena fatua* L. and *Avena sativa* L.) have a long after-ripening requirement but the seed will normally grow if placed to germinate in 50-100 ppm of gibberellic acid (GA) in water. This technique is really only useful when dealing with small numbers of seeds such as hybrids because the new seedlings must be transplanted from the water solution soon after germination. It does demonstrate, however, that GA is effective in overcoming dormancy.

In breeding programs, breeders often wish to either harvest seed and then sow it directly in soil, or to send harvested seed to another location (winter or summer nursery) where it will be sown almost immediately. Such seed may be completely or partially dormant and may either fail to emerge or may emerge in an erratic manner. In either case, the performance of the line will appear inferior to its neighbors and would not likely be retained in the program. Thus there is a tendency in programs designed to grow two or more generations a year to select against lines with adequate levels of post harvest dormancy.

The technique we have developed for dormoats, and have used extensively in our regular oat program, is to immerse the seed in a solution of 50-100 ppm of GA dissolved in acetone (no added water). The seed is left in the solution for 5-10 minutes and then the acetone is removed by drying the seed in a stream of rapidly moving air (fume hood). The seed is not damaged by the acetone and by adjusting the concentration of GA in the solution, there is enough left on the seed to stimulate germination when the seed imbibes water from the soil. A useful feature of the technique is that the seeds can be left in their paper envelopes during treatment in the acetone bath (adhesives not soluble in acetone) provided a non-acetone soluble ink (prefer pencil lead) is used to identify each envelope. For oats we infiltrate the acetone solution under the hulls of the kernels by using partial vacuum but this is not necessary for hull-less oats.

Use as little GA as possible to obtain the desired result. Excessive concentrations of GA cause the seedling leaves to assume a yellow coloration and to elongate excessively. Each season, run a GA concentration series on suitable check cultivars to evaluate the "depth of dormancy" which will vary depending upon conditions at the time of ripening.

A Partially Automated Harvest Sample Data Collection System

C. F. Konzak, M. A. Davis, and M. Wilson
Washington State University

A new system for collecting machine readable data to speed up processing of harvest samples was devised and prototypes tested in remote laboratory situations.

The system makes use of bar code labels (similar to those used on packages and cans in drug, grocery, hardware stores) for sample identification, a light pen to read them, a specially designed electronic platform scale (laboratory balance), and a portable data logger.

The new scale was designed and developed jointly by Weigh Right Electronic Systems, Inc., Spokane, WA and Washington State University. It will be marketed starting in 1980 by Weigh Right. The electronics of the scale includes an interface to convert the weight information from binary to digital codes, to RS232 signals or to standard light pen readable numerical bar codes (MSI-Plessey, UPC, or the alphanumeric Code 39* systems as per the users selected choice at the flip of a switch. This converter will be marketed separately to allow those currently owning electronic scales to add the new capability to virtually any make of electronic scale.

The new scale will be available with a choice of limits from about 5 Kg to about 46 Kg, with a variable sensitivity readout range, allowing for weighing 0.1 g or 1 g differences.

The unit is about 30 cm square and about 12.5 cm high, with a stainless steel platform. It can be operated for about 20 hours on its 12 volt rechargeable battery or to a 110 or 220 v power supply, so that it can be taken to remote field locations to collect data. A standard light pen can be plugged into an input port on the right side of the scale, and an output port allows attachment of data storage or capture device, in our case a portable electronic data logger. In our prototype system development tests we used an AZURDATA SCOREPAD* for data capture. We transmitted the data to our university computer system (Amdahl V6) via a mini computer or a portable memory terminal. WYLBUR-ORVYL software has been utilized for entry or data and correction of errors via a cathode ray tube terminal (CRT). We also tested a portable data logger with built-in software which allowed direct line-by-line transmission of data using only an associated CRT or printing terminal for communication with the main frame computer and for output reading. The direct line-by-line transmission of data proved simple and would result in a significant saving in hardware costs to communicate with the main computer.

The system we designed for processing yield (or test weight) data should permit a number of significant cost savings, besides the savings in time and reduction in errors.

We now color code our harvest bags and/or tags used on harvest or storage bags, using acrylic spray paints available in a wide range of colors.

The color code combinations can be used to distinguish specific trials grown at several locations, with each location or nursery assigned a particular color or combination as needed. The color coding allows for the unique primary data input which is keyed by hand into the data logger prior to recording the sample identification and weights. A standard format was designed to fit the characteristics of the software in the data logger, in our case all data had to be numeric, but there were several spacer characters available which were used to reduce input errors.

With the color coding system providing for uniqueness of the location and trial number, it was possible to use sequential numbers only for identifying the plot samples from each nursery. As a result, we were able to order many duplicates of stick-on plot identification labels with sequential bar coded numbers. The labels could be read directly into the data logger by rapidly passing the light pen either direction over the surface of the bar codes.

The bar coded labels we used were mylar plastic coated and were produced in sheets of 70 numbers per sheet, using a photo-offset printing process. These labels could suffice as the only ones attached to the samples, or might at least allow a reduction in the number of labels carrying detailed identification.

The processing sequence employed was as follows:

1. Samples from a given nursery are collected, as a group in boxes at harvest (it was not necessary to put them in numerical order).

2. The nursery and location data, year and date of recording is keyed into the data logger and the data logger readied for accepting identification and weight data.

3. A sample placed on the scale platform.

4. The bar coded label is scanned with the light pen (entry of the plot number is acknowledged by the data logger with an audible beep).

5. The sample weight registers on the display of the scale, and once the weight stabilizes (less time required for the 1 g division scale) a button on the scale is pressed to enter the weight into the data logger, signalled by an audible beep.

6. The sample is then removed from the scale and if to be kept or bulked, is placed in a larger bag with a color coded tag and a printed label. In 1980 we plan to write on the tag the plot numbers of the replicates to be placed in the bag to simplify the grouping or bulking of samples.

7. The next sample is then placed on the scale and the process repeated.

8. When all data from each nursery is recorded, data from another nursery is processed, following exactly the same sequence of procedures, until the memory of the data logger is filled. The data logger memory is then dumped via a procedure described earlier.

9. After dumping the data logger, it would be desirable to obtain feedback at least by plot number sequence to be sure no samples were missing, and if the plot and replicate member and randomization layout were stored previously in the computer memory, a simple listing of the data by test entry and plot numbers would provide assurance that all of the data had been collected.

Additional options under investigation include:

1. Quick output summary of data allowing decisions to be made about the discarding of samples.

2. Subsampling for cleaning and volume weight (e.g., test weight) data collection.

3. Determining sample moisture content in order that correction for moisture content might be possible.

*Neither the mention of trade names nor the existence of contracts between the Washington State University Research Foundation constitutes endorsement of manufacturers or their products.

1979 OATS DATA AUTOMATION WORK

Marie Lee, D. H. Henderson, Elizabeth Stanton, Roger Smith
SEA-AR, U.S. Dept. of Agriculture,
Beltsville, Maryland

During 1979 the Statistics and Simulation Staff was reassigned from the Communications and Data Services Division of SEA-AM to The Office of the Deputy Director for Agriculture Research. The impetus was to move this function closer to the agricultural scientific community to provide needed statistical, modeling/simulation and scientific data base related support. Listed below are the Oat related projects completed during 1979.

Uniform Early and Midseason Oat Performance Nursery System developed for Dr. Howard Rines. The interactive remote data entry and analyses system provides remote data entry capabilities via computer terminal, performs appropriate editing, calculates required statistics and generates report in final copy form. The system automatically updates a historical data base with current data. The historical data base contains information on nursery entries from the mid 1960's. Retrieval and analyses on the system are limited only by one's imagination. The system could easily be adapted to report and analyze other commodities.

Gene Data Bank System represents the automation of Agriculture Handbook Number 509 titled, "Oats: A Standardized System of Nomenclature for Genes and Chromosomes and Catalog of Genes Governing Characters." The interactive retrieval system contains gene descriptions, gene symbols, who and when reported and the gene host. The system can be easily updated as new genes are found.

Oat Worker File contains a worldwide file of oat workers and possesses word processing capabilities for personalized form letters and address labels. The file can be easily edited and updated.

DEVELOPMENT OF PREDICTION EQUATIONS FOR GROAT-TO-HULL RATIOS

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Test weight and groat to hull ratio (determined by the McGill Rice Sheller, alone or in combination with hand dehulling) were measured in seven samples representing four species of *Avena* and in 48 samples of *A. sativa*. The oat kernels were passed through the sheller six times and the results were used to calculate simple and multiple correlations and prediction equations for groat-to-hull ratios. The correlation coefficient was 0.69 ($R^2 = 0.47$) if only test weight was included in the prediction equation. The correlation coefficient increased up to about 0.95 ($R^2 = 0.90$) if the amount of sheller-separated groats were included in the equation.

A NEW CONCEPT IN BIRD CONTROL FOR SMALL GRAIN PLOTS

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The cereal plot areas at the University of Saskatchewan are essentially surrounded by residential areas which provide an ideal roost for house sparrows. These birds cause a great deal of damage to our plots, particularly barley and later maturing wheats.

In the past many different methods of control, including poisons, trapping, shotguns, etc., were tried. None met with more than limited short-term success, and most were expensive and publicly unacceptable.

In view of these problems a new method was tried in 1979. We used birds to control the birds. Trained falcons (natural predators of the sparrow) were used to drive away the sparrows.

Our program was a co-operative venture with Dr. L. Oliphant of the Western College of Veterinary Medicine. He and his workers supplied the falcons and we supplied the problem. The end result of this first year was a moderately successful program (definitely as effective as our previous shotgun system and less expensive), a lot of learning, and the generation of new ideas for next year.

In 1979 four merlins were flown twice a day for varying lengths of time. Repeated flights caused abandonment of feeding areas more than 100 meters from cover. Feeding spots closer to cover were more difficult to handle and the dispersal of the sparrows tended to be temporary.

Several other observations were made during the season. One was that the sparrows moved into the crop from edges; they did not like to drop into continuous crop. Hence, the pathways we have in our plots are just to their liking. One resulting suggestion is to cut pathways through any cover or lure crops you might have in the vicinity of your plots to attract the birds to these areas.

Silhouettes resembling the falcons were effective in keeping the sparrows away during non-flight periods of the falcons. The key to this is that they must move about in the wind. The best type were held aloft by balloons.

After some days of flying the trained merlins, it was noted that just their calls became sufficient to cause the sparrows to stop feeding and leave. We hope next year to record the call of the predator and with loudspeakers use this to aid in control during non-flight periods.

One of the best off-shoots of the program was the luring of native falcons into the area. These birds would come in and continue to hunt after the trained falcons were recalled. We are investigating the possibility of establishing a few breeding pairs of falcons in areas adjacent to our plots to give us some local natural predation to keep our sparrow population at a minimum.

Probably the best result of the program, however, was its public acceptance compared to our other programs, particularly shotguns. No adverse comments were received although many interested people did stop and question us.

The relative success of this first year has convinced us to carry on with the program in 1980. Since we now have corrected some initial errors we anticipate the program will improve and be even better for all concerned in the future.

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