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OAT NEWSLETTER

Vol. 24

July 1, 1974

Sponsored by the National Oat Conference

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Volume 24

Edited and multilithed by the Department of Botany and Plant Pathology, Iowa State University, Ames, Iowa 50010. Costs of preparation financed by the Quaker Oats Company, Chicago, Illinois 60654.

July 1, 1974

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Marr D. Simons, Editor

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ORGANIZATION OF THE NATIONAL OAT CONFERENCE

EXECUTIVE COMMITTEE

Chairman: C. F. Murphy
*Past Chairman: C. M. Brown
*Secretary: L. W. Briggle
*Editor of Newsletter: M. D. Simons

REPRESENTATIVES

North Central Region: D. D. Stuthman, D. T. Sechler, M. D. Simons
Southern Region: C. F. Murphy, M. E. McDaniel
Western Region: D. M. Wesenberg, C. F. Konzak
U.S.D.A. Technical Advisor: L. W. Briggle
U.S.D.A., N.P.S., Cereals: L. P. Reitz

*Non-voting members

Minutes of the Executive Committee Meeting
American Oat Workers Conference
February 12, 1974 Ames, Iowa

Chairman C. M. Brown presided. C. F. Murphy was elected as new Chairman of the American Oat Workers Conference and L. W. Briggle was re-elected as Secretary. New officers take office immediatly after adjournment of the present Conference. J. E. Grafius will rotate off the Executive Committee (was past Chairman). Members of the Executive Committee after February 14 will be :

C. F. Murphy, Chairman and Southern Representative
C. M. Brown, Past Chairman
L. W. Briggle, Secretary and USDA-ARS Representative
M. D. Simons, Newsletter Editor, Secretary NCR-15, and NC Representative
D. D. Stuthman, Past Chairman NCR-15 and NC Representative
D. T. Sechler, Chairman NCR-15 and NC Representative
H. G. Marshall, NE Representative
N. F. Jensen, NE Representative
D. M. Wesenberg, Western Representative
C. F. Konzak, Western Representative
M. E. McDaniel, Southern Representative

Two invitations were extended as prospective locations for the next meeting of the American Oat Workers Conference in 1978. H. G. Marshall indicated that Pennsylvania State University would like to invite the group and M. E. McDaniel spoke for Texas A&M University. After some discussion it was decided that the full membership of the Conference should decide by vote.

There was considerable discussion on the effect of the USDA-ARS recent reorganization on the overall leadership and coordination of research on oat improvement in the U.S. C. F. Murphy and H. G. Marshall were instructed to prepare a resolution for consideration at the business meeting of the Conference on February 14.

Considerable discussion was offered relative to the selection of nominees for the "Distinguished Service to Oat Improvement Award". Nine people were nominated for the honor and it was decided to select no more than three. Each member of the Executive Committee was instructed to vote for 4 of the 9, and the three nominees receiving the highest number of votes would automatically be chosen. O. T. Bonnett, H. L. Shands, and M. B. Moore were elected.

The Oat Newsletter was another topic of discussion. J. A. Browning had previously submitted his resignation as editor. The Executive Committee designated M. D. Simons as the new editor, and moved (Grafius, Stuthman) to express appreciation to Dr. Browning for his services and to D. J. Schrickel for financial support from the Quaker Oats Company.

Respectfully submitted,

L. W. Briggle

L. W. Briggle, Secretary

Minutes of the Business Meeting
American Oat Workers Conference
February 14, 1974, Ames, Iowa

Chairman C. M. Brown presided. He announced that C. F. Murphy had been elected by the executive committee as the new Chairman, and L. W. Briggle was retained as Secretary.

The committee report on oat gene nomenclature was given by M. D. Simons. Three additional gene assignments were added since the last meeting (Raleigh, North Carolina in 1970).

J. A. Browning reported that 500 copies of the last Oat Newsletter had been printed and 400 distributed. The Newsletter was financed by the Quaker Oats Company (approximately $800). Dr. Browning resigned as Newsletter editor, and M. D. Simons succeeds him as editor.

Four resolutions were presented, discussed, and accepted by those attending the Conference. Resolution number 1 (Murphy, Schmidt) related to the effect of the USDA-ARS reorganization on federal and state oat research programs. Resolution number 2 communicated appreciation to the Iowa State University hosts for their efforts in making the Conference a success. Resolution number 3 directed thanks to Dr. Browning for serving several years as the Oat Newsletter editor. Resolution number 4 (McKenzie, Shands) involved possible control of buckthorn, the alternate host of crown rust on oats. Complete texts of the resolutions follow these minutes.

A motion (Browning, Gafius) concerning organization changes of the American Oat Workers Conference was passed. It reads as follows: The American Oat Workers Conference Chairman is directed to appoint an ad hoc committee 1. to study the organization of the Conference, 2. to make recommendations for reorganization in light of contemporary oat work and regional and national representation, 3. to incorporate our colleagues from Canada into the structure of the reorganized Conference, and 4. to complete this assignment in time for study prior to the 1978 meeting of the American Oat Workers Conference. Canadians are to be represented on the ad hoc committee.

Invitations were received from Texas A and M University and Pennsylvania State University for the next conference location (1978). College Station, Texas was selected by popular vote.

J. C. Craddock read a letter reporting on the status of the long awaited Oat Classification Bulletin written by F. A. Coffman. Those attending the Conference instructed the Secretary to write a letter to Dr. Coffman expressing gratitude for his dedication to this effort.

Respectfully submitted,
L. W. Briggle
L. W. Briggle, Secretary

Appreciation is expressed to D. T. Sechler for recording the minutes at the meeting.

Resolution Number One

The following resolutions were adopted by the American Oat Workers Conference held at Iowa State University, Ames, Iowa, February 11-14, 1974.

Whereas, the United States Department of Agriculture, through its investigation leaders, has long provided national and regional leadership and coordination for state and federal research programs on oats and other cereals; and

Whereas, this leadership and coordination has fostered informal cooperation among cereal researchers throughout the nation and has enabled them to make accomplishments and acquire information which could not have been done independently; and

Whereas, the results of this cooperative endeavor have been most beneficial to the nation generally, by providing basic knowledge, varieties, and production information essential for the stable and efficient production of food and feed grains; and

Whereas, the reorganization of the Agricultural Research Service of the U.S. Department of Agriculture and relocation of personnel has disrupted this established and beneficial cooperative program of research, and has significantly weakened coordination and lines of communication between researchers both within and between regions; and

Whereas, the national research program in oats and other cereal crops has benefited tremendously from the leadership and coordination of investigation leaders formerly located at Beltsville, Maryland; therefore be it

RESOLVED, that the 1974 American Oat Workers Conference go on record as encouraging the administrators for the Agricultural Research Service to consider the detrimental impact of the loss of such leadership on the national research program and urge them to appoint national technical advisors, or other such leadership, to insure the continuation of regional and national leadership, coordination, and cooperative research for specific crops; be it further

RESOLVED, that the Agricultural Research Service administrators involved recognize the need to maximize the input and influence of the National Program Staff in regional and area planning, to insure an integrated national program for specific crops; be it further

RESOLVED, that copies of this resolution go to appropriate administrators within the Agricultural Research Service, USDA, to Directors of Agricultural Experiment Stations and to other appropriate individuals and organizations.

Resolution Number Two

Whereas, the 1974 American Oat Workers Conference has been one of our most productive meetings; and

Whereas, the success of this meeting was greatly enhanced by our gracious hosts at Iowa State University, be it

RESOLVED, that we hereby welcome the opportunity to express our appreciation to our hosts for the fine facilities and for the many courtesies extended.

Resolution Number Three

J. Artie Browning has acted as editor of the Oat Newsletter for the past several years. Under his guidance the Newsletter has been edited, produced, and distributed to 500 Oat Workers annually throughout the world. The editor's position is considered to be an arduous, thankless task. We would like to change this concept. The job is arduous, that we agree, but not thankless. We express our thanks to Dr. Browning for a job well done.

Resolution Number Four

Whereas, crown (leaf) rust (*Puccinia coronata* Cda.) is an economically important disease of oats in North America; and

Whereas, buckthorn, *Rhamnus cathartica* L. is well know to accelerate epidemics and to facilitate the production of new races of rust that can attack previously resistant varieties, be it

RESOLVED, that the American Oat Workers Conference ask all relevant states and provinces to classify *R. cathartica* as a prohibited noxious weed and to mount educational programs to inform the public as to why eradication is desirable to protect their interests.

It is specifically stated that growth and maintenance of *R. cathartica* for experimental purposes by bonafide agencies shall be permitted.

Report of Committee on Oat Gene Nomenclature

M. D. Simons and N. F. Jensen

Genes recorded since the last summary, which appeared in the 1971 Oat Newsletter 22:2-3, 1972, are as follows:

E-1. Stuthman. (1972). Dominant gene conditioning presence or absence of a single band from mesocotyl and coleoptile tissue, associated with isozyme system in oats.

E-2. Stuthman. (1972). Dominant gene conditioning presence or absence of a single band from flag leaf tissue, associated with isozyme tissue in oats.

Pc-53. Simons. (1972). Gene lacking clear dominance for resistance to many crown rust races derived from A. sterilis 6-112-1-15 via H441.

Simons, M. D. 1972. Unpublished data. Department of Botany and Plant Pathology, Iowa State University, Ames, Iowa 50010.

Stuthman, D. D. 1972. Unpublished data. Department of Agronomy and Plant Genetics, University of Minnesota, St. Paul, Minn. 55108.

Spas Simeonoff Ivanoff, 1899-1973

At the age of 17, Spas emigrated from Bulgaria where he was born in Sevlievo on March 20, 1899. With a determination to learn the language of his adopted country and avail himself of the education opportunities opened to him, he earned a B.S. degree in agriculture by 1928 at Cornell University. From the University of Wisconsin he earned a M.S. degree in Plant pathology in 1930, and his Ph. D. degree in biology in 1932.

He remained as a research associate at the University of Wisconsin until 1937, when he accepted a position as plant pathologist at the Texas Agricultural Experiment Station at Crystal City. In 1945 Spas joined the Mississippi Agricultural Experiment Station, Department of Plant Pathology and Physiology, where he advanced in rank to Head, in 1954. It was at Mississippi State that Spas developed a keen interest in oat diseases, particularly leaf blotch and Victoria blight. 'Midsouth' (C.I. 6977) with Victoria blight resistance, and 'Forager' (C.I. 7136), a grazing oat, were two varieties released by him.

Spas retired as Head of the Department of Plant Pathology at Mississippi State University in 1964 and accepted an appointment as Visiting Professor at Belhaven College in Jackson, Mississippi, where he taught botany for 4 years.

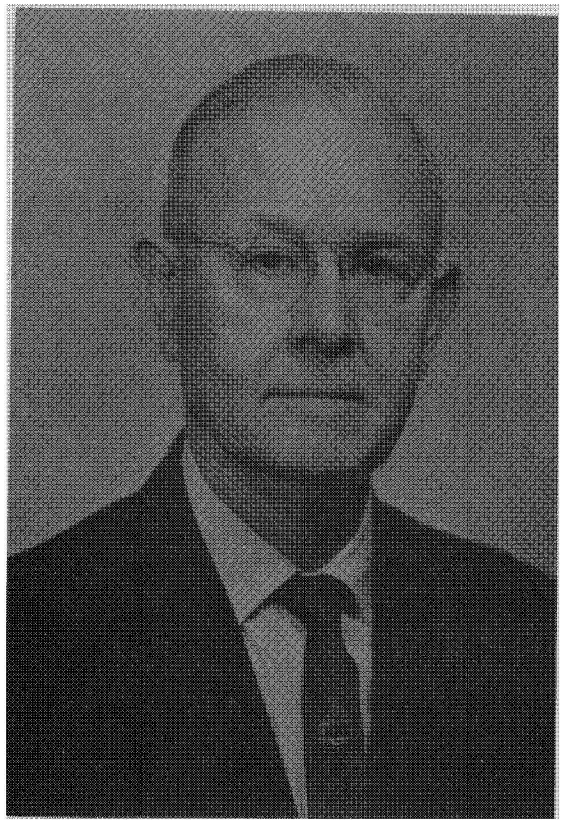
Upon his second retirement in 1968 he moved to his cabin at Little Sturgeon Bay, Wisconsin, where he passed away on October 26, 1973. He is survived by his wife, Julia.

DISTINGUISHED SERVICE TO OAT IMPROVEMENT AWARD

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

People who were awarded this honor prior to the 1974 meeting were I. M. Atkins, R. M. Caldwell, F. A. Coffman, H. K. Hayes, G. K. Middleton, and D. E. Western.

At the 1974 meeting of the National Oat Conference at Ames, Iowa, Chairman Brown appointed a committee to nominate candidates, and three people were chosen in accordance with National Oat Conference procedures. Photographs and biographies of the three selected to receive the award for distinguished service to oat improvement follow.



O. T. Bonnett

Dr. Orville Thomas Bonnett, Professor Emeritus of Agronomy, University of Illinois, has made many contributions to his profession. He is particularly well known for his research in small grains improvement and in plant morphology and development. Dr. Bonnett was also regarded as a most outstanding teacher of plant breeding and plant morphology by students and colleagues alike.

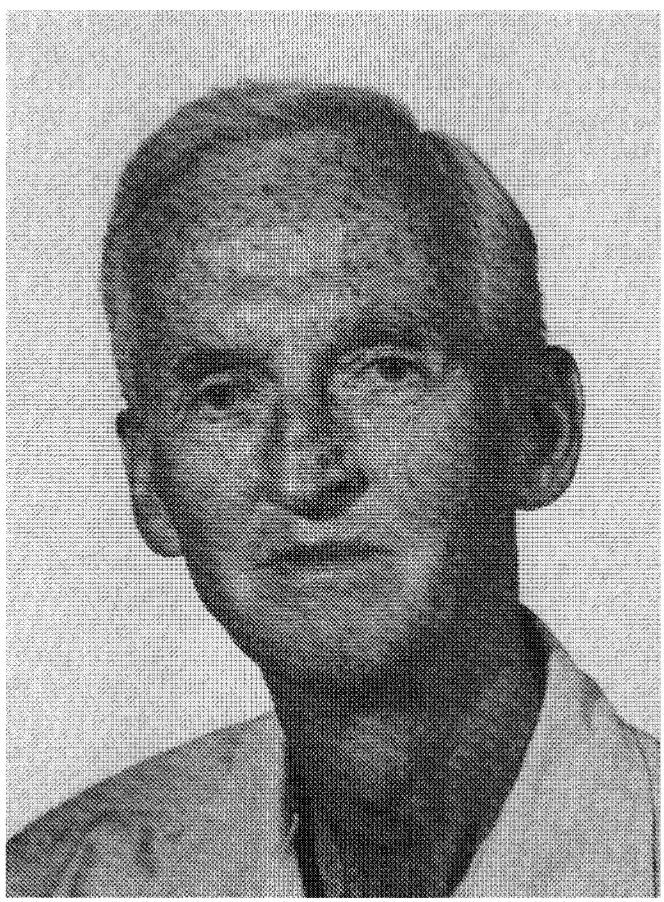
His professional career began as a teacher in a rural school at Silverdale, Kansas, 1913-1914. He was county agent, Marshall County, Kansas, 1919-1921; Vocational Agriculture teacher at Alton, Kansas, 1921-1926; and Instructor, University of Wyoming, 1927-1928. Dr. Bonnett came to the University of Illinois in 1928 where he advanced through the various instructional and professorial ranks before becoming Professor Emeritus in 1962.

Dr. Bonnett was leader of the Illinois small grains breeding program for a number of years and, during that time, developed five improved soft winter wheat varieties and four spring oat varieties. One of his major contributions to small grains improvement was the development of the "hill plot" method of testing that continues to be widely used by plant scientists.

Even though Dr. Bonnett was quite occupied with small grains breeding, he still found time to conduct a monumental amount of research in plant morphology and development. Largely as a result of his contributions in this field, he was awarded a special Guggenheim Fellowship in 1948 to permit him to pursue his investigations on the morphology of the ear and tassel of corn. His research on plant morphology and development included work with oats, wheat, corn, barley and many other grasses. The publications that resulted from this classical research are held in high regard and are widely used by scientists throughout the world. It is significant that Dr. Bonnett continued this fine research for more than ten years after retirement and his most recent publication was completed within the past year.

Dr. Bonnett is a member of Sigma Xi, Alpha Zeta, Gamma Sigma Delta, Phi Kappa Phi, Scabbard and Blade, American Society of Agronomy, American Botanical Society, American Association for the Advancement of Science, and is a Fellow of the American Society of Agronomy.

Dr. Bonnett was born June 21, 1894 at Winfield, Kansas. He received his undergraduate training at Kansas State University, being awarded the B.S. degree in 1918 and the M.S. degree from the same institution in 1927. He received his PhD degree from the University of Illinois in 1933.



M. B. Moore

M. B. Moore

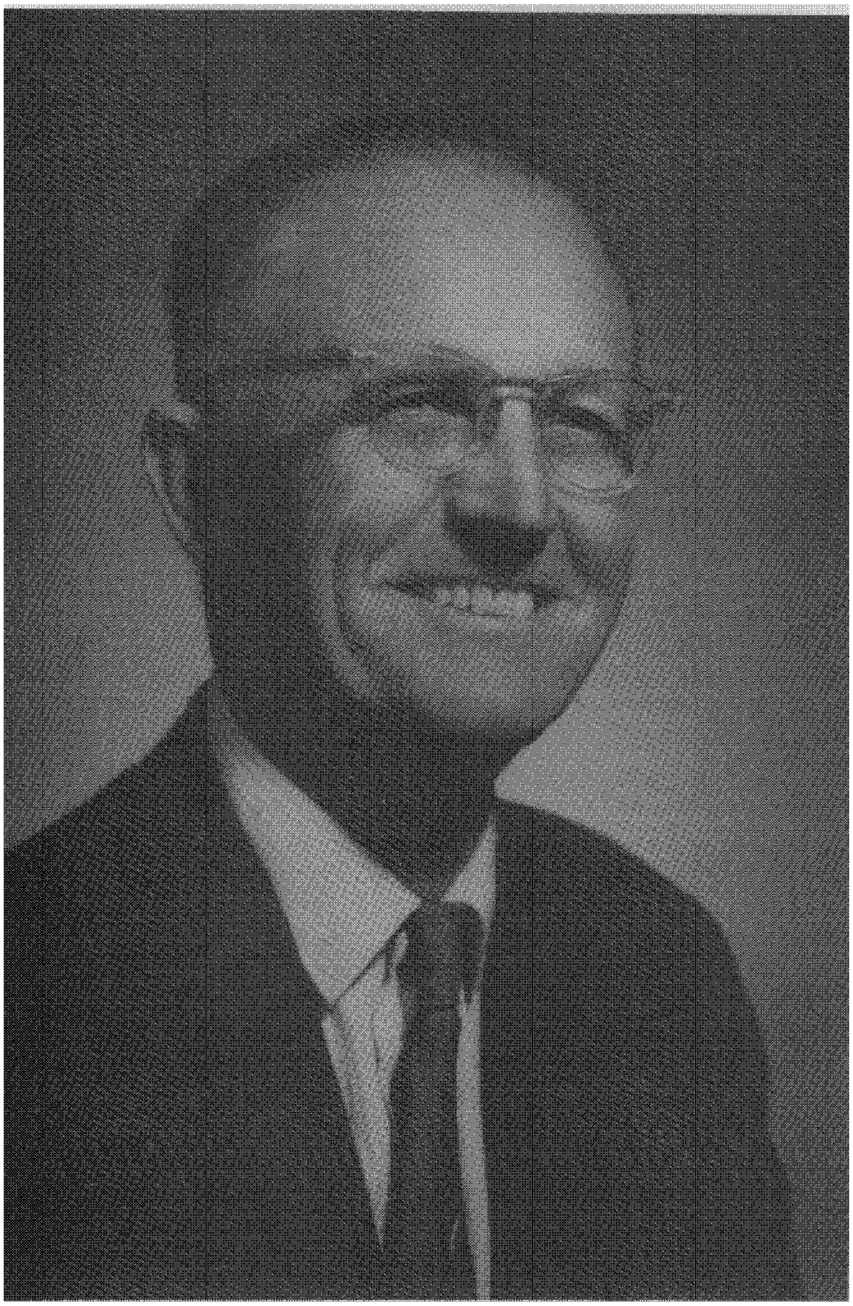
Mr. Matthew B. Moore, Professor Emeritus of Plant Pathology at the University of Minnesota, has been a leader in all pathological phases of oat improvement. In 1929 he began as a technician with the U. S. Department of Agriculture, working for the prevention of grain rust, but soon joined the staff at the University of Minnesota as an Instructor of Agricultural Botany and assistant in Plant Pathology. Mr. Moore was an Instructor of Botany for one year (1931-1932) at Louisiana State University. He returned to the University of Minnesota as a member of the Plant Pathology Department and remained until his retirement on June 30, 1973. In 1960 Mr. Moore spent 4 months on research at the Alaska Agricultural Experiment Station and again from February 1 to August 31, 1962 was on sabbatical leave as a consultant to the Alaska Agricultural Experiment Station. While there he advised on agronomic disease problems, principally barley yellow dwarf, stripe and false stripe, timothy eye spot, and alfalfa black stem.

In over four decades of teaching "Introductory Plant Pathology" and "Plant Pathology for Advanced Students" courses, Mr. Moore influenced between 3000-4000 students, many of whom were guided into the field of plant pathology by his extraordinary abilities as a teacher. His students consider him one of the best instructors on the campus.

Mr. Moore, a natural-born mechanical genius, has applied his talents to problems related to plant pathology. Mechanical innovations were designed to improve pathological techniques of inoculation, seed treatment of small grains, and bird depredation control in field research plots. While his research activities have been concerned with all oat diseases, his work with crown rust in particular has been most rewarding. Over tremendous opposition, Mr. Moore was successful in establishing on the St. Paul Campus one of the first buckthorn plots for the etiological study of crown rust.

He desired to break away from the traditional specific gene for resistance breeding concept and try to accumulate a series of non-specific genes for more lasting protection against the ravages of crown rust on oats. A whole series of Minnesota-developed breeding lines, which resulted from rigid selection under crown rust epidemic conditions in his buckthorn nursery, have performed very well in the International Oat Rust Nursery over the past 5 years. This series is now available to oat breeders for use as crown rust resistant germplasm.

Mr. Moore was born April 11, 1905 at St. Paul, Minnesota on a small fruit farm which has since become engulfed by the expansion of the developing city. His present home was included among the original farm buildings. He attended the School of Agriculture (high school) on the present location of the University of Minnesota Institute of Agriculture, and graduated in 1924. He obtained his B.S. degree in 1929 and an M.S. degree in 1934, and did further graduate work, all at the University of Minnesota.



H. L. Shands

H. L. Shands

Dr. Hazel Lee Shands, Professor of Agronomy at the University of Wisconsin, has often been referred to, both professionally and affectionately, as the "Dean" of American oat breeders. Examination of the list of 16 oat, 2 barley, 4 winter wheat, and 2 winter rye varieties developed by Dr. Shands at Wisconsin reveals why this title is appropriate and also demonstrates his superior capability as a small grain breeder. These varieties were the product of intense ambition and untiring vigor, coupled with a creative knowledge of material and great skill in performance evaluation.

Starting with the oat variety Vicland in 1941, his varieties have been outstanding for their disease resistance, wide adaptation, and excellent grain quality. Branch, Sauk, Beedee, Goodfield, Garland, Holden, Lodi, Froker, and Dal, to single out a few varieties, all exhibited important contributions over existing varieties in one or more specific traits. His response to recent emphasis on development of high protein oats has been the release of Dal and Goodland, both over 2 percentage points higher in groat protein than most available varieties.

Dr. Shands was instrumental in organizing the National Oat Conference during the period 1946-1950, serving as Chairman of the first conference in 1950. He has served as Chairman of both the North Central Oat Conference and the North Central Barley Conference. His wit, humor, and scientific knowledge have been a stimulation and inspiration to his colleagues whenever cereal breeders have gathered together.

He has advised and directed the graduate research programs of 23 Ph.D. candidates. Eight others received terminal M.S. degrees. He developed and has taught annually, since 1935, a course in grain crops.

Dr. Shands has demonstrated the unique ability to establish a rapport with his scientific colleagues, with industry, with agricultural advisory groups, and with farmers. His help and tireless efforts in relating scientific accomplishments to the needs of the farmer and agri-business have generated widespread confidence by the farmer, seed-grower organizations, and industry in his own breeding and research programs and in the Department of Agronomy, University of Wisconsin.

He advised and personally participated in oat breeding programs in Brazil and Mexico, and provided germplasm for these programs as well as those in Chile and Columbia. He has willingly shared his germplasm with oat workers the world over.

Dr. Shands was born October 19, 1908, at Landrum, South Carolina. He received his B.S. degree from Clemson University in 1929, and the Ph.D. degree from the University of Wisconsin in 1932. Starting as an "Assistant in Agronomy," he rose to the rank of Professor in 1946. He was elected a Fellow in the American Society of Agronomy in 1955, and holds membership in Kappa Alpha Sigma, Phi Sigma, Gamma Alpha, Sigma Xi, and Gamma Sigma Delta honorary societies. He is the author of numerous research papers and Wisconsin Agricultural Experiment Station bulletins. Dr. Shands is scheduled to retire from the University of Wisconsin staff in July, 1974.

ANNOUNCEMENTS AND INSTRUCTIONS

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

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

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

PLEASE DO NOT CITE THE OAT NEWSLETTER IN PUBLISHED BIBLIOGRAPHIES

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

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

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

II. ABSTRACTS OF PAPERS PRESENTED AT THE NATIONAL OAT CONFERENCE

Physiological Studies of Nitrogen Metabolism in Oats. Part 1.

David M. Peterson

The following steps involved in nitrogen metabolism in the cereal plant were discussed with regard to their possible regulation of groat protein concentration in oats: 1) uptake of nitrate, 2) transport of nitrate to the leaves, 3) reduction of nitrate and amino acid synthesis, 4) protein synthesis in leaves, 5) leaf protein degradation, 6) remobilization of amino acid residues to developing grain, and 7) protein synthesis in the grain. It is thought that nos. 3, 5, 6, and 7 above are more likely to be involved in regulation than the others.

Six oat cultivars grown in the field were compared for their ability to assimilate N and to remobilize it into the developing grain. There was no direct relationship between total shoot reduced N and groat protein concentration in these cultivars. When the proportion of the total shoot N which was found in the panicle at maturity was compared among 3 of the cultivars with equal yield, a direct relationship to groat protein concentration was apparent. These results indicate the probability that protein degradation and remobilization of amino acid residues into the panicle may be important controlling factors of groat protein concentration.

Physiological Studies of Nitrogen Metabolism in Oats. Part II.

L. E. Schrader

The *in vitro* instability of nitrate reductase activity from leaves of oats and other small-grain cereals was reported. Decay of activity was exponential with time, suggesting that an enzyme-catalyzed reaction was involved. The rate of decay of nitrate reductase activity increased as leaf age increased in all species studied. Addition of 3% (w/v) bovine serum albumin or casein to extraction media prevented or retarded the decay of nitrate reductase activity for several hours. In addition, the presence of the added protein in the enzyme homogenate markedly increased nitrate reductase activity, especially in older leaf tissue.

A second study involved a comparison of a high and low protein cultivar. Nitrate reductase activity per plant was similar for the two cultivars and exceeded the level needed to account for the actual accumulation of reduced nitrogen in the whole plant. In addition to leaf blades, leaf sheaths and floral parts had significant levels of nitrate reductase at certain times. Patterns of accumulation of total reduced nitrogen by the groats was comparable in the two cultivars. However, the contribution from various vegetative parts (remobilized nitrogen) varied. Analyses of carbohydrate storage and remobilization in vegetative tissue showed the high and low protein cultivar to be markedly different. The high protein cultivar was less efficient in starch deposition. Fructan deposition and remobilization was important in the low protein cultivar, but contributed little to groats in the high protein cultivar. A comparison of nitrogen and carbohydrate data indicated that groats of both high and low protein cultivars had a similar content of nitrogen, but groats of the high protein cultivar had less carbohydrate, thus accounting for its higher protein concentration.

Influence of Ethrel on Seed Set in Oats

R. A. Forsberg

While cytoplasmic and cytogenic schemes have been utilized in the development and production of hybrid wheat and barley, a controllable sterility system in oats has not been found. This has led to an interest in the use of chemical gametocides, especially in Ethrel (2-chlorothyl phosphonic acid).

Ethrel was applied to Jaycee, an earlier type, and Froker, a later type, at each of three plant growth stages--early-, mid-, and late-boot in 1972, and very early-, early-, and mid-boot in 1973. Five application rates--control; .5, 1, and 2 lbs. per acre; and a split application of 2 lbs. initially followed by 2 lbs. at the next growth stage--were applied to 3 x 5-ft. nursery plots replicated three times. Six panicles per plot were enclosed in glassine bags prior to anthesis for self-fertility determinations. Nine square feet per plot were harvested for grain yield. Application volume was 60 gallons per acre.

At the 2 lb. rate, seed set in primary florets of Froker was reduced only 10, 13, and 7% below control levels in very early-, early-, and mid-boot stages, respectively. Reduction in seed set was greater in Jaycee than in Froker, e.g., down 68, 65, and 47% below control levels at the 2 lb. rate for the respective three stages.

The variable reduction in seed set was accompanied by a reduction in number of spikelets per panicle, delayed heading and restricted panicle emergence and a 3-36% reduction in plant height, all of which combined to cause severe reductions in grain yield. For Froker, the .5 lb. rate reduced yield by 69% at very early boot, compared to a 29% reduction at early boot and only a 9% reduction at mid boot.

At stages used in this study, Ethrel applied at rates low enough to prevent undesirable side affects did not cause sterility; and if applied at higher rates, side effects were quite drastic. Liquid Ethrel apparently has little potential for use as a male gametocide in spring oats if a high level of male sterility is desired.

Reaction to Manganese Deficiency in Progeny from Three Oat Crosses

D.M. Wesenberg, J.A. Benson, and R.M. Hayes

Differential gray speck or manganese deficiency symptoms were first reported for entries in the Uniform Northwestern States Oat Nursery in 1970 at Bonners Ferry, Idaho by J.A. Benson. He reported gray speck on a scale of 0 to 10, where 0 is equivalent to no visible symptoms and 10 is most severe. G.A. Murray and Benson subsequently studied the response of 'Cayuse' and 'Park' oats to foliar applications of manganese sulfate. They reported at the 1973 American Society of Agronomy meetings that yields of gray speck susceptible Cayuse were increased 1425 kg/ha by application of 3.6 kg/ha Mn and yields remained constant at higher rates of application.

Four F_2 populations were planted on DeVoignes silt loam at Bonners Ferry in 1972 to study the gray speck reaction of diverse oat genotypes. The four crosses studied were 63Ab7868/Cayuse; Lodi/Park; Lodi/Cayuse; and Park/Cayuse. Gray speck reactions reported for these parents in the 1970 and 1971 Uniform Northwestern States Oat Nursery at Bonners Ferry indicated that the four crosses represented Susceptible/Susceptible; Resistant/Resistant; Resistant/Susceptible; and Resistant/Susceptible, respectively. The four F_2 populations were each derived from single F_1 plants. F_2 plants were classified for gray speck reaction on July 7, 1972 when the plants were all well tillered and at about the jointing stage of growth. The F_2 gray speck data are summarized in Table 1. Most F_2 gray speck reactions were within observed parental extremes with only about 4% of over 1100 F_2 plants exceeding these parental extremes.

Table 1. Gray speck reaction* (0-10) for F_2 and parental populations at Bonners Ferry in 1972.

Cross	Population Average P_1	P_2	F_2	F_2 Range	No. F_2 Plants
63Ab7868/Cayuse	8.1	5.4	6.6	0.5 - 10.0	286
Lodi/Cayuse	0.4	6.4	3.4	0.0 - 8.0	283
Park/Cayuse	1.0	3.9	3.1	0.0 - 8.0	265
Lodi/Park	1.3	1.0	1.2	0.0 - 4.0	313

* Gray speck 0-10, where 0 = no symptoms and 10 = most severe symptoms.

The checks for the female parent represent the female plant used in the cross. The male parent checks, Cayuse and Park, were also derived from single plants, but not necessarily the exact plant used as a male parent. The reactions of checks in 1972 were as observed in previous seasons with the exception of the Cayuse check for Park/Cayuse which averaged only 3.9 for gray speck reaction. The relatively low value for Cayuse in this instance probably reflects local soil conditions which did not favor development of gray speck symptoms.

One hundred F_3 lines of each of three crosses were grown in two replicate trials at Bonners Ferry in 1973. F_3 populations were classified for gray speck reactions at about the same stage of growth as the F_2 populations. The F_3 gray speck data are summarized in Table 2.

Table 2. Gray speck reaction* (0-10) for F_3 lines and parental populations grown at Bonners Ferry in 1973.

Cross	Population Average			F_3 Range	No. F_3 Lines
	P_1	P_2	F_3		
63Ab7868/Cayuse	7.6	6.4	6.3	1.0 - 9.0	100
Lodi/Cayuse	1.7	7.7	4.4	1.0 - 7.5	100
Lodi/Park	2.0	2.6	2.2	1.0 - 5.0	100

* Gray speck 0-10, where 0 = no symptoms and 10 = most severe symptoms.

Average grain yield of F_2 plants was measured for each of 11 reaction classes for the four crosses grown in 1972. These yield data are summarized in Table 3. Certain averages represent only 1, 2, or 3 plants as indicated; however, most averages represent 5 or more plants. In general, for all crosses, a gradual decline in yield was observed as the severity of gray speck reaction increased. Similar associations were observed for F_3 populations.

Table 3. Average grain yield (g) of F_2 plants in gray speck reaction classes 0 - 10.

Gray Speck Class	63Ab7868 / Cayuse	Lodi / Cayuse	Park / Cayuse	Lodi / Park
0	----	21.7‡	28.8	28.2
1	33.5	31.0	26.9	24.7
2	36.2	23.4	29.3	21.6
3	59.0*	25.4	23.4	20.8
4	33.0	22.0	20.8	15.0
5	31.8	19.7	19.1	----
6	27.7	16.4	17.1	----
7	21.9	15.1	20.3	----
8	15.7	13.0‡	9.0*	----
9	11.3	----	----	----
10	5.5+	----	----	----

* One plant. + Two plants. ‡ Three plants.

Prospects for Further Improvement of Winter Hardiness in Oats

H. G. Marshall[1]

In the early 1920's winter oats were restricted to the deep south of the United States because of low winter hardiness. Since that time, the winter hardiness of oats has been steadily increased by the selection of natural variation in old cultivars and the isolation of transgressive progeny following hybridization. 'Culberson' cultivar was considered the first advance in hardiness, and 'Winter Turf' was the most winter-hardy oat when the Uniform Winter Hardiness Nursery was established in 1926. The most significant step-up in winter hardiness occurred with the development of 'Wintok' by the Oklahoma Station in 1932, and Wintok remains a winter hardiness standard today. As an indication of the magnitude of the Wintok improvement, that variety has exceeded Winter Turf by 19 percent over the past 20 years in the Uniform Winter Hardiness Nursery grown in many states each year. The nearest thing to a major improvement over the Wintok winter hardiness is the variety 'Hickory' which represents about a seven percent improvement. However, that variety is only of parental value because of weak straw and most commercially useful varieties have not surpassed the Wintok level of hardiness. A lack of genetic variability among the commonly used parents probably is the primary reason a major breakthrough for winter hardiness has not been made since 1932.

Some of the best combinations of winter hardiness and other characteristics have resulted from transgressive segregation following crosses between winter and spring oats. Only a few spring oat varieties have been used in such crosses, relative to the vast number available, and this pool of genetic diversity is largely untouched. However, one needs some basis for selecting those spring oats that might be expected to contribute most toward transgressive segregation for winter hardiness when used in crosses with winter oats. Based on my experiments in the field and in controlled freezing tests, the performance of winter x spring (or reciprocal) F_2 bulks, using a common winter parent, can be used to identify the spring varieties that might be most useful for extensive use in the breeding program. As an example of differences associated with the choice of spring parent, C.I. 9168 (winter) x 'Rapida' (spring) had only 20% field survival in the F_2 compared to 100% for C.I. 9168 (winter) x 'Titus' (spring). Based on other studies comparing early and late generation bulks, the F_2 performance should be of value in selecting elite spring oat parents.

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Wild hexaploid oats appear to represent another source of diverse genes for winter hardiness. Certain collections of *Avena fatua* L. from the western United States have freezing resistance equal to the cultivar 'Norline', but my comparisons of F_2 bulk populations from crosses of wild parents with a common domestic winter oat parent, show that freezing resistance *per se* of the wild oat may not indicate parental value. Similar experiments were conducted with collections of *A. sterilis* L. and *A. ludoviciana* Dur. A few elite parents from these species are being used in crosses with winter oats to develop bulk and bulk composite populations that will be carried under natural selection pressure for winter hardiness and screened for improved types.

If current male gametocides prove effective, it may be feasible to use similar procedures to screen many other spring oat and wild oat varieties for the genetic diversity needed to further improve the winter hardiness of oats.

A New Dwarf Oat

R.I.H. McKenzie and Doug Brown

A new dwarf oat, the result of a mutation breeding program using 1150 Rads of fast neutrons, has been developed at the Canada Agriculture Research Station in Winnipeg. Agronomically, this new line, Dwarf O.T. 184, is similar to its mother line, a desirable backcross line of Harmon with genes Pg 2, 4 and 9 for stem rust resistance.

Dwarf O.T. 184 is 40% shorter than the mother line (54 versus 96 cm.) resulting from shorter internodes (9 versus 18cm.). The number of nodes and pannicle length, however, was the same for both lines. The dwarf is two to seven days later in maturity.

F_2 segregation ratios of crosses with the dwarf suggest that one gene controls this trait with the dwarf allele being dominant. F_1 plants from crosses of Dwarf O.T. 184 with a wide range of plant height types were all the same height.

Because previous oat dwarfs have been erratic in their cytological behaviour, and because this new dwarf arose from a mutation breeding program, its cytological behaviour was studied. Any chromosomal abnormalities would reduce the utility of Dwarf O.T. 184 in crossing. Root tips of dwarf plants that had been selfed for 5 generations post-mutation showed that 42 chromosomes are present. Root tips of F_1 plants arising from crosses with lines of varying plant height also indicated that 42 chromosomes are present. Twenty-one pairs of chromosomes were seen at first metaphase in pollen mother cells collected from some of these F_1 plants. In PMC's from F_1 plants of other crosses 19 pairs plus one quadrivalent were present indicating a translocation. However, chromosomal translocations are relatively common and do not impede interline corssing. From all these results it would appear that the cytological behaviour is normal. It should be possible to transfer this dwarf characteristic without difficulty.

At present the yield of this dwarf line compared to other varieties is not known. It does produce plump seeds and in the field the plant tillers well. In the absence of shading by plants of normal height sterility is not a problem. If the yield is satisfactory, this dwarf line may be useful as a cultivar without further breeding or selection. To date, Dwarf O.T. 184 has been used in crossing programs with the aim being to utilize this dwarf characteristic.

Inheritance of Node, Branch, and Spikelet Number in Oat Panicles. Diallel Analysis of F_1 and F_2.

Young-am Chae and R. A. Forsberg

While the conventional components of yield, namely, number of panicles per unit area, number of seeds per panicle, and seed weight, have received considerable attention, within-panicle characteristics, other than number of seeds per panicle and seed weight, have been studied less extensively. We therefore determined the nature of gene action and inheritance controlling six oat (*Avena sativa* L.) panicle traits based on data from F_1 and F_2 generations of a diallel cross among seven parents.

Traits measured were panicle length, number of nodes per panicle, number of branches per node, number of branches per panicle, number of spikelets per node, and number of spikelets per panicle. The parents represented a wide range in panicle characteristics. Selections C7, C5, and Lodi had long panicles with a higher number of spikelets per panicle, Beedee and Froker were intermediate, and Orbit and Jaycee had shorter panicles with fewer spikelets per panicle.

Additive genetic variances were significantly different from zero in both 1972 and 1973 and in both F_1's and F_2's, and additive effects of genes were more stable than dominance effects. The degree and direction of dominance varied with traits, generations, and years except for number of spikelets per node and number of spikelets per panicle which remained at partial dominance in both years and generations.

Long panicle and large numbers of spikelets per node and per panicle were controlled by recessive genes, while dominant genes controlled large number of branches per node and per panicle. Relatively higher heritabilities were obtained for panicle length (42-80%), number of spikelets per node (79-82%), and number of spikelets per panicle (63-79%). Among these six panicle traits and based on higher heritability and greater stability over environments, number of spikelets per panicle appears to be the most reliable selection criterion for possible yield improvement.

Simulated Hail Damage on Oats

Dale L. Reeves, South Dakota State University, Brookings

Hail damage was simulated by bending stems and hitting the oat plants in various stages of growth. These are preliminary results based on Chief and Froker grown at two locations in 1973. Blast varied between varieties and between locations. Hitting the sheath during the boot stage with a short dowel on a "hail gun" increased blasting up to twice the natural blast in some cases. This hitting in the early boot stage averaged a 6% reduction in yield. Bending the flag leaf below the collar but above the head in early boot gave an 8% yield reduction.

Three treatments resulted in a 29% reduction in yield. These were (1) bending at the approximate base of the head during late boot, (2) bending 1 1/2 inches below the base of the panicle, and (3) bending 2 inches below the flag leaf collar with the bending treatments applied at the heading stage --heading referring to when 50% of the panicles have completely emerged from the sheath. Applying the same bending treatments during the soft dough stage caused smaller losses. The bending below the flag leaf caused a 24% reduction in yield while bending below the head caused only a 10% reduction. This difference may be due to the difference in the affect on the flag leaf blade because the lower bend greatly affects its position and causes two bends to be present in the translocation system between the leaf blade and the grain.

Test weight was significantly reduced only when the treatments were applied at the heading stage. These caused a 10% reduction in test weight or about 3 pounds per bushel. Even though the bending treatments at the heading stage had similar effects on test weight, they did not have equal effects on 1,000 kernel weights. Bending below the head appeared to be more severe than if bent below the flag leaf collar. Samples were also screened to determine the effect on kernel size. No treatment had any effect on the percent thin oats (those going through a 0.064" screen). However, the percentage of the grain remaining on top of a 0.0859" screen was significantly reduced by the bending treatments at the heading stage especially in the Froker variety which is characterized by plump kernels. Head droppage was very slight with the only significant droppage occurring in plots which had been bent below the head usually in the heading stage.

Alien Chromosome Substitution -- a Cause of Instability for Leaf Rust Resistance in *Avena*

D. C. Sharma and R. A. Forsberg

Workers attempting interploidy gene transfer in *Avena* via conventional chromosome pairing and crossing over have frequently encountered instability among resulting progenies, e.g., leaf rust resistant and susceptible progenies from a resistant parent plant. A cytogenetic investigation was undertaken to determine the cause of instability existing in advanced generations (F_{11} to F_{13}) of the cross, derived-tetraploid C.I. 7232 (2n=28) x *A. sativa* cv. Clarion (2n=42).

The nature of instability in this material became apparent with the discoveries of monosomic alien substitution and the differential transmission of the alien chromosome through the egg and pollen. Resistant plants had a chromosome complement of 20" +I' + I'A, with the alien chromosome (I'A) carrying a major gene for leaf rust resistance. High maternal transmission of the alien chromosome (39%) and lack of transmission through the pollen in 21-chromosome gametes maintains heterogeneity and instability for resistance to leaf rust in these lines.

Positions of the centromere in the two univalents in resistant monosomic alien substitution (20"+I'+I'A) plants, of the alien chromosome in resistant alien addition (21"+I'A) plants, and of the *sativa* univalent in susceptible monosomic (20"+I') plants indicated that the alien chromosome was submetacentric and that the hexaploid univalent was metacentric.

Pairing affinity exists between the alien and the hexaploid-oat monosomes. This conclusion was based cytologically on the presence of a loosely paired, heteromorphic bivalent and was further supported by a relatively high meiotic index (few micronuclei), clear indicators of a phylogenetical relationship between the two chromosomes. However, recombination and gene exchange between the two chromosomes occur very rarely but were observed in the case of a kernel-color marker.

Present Status of Identification of Oat Monosomics

K. Sadanaga

Karyotype of over 60 monosomic lines have been prepared. Seventeen out of the 21 different monosomics have been identified. The identified monosomics include 2 in the SAT (satellite), 3 in the M (median), 5 in the SM (submedian), and 7 in the ST (subterminal) groups. Monosomics were identified on the basis of one or more of the following methods: 1) chromosome morphology; 2) plant morphology; 3) F_2 segregation ratio in monosomic hybrids between monosomics and marker genes; and 4) chromosome association in hybrids between monosomics and monotelocentrics.

GROAT PROTEIN DIFFERENCES IN RECIPROCAL OAT CROSSES

Harbans S. Sraon and Dale L. Reeves

Four oat genotypes with diverse protein content (14-27%) were crossed to make a complete diallel to study the differences in protein content of reciprocal crosses. Groats from F_1 plants grown in the greenhouse were analyzed for protein content. The protein was 1.6 to 4.2% higher when Avena sterilis was used as the maternal rather than paternal parent. This trend was less pronounced within the A. sativa material. The protein content was higher when the high protein line was used as the maternal parent. However, in one cross the opposite effect was noted.

A similar influence of the maternal parents was also observed in groats obtained from F_2 plants that were grown in the greenhouse. When grown in field conditions F_2 material showed a tendency in some crosses to follow the same trend but due to a large genotype X environment interaction, it was not possible to detect differences in reciprocal crosses with precision.

Pathogenicity of Crown Rust Isolates in Recent Years

M. D. Simons

Races of race group 264B have dominated the crown rust picture for the last several years, accounting for around 80% of all isolates identified These races all parasitize the key crown rust differentials Landhafer, Santa Fe, and Trispernia. As a natural grouping, the 264B races can be readily distinguished from the older 264A races by the susceptibility (or greater susceptibility) of supplementary differentials such as Ascencao and X-421 (Wahl #2) to 264A.

Certain potential sources of crown rust resistance that were tested in 1972 and 1973 for reaction to all isolates used in the survey appeared very promising. None of those isolates parasitized Coker 234. Lines parasitized by only a very small number of isolates included X421, H441, Pc-38, Pc-39, and Pc-48.

Report on 1973 Oat Stem Rust Survey

P. G. Rothman and A. P. Roelfs

Thirteen races of oat stem rust (Puccinia graminis avenae) were identified in the 1973 physiologic race survey conducted by the Animal and Plant Health Inspection Service in cooperation with the Agricultural Research Service. Race 31 comprised 64% of the 996 isolates identified from 365 collections. Race 61 was next most frequent with 25% (Table 1).

Eight races of stem rust were identified from 63 uredial collections received from 10 of the 35 locations growing the 1973 Uniform Oat Rust Nursery. Race 31 comprised 29% of the 167 isolates identified and race 61, 26% (Table 2). However, by using the data from only those nurseries where natural rust infection occurred, race 31 comprised 36% of all identified isolates and race 61, 60% (Table 3).

A perception of the race situation with oat stem rust can be obtained from Table 4. The race 6 group with virulence for genes Pg-1, Pg-2, Pg-3, and Pg-4 appears to be declining in prevalence, while the race 7 groups with virulence for genes Pg-1 and Pg-4 is again increasing in prevalence. Pg-2 is effective against race 61 and is present in many of the commercial oats grown today.

Table 1. Percentage of prevalent races identified from all uredial collections received in the 1973 race survey.

Old Race	1	2AH	6AF	7F	6F	1H	2H	2AH	6AH	11AH	6AFH	1AH	4AFH
New Race No.	1	15	31	61	72	76	77	86	87	91	94	98	99
Percentage	*	*	64	25	*	*	1	1	4	*	2	2	*

* Less than 1%.

Table 2. Percent of prevalent races identified from all uredial collections received from the 1973 UORN.

Old Race	6AF	7F	6F	2AH	6AH	11AH	6AFH	4AFH
New Race No.	31	61	72	86	87	91	94	99
Percentage	29	26	*	7	26	2	8	2

* Less than 1%.

Table 3. Percent of prevalent races identified from uredial collections received from locations of natural stem rust infection 1973 UORN.

Old Race	6AF	7F	6AH
New Race No.	31	61	87
Percentage	36	60	4

Table 4. Prevalence of race 6 and 7 groups expressed as percent of total isolates identified between 1956 and 1973.

Race Group	1956	'57	'58	'59	'60	'61	'62	'63	'64	'65	'66	'67	'68	'69	'70	'71	'72	'73
6	1	2	1	9	27	61	72	85	87	85	81	98	79	82	82	70	51	68
7	67	64	58	68	35	25	20	8	8	5	1	1	9	2	3	17	33	25

Oat disease research at Ottawa

R. V. Clark

1. In cooperation with T. Rajhathy oat species material collected during recent Canadian excursions to the Middle East has been screened for septoria resistance and found to be quite susceptible. However, a small number have shown some resistance. The resistant types are largely diploids but a few are hexaploids. Several are being used in crosses in an effort to transfer the resistance to cultivated types and at the same time learn something about the genetics of resistance.

2. The effect of 7-, 14- and 21-inch row spacing on disease development and yield of oats was compared in duplicate blocks with one block sprayed with 5 applications of maneb fungicide and the other unsprayed. Plants in 14- and 21-inch spaced rows produced less seed than those in rows 7 inches apart when unsprayed but there was little difference between yields from the various row spacings when they were sprayed. There was, however, a substantial increase in yield of all sprayed plants (75-100%) compared with unsprayed ones primarily due to the control of crown rust. The quality of the sprayed crop was much improved also because of freedom from lodging and secondary organisms on the straw and seed.

3. In cooperation with V. Burrows it has been found that "dorm oats" (A. fatua x A. sativa) seeded in the fall produced somewhat less crown and stem rust than the same strains seeded in the spring. This was done by growing both types together in the field and in the growth room and inoculating them with a mixed culture of the two rusts. The difference in disease development would appear to be more than disease escape due to time of maturity.

Influence of Genetic Background on the Expression of Genes Conditioning Crown Rust Resistance in Oats.

M. E. McDaniel, Texas A&M University.

PC45 was isolated from an *Avena sterilis* collection from the Middle East. It previously has been described as a dominant gene conditioning resistance to a rather broad spectrum of virulent races of crown rust. However, when Pendek backcross lines homozygous for the PC45 resistance were crossed to a number of susceptible Texas breeding lines, the F_1 plants appeared to be fully susceptible to crown rust races 325 and 264-B. F_2 populations from the susceptible F_1 plants segregated in a ratio of approximately 1 resistant : 3 susceptible to these races, thus indicating that the PC45 gene was recessive. In other crosses, F_1 and F_2 reactions indicated partial dominance. Full dominance was exhibited in one cross. No maternal (cytoplasmic) influences were indicated by studies of reciprocal crosses in which PC45 exhibited the various levels of dominance. All parents used in this study (other than the Pendek backcross PC45 resistance source) appeared to be fully susceptible to the crown rust races used in this study. It is obvious, however, that genes in the various susceptible parents had a pronounced effect on the expression of the PC45 gene.

Maganese Deficiency of Oats in Western Canada

J. W. Martens & R.I. H. McKenzie

A survey of 245 farm fields in Manitoba and Saskatchewan in 1973 indicated that manganese deficiency in oats is common over a wide range of soil types including sand, peat, high lime, sandy loam, clay loam and heavy clay soils. The Mn content of the flag and penultimate leaves was determined by atomic absorption spectrometry using samples collected from each field. Deficiency symptoms (necrosis) are commonly expressed when Mn levels drop to 15 ppm or bleow. Mn levels in leaf tissue ranged from 6.6 to 82.4 ppm and were under 20 ppm in 71 of 245 samples. Determinations of available soil Mn (Diethyltriaminepentacetic acid extraction + AAS) indicated mean levels of 10.8 ug/g in fields where the leaf tissue level was below 15 ppm compared to 20.0 ug/g where the leaf tissue level was above 30 ppm. Symptom expression on the same soil varies from season to season and Mn uptake and symptom expression vary with plant genotype. A susceptible cultivar on a 'deficient' soil dropped from 35 ppm Mn at the 4 leaf stage to a low of 14.5 ppm just before heading. A susceptible cultivar on 'normal' soil maintained a level of over 60 ppm throughout the growing season with only a slight drop just prior to heading.

Formation of Crown Rust Telia on Oats

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Divergent views exist concerning the formation of teliospores on oats indicating inter alia the possible role of oat varieties, their age and reaction to disease, prevailing temperature and humidity etc. responsible for the development of Telia. Recently it has been reported from India that the telial formation on oats are governed only by high relative humidity, irrespective of any other factors. With a view to critically study the formation of teliospores, several oat collections representing diploid, tetraploid and hexaploid oats and a few hexaploid oats with varying disease reaction were grown in 3 x 4 M plots, replicated twice at the Indian Grassland and Fodder Research Institute, Jhansi, India (78 E long., 25°N lat and 275 m alt). Artificial epiphytotic condition was created through the susceptible hosts grown as border lines to each plot and were repeatedly inoculated. Sufficient uredoinoculum was produced on such hosts at the boot and later stages during December to middle of January at the temperature range minimum 6.2 to 9.2°C and maximum 23.4 to 28.2°C with 47 to 90 percent relative humidity. The inoculum gradually spread over all the cultivars. Telial formation started during 3rd week of February and the process was completed by the 3rd week of March, 1973 at the temperature range minimum 7.5 to 11.7°C and maximum 21.4 to 33.6°C with relative humidity 65 to 82 percent. The observations recorded are tabulated below.

It was found that telia developed on 15 cultivars out of 17, irrespective of the genotype and their reaction to the disease. Percentages of the telial production were also found to be independent to the disease reaction. On cultivars Nos 1668-2670 and VIII-578 all the uredosori were converted into telia, both on the leaves and on the stem. However, on the variety Victory and species *Avena strigosa* and *A. weistii*, telial development was above 70 percent but restricted to the leaves. The present information thus confirms the role of high humidity in the formation of crown rust telia on a variety of host plants, irrespective of their ages and reaction to disease.

Formation of crown rust telia on varied oat cultivars with different disease reactions

Cultivars		EC/IC number	Disease reaction	Telial formation
Avena fatua	(6x)	93709	S	a
IG 68-2670	(6x)	-	R-S	e
IG 68-3076	(6x)	-	R	a
VIII-578	(6x)	-	S	e
ag 331	(6x)	-	R	o
Curt	(6x)	-	HS	b
Gopher	(6x)	-	S	c
Kent	(6x)	-	S	b
Sauta Fe sel.	(6x)	5844	R	b
Benton	(6x)	-	R	a
Victory	(6x)	-	HS	d
Victoria	(6x)	7003	R	b
Avena _barbata_	(4x)	93714	S	a
_A_. _strigosa_	(2x)	73703	R	d
_A_. _longiglumis_	(2x)	93707	S	b
_A_. _weistii_	(2x)	93715	S	d

o = no telia

a,b,c,d & e = telia upto 10,25,50,75 and 100 percent respectively.

R = resistant

S = Susceptible

HR = Highly resistant

HS = Highly susceptible

"Looking Back"
At Some Things we Failed to Do Along the Way

I. M. Atkins
Texas A&M University

Having spent more time in one location than most oat researchers (43 years), I am going to assume that I have the right to dish out advice to the younger generation. Those of us in oat research did many things right, some things wrong and at times perhaps our emphasis was wrong. I realize that you did what you had to do. But, lets "look back" at some of our sins of Omission and Commission and hope that it helps some one.

1. We failed to build a plant adequate for the job:

"A chain is only as strong as the weakest link". We have all followed this "truism", working hardest on the thing we felt was the weakest link under our condition- crown rust, stem rust, cold tolerance, straw, quality et. This is good and probably was all we could embrace at the time. But, concentrating on this weakest link, we failed to build a total oat plant that can compete with other crops. Many other crops have outstripped oats because researchers have produced new varieties or hybrids with the potential to utilize high levels of fertilizer, moisture or cultural practices which contribute to high yields. In Texas we have our Sturdy wheat which now has exceeded 100 bushels per acre; the Northwest has Gaines wheat, which has exceeded 200 bushels per acre; and, you are all familiar with the records of the Mexican wheats.

The Texas state average yield of wheat has gone from 14-16 bushels per acre in the 40's to 26-30 bushels in recent years. The average yield of sorghum has jumped from 24.6 bushels in the period 1949-58 to 59 bushels in 1972 and 62 in 1973. The average yield of corn jumped from 19.9 for 1949-58 to 86 bushels per acre in 1972. Hybrids, shifts to irrigated areas, fertilizer cultural changes and other factors contributed.

The average yield of oats in Texas has increased to some extent but we are still in the 25 to 40 bushel range. Again, looking back, we find that the state averaged 38 bushels in 1900, 35 in 1919 and 34 in 1931 so it appears we have some catching up to do. One reason for the low grain yield in Texas is that growers graze the "living daylights" out of the oat crop from December to March 1 then take the livestock off and expect it to make a grain crop with depleted fertilizer elements and often inadequate spring moisture. The Texas seeded acreage has held up better than most states. About 2 million acres are seeded but only 200,000 to 500,000 are harvested, the others are grazed off. Oklahoma once grew more than 1.5 million acres and now grows only 100,000. Even Iowa now grows only about 1.5 million and they grew 5.5 million as recently as 1950-59.

So, maybe we are still working the old draft horse of the 30's. He has a few bone spavins so he falls down some times and he has a few fistulas, which we keep plugged up with antibiotics (resistant varieties) but these frequently break out at new places.

2. We depended on one load of dirt to fill the hole in the dam.

Single gene resistance- call it vertical, specific or what have you- is a beautiful thing and it is a wonder that we as plant breeders were sure it would solve our problems. And, it has served us, we cannot discard it or down grade its importance. Even the Victoria gene, with its associated problems served Texas and much of the South for 10 to 15 years. Farther north it was of lesser value. I well remember how confident we were in the 30's of the Hope gene in wheat and the Victoria gene in oats. Starting with Red Rustproof and Fulghum, our basic varieties of that day, we developed Ranger, Rustler, Fultex and Alamo in the 40's and for a time they became a whole new ball game in oat culture. But, before we brought them to full use, we began to find cultures of race 45.

When the Victoria was no longer useful, we turned to Santa Fe, Landhafer, Trispernia and others in rapid succession. Frequently the new source of resistance could be increased. Now, we are on the sterilis bandwagon. Will it last any longer? We hope so but perhaps not. Even a ground squirrel knows to dig more than one entrance to his den. We apparently did not.

Now, we are proposing several alternate systems. The methods are complex and require a lot of facilities and "people" to shift with the boat. These too will not be perfect or even adequate under some conditions. When the rust organism bombards the crop for 6 to 8 months, as it does in South Texas, no method may hold the line. McFadden used to say that, "Multilines just multiply all the races instead of one or two". We have tried to pile up genes but after 43 years, I still do not know how. Tolerance is not adequate in South Texas as we have seen while using Red Rustproof for 100 years and specific resistance has not held up long.

Red Rustproof strains have a "lot going for them" in modern terms. They have been in Texas for 100 years. In our 60 year research program at TAMU, we have observed their ability to survive and recover from rusts, low temperatures, drouth, and diseases. They have many good things about them but also a lot of faults so we have not used them as much as we should have in the breeding program. I have observed New Nortex reduced to a 20 percent stand by low temperatures, yet in a favorable late spring season, it may recover and yield as much as a hardy variety that survived 100 percent. Likewise, when a new variety with specific resistance was attacked by a new race, that new variety was easily killed but Red Rustproof would be slowly rusted and often make a fair to good crop of grain. But, if the going gets rough enough, Red Rustproof also will be killed.

Bands of varieties with different sources of resistance may or may not be adequate to cope with some situations. Dr. McFadden moved to Texas in 1938 to set up a rust barrier to prevent over wintering of rust in Texas (Proposed by McFadden, Humphrey and Salmon). Apparently by 1943, he was having doubts about this because on May 19, 1943 he wrote Dr. Stanton that "We may not be able to combine resistance to all physiologic races of the rusts. In such case, the next best bet would be to set up zones across the growing region in which resistance to specific races would be worked on in each zone. This would have a tendency to cut down on the northward migration of inoculum from one zone to another. Then Dr. Stanton threw cold water on that by answering "The rust will jump over the zones".

The 1969 Texas Almanac has this statement in it in a discussion of crops in Central Texas. "Rust is the dreaded disease of small grains in Texas."

It still is

3. We rode single when we should have been riding double.
Oats are a beautiful dual purpose crop-grain and forage.

When Texas was being settled, the 1869 Texas Almanac states "Wheat grows luxurantly throughout the winter months offering the finest pasture for livestock." While we have used oats for winter pasture, we have not fully utilized them. It took farmers to demonstrate to us some potentials that we should have worked out. Early seeding and use of fertilizers for forage are cases in point. Researchers said "we cannot seed early because of insects and diseases; and, oats are a low value crop so we cannot spend much on fertilizer". Farmers said, "we must seed early if we are going to have winter pasture". And, they soon found out how well oats responded to fertilizer. So, they started seeding in September and August, often in dry soil.

Most research forage tests were seeded in October 15 to November 15, as for grain. With such seedings not much forage is produced until midwinter or spring. While forage is needed at this time, it also is needed much earlier. Growers, who seeded early, produced a heavy thick stand with plants 6 to 12 inches tall by December 1 in favorable seasons. Temperatures after December 1 are often not favorable for forage growth.

An example: One member of Grain Research Associates sells 50,000 bushels of seed oats to one large grower near Marlin, Texas each fall. This grower plows out the stubble of the previous crop in June and prepares seedbeds in July. In late August he seeds and fertilizes, in dry soil if necessary, and has the planting ready for the first fall rains. He uses 500 pounds of 13-19-0 fertilizer at seeding, plus 150 pounds Ammonium nitrate in the spring. He seeds 3.0-3.5 bushels of oats per acre and then "flies on" 10-15 pounds of ryegrass on the surface. Normally he is able to graze this from November or December until the next June. The cattle then go to the feed lot for finishing. He usually handles about 10,000 cattle per season.

Another thing that growers taught us is that New Nortex (Red Rustproof oats) and ryegrass behave very differently if seeded in August than if November seeded. Both these crops tend to grow slowly, producing a prostrate plant during the winter and the greatest amount of forage in the spring. But, if seeded in August, the plants are more upright, leaves are as broad as the intermediate winter types and forage growth is rapid at this higher temperature and longer day length situation. We proved this to be true in clipping tests this fall as given below.

Production of New Nortex oats at the Texas Experiment Station at McGregor, Texas, 1955-69 when planted October 15 to November 15.

Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	Total
				TAES, McGregor 1955-69						
			0 ——	——	——	996 ——	——	4672 ——	——	5386
	Seeded			GRS, McGregor 1972						
	0 ——	——	——	2273	Killed by low temperatures					?
				GRS, Denton, 1973						
	0 ——	——	2188	1175—	—527—					?

In 1972 we produced 2273 pounds of dry matter by December 1 and in 1973 we produced 2188 pounds by November 1 and another 1702 pounds by January 1, total 3890 by January 1 whereas from November planting over the period 1955-69 only 996 pounds were produced by Feburary 1. Furthermore, this supplies the green forage at the time it is most needed. September seeded ryegrass produced 4946 pounds by January 1 in 1973. Both 1972 and 1973 were very favorable fall seasons.

In my opinion, there is still a lot to be learned in the field of management of oats for winter pasture.

4. We refused to compromise on cold tolerance.

Under Texas conditions, widespread and serious winter injury to small grains occurs about once in 10 years with lesser injury in other years and the hazard presents a regular threat to the crop.

We have attempted to breed oats of sufficient hardiness to withstand these sudden changes in temperature and have been moderately successful in varieties such as Mustang, Bronco and Norwin. However, when we do this we defeat our other major objective, that of high forage production. If a variety stays dormant in prostrate growth, then it does not produce enough forage to suit the grower. Certain sections of Texas and other states must have this degree of cold tolerance but for most of Central Texas and the southern part of other Southern states, it seems more practical to develope a more moderately hardy plant that will excell in forage production, now the most valuable product of the crop. When the severe freezes occur, even the most hardy varieties are damaged. Therefore, it seems more practical to consider winter killing one of the hazards of production along with hail, drouth and lesser diseases.

Finally, "looking back" we can see some things that we did wrong or, at least, that we might have done better. I hope your multilines, your geographic zones with different sources of resistance, your "piling up" of genes or your development of tolerant varieties will permit you to endure, escape or prevent damage from the rusts. If this works out, give some additional attention to breeding a better race horse (oat plant) that can compete with others in the field. You may develop a winner yet.

Small Grain Forage Screening Nursery

R. D. Barnett
Institute of Food and Agricultural Sciences, University of Florida

At the Febrary 1973 meeting of the Southern Small Grain Workers Conference interest was expressed in cooperative forage work and a committee was formed composed of Robert Shank, Overton, Texas, Chairman; Ron Barnett, Quincy, Florida; and Norman Merwine, State College, Mississippi. It was the concensus of this committee that a screening type nursery would best suit the needs of interested persons. Therefore, the first Small Grain Forage Screening Nursery was initiated for the 1973-74 season. The nursery was grown at 26 locations in 12 states. The first nursery, which included 130 entries, was composed of 21 ryes, 58 wheats, 9 triticales, 27 oats, and 15 barleys.

The objectives of this nursery are to give the cooperators an opportunity to evaluate a large number of potentially new varieties of small grains for forage and to provide the originators of the entries with information on the potential usefulness and adaptability of his material. Data is obtained on forage potential in the fall, winter, and spring; disease and insect resistance; and winter hardiness.

The results of the 1973-74 nursery should be available in late summer 1974. Entry into the nursery is open and the seed is available to all breeders and testers who are interested in forage production. Though the nursery is most likely to serve those in the Southern Great Plains and Southeastern United States, anyone noticing a line that shows forage potential is invited to send 1 pound to the committee for inclusion in the nursery. If smaller amounts are available please send them for increase and subsequent inclusion in the nursery.

Development of Useful Germplasm from Wild Oat Species

L. W. Briggle

We now have approximately 6,000 collections of *Avena sterilis* in the ARS-USDA World Collection maintained at Beltsville, Maryland by J. C. Craddock. Only part of these have been tested for desirable characters, such as disease resistance. On the basis of results obtained from those inoculated with crown rust, *A. sterilis* represents virtually an unlimited source of resistance. Many of the collections have proved to possess differing levels of tolerance (or resistance) to oat stem rust, barley yellow-dwarf virus (BYDV), smuts, soilborne mosaic virus, and other diseases. Primary emphasis is now directed toward isolating genes for crown rust resistance from *A. sterilis* and incorporating the most useful genes into our near-isogenic line program and into the Minnesota oat breeding program.

Many of the *A. sterilis* collections produce seed very high in protein content. Some seed samples contain more than 30% groat protein. Efforts to transfer such high protein content into common oats, *A. sativa*, have not been successful to date.

The Amino Acid profile of the few *A. sterilis* collections analyzed so far differs little from common oats, *A. sativa*. More analyses are planned.

By far most of the 6,000 *A. sterilis* collections are from Israel and Spain, and a few from North Africa. We hope to sample the populations indigenous to Morocco through the University of Minnesota-AID project at Rabat, Morocco.

A. fatua, the wild oats of our own country, may represent virtually an untapped source of genetic variability for our own oat breeding programs. We recently tested a small group of collections from California and found resistance to race 203 of crown rust. Dr. V. L. Youngs of the USDA-ARS and University of Wisconsin National Oat Quality Laboratory found that some had good groat percentage and high groat protein content. As a result, we plan an extensive collection of *A. fatua* from the fields and roadsides of western Minnesota, North Dakota, South Dakota, Montana, Idaho, eastern Oregon, eastern Washington, and California. Many different morphological types occur in this area, and very possibly variability occurs in other genetic traits, such as disease resistance, quality characters (protein content, possibly amino acid balance, etc.), yield genes (some genotypes tiller profusely and produce much more seed than others), and winterhardiness in facultative and winter types. After collections are made and the seed increased of each, tests will be conducted for crown and stem rust resistance, BYDV reaction, protein and oil content, and selected ones will be analyzed for amino acid profile.

Improvement of Protein Quality in Oats

L. W. Briggle

The 289 varieties and lines of oats referred to earlier were analyzed for amino acid content as well as for total protein. Lysine values ranged from 5.2 to 3.2 percent of protein, and averaged 4.2. Threonine ranged from 3.5 to 3.0 percent, with a mean of 3.3. Methionine ranged from 3.3 to 1.0 percent, with a mean of 2.5. These values have to be considered as preliminary, because they are based on one grain sample produced at one location one year. Those varieties or lines that were highest or lowest in protein, oil, or one of the limiting amino acids were included in a special "multiple analysis" experiment now underway. This experiment will be grown at 3 locations (St. Paul, Madison, Aberdeen) for 3 years (1972-73-74). Yield, protein and oil content, and amino acid profile will be determined on each entry by replicate. We hope to get a good measure of genotype versus environmental influence, again on protein and oil content in relation to yield, but more specifically on individual amino acids in the protein. Additional oat varieties high or low in the various amino acids were grown (and will be continued) in other nurseries to get supplemental data on genotype versus environmental effect.

Chemical analysis does not fill every need in evaluating oat protein quality. Availability of specific nutrients to the ingesting organism, human or animal, is not measured. Several high protein lines have been bioassayed through feeding trials using meadow voles (under an ARS-USDA grant with Michigan State University). Although results proved to be variable, five lines were selected from those tested on the basis of PER (protein efficiency ratio), and were further evaluated through repeat vole tests and rat tests at Michigan State University. Results from the two tests were similar. Further tests involving the five selected lines are planned. In addition, all entries (by replications) in the multiple analysis nursery grown at St. Paul and Aberdeen in 1972 were bioassayed through use of voles.

Plans are presently underway with personnel in the Department of Food Science and Nutrition on the St. Paul Campus for cooperative evaluation of oat protein quality through rat bioassays. The first trials began shortly after January 1, 1974. It is hoped that this cooperative effort will develop into more than variety or line testing. We are interested in the effect of supplementing one or more of the limiting amino acids to determine, for example, if lysine is really limiting in oats. By chemical analysis (4.2%) it should not be, but knowledge concerning availability of that lysine is lacking. We have also contacted people in the Department of Animal Science on the St. Paul Campus relative to cooperative work on large animal feeding trials. Definite interest was expressed, and we hope to develop cooperative research plans for the future.

Our overall procedure for improvement of oat protein quality is to search for <u>genetic</u> variability in level of the limiting amino acids, study the genetics of high and low level genotypes, transfer genes for that particular desirable character into useful germplasm, and finally to make that germplasm available to others.

USDA Oat Collection

J. C. Craddock

The USDA Oat Collection has survived the ARS reorganization with little or no change in the overall program. We are now a part of the Plant Genetics and Germplasm Institute, Germplasm Resources Laboratory. The new telephone number is: 301-344-3022.

As a result of the reorganization, I am now responsible for the clearing of proposed names for the new oat cultivars. Only one proposed name should be submitted for each new cultivar. When requesting a name clearance, please indicate the station number, and the CI number if one has been assigned.

The Oat Abbreviation List is now being compiled. Hopefully this will be available for distribution by July, 1974.

A list of the Registered Oat Cultivars (PGGI 73-9) is available upon request.

There were only 13 entries accessioned by North American plant breeders. Does this low figure '13' suggest that maybe much valuable germplasm is not being offered to the collection? I urge you to review your breeding materials for worthwhile lines and make them available to other workers by adding them to the USDA Oat Collection. All that is required is a 10-400 gram sample of each entry and a statement that the cultivar is open stock. Information such as designation, pedigree, description, and any unique characteristics it may possess would be helpful in documenting the selection.

There have been no seeds from F_1 and F_2 plants added to the oat gene bank since 1968. Without your help this project cannot exist. Rather than discarding this type of seed, REMEMBER THE GENE BANK.

The new accessions to the USDA Oat Collection are listed on the following page.

C. I. NUMBERS ASSIGNED IN 1973

C. I. Number	Name or Designation	Parentage	Source
9194	NOBLE	Tippecanoe/14/CI 7676/13/Putnam*5/Minn313/12/Putnam*5/Minn313/10/Minhafer/9/Mo-0-205/8/Clinton*7/Landhafer/7/Clinton*7/Landhafer/2/Clinton*7/Landhafer/6/Clinton*7/Landhafer/4/R.L. 2105/3/Clinton/2/Boone/Cartier/5/Clinton*7/Landhafer/4/R.L. 2120/3/Clinton/2/Boone/Cartier/11/Putnam*5/Minn313(Purdue571)*2/2/Albion	Indiana
9195	STOUT	Shield sib/3/Clinton/Bond/2/PI 174544-3/12/Milford/2/Clinton*2/Ukraine/11/Clintland/9/Clintland*7/Landhafer/7/Clinton*7/Landhafer/2/Clinton*7/Landhafer/6/Clinton*7/Landhafer/4/R.L.2105/3/Clinton/2/Boone/Cartier/5/Clinton*7/Landhafer/4/R.L.2120/3/Clinton/2/Boone/Cartier/8/Clinton/2/Boone/Cartier/10/Clintland*3/Minn313	Indiana
9196	SCOTT	Garry/Clintland	Canada
9197	GEMINI	Sel. made (Burrows, 1962) from a bulk population (F_8 to F_{10}) of 2 interspecific oat crosses *Avena strigosa*^{2} (2n=28) x *Avena sativa* (2n=42). The 2 crosses were C.D.3820^2 x Victory and C.D.3820^2 x Abegweit made by Dr. F. Zillinsky, 1944-55.	Canada
9198	TAM 0-301	Ab555/3/Ora/63C3868-4-2/2/Ora/PI 295919	Texas
9199	TAM 0-312	Ab555/3/Ora/63C3868-4-2/2/Alamo-X/PI 296244	Texas
9200	MN71101	Lodi/Portage	Minnesota
9201	SUNBURY	Garry/Pennfield,Sel.16	Pennsylvania
9202	GOODLAND	Trisperina/Belar/2/2*Goodfield/3/Garland	Wisconsin
9203	SD955	Neal/Clintland 64	South Dakota
9204	SALEM	Goodfield/Moregrain	North Carolina
9205	HUDSON	CI 6792/Rodney/2/OT 174/3/RL 2877/4/Pendek/Lodi	Canada
9206	OA 272	Gemini/CAV 2700/2/Rodney	Canada

OAT RESEARCH WITH WASTEWATER

A. D. Day and R. M. Kirkpatrick

Experiments were conducted at Tucson, Arizona to study some effects of treated municipal wastewater on growth, yield, and quality of oats (Avena sativa L.) grown for pasture forage and grain. No differences were observed in plant height, tillers per plant, green forage yield, and total protein between forage grown with well water plus suggested amounts of N, P, and K and forage grown with wastewater alone. Oats produced more dry forage when grown with well water plus suggested N, P, and K than when irrigated with wastewater. Wastewater produced forage with higher moisture content than well water plus N, P, and K. When grown for forage, cultivars differed in plant height, dry forage yield, and total protein content.

Oat grain data showed no differences between irrigation and fertilizer treatments for maturity, plant height, panicles per unit area, grain yield, and total protein. Well water plus suggested N, P, and K resulted in fewer seeds per panicle and heavier seeds than wastewater. Cultivars differed in maturity, plant height, panicles per unit area, seeds per panicle, seed weight, grain yield, and total protein. Treated municipal wastewater can be utilized to produce oats with grain yields and forage and grain protein contents approximately equal to those obtained when oats are grown with well water and suggested levels of N, P, and K.

Relations between the morphology of oat panicles and kernel development.

G. Frimmel, Nordsaat G.m.b.H. Waterneverstorf, West Germany

During the last years increased attention was paid to the quality of grains in general. In oat breeding too not only the yielding capacity, standing ability, resistance for different diseases should be the aim for the breeder, but also the quality of the yield. From the description of panicles we try to draw some conclusions which eventually can be used in selections. The investigations are not yet finished, but some details may be of interest.

The description was carried on 28 varieties and ten panicles per variety. The panicles were chosen randomly from the field, where the varieties were grown in double rows of 1 m length with an interval of 14 cm between the rows and 28 cm between the double rows and about 30 plants per double row. The number of whorls, of florets and the thousand kernel weight were counted per panicle but also per different whorls. The number of sterile florets was determined for spikelets with one floret, with two and with three florets. The means as well as the lowest and the highest values for varieties are given in tables 1 and 2. As can be seen there is a great variation for all these characters.

Table 2 shows the general rule that the number of flowers per whorl decreases from the base of the panicle to the top. Deviations from the means are remarkable. There exist varieties having more than 5o% of florets on the lowest whorl and others having a considerable lower number. The quantity of sterile florets is also decreasing from the base to the top. Spikelets with a primary floret only are accumulated on the basal whorls and spikelets with a tertiary floret are accumulated at the top of the panicles. The kernel weight is increasing acropetally with decreasing differences from whorl to whorl.

To evaluate the significance of the variation of these characters, correlation coefficients were calculated for some relations which seemed to be of most importance (table 3). A high and significant correlation exists for the number of whorls per panicle and the number of florets per panicle. Concerning the amount of sterile florets per panicle a fairly high negative correlation was found with the number of whorls but not with the number of florets per panicle.

The correlations which show an increase of sterile florets with increasing spikelets with one floret only and decreasing sterile florets with increasing spikelets with two florets are slightly below the significance level of $P \approx 5\%$.
The kernel weight is negatively correlated with the number of whorls and with the number of florets per panicle, both correlations being significant.

There exist also significant relationships between kernel weight and the distribution of florets on the first (basic) and the second whorl, viz. a higher kernel weight in basic whorls with a great proportion of florets and in second whorls with a smaller proportion of florets. These relations are influencing even the total kernel weight per panicle although just not significant.

The correlation coefficients for the distribution of florets on the first and the second whorl and the percent of sterile florets for the corresponding whorls or the whole panicle are not significant. On the other hand a quite good correlation was obtained for the amount of sterile florets on the first whorl and the amount of spikelets with one floret on the same whorl and also a significant correlation for percent florets per the first whorl and the amount of spikelets with one floret.

Some of the results are in good agreement with other investigations. For instance it was stated by Mac Key(1) that "the number of branches at the basal whorl, as well as the successive reduction at whorl of higher position, follows a general varietal pattern ."
He explained further, that "the earlier differentiated spikelets of a panicle will generally carry more flowers than the later ones; the flower number thus decreases basipetally".
He observed too the acropetal increase of the seed weight within the panicles. Nicolaisen(2) found a correlation between the number of whorls and the number of spikelets per panicle. Though our investigations are based on 28 varieties only, the mentioned agreement with other statements allows certainly to rely on other results. Nevertheless our investigations will be extended to other varieties in the future and the results compared. To describe the seed quality here only the thousand kernel weight is used. The hull content seems to be the most important quality factor predominating over the quality features as protein or fat content (3) and will be investigated. However, the kernel weight is to be considered not only as a factor for yielding ability but according to Nicolaisen (l.c.) a quality factor too, because of the relation of kernel weight and the weight of the caryopsis and the negative relation of kernel weight and hull content as a consequence.

From our results the conclusion can be drawn that for the improve of kernel development panicles should be selected which show a restricted number of whorls but a relatively high number, but not a maximum of florets per whorl with a high proportion of florets on the basal whorl. Spikelets should carry a high amount of secondary (and also tertiary) florets and the number of spikelets with a primary floret only should be low.

The morphology of oat panicles is interpreted as a consequence of the typ of the developmental rhythm and the variation of sterile florets and kernel weight is a consequence of this morphology. If the development proceeds slowly, i.e. if there is a great time interval between the formation of the first and the last spikelet, the earlier developed spikelets will be favoured in the course of the competition and the disatvantage of the later developed spikelets will lead to a smaller number of florets per spikelet, to a higher number of sterile florets in such spikelets and to a smaller kernel weight. The aim should be to select for improved synchrony of spikelet development within the panicle.

References:

(1) Mac Key, J.: 1959

Morphology and Genetics of oats.
Handbuch der Pflanzenzüchtung II, 467 - 494,
2nd edition, Paul Parey, Berlin und Hamburg.

(2) Nicolaisen, W.: 1940

Hafer, Avena sativa L.,
Variabilität und Vererbung der Werteigenschaften.
Handbuch der Pflanzenzüchtung II, 235 - 268,
1st edition, Paul Parey, Berlin und Hamburg.

(3) Frimmel, G.: 1958

Die Bedeutung des Fettgehaltes bei der Beurteilung
von Hafererntern.
Bodenkultur 10, 41 - 47.

Table 1

Means and extreme values of different characters per panicle of 28 varieties and ten panicles per variety

	Mean	Lowest Value	Highest Value
Number of whorls	4.8	3.1	5.9
Number of florets	117.5	30.o	202.8
Number of sterile florets	14.4	2.7	39.o
% florets in spikelets with one floret	3.6	0.1	16.o
% florets in spikelets with a secondary floret	81.4	14.7	98.8
% florets in spikelets with a tertiary floret	14.5	0.o	72.5
Thousand kernel weight	31.3	23.8	40.2

Table 2

Characters of table 1 per whorl from the base of the panicle (I) to the top (VI). Relative values (Number per panicle = 100). 28 varieties and ten panicles per variety

		Mean	Lowest Value	Highest Value
% florets per whorl	I	41.3	21.4	55.5
	II	28.6	23.9	31.9
	III	15.7	10.1	24.1
	IV	8.9	2.o	18.2
	V(n=26)	5.4	1.5	9.2
	VI(n=11)	1.7	0.3	4.5
% sterile florets per whorl	I	18.2	3.o	41.7
	II	13.8	2.3	43.4
	III	10.8	2.1	28.3
	IV	10.o	0.o	20.5
	V(n=26)	10.o	0.o	48.o
	VI(n=11)	7.9	0.o	25.o
% florets in spikelets with one floret per whorl	I	5.8	0.2	30.9
	II	3.7	0.o	25.7
	III	1.5	0.o	7.1
	IV	1.o	0.o	8.8
	V(n=26)	1.1	0.o	9.1
	VI(n=11)	0.4	0.o	1.6
% florets in spikelets with a secondary floret per whorl	I	84.1	23.3	97.7
	II	82.4	11.5	99.6
	III	76.2	7.9	99.3
	IV	76.o	0.o	100.o
	V(n=26)	71.2	0.o	100.o
	VI(n=11)	80.o	28.6	100.o
% florets in spikelets with a tertiary florest per whorl	I	9.8	0.o	67.2
	II	13.3	0.o	74.9
	III	22.3	0.o	71.2
	IV	24.2	0.o	90.9
	V(n=26)	26.1	0.o	100.o
	VI(n=11)	19.7	0.o	75.o
Thousand kernel weight per whorl	I	29.5	21.8	40.1
	II	31.4	23.3	40.o
	III	32.8	24.7	41.o
	IV	33.2	24.1	42.8
	V(n=26)	33.9	24.1	45.6
	VI(n=11)	33.2	25.o	38.8

Table 3

Correlation coefficients for some relations between characters which are listed in table 1 and table 2

	Number of whorls per panicle	Number of florets per panicle	% florets in spikelets with one floret	% florets in spikelets with two florets	% florets in spikelets with three florets	Thousand kernel weight per panicle
Number of florets per panicle	0.741***					
% sterile florets per panicle	- 0.537**	- 0.174	0.3o4	- 0.334	0.224	0.o64
Thousand kernel weight per panicle	- 0.473*	- 0.58o**				

	% florets per I	% florets per II	% florets per III	% florets per IV
% sterile florets per panicle	0.235			
% sterile florets per whorl I	- 0.o6o			
% sterile florets per whorl II		0.o87		
Thousand kernel weight per panicle	0.342	- 0.358		
Thousand kernel weight per whorl I	0.432*			
Thousand kernel weight per whorl II		- 0.4o1*		
Thousand kernel weight per whorl III			- 0.o25	
Thousand kernel weight per whorl IV				- 0.218

	% florets in spikelets with one florets per I	% florets in spikelets with two florets per I	% florets in spikelets with three florets per I
% florets per whorl I	- 0.391*	- 0.166	0.334
% sterile florets per whorl I	- 0.49o**	- 0.339	0.1oo

* significant at the level of $P < 5$ %

** significant at the level of $P < 1.0$ %

*** significant at the level of $P < 0.1$ %

Preliminary Studies on Damage Evaluation Caused by *Puccinia coronata* Cda.

Lucy Gilchrist
Instituto de Investigaciones Agropecuarias, Temuco, Chili

This research was conducted at Carillanca Experimental Station located at Temuco (Southern Chile) during the cropping season of 1972.

The principal objective was to evaluate the incidence of *Puccinia coronata* Cda on different oat varieties.

The fungicide used was Plantvax. The dosage used was 1 g/l applied once a week.

Some plots showed an unsatisfactory fungicide protection. Barley Yellow Dwarf affected the experiment to a great extent. These two factors caused errors which did not allow reliable conclusions.

The damage caused by *P. coronata* generally begins when the plants are at growth stage 10.1 to 10.4 (heading) of the Feeckes-Large Scale.

Table 1 shows the average amount of crown rust on each variety, with and without fungicide, expressed in percentage.

The highest percentage of infection was obtained in one of the five replications of the Markton variety without fungicide protection. This plot reached 80% infection at ripening stage 11.1.

Maximum infection of fungicide treated plots was obtained in one replication of the Honami variety where infection reached 40%.

These results may indicate that Plantvax is not the best fungicide to use in this kind of experiments.

Table 1. Development* of *Puccinia coronata* on six oat varieties with and without fungicide protection.

Variety		Stage of growth	Date	% of leaf infested	
				Without fungicide	With fungicide
Honami	8	Stem Extension	12,7	0	0.02
	10.5	Flowering	12,28	2	0.02
	11.1	Ripening	1,5	18	2.6
	11.2	Ripening	1,9	48	10.4
	11.2	Ripening	1,18	44	7.0
Markton	9	Stem Extension		1	0.0
	11.1	Ripening		3	0.0
	11.1	Ripening		27	0.9
	11.1	Ripening		50	4.4
	11.3	Ripening		30	7.2
Condor	10.5	Flowering		0	0.6
	10.5	Flowering		1	0.1
	11.1	Ripening		17	1.6
	11.1	Ripening		16	4.4
	11.2	Ripening		14	3.4
Alteza	10	Stem Extension		0	0.5
	10.5.3	Flowering		0.5	0.3
	11.1	Ripening		28	1.4
	11.1	Ripening		42	1.4
	11.3	Ripening		30	3
Inac 8	10.1	Heading		0	0
	11.1	Ripening		0	0
	11.2	Ripening		0	0
	11.3	Ripening		0	0
	11.4	Ripening		0	0

* Each value is an average of five replications.

Feeding value of naked oats

G. Jenkins and P.R. Hanson
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In the 1972 Oat Newsletter we reported on the yield, grain composition and general agronomic performance of a naked oat selection, AJ 107/12/29. We have since obtained results from a chick feeding experiment with this selection performed in the Department of Applied Biology, University of Cambridge, under the supervision of Dr. K.J. Carpenter and Mr. G. Tobin, whose assistance is gratefully acknowledged. The results are summarised in the table below, with live weight gains and food conversion efficiency ratios observed after 17 days on the test diet.

Test material*	Metabolisable energy (Kcal/g dry matter)	Wt. gain per 3 chicks (g)	Food eaten (g)	Gain/g food eaten
Glucose	-	868	1,455	0.596
Barley (cv.Maris Trojan)	3.18	802	1,335	0.600
Wheat (cv.Maris Huntsman)	3.63	882	1,396	0.632
Husked oats (cv.Maris Tabard)	2.78	872	1,380	0.631
Naked oats (cv.AJ 107/12/29)	3.60	911	1,353	0.672
S.E.		29.0	27.5	0.0125

*The test material formed 50 per cent of the diet in each case, the remainder of the diet comprising a standard 'basal' providing protein, minerals and vitamins.

Metabolisable energy values for the oats agree with those recorded in the literature (Hill *et al* (1960), Poultry Sci. **39**, 573-579).

In this experiment the naked oats had a clear advantage over wheat, barley and husked oats in food conversion efficiency. The nutritional advantages of naked oats in comparison with husked oats have, of course, been long established (Moon, F.E. and Thomas, B. (1937)., Jour. agric. Sci. **27**, 458-464) but the results reported here are for a naked oat selection of improved agronomic value.

Progress Toward International Standardization in Crop Research Data Recording

C. F. Konzak

Among the newsworthy international developments expected to play a key role in the standardization of methods for crop research data recording is the establishment at the United Nations Food and Agriculture Organization (FAO) Headquarters in Rome of a central unit to coordinate documentation and exploration activities by genetic resource centers. Two senior staff members to be recruited early in 1974 for the Crop Ecology and Genetic Resources Unit of the FAO Plant Production and Protection Division will be responsible for these two important programmes. Activities by the "FAO-IAEA Working Group on International Standardization in Crop Research Data Recording" will be continued in a supportive role to the FAO genetic resources documentation programme, and for the documentation of mutant collections by the Joint FAO/International Atomic Energy Agency Division of Atomic Energy in Food and Agriculture.

A prime objective of the FAO programme will be to establish a network for exchange of information among those genetic resource centers now in existence and under development in several areas of the globe.

Notable among steps taken as part of the activities of the FAO-IAEA Working Group are back-up developments toward coordinating the coding of breeding station crop accession series, carried out to date by Dr. E. Porceddu, Centrol Germo Plasmo, University of Bari, Italy. All stations contacted have agreed to cooperate in the use of unique accession codes for original materials and to maintain the original identity of introduced materials.

A preliminary version of the revised Feekes growth stage scale, "a decimal scale for growth stages in cereals" by J. C. Zadoks, T. T. Chang and C. F. Konzak, is to be published as a supplement to the January 1974 issue of the Eucarpia Bulletin. Uniform 1 and 2 digit code scales are described for the major cereals, wheat, rice, barley and oats. One or more final version(s) including diagrams or photographs is expected to be completed during the coming year, and the approach applied as appropriate to some other major crops. German - English, English - German Thesauri have been prepared by L. Seidewitz at the German Gene Bank in Braunschweig for studies on the interconvertability of information with relation to the language problem.

Banks of information on accessions of certain crops held at a number of genetic resource centers (GRC) are now under development, with some having complied all information now available. Some of these GRC's are using the TAXIR information retrieval system and a few are already testing practical applications for meeting specific requests. Two publications sponsored by the International Seed Testing Association (ISTA) are concerned with tests for genuineness of cultivars. One of these was developed by the ISTA Variety Committee - Working Group on Herbage Varieties and published in the Proceedings International Seed Testing Association 37:443-495, 1972. The second is a handbook on seed testing by O. Ulvinen, A. Voss, H. C. Baekgaard and P. E. Terning and is available from ISTA, Secretariat, N-1432 As - N.L.H. Norway. These works represent international cooperative efforts towards standardized crops research data recording and evaluation methods. Similar efforts are in progress in several other countries with the goal of unified concepts and procedures because of the mutual interests involved. Mr. A. F. Kelly, NIAB, Cambridge, is the FAO-IAEA Working Group contact for this activity.

The writer is currently working on the development of records on induced mutants, and on records of scientists working with induced mutation methods for the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture and on aspects of standardization of methods for crop research recording in relation to the mutual interests of FAO and IAEA.

STEM RUST ON WILD OATS

N. H. Luig
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Oat stem rust survives well on wild oats in Australia. A large number of single plant progenies from common wild oats (*A. fatua* L.) and winter wild oats (*A. ludoviciana* Durieu) were tested with strains of *P. graminis avenae*, *P. graminis tritici*, *P. graminis secalis* and four cultures of grass stem rust described by Luig and Watson (1972). Two of these cultures represent *P. graminis lolii* and *P. graminis dactylidis* respectively, and the other two could be of hybrid origin.

All wild oat lines were susceptible to oat stem rust and resistant to wheat stem rust, rye stem rust and the culture of stem rust of cocksfoot; but with the other three grass stem rust cultures, variability was apparent. Certain genotypes were susceptible to the three cultures as well as to *P. graminis avenae*. The possibility that such mutual hosts serve as a medium for somatic hybridization between these *formae speciales* of *P. graminis* is indicated.

All four grass stem rust cultures cannot attack the Australian cultivars of oats, wheat and rye, but when inoculated on selected oat varieties, the resulting high seedling infection types suggest that three of them must be closely related to oat stem rust. The fourth culture (*P. graminis dactylidis*) induced infection type ";1+" on Short Oats (*A. brevis*), "2=2-" on Glabrota (*A. strigosa*) and ";1=" on Erban (*A. sativa*), but only an immune reaction on our other oat accessions. All four cultures, however, condition distinctly lower infection types on the oat stem rust differential set than exhibited by strains of *P. graminis avenae*.

Oat Stem Rust in Eastern Australia

N.H. Luig and E.P. Baker
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Field collections of oat stem rust from New South Wales, Queensland, Victoria and South Australia have been tested during the last three seasons 1970-1973. A high proportion of these samples came from wild oats. Barberry bushes are rarely found in eastern Australia, and examination of occasional aeciospore formation has so far failed to indicate the presence of P. graminis avenae on barberry in this country.

All resulting cultures from the collections were inoculated on sets comprising the seven differentials used by Stewart and Roberts (1970) or substitutes carrying the same major genes, testers which combine certain of these genes, and variety C.I.3034 which carries Pg-1 and pg-11. Notes were recorded after 14 days on seedlings maintained at temperatures ranging from 15^{o}-21^{o} C. By this procedure we were able to distinguish 22 different strains - a degree of variability quite unexpected as acreages sown to cultivars possessing genes for resistance (Garry, Saia, Burke, Lampson, Laggan) are too small to give strains with genes for virulence on them a definite advantage.

No cultures virulent on plants with pg-8 were found, suggesting that in Australia this gene is the best source of resistance among the genes present in the differentials. All other genes differentiated between the cultures. On Sevnothree and Joanette Strain both which carry Pg-3, clearly two levels of resistance were exhibited. The two infection types on these varieties were very temperature-sensitive, high temperatures resulting in susceptibility.

On Rodney (Pg-4) 3 strains were virulent, 18 were avirulent (infection type "1") and 1 strain produced an intermediate reaction (i.e. "2+"). The resistant infection types on Saia ranged from a "0;" to an "X", with 4 strains being fully virulent. Two strains produced susceptible infection types on C.I.3034.

Oat Rust in 1973

A. P. Roelfs

Crown rust was light to moderate in the southern United States in 1973. The amount of rust overwintering was reduced by freezes which killed much of the oat foliage during January. Crown rust spread northward at approximately the normal rate, and was observed at St. Paul, Minnesota by mid-June. Disease development was retarded in Iowa, Minnesota, South Dakota, and North Dakota by dry weather in July. Rust was moderate to severe in much of Wisconsin.

Stem rust development was earlier than normal in the South, near normal in the central, and later than normal in the northern United States. The time of the earliest reports of oat stem rust during the past four years at selected areas are shown in Table 1. Stem rust was found in December of 1972 in central and southern Texas, and was observed throughout the winter. Disease spread in the spring was rapid; however, severities remained low. Colder than normal weather probably delayed an early spread of stem rust into the central states, where rust appeared at near the normal time. The summer drought limited the increase in much of the major producing area of Iowa, Minnesota, and the Dakotas. However, stem rust was present at crop maturity in trace amounts in nearly 100% of the Minnesota and Wisconsin fields visited. Little rust was observed in the Dakotas. The number of collections of oat stem rust received by the Cereal Rust Laboratory during the period 1970 through 1973 is shown in Table 2. As the effort made to collect rust is fairly constant from year to year, the number of collections is an indication of the prevalence and severity of rust. It is also apparent that few collections of stem rust are made in the central states where little oats are grown. This makes it difficult to trace the movements of races from south to north.

Table 1. Earliest reports of oat stem rust during 1970, 1971, 1972, and 1973 by area.

Location[1/]	1970		1971		1972		1973	
	Date	Severity[2/]	Date	Severity	Date	Severity	Date	Severity
S. Texas	3/17	Trace	4/27	Trace	4/11	100%	1/24	Trace
C. Texas	5/23	Trace	3/17	70%	4/20	Trace	4/24	10%
N.C. Texas	5/23	75%	6/03	Trace	5/16	10%	5/31	10%
La.	--		4/19	100%	4/21	Trace	--	
C. Ark.	--		--		4/27	5%	4/30	5%
Okla.	--		5/??	Trace	5/22	Trace	5/10	10%
S. Kansas	6/18	Unknown	--		--		6/20	Unknown
N.E. Kansas	6/15	Trace	6/27	Trace	6/16	5%	6/12	Trace
S.E. Nebr.	--		6/22	Trace	6/28	Trace	6/26	5%
S. S.Dakota	7/08	Trace	7/20	5%	7/24	Trace	7/07	5%
C. Iowa	6/24		6/25		7/07	Trace	7/07	5%
S. Minn.	7/03		7/09		7/06	Trace	7/09	Trace
S. N.Dakota	7/02	Trace	7/20	Trace	7/25	Trace	8/02	Trace
Calif.	--		5/??	Light	6/08	Light	--	

1/ S = southern, C = central, N = northern, and E = eastern.

2/ Severity at location when rust was first found.

Table 2. Number of collections of oat stem rust from oats or wild oats from selected states in the years 1970-1973.

State	1970	1971	1972	1973
Texas	20	35	44	62
Arkansas	0	0	3	3
Oklahoma	0	1	1	4
Kansas	4	1	2	2
Nebraska	0	9	21	8
South Dakota*	38	17	12	12
Iowa*	92	42	10	64
Wisconsin*	79	36	14	44
Illinois	3	0	2	8
Ohio	0	0	0	4
Minnesota*	170	85	52	86
North Dakota*	56	18	17	10
Montana	0	0	2	0
TOTAL	462	244	180	303

* Major oat producing states.

Studies on Leachates from Imbibed Viable and Non-viable Oat Seeds

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Leakages of metabolites from imbibed seeds have been correlated with germination values and vigor. Rapid leaching has been shown in pea up to first 15 min of soaking (See: Maguire, 1973) though most of the studies were done 24 h after soaking. First 6 h of imbibition play important roles in cellular differentiation (Roberts and Osborne, 1973). Hence it was considered of interest to investigate the leachates for electro-conductivity, peroxidase activity and total sugar content at different phases during first 24 h after soaking.

50 seeds of oat [Avena sativa cv. N.P. Hyb.1; 0 per cent = non-viable (V) and 95 per cent = viable (V)] in each case were soaked in 20 ml glass distilled water at 28°C for 15 min; 6 h and 24 h and at the expiry of soaking duration leachates were used to determine electro-conductivity (micromho/ Cm^2/g initial wt); peroxidase activity (O.D./10 min/g initial wt) and total sugars as g/g initial wt and seeds were employed for the determination of water uptake per seed (mg); peroxidase activity and total sugars (mg/g dry wt). 100 seeds in each case were germinated at 28°C for 6 days to determine their viability. Experiments were repeated and results (mean of 3 separate determinations) are presented here in Table 1.

There is higher electro-conductivity, peroxidase activity and total sugars in leachates of NV seeds as compared to V seeds, throughout. Leaching of metabolites increases with duration of soaking. There is higher water uptake and peroxidase activity in V seeds when comparison is made with NV seeds. Total sugars exhibit reverse trend; being more in NV seeds. It may be due to the fact the sugars are being utilized for growth processes in V seeds where active growth is taking place. We have shown that ascorbic acid and its enzymic utilization as well peroxidase and amylase activities are significantly higher in V seeds as compared to NV seeds, (Saxena et al. 1973). It is clearly evident here that there is a good correlation of loss of sugar and increases electro-conductivity with per cent germination. It appears that during storage permanent damage has been done to the seed membrane and thus on soaking seed leaches appreciable amounts not only of sugars but of enzymes also. We obtained similar findings in case of Sorghum also, (Saxena and Chinoy, 1974). Peroxidase activity in view of its easy and quick determination can serve as an useful parameter in V and NV seeds screening in comparison to the determination of electro-conductivity and anthrone test for total sugars.

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3. Saxena, O.P. and Chinoy, J.J. (1974): Physiological studies on leachates of viable and non-viable seeds of Sorghum. Sorghum Newletter 17: (In Press).

4. Saxena, O.P., Chinoy, J.J., Shah, H.K., Mehta, D. and Ghesani, P.I. (1973): Metabolic changes associated with viability in Sorghum. Ibid. 16: 36-39.

Table 1. Biochemical changes @ in leachates and in seeds (viable and non-viable) of oat during early phases of imbibition.

Time after soaking	Type of seed	Leachates			Seeds		
		Electro-conductivity	Peroxidase activity	Total sugar	Water uptake	Peroxidase activity	Total sugar
15 min	NV*	37.9	0.17	606.6	6.1	57.2	32.5
	V**	23.3	0.12	404.6	8.1	64.3	26.0
6 h	NV	58.1	0.34	1325.4	9.3	55.8	29.5
	V	30.2	0.20	728.8	11.6	67.7	24.5
24 h	NV	68.0	0.88	2196.6	12.6	51.0	9.8
	V	38.1	0.21	1225.1	14.3	65.6	9.0

@ Various units to express metabolites are given in the text.

NV* = Non-viable seeds showing no sign of growth even after 6 days.

V** = Viable seeds showing 95 per cent normal germination as per ISTA Manual (1966).

HIGH PROTEIN OATS CONTRACT PROGRAM

Donald J. Schrickel

QUAKER OATS COMPANY

It was indicated to us from oat researchers and experiment station testing that levels of protein in oats could be increased by growing certain varieties and by applying certain quantities of fertilizer, particularly nitrogen. Our objective in our 1973 High Protein Oats Contract Program was to determine whether or not this information could be applied to field conditions and enable us to obtain commercial quantities of oats for processing which would exceed the protein levels of oats available on the open market.

The program was offered to growers in our major origin territory including the Dakotas, Minnesota and Iowa. Participation was the greatest in West Central Minnesota due to several reasons, including the interest expressed by elevator managers, adaptability and growers' knowledge of acceptable varieties, and the competition from other crops.

A total of 2,840 acres were contracted, and approximately 2,700 acres planted. Average yields were 70 bushels per acre, with a range of 40 bushels to 115 bushels per acre. Several growers did not harvest their contracted acres for grain because of extreme drought in Northeast South Dakota.

Growers were required to plant certified seed of one of four varieties: Iowa Multiline E Series, Diana, Dal or Jaycee. They were selected because they were consistently high in protein, reasonably well adapted, and were available.

Fertilizer recommendations were as follows:

Nutrient	Pounds per Acre
Nitrogen (N)	10 to 50
Phosphate (P_2O_5)	25 to 40
Potash (K_2O)	15 to 30

Quantities of fertilizer could be varied depending on fertility levels and previous cropping practices. It was suggested that one-half of the nitrogen be applied at planting time and one-half top-dressed during the leaf stage but before the boot stage.

Most of the acres were planted to the varieties Dal, Diana and Iowa Multiline E Series, with only a small acreage planted to Jaycee. A sample of oats was obtained from each five acres of production and sent to our Laboratory for protein analysis. Protein determinations were made on the groat on an "as is" basis.

Overall, the protein percentage averaged 18.5 in comparison to 16.0 on oats which would have been available to the market in the same production areas.

In West Central Minnesota, where 1,500 acres were grown, the most significant data were accumulated. This revealed that, at one primary location, protein concentration was consistently one-half percentage point higher than at two other primary locations, but, in total, we found little relationship between protein concentration and location.

The variety Dal was consistently highest in protein at all locations and was one-half percentage point higher than Iowa Multiline E, while Diana was consistently one-quarter percentage point higher than Iowa Multiline E.

The amount of nitrogen fertilizer applied affected protein as follows: the 30 to 50 pound rate per acre produced .8 percentage points more protein than the rate of 30 pounds or less. A rate of 50 pounds or higher produced 1.1 percentage points more protein than the rate of 30 pounds or less.

There was no significant increase in protein when nitrogen fertilizer was top-dressed as compared to application at planting time. No determination was made on the effect of fertility levels prior to the oats crop nor regarding the previous cropping practices.

As a result of this experimental program, we are proceeding with a larger program in 1974. We will require one of the four varieties previously listed plus Iowa Multiline M Series, Chief and Otee. We will require a minimum per acre rate of 40 pounds of nitrogen, 25 pounds of phosphate (P_2O_5) and 15 pounds of potash (K_2O). The program will be offered in specified areas of Iowa, Minnesota, North Dakota and South Dakota.

ADDITIONS TO THE SMALL GRAINS COLLECTION DATA BASE

R. T. Smith and J. C. Craddock, USDA, ARS

The small grains tape file has been expanded to include pathological and additional quality and agronomic data. The agronomic characteristics include yield in kilos per hectare and number of seeds per head. The quality indices include: oil content in percent, additional sapce for another protein determination in percent, and whether or not an amino acid profile is available for a specific variety.

The pathological data fields include: a disease code referring to a specific pathogen (e.g., mildew) or a specific condition (e.g., wheat powdery mildew culture 44, Fargo, N.D. 1975); a major severity field (range 0-99) referring to area size of host covered by the disease symptoms; a major response field (range TR = trace resistance, VR, R, MR, M, MS, S, VS = very susceptible and escape) referring to degrees of resistance; and a growth stage field (seedling, juvenile, shoot-boot, and adult) referring to stage of growth of host when data were recorded.

Cooperators concerned with preservation and distribution of helpful information can add data to the small grains file by either of two methods: (1) by supplying typed or handwritten data; or (2) by supplying formatted, described machine readable data (cards or tape). Data on items that do not have a CI or PI number should not be sent in to be added to the Small Grains Collection file unless seed (10-400 grams) is provided. The doner is also requested to declare the material open stock and ask that a CI number be assigned.

In 1973, the following information was added to the expanded file: for barley - reactions of 600 Ethiopian accessions to two mildew composites (codes 18, 19), one leaf rust race (code 20), three net blotch cultures (codes 24-26), septoria (code 27), barley stripe mosaic virus (code 28), two loose smut races (codes 29, 30), scald (code 31), spot blotch (code 32), and two barley yellow dwarf virus studies (codes 33, 34); for oats (*Avena sterilis*) - protein content and reactions from nine crown rust studies (codes 1-9), one stem rust race (code 41), three barley yellow dwarf virus studies (codes 21-23), one *Helminthosporium avenae* study (code 61), and one soilborne mosaic virus study (code 81); for wheat - reactions of 2,400 varieties to one powdery mildew composite at two stages of growth (codes 10, 11), and five stem rust races and one stem rust composite (codes 12-17).

Information on these crops can be obtained from Dr. J. C. Craddock, Small Grains Collection Building 046, BARC-W, Beltsville, Maryland 20705. Requests can be in general form (e.g., a listing of all barleys by CI or PI number tested with net blotch including reactions) or in specific form (e.g., a listing of all *Avena sterilis* selections by PI number having protein content above 25 percent combined with a crown rust coefficient of less than 5 percent).

A Decimal Code for the Growth Stages of Cereals

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C. F. Konzak, Washington State University

Editorial note:

This contribution was originally intended for publication in Crop Science, but for various reasons, was deemed inappropriate for that Journal. It was then recommended, with the acquiescense of the senior author, for inclusion in the various cereal crop newsletters. It is presented here for the consideration and the use of oat workers.

M. D. Simons

Preface

The Board of Eucarpia has recognized the importance of an internationally acceptable scale for the recording of growth stages of cereals. It was therefore decided that the final version of the decimal Feekes scale, as designed by Zadoks, Chang and Konzak, should be published in the Bulletin of Eucarpia, to give a good start to the wide spreading that such a scale ought to have.

The first draft of this scale was produced in 1965 and has been discussed from that time both within and outside Eucarpia. Many amendments were made to create the possibilities for usage in many fields of research and agricultural practice.

In the near future the authors will publish this scale in a more extensive form, together with a set of illustrations. This publication will also include maize and sorghum. It was, however, considered to be useful not to wait any longer with publishing the short version, which is suitable for wheat, barley, rye, oats and rice. With this publication Eucarpia hopes to help in the so much needed international standardization.

W. Lange
EDITOR

Introduction

The best known and most widely used scale for the recording of growth stages of cereals probably is the scale designed by Feekes (1941), as illustrated and amended by Large (Chiarappa, 1971; Large, 1956). The main morphological stages of cereals, easy to recognize, were numbered from 1 to 11 in ontogenetic order from seedling emergence until grain ripening. Some crucial growth stages were subdivided, and the subdivisions were indicated by numerals in one or two additional columns. The Feekes scale is well suited to the small grain cereals in North West Europe, especially wheat, but it can also be applied to wheat, barley, rye, oats, and to rice (A.O. Klomp, unp.)

in other parts of the world. However, the relative importance attached to a growth stage may vary from area to area and from crop to crop, and therefore a scale designed for North West European conditions is not necessarily the most suitable scale elsewhere. The four-digit Feekes scale is inefficient for data processing, and for storage and retrieval by means of a digital computer (see Loegering, 1968).

General principles

A few general principles for the design of a scale for plant growth stages can be mentioned:

1. The growth stages distinguished must be easily recognizable under field conditions, even by an observer with little technical training, without specialized equipment.
2. The growth stages must be graded in the order of their ontogenetical appearance.
3. Most 'rough and ready' applications of the scale do not permit the use of more than nine or ten stages. These are the <u>principal growth stages</u>.
4. The principal growth stages should be identified by symbols, for example the numbers 0 to 9, which should correspond with the positions available in one column of a punch card, to be acceptable as a common denominator for all languages.
5. In order to provide for more detail, as needed in more refined studies, each principal growth stage should be subdivided into <u>secondary growth stages</u>.
6. The secondary growth stages also should be coded by means of symbols, e.g. the numbers 0 to 9, for the same reasons as given above.
7. Thus, the principal growth stages are indicated by a one-digit code, and the principal plus secondary stages are indicated by a two-digit code.
8. The scale should be applicable to most or, preferably, to all cereals (in principle to all <u>Gramineae</u>).
9. The scale should be applicable in all or most places of the world.
10. Each coded stage should be illustrated to provide for universal intelligibility.

In the attempt to meet these requirements, which were at times conflicting with each other, some liberties had to be taken with the original idea at the onset of the work: a decimal Feekes scale.

Principal growth stages (Table 1).

The principal growth stages are self-explanatory. The 'borderlines' between the growth stages mentioned may be established by means of the detailed classification of secondary growth stages (see below), but the reader should realize that plant growth is continuous without stopping at arbitrary 'borderlines'. In the scale of growth stages, the code 0 designates germination, including the period from the dry seed until the appearance of the coleoptile. Code number 1 designates seedling growth, up to tillering. Code 2 indicates tillering, and code 3 stem elongation including the appearance of the flag leaf. Code 4 covers the booting process. Inflorescence emergence and anthesis were placed in separate principal growth stages, codes 5 and 6, because both are processes which allow the assessment of small but distinct differences in growth rhythm between cultivars. The process of caryopsis development is divided into three stages, code 7 - milk development, code 8 - dough development, and code 9 - ripening, because these stages are particularly important for yield prediction, quality, crop loss and other evaluation research.

Special conditions

Rice presents a special problem since most of the Asian rice cultivars are largely grown under the transplanting procedure. Transplanting often induces a stoppage of development flollowed by recovery. While not a growth stage, the recovery process may involve stages worthy of recording. This special problem has been met with a special solution, the use of the letter T. Neither in field work nor in computer programming does the use of one extra symbol beyond the 0 to 9 range cause unsurmountable problems.

In many areas of the world, direct seeding of rice is practiced.

Secondary growth stages (Table 2)

The detailed classification of the secondary growth stages uses a second digit, coded from 0 to 9, per principal growth stage. As it is unrealistic to attempt to define too closely, not all positions need to be used.

Usually, position 5 is reserved fro the middle or medium value. Sometimes, positions have been reserved fro intermediate notes, to be used when desired.

The detailed classification serves several purposes. First, it conserves the Feekes scale stages which have shown merit. Second, the two-digit scale permits the introduction of details needed at times for specific purposes. For instance, the number of leaves (codes 11 to 19) and the number of tillers per plant (codes 21 to 29) have been included as an addition to the Feekes scale to serve for studies on the epidemiology of cereal diseases and on herbicide applications. An assessment of tillering patterns in relation to other growth processes is a must in many rice research projects. Furthermore, the booting stages have been distinguished especially to meet the needs of gametocide application. Finally, a third purpose of the detailed classification is to give the scale some adaptability to various crops, crop management uses, and special interests (see below).

The germination stage, code 0, received much attention for several reasons. A subdivision of this stage can be useful in weed control, seed pathology, radiobiology, seed laboratory work, and it is important to determine the right moment to sow pre-soaked rice seed in direct seeding by aircraft. The seedling stages, codes 10 to 19, are important in greenhouse procedures for disease resistance testing, and have been used extensively in weed control studies and epidemiological field work. The tillering and stem elongation stages, codes 20 through 39, are important in many aspects of agronomic research. In wheat barley and rye, some cultivars have a prostrate or semi-prostrate habit (as is common with many winter wheat cultivars). In these cultivars the early prostrate growth is followed by 'pseudostem (leaf sheath) erection' (code 30). Code 30 can also be used for pseudostem elongation in rice, a process distinct from shooting or internode elongation (Milthorpe and Ivins, 1966).

In rice, leaf sheath (pseudostem) elongation (code 30) distinctly precedes shooting or internode elongation (codes 31 to 39) in traditional tropical cultivars. In some rice cultivars with a long vegetation period there is seemingly a stand-still in the development of the crop just in the stage of leaf sheath elongation. Code 39, 'flag leaf ligule just visible', is equivalent to the 'opposite auricle stage' in rice, the stage when the auricles of the flag leaf are at the same height as the auricles of the penultimate leaf. This growth stage is important in rice because it practically coincides with meiosis (Chang and Bardenas, 1965).

In barley meiosis takes place at about the same stage as in rice, when the flag leaf ligule is just visible (code 39). In wheat and rye meiosis coincides with the early booting stages (code 41 for wheat and code 43 for rye). In barley, wheat and rye meiosis begins just above the middle of the ear, and proceeds upwards and downwards. The whole process of meiosis, however, can strongly be influenced by the environment, which means that the stages should not be taken too stricktly (personal communication, W. Lange, 1973).

It seemed appropriate to allocate a great number of positions (up to 20) to the processes of inflorescence emergence and anthesis (codes 50 through 69) for the estimation of slight but sometimes agronomically important developmental differences. Estimates of differences during inflorescence emergence and anthesis may both be needed for a precise description. Inflorescence emergence may be practically synchronous all over the crop, so that nearly all stems have simultaneously completed 1/4, 1/2 or 3/4 of their inflorescence emergence. Alternatively, inflorescence emergence may vary in time between as well as within plants, such that the lack of synchronization within the crop is conspicuous. In the former case, the odd numbered codes of stages 5 and 6 are more suitable, in the latter case the even numbered codes are more descriptive. For example, for a synchronous wheat crop with 1/2 of each of the ears emerged one could use code 55, but for a non-synchronous wheat crop code 54 could be used to indicate the stage at which 50 per cent of the stems in the population had their ears extruded at least half-way. A synchronous oat crop with all plumes fully emerged could be described by code 59, but a non-synchronous oat crop with 50 per cent of the plumes fully emerged might be characterized by code 58.

In wheat and rye, anthesis usually occurs after heading; it begins just above the middle of the ear, and proceeds upwards and downwards. In some barley cultivars, the flowers open little if at all; the anthesis stages (codes 60 to 69) can be omitted, though with the advent of F1 hybrid barley the situation may change. In rice, flowering proceeds from the top of the panicle downwards, and in tropical areas immediately follows heading. However, inflorescence emergence and anthesis can be separated by a few days at higher latitudes or in case of adverse weather conditions.

The early dough stage (code 83) of wheat is a crucial stage in the Netherlands, Northern Germany and Australia, because from that stage onwards observations have to be made for the prediction of sprouting in the ear (Belderok, 1968);

Concurrent use of codes

In synchronous crops, different codes can be used concurrently. For example, in a seedling with three leaves the first tiller may have appeared, so that codes both for leaf number (code 13) and for tiller number (code 21) are applicable. For ordinary use, it is advised to utilize the highest ranking code, i.e. code 21. For more precize description, as might be desirable for herbicide application, the two codes could be used concurrently, i.e. 13, 21. A similar situation may occur at inflorescence emergence and anthesis, e.g. 57,61.

In asynchronous crops, it is again advisable to use the highest ranking code number for the description of the growth stage. For more precise description, one might indicate the range of growth stage, e.g. 57-61.

Discussion

An internationally acceptable scale for the recording of growth stages in cereals is obviously needed. But this statement has previously marked the end of the agreement. There is nearly complete disagreement about how to implement the agreed principles. This is logical, because a scale which does not arouse objections will, by that very reason, satisfy nobody. Furthermore, there exist much local or regional considerations that are sound and acceptable. In addition, it seems presumptuous to expect that one scale will cover all possible circumstances. Two typical examples of regional argument will be given. The Feekes scale, developed under North West European conditions, uses 4 principal positions (Feekes codes 2 to 5) for a group of growth stages taking only 2 principal positions (codes 2 and 3) in the new scale. Feekes' pre-occupation was with winter wheat, autumn-sown and with good winter hardiness, and therefore he rightly emphasized the winter growth stages. His scale is somewhat ambiguous for the early stages of spring wheat and of the erect South European short cycle winter wheats (with little or no need of vernalization by low temperature). In this proposed scale, some of Feekes' stages have been transferred from the principal to the secondary group of growth stages. The Feekes scale lacks detail in the post-anthesis stages, a definite weakness for use in North America. The typical North American interest in these stages has to do with matters such as quality control, prediction of harvest time and yield, etc. Here, the new scale uses three principal stages after anthesis where the Feekes scale has only one.

The numerical codes proposed for each growth stage are not entirely arbitrary, but are based on written tradition. A scale developed in Switzerland (Keller and Baggiolini, 1954) is an extended Feekes scale in which growth growth stages have been coded by letters. Another, recent proposal is a recoded Feekes scale using the numbers 1 to 22 (Brouwer, 1972). Such letter or number codes share all the disadvantages of the Feekes scale mentioned above, without the positive advantage of adaptability. Therefore, the risk of some arbitrariness is acceptable in the knowledge that there are many ways to allot the ten available principal positions to more than ten definable growth stages (Kilpatrick, 1970). In this context, it is encouraging that the European Brewery Convention with its network of barley field trials covering fifteen nations accepted a first draft of Broekhuizen & Zadoks' decimal Feekes scale for use, and utilized it from 1967 onwards for all its data processing by means of a computer. A temporary decimal growth stage scale was used for

FAO/IAEA co-operative rice and durum nutant trials from 1966 (Anon., 1968; Bogyo et al., 1969; Chang, 1968; Tessi et al., 1968), for a regional cereal testing program in the Western United States (McNeal et al., 1971) and for the International Yellow Nerseries (personal communication, R. W. Stubbs, 1973).

Acknowledgements

With gratitude the authors remember the late Dr. S. Broekhuizen and his constant optimism, even in the matter of international scales. Thanks are due to Dr. W. Feekes for his permission to revise his well known and widely used scale, to Mr. A. O. Klomp (Sittingbourne, Kent, England) for his part in adapting the original Feekes scale to rice, to Dr. F.G.H. Lupton (Plant Breeding Institute, Cambridge, England), Drs. D. G. Miller, J. D. Maguire and R. E. Witters (Dept. of Agronomy and Soils, Washington State University, Pullman, Washington, USA) for their helpful suggestions, and to many others, who did not, yet, or not fully agree with the present proposal, but showed their interest by giving their highly valued comments. The interest shown by Drs. Leon and Chiarappa (F.A.O., Rome) is greatly appreciated.

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Table 1. A decimal code for the growth stages of cereals. Principal growth stages.

1-digit code	Description
0	Germination
1	Seedling growth
2	Tillering
3	Stem elongation
4	Booting
5	Inflorescence emergence
6	Anthesis
7	Milk development
8	Dough development
9	Ripening
T	Transplanting and recovery (rice only)

Table 2. A decimal code for the growth stages of cereals. Secondary growth stages.

2-digit code	General description	Feekes' scale	Additional remarks on wheat, barley, rye, and oats
	<u>Germination</u>		
00	Dry seed		
01	Start of imbibition		
02	-		
03	Imbibition complete		
04	-		

Table 2 (continued).

2-digit code	General description	Feekes' scale	Additional remarks on wheat, barley, rye, and oats
05	Radicle emerged from caryopsis		
06	-		
07	Coleoptile emerged from caryopsis		
08	-		
09	Leaf just at coleoptile tip		
	Seedling growth		
10	First leaf through coleoptile	1	
11	First leaf unfolded 1)		Second leaf visible (1 cm)
12	2 leaves unfloded		
13	3 leaves unfolded		
14	4 leaves unfolded		
15	5 leaves unfolded		50 per cent of laminae unfolded
16	6 leaves unfolded		
17	7 leaves unfolded		
18	8 leaves unfolded		
19	9 or more leaves unfolded		
	Tellering		
20	Main shoot only		
21	Main shoot and 1 tiller	2	
22	Main shoot and 2 tillers		
23	Manin shoot and 2 tillers		
24	Main shoot and 4 tillers		This section to be used to supplement records from other sections of the table: "concurrent codes"
25	Main shoot and 5 tillers		
26	Main shoot and 6 tillers	3	
27	Main shoot and 7 tillers		
28	Main shoot and 8 tillers		
29	Main shoot and 9 or more tillers		
	Stem elongation		
30	Pseudo stem erection 2)	4-5	In rice: Vegetative lag phase
31	1st node detectable	6	Jointing stage
32	2nd node detectable	7	
33	3rd node detectable		Above-crown nodes
34	4th node detectable		
35	5th node detectable		
36	6th node detectable		
37	Flag leaf just visible	8	
38	-		
39	Flag leaf ligule/collar just visible	9	Pre-boot stage In rice: Opposite auricle stage

Table 2 (continued).

2-digit code	General description		Feekes' scale	Additional remarks on wheat barley, rye, and oats
	<u>Booting</u>			
40	-			
41	Flag leaf sheath extending			Little enlargement of the inflorescence, early-boot stage
42	-			
43	Boots just visibly swollen			Mid-boot stage
44	-			
45	Boots swollen		10	Late-boot stage
46	-			
47	Flag leaf sheath opening			
48	-			
49	First awns visible			In awned forms only
	<u>Inflorescence emergence</u>			
50	First spikelet of inflo-	N	10.1	
51	rescence just visible	S		
52	1/4 of inflorescence	N	10.2	
53	emerged	S		
54	1/2 of inflorescence	N	10.3	
55	emerged	S		
56	3/4 of inflorescence	N	10.4	
57	emerged	S		N = non-synchronous crops
58	Emergence of inflo-	N	10.5	S = synchronous crops,
59	rescence completed	S		see text
	<u>Anthesis</u>			
60	Begining of anthesis	N	10.51	Not easily detectable in barley. In rice: Usually immediately following heading
61		S		
62	-			
63	-			
64	Anthesis half-way	N		
65		S		
66	-			
67	-			
68	Anthesis complete	N		
69		S		
	<u>Milk development</u>			
70	-			
71	Caryopsis watery ripe		10.54	
72	-			
73	Early milk			
74	-		11.1	
75	Medium milk			Increase in solids of liqui endosperm notable when crus ing the caryopsis between fingers
76	-			
77	Late milk			
78	-			
79	-			

Table 2 (continued).

2-digit code	General description	Feekes' scale	Additional remarks on wheat, barley, rye, and oats
	<u>Dough development</u>		
80	-		
81	-		
82	-		
83	Early dough		
84	-		
85	Soft dough	11.2	Finger nail impression not held
86	-		
87	Hard dough		Finger nail impression held, inflorescence loosing chlorophyl
88	-		
89	-		
	<u>Ripening</u>		
90	-		In rice: Terminal spikelets
91	Caryopisis hard (Difficult to divide by thumb-nail) 3)	11.3	In rice: 50 per cent of spikelets ripened.
92	Caryopsis hard (can no longer be dented by thumb-nail) 4)	11.4	In rice: Over 90 per cent of spikelets ripened 5)
93	Caryopsis loosening in daytime		
94	Over-ripe, straw dead and collapsing		
95	Seed dormant		
96	Viable seed giving 50% germination		
97	Seed not dormant		
98	Secondary dormancy induced		
99	Secondary dormancy lost		
	Transplanting and recovery (rice only)		
T1	Uprooting of seedlings		
T2	-		
T3	Rooting		
T4	-		
T5	-		
T6	-		
T7	Recovery of shoot		
T8	-		
T9	Resumption of vegetative growth		

Notes to Table 2.

1) Stage of seedling inoculation with rust in the greenhouse.
2) Only applicable to cereals with a prostrate or semi-prostrate early growth habit.
3) Ripeness for binder (ca 16% water content). Chlorophyll of inflorescence largely lost.
4) Ripeness for combine harvester (< 16% water content).
5) Optimum harvest time.

IV. CONTRIBUTIONS FROM OTHER COUNTRIES

A number of contributions were received from other countries, but most of these reported research or other matters of special interest. Consequently they have been included in the sections "SPECIAL REPORTS" or "OAT CULTIVARS".

Oat Production and Problems in Western Canada 1973

R. I. H. McKenzie, J. W. Martens, D. E. Harder, J. J. Nielsen and P. D. Brown

Production

In 1973, 5,370,000 acres were estimated to have been harvested for grain in Western Canada and another one million acres were used for forage. Harvested yields were 51.0 bushels (34 lb. bushel) per acre which is exactly the same as in 1972. Yields in Alberta were slightly over 55 bushels per acre while in Saskatchewan and Manitoba they were about 49 bushels. Most of the oat crop (70%) in Western Canada is grown on stubble land where yields in 1973 averaged 48 bushels per acre, compared to 60 on summerfallow. By comparison only 61% of the barley and 19% of the wheat are grown on stubble land in this area.

Crown rust and drought on the eastern prairies reduced yields. But low growing season temperatures resulted in good moisture efficiency and better than expected yields were obtained.

Varieties

Harmon continues to be the most popular variety with 39% of the acreage followed by Rodney with 15%. Garry and Kelsey follow with 9% and 8% respectively. Grizzly, Sioux, Random, Fraser and Victory are grown to a lesser extent. The popularity of Harmon and Rodney appears to be due to farmer preference for their large plump kernels and their high bushel weight. Many of the other varieties are better yielders.

Hudson, a new rust resistant variety, was licensed in January 1974 (see New Oat Cultivars Section).

Oat Rust

Oat stem rust infections were light or absent on most uniform rust nurseries grown across Canada with only 6 out of 28 locations having trace infections. Light infections developed on crops throughout most of Manitoba and eastern Saskatchewan late in the season but caused almost no crop losses. The physiologic race distribution in Western Canada remained largely unchanged from 1972 with 2 races, C10 (Pg9/Pg1, 2, 3, 4, 8) and C23 (Pg2, 4, 9/Pg1, 3, 8) comprising over 98% of the rust population. The new source of resistance derived from *Avena sterilis*, gene pg13, was resistant to all field cultures in 1973. A new avirulent race (Pg1, 2, 3, 4, 8, 9, 13/) was also found.

Crown rust infections were generally light in Western Canada in 1973, and only late-sown crops were moderately affected. Races 295 and 326 predominated in Western Canada, while in Eastern Canada the main races were 210, 284, and 330. In Eastern Canada infection by crown rust was generally more severe, and there was greater diversity of races than in Western Canada. Much of the increased crown rust problem in Eastern Canada is attributed to heavy buckthorn infestation. Tentative steps have been taken in Manitoba to eradicate buckthorn.

The main crown rust resistance genes presently used in the Winnipeg breeding programs are Pc38 and Pc39. There was a slight increase in virulence on lines with Pc38 in 1973, but lines with Pc39 have remained resistant. Genes Pc38 and Pc39 are being combined to provide highly effective crown rust resistance.

Oat Smut

In 1970 a race of loose smut, *Ustilago avenae*, with virulence on the differentials Atlantic (which identifies virulence on varieties with Victoria resistance) and Clintland, was found in Manitoba and Saskatchewan. This race is also virulent on the commercial cultivars grown in Western Canada. It has since increased in incidence. In 1972 and 1973 two collections of covered smut, *U. kolleri*, were found to be virulent on Atlantic, but not on Clintland. Resistance to these virulent races, derived from Markton, is being utilized in the breeding program.

V. CONTRIBUTIONS FROM THE UNITED STATES

FLORIDA

R. D. Barnett and H. H. Luke

The Oat acreage increased some the past two years because of the shortage of planting seed of other small grains particularly rye. In 1973 32,000 acres were planted for all purposes with 11,000 acres yielding 38 Bu/A being harvested. In 1974 33,000 acres were planted for all purposes. Probably 95% of the oat acreage in Florida was planted to the Florida 501 variety. Since Florida 501 is now completely susceptible to prevalent races of crown rust we are recommending that farmers plant Coker 227, Coker 234, and TAM 0-312 varieties. These three varieties have been completely free of crown rust in Florida.

Efforts are underway in the breeding program to combine the vertical crown rust resistance of A. sterlis derivatives with the horizontal resistance of the Red Rustproof oats. We are also hoping to utilize the crown rust resistance in A. strigosa. We have one diploid line (FL70Q1153) that is approximately 2 weeks earlier in maturity, one foot shorter in height, and has stiffer straw than Saia. We are planning expanded forage tests with it in the coming year. It is not very winter hardy and thus could not be grown successfully very far north. But it makes vigorous growth in the fall and early winter and may have a place in temporary grazing programs. It may have some potential for sod seeding in permanent pastures and might help fill the gap in forage availability in October, November, and December.

Studies on the inheritance of horizontal resistance to crown rust were continued. Crosses between Fulghum (susceptible)and Red Rustproof 14(resistant) were made and F_1 and F_2 plants were evaluated during the spring of 1973 and 1974. Results indicated that the susceptibility of Fulghum is partially dominant. Although we did not determine the number of genes involved, it appears that the horizontal resistance of Red Rustproof 14 is controlled by multiple gene action. Moreover, several F_2 plants were observed to have "late-rusting" but not "slow-rusting" characteristics. Red Rustproof type F_2 plants with the Fulghum type rust reaction (susceptible) were rather common, but F_2 plants of the Fulghum type that expressed the Red Rustproof type resistance were not observed.

IDAHO

D. M. Wesenberg and R. M. Hayes

Eleven replicated yield trials composed of 260 entries were grown under irrigation at Aberdeen and Twin Falls in 1973. Sixty Aberdeen selections in these trials averaged higher in yield than 'Cayuse'. In the nonirrigated trial at Tetonia 68Ab644 (Cayuse/'Orbit') averaged highest in yield with 56.5 bu/A or 7.0% higher than Cayuse.

The Uniform Northwestern States Oat Nursery was grown at 11 irrigated and 14 nonirrigated locations in seven states and Saskatchewan in 1973. 71Ab694 (Cayuse/Orbit) averaged 76.6 bu/A in the nonirrigated trials and ranked first in yield among the 25 entries in the Uniform nursery. WA 6013 (CI 2874/Cayuse) ranked first in yield in the irrigated trials with an average yield of 152.4 bu/A. Cayuse averaged 75.4 and 144.4 bu/A in the nonirrigated and irrigated trials, respectively. 71Ab694 averaged about one pound higher in test weight than Cayuse over all locations, but WA 6013 was lower than Cayuse in test weight.

Average groat protein content for the 25 entries in the 1973 Uniform Northwestern States Oat Nursery ranged from 13.5 to 17.1% over five locations in Idaho, Montana, and Oregon. 'Park', WA 6031, and 'Markton' averaged highest in groat protein content with 17.1, 16.8, and 16.5%, respectively. The protein determinations were made by the USDA Oat Quality Laboratory, Madison.

Indiana

H. W. Ohm, F. L. Patterson, D. N. Huber, G. E. Shaner, J. J. Roberts, R. E. Finney (Breeding, Genetics and Pathology), Kelly Day, O. W. Luetkemeier (Variety Testing) and B. J. Hankins (Extension).

Approximately 261,000 acres of oats were harvested in 1973. Yields were disappointingly low at 49 bushels per acre -- down 10 bushels from the previous year. Wet weather delayed planting till mid- or late April. Moisture continued to be ample till near maturity when hot, dry conditions decreased kernel weight somewhat.

Incidence of yellow dwarf virus was significant in 1973 and contributed to the low average state yield.

Seed of Noble, CI9194 and Stout, CI9195 was distributed to certified seed growers for planting in spring 1974. These two varieties are described in the new variety section of this newsletter. Variety protection for Noble and Stout has been applied for under the Plant Variety Protection Act in accordance with the certified seed option. Breeders seed will be maintained by the Purdue University Agricultural Experiment Station, West Lafayette, In. 47907.

We are increasing seed of Purdue 61353B3-9-3 for possible release. This genotype would offer the Cerch du Bach source of resistance to crown rust in an early oat.

Mark Iwig joined the small grain workers at Purdue in June of 1973 and is working on his M.S. degree as a graduate assistant. His thesis research is on oat protein improvement.

IOWA

K. J. Frey, J. A. Browning, M. D. Simons, and K. Sadanaga

Oats harvested for grain in Iowa occupied 1.25 million acres in 1973. The use of multiline cultivars continued to increase to where it is estimated that over half of the Iowa acreage was sown to these cultivars in 1973.

In our oat research program, major emphasis continues to be placed on development of cultivars with high grain yield and high groat-protein content. Experimental lines with 22.0% groat protein and good agronomic traits have been quite easy to obtain from crosses of the type *Avena sativa* I x *A. sterilis* 2 x *A. sativa* II 3 x *A. sativa* III. Only certain *A. sterilis* collections make good parents in such crosses, but the bulk method of screening the F_3 groats from such crosses (with each F_3 lot tracing to a single "Bc_2" F_1 seed) has been very successful in selecting the best progenies in which to pedigree or pure-line select for groat-protein percentage. *A. sterilis* lines from which we have had most success in transferring genes for high groat-protein percentage are 66Ab-213, 66Ab-335, 66Ab-108, 66Ab-213, 66Ab-496, 66Ab-555, and 66Ab-980.

Changes in personnel: Tunde Fatunla and Phattakun Chandhanamutta completed Ph.D. degrees and returned to their respective positions in Nigeria and Thailand. Apinya Tantivit completed an M.S. degree and returned to Thailand. New graduate students who joined our project in September were Robert Segebart from Iowa State University, Alan Elliott from Pride Seed Corn Co., Abdulmajid Rezai from Iran, and Ventura Gonzalez from Venezuela.

KANSAS

E. G. Heyne and E. D. Hansing

Oats were seeded on only 143,000 acres for 1973 and the production was 4,000,000 bushels, the smallest oat crop in the state in over 100 years. The average yield was 40 bushels per acre from the 100,000 acres harvested. A factor in reduced acreage was the wet spring, especially March. We were able to seed only two of our planned location trials as the date when fields dried out was past 15 April. However, conditions were good for oats even with late seeding and some cultivars yielded over 100 bushels per acre in the nursery trials at Manhattan. There were no serious disease problems in 1973.

We are not carrying on any breeding work at the present time. However, we have grown a composite bulk of winter oats in south central Kansas for several years. We have not had a good winter killing year and would like to see a percentage of the population eliminated before selections are made. In 1972 and 1973 winter oats yielded 100 bushels per acre at Hutchinson and the 1974 crop also has survived very well so we are expecting good yields again.

There was an increased demand for seed oats in the spring of 1974 as the expected acreage was predicted to be over 300,000 acres. Seeding conditions were generally good in 1974 and oats has grown well. E. G. Heyne.

Except for 'Kanota' which is only grown on a small acreage, in Kansas, all of our oat cultivars have sufficient resistance to loose smut and covered smut for effective control of these diseases under field conditions.

Flowable fungicides are a new development in seed treatments. These formulations are better adapted to go through our modern liquid seed treating machinery than wettable powders. In addition, they thoroughly cover the seed. Vitavax 200 Flowable Fungicide (17% thiram and 17% carboxin) controls loose smut and covered smut. E. D. Hansing.

Michigan

J. E. Grafius and Dimon Wolfe

We plan 3 releases of new oat varieties from MSU. The first, Mariner, was made available to growers of certified seed in 1973. Mackinaw will be available in 1974 and -20 the year following. Data on height, maturity, lodging, test weight and yield in Table 1 and 2 show that the 3 releases are quite different and allow the seedsman and the grower a choice to suit his needs.

Table 1. AVERAGE YIELD '68-73

	INGHAM[1]	TUSCOLA	LENAWEE	KALAMAZOO	AV.	
					YIELD	T.W'T
Mariner	117	115	105	75	103	36
-20	115	115	114	78	105	34
Mackinaw	111	110	105	63	98	34
Garry	115	107	98	73	98	32
AuSable	112	102	101	74	97	34
Clintland 64	91	96	84	61	83	34
LSD	6	5	4	7	3	

[1] Three year average at Ingham, 5 year average for Tuscola and Kalamazoo, 6 year average for Lenawee.

Table 2. AVERAGE DATA OF HEADING, HEIGHT AND PERCENT LODGING

	HEADING JUNE	HEIGHT	% LODGING
Mariner	28	53	21
-20	29	52	8
Mackinaw	33	57	0
Garry	30	57	38
AuSable	32	54	8
Clintland 64	26	49	0

The new releases have field tolerance to red leaf and to Septoria black stem - our two most serious diseases. All are susceptible to common races of leaf and stem rust, but rust has not been a problem in the lower peninsula for 20 years.

Minnesota

D. D. Stuthman and L. W. Briggle

The 1973 harvested acreage of oats exceeded 2.5 million acres, a small increase over 1972. Production was approximately 140 million bushels, about 14 percent above the previous year. Growing conditions were generally favorable except for insufficient moisture late in the season. Cool nights during the filling period prevented serious loss from the dry conditions.

A variety survey conducted by the Minnesota Crop and Livestock Reporting Service indicated a substantial change since 1967. Currently, the three leading varieties are Froker (19%), Lodi (18%) and Rodney (14%). Two varieties, Lodi (38 to 18) and Garland (22 to 8) had the largest decrease, and Froker the largest increase (0 to 19). Two other items from the survey are of interest. First, the percentage of the acreage used as a nurse crop dropped from 35 to 28. Secondly, approximately 17 percent of the acreage was seeded with certified seed.

The improvement of protein content utilizing the species Avena sterilis has received major attention in our breeding efforts recently. Although we have encountered some difficulties, we are still optimistic that we can improve the protein content of oats using A. sterilis germplasm. We have derivatives equal to Dal or Otee in protein and yield but deficient in one or more other agronomic characters. Some selections exceed those two varieties for either yield or protein but are below them in the other. We have just completed the second cycle of intercrossing of selected derivatives and will be growing F_2 plants in 1974 field nurseries. With repeated intercrossing of selections we hope to accumulate "protein genes" and to break linkages between these genes and undesirable A. sterilis characteristics. An added benefit from the A. sterilis germplasm has been some excellent crown rust resistance even without conscious selection for resistance.

Ken Ziegler and Donn Cummings have initiated graduate studies in Plant Breeding during 1973.

MISSOURI

Dale Sechler, J. M. Poehlman, Paul Rowoth, Charles Kruse, Lewis Meinke, and Tim Flanders

Oats were harvested from only 41,000 acres in 1973, the lowest in many decades. The average yield of 34 bu/acre was the lowest since the early 1960's. Due to the very wet spring, many potential acres were never seeded and others were seeded too late for good yields. The 90,000 acres seeded, compared to 41,000 acres harvested for grain, reflects not only an large abandonment due to poor performance but also an increased use of oats for hay.

BYDV disease was very damaging over much of the State. Crown rust infections were rather heavy in some areas. Loose smut was seen frequently in oat fields but the percentage of infection was relatively low.

The spring oat acreage planted in 1974 increased sharply over that of 1973 and the 250,000 acres reported (Crop Reporting Service) is comparable to the 1972 acreage. In most cases the crop was seeded early, stands are good, and prospects are excellent for a good yield.

Although Columbia recorded temperatures as low as -18 F in December and January of the 1973-74 season, there was snow when temperatures were most extreme and winterkilling in winter oats was minimal. During the 1972-73 season, temperatures dropped only to -7 F but very good differential killing was observed in the nurseries.

Otee, Jaycee, and Nodaway 70 are the most widely grown spring oat varieties. The very limited winter oat acreage is in Southern Missouri where the Kentucky varieties are primarily used.

Tests to determine the desirable characteristics of a variety to be grown for hay indicate the desirability of an early, tall variety even though hay from the tall variety may be slightly less digestible.

Observations on the pattern of dry matter accumulation in oats, under greenhouse conditions, indicate that weight of roots exceeds that of above ground growth for about 2 1/2 wks after emergence and reaches a maximum soon after the plant flowers. Dry matter in the leaves and stems, as a percent of total dry matter, reached its peak also just prior to flowering. The pattern and rate of accumulation was very similar in a short and tall variety.

Personnel items:

Dr. Leo Duclos, who was located at the Delta Research Center, took a leave of absence to work with Purdue University on their project in Brazil. Charles Kruse has continued the small grain work at Portageville.

OHIO

Dale A. Ray

Production. Ohio farmers harvested 540,000 acres of oats in 1973, which represented a rapid recovery from the record low in 1972 to about the average figure for the previous five-years. Average yield was down to 48 bushels per acre, the lowest since 1959. Adversely wet, cold weather in the early spring months caused a reduction in oat acreage and delayed much of the seeding beyond the optimum period. The contrast of hot, dry weather after plant heading served to hasten maturity and contributed to poor kernel filling and low bushel weights. Cereal leaf beetles were widespread in infestation but on a later shcedule than in previous years and did not appear to affect yield. Barley yellow-dwarf and crown rust were severe in some fields but appeared to be localized.

Oat Varieties. Clintford, Clintland 60, Dal, Garland, and Otee varieties were recommended for grain production, with Ohio farmers advised to use Dal and Rodney for forage purposes. Noble and Otee were the outstanding varieties for yield in the 1973 state-wide performance trial. Noble and Stout presently are being considered for addition to the list of recommended varieties.

Oat Breeding. Oat breeding materials and all rod-row nurseries at Columbus were subjected to a natural epidemic of barley yellow dwarf. Only dwarf-tolerant lines and check-varieties produced acceptable yields. Eighteen advanced-generation selections from Avena sterilis x Avena sativa crosses were compared with standard oat varieties in a replicated rod-row test. Several good yielding lines exhibited low kernel quality and genetic instability. Rigorous reselection became necessary before progress on protein increase can be evaluated. Leonardo Corral completed his M.S. study on the use of Ethrel for inducing male sterility in Clintford oats. Partial male sterility was obtained with low concentrations of Ethrel, while high concentrations of the chemical produced complete male and female sterility. Although the results did not support the potential of the material for field-scale production of hybrid oat seed, the procedure may have promise for increasing natural crosses and the development of interesting bulk crosses.

OKLAHOMA

H. Pass, L. H. Edwards, E. L. Smith, and E. A. Wood

Production. The oat crop for 1973 was nearly 8.0 million bushels, an increase of 37 percent over the previous year. Harvested acreage, at 194,000 acres, was up 25 percent and the average yield, at 41.0 bushels, was greater by 3.5 bushels than the 1972 crop. Planted acreage was up only 3 percent to 350,000. Grain quality was excellent due to the ideal weather for filling the grain.

Oat Varieties. Cimarron has been the popular variety with the formers for sometime. However, Checota and Chilocco are gaining in acceptance. Nora has taken over considerable acreage, but has been limited by occasionally winter killing and by the fact much of the acreage is grown for hay.

Oat Breeding. The oat breeding program has been reduced. A major part of the limited breeding work is to incorporate greenbug resistance into our winterhardy types. The source of resistance being used is P.I.186270 which has very little winterhardiness.

SOUTH DAKOTA

D. L. Reeves

Production. Oat acreage remains quite stable. Production was reduced in some parts of the state in 1973 due to very dry conditions. Disease problems were small due to the dry weather. The primary varieties are now Burnett in the western part of the state and Froker in the east.

Research. The major emphasis on developing high protein varieties that have stiff straw. Most of the material being used in this program is *A. sativa*. The simulated hail study is being continued.

Personnel. Mr. Harbans Sraon has completed his Ph.D. work in May, 1974.

TEXAS

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

Production: The 1973 season was very favorable for oat production in Texas. Of the 2,100,000 acres seeded, 650,000 acres were harvested, and the average yield of 41 bushels per acre established a new record for the state. The harvested acreage was up sharply from the two previous seasons in which only 9 and 17% of the state acreage was harvested. The 1973 season also was very favorable for oat forage production, and excellent livestock gains from grazing were obtained in Central and South Texas.

Rusts: Crown rust races 264B and 325 continued to predominate. Of 83 viable cultures collected from Robstown (South Texas, near Corpus Christi) to Chillicothe (Rolling Plains area just south of the Oklahoma border), 65% were identified as 264B and 26% were identified as 325. Races 276, 263, 264A, and 333 also were identified, but each of these races made up less than 5% of the total cultures identified.

Texas stem rust collections were concentrated in South and Central Texas, as little stem rust was found in the other oat producing areas of the state. Of 164 isolates from 57 collections, 53% were identified as race 61 and 31% were identified as race 31. Races 1, 15, 72, 77, and 98 constituted the remaining 17%

Crown rust continues to cause severe damage, especially in the Coastal Bend Area of South Texas. TAM 0-301, TAM 0-312, and Coker 234 are the only oat varieties adapted in South Texas which have adequate crown rust resistance to provide reliable production. Each of these varieties has crown rust resistance from *A. sterilis*.

Stem rust usually is much less serious than crown rust, and its occurrence is very "spotty". Stem rust did become damaging in some commercial fields in the Pearsall area south of San Antonio in 1973. All of the varieties presently grown in Texas appear to be susceptible to one or more of the current stem rust races.

We have noted that some varieties consistently show more severe stem rust symptoms than others, although "Type 4" pustules are found on both. The crown rust resistant varieties TAM 0-312 and Coker 234 appear to be especially vulnerable to stem rust.

Breeding and Genetics: 71C3090 was increased and released as TAM 0-301. It is recommended as a grain and forage oat for South Texas. It does not have sufficient winterhardiness to allow reliable production north of Waco, Texas.

71C3098 was increased and released as TAM 0-312. It is recommended as a grain and forage oat for South and Central Texas. Both TAM 0-301 and TAM 0-312 have been described previously in the 1972 Oat Newsletter, pages 71 and 72. More complete descriptions can be found in Registration Articles published in the Jan.-Feb., 1974, issue of *Crop Science*.

We have determined that the varieties TAM 0-301, TAM 0-312, and Coker 234 have different genes conditioning resistance to crown rust race 264B, as susceptible F_2 segregates were obtained from all crosses among these varieties.

Crosses with the susceptible variety Ora indicated that resistance of each of the above varieties is conditioned by single genes with near-complete to complete dominance.

Virescent plants were discovered in progenies from crosses of _A. sterilis_ with cultivated oats. Crosses of virescent plants and normal plants were studied. Virescent plants occurred in low frequencies in the F_2 progenies; it appears that recessive alleles at three loci may condition this trait.

WISCONSIN

H. L. Shands, J. J. Schreck, R. D. Duerst, V. L. Youngs, and Y. Pomeranz

Groat Protein Percentage in Response to Nitrogen Application to Soil

This is a preliminary report of several experiments where oat groat protein has been determined after different amounts and sources of nitrogen have been applied to several oat varieties grown 1967-1972 under nursery conditions. Nitrogen (protein) was analyzed in several laboratories including Markely of Minneapolis, Ochs of Denver, USDA contract in California, and in the National Oat Quality Laboratory at Wisconsin.

The first group of experiments concerned 50 lbs/A nitrogen applied as ammonium nitrate using Garland and Lodi varieties. Eight culture variations were used following corn or alfalfa, with thin or normal seeding rate, and with or without applying ammonium nitrate to the soil. Garland averaged higher protein than Lodi; groats from plants grown in prior alfalfa land had higher protein than that from prior corn land; low seeding rate groats were higher in protein than high seeding rate groats, and groats had higher protein when 50 lbs of nitrogen was applied at planting compared to none added. The magnitude of the differences for contrasting culture conditions averaged about .5% protein except .79 higher protein in prior alfalfa land.

Two varieties, Dal and Goodland, received 100 lbs/A of nitrogen applied at medium boot stage utilizing (1) ammonium hypophosphate, (2) ammonium nitrate, (3) potassium nitrate, a 50-50 mixture of the first and third compounds, and a 50 lbs/A of foliar application of the first. Goodland averaged higher groat protein percentage than Dal and seemed less responsive. The increase in groat protein percent averaged 1.04 percent for the 3-year period. Potassium nitrate and ammonium nitrate seemed more effective than ammonium phosphate.

Urea solutions of 0, 50, and 100 lbs/A were sprayed on foliage of 10 varieties in 1971 and 6 of the same in 1972. Fifty lbs increased groat protein percent .68 over the control in 1971 and half that amount in 1972. The 100 lb application increased protein over the control .89 and .85 for 1971 and 1972, respectively. Urea spray of 100 lbs/A raised protein % of Dal more than for Goodland.

Sulfur coated urea as 100 lbs/A of nitrogen was applied to drill plots of Goodland June 14 or June 21 in 1971 and was repeated June 15 and June 22 in 1972. The first date of application seemed more effective raising protein than the second date.

In most of the above experiments plot size has been too small to measure accurately grain yield. Yield increase, when measured, has been small and probably not profitable. Basic fertilizer for oats has been 300 lbs 10-10-10 disked in just prior to planting.

VI. OAT CULTIVARS

Status of F. A. Coffman's Oat Classification Manuscript

A letter from F. A. Coffman, dated May 12, 1974, stated that the Oat Classification manuscript had been edited in the U. S. Department of Agriculture. At the time the letter was written, the manuscript was being given a final checking prior to going to the printer.

The manuscript includes over 600 typed pages, 25 illustrations, and over 200 literature citations. Over 400 oats are included.

Alphabetical List and Descriptions of New Oat Cultivars

Name	Origin	Described on page:
Cassia	N. S. U. Australia	
Hankkiua-773	Finland	
Hudson	Manitoba, Canada	
Iniap-67	Ecuador	
Moiwa	Hokkaido, Japan	
Noble	Indiana, USA	
Santa Catalina	Ecuador	
Stout	Indiana, USA	
TAM O-301	Texas, USA	
TAM O-312	Texas, USA	

Cassia

F. Mengersen

The new dual purpose oat variety Cassia was released by the New South Wales Department of Agriculture in 1973. It was bred by Dr. F. Mengersen at the Temora Agricultural Research Station from the cross of Coker's Fulgrain x Osage^2 made in 1957. It is recommended as a grain variety for the Western, Mid Western and Southern Regions as a replacement for Avon in the higher rainfall areas.

Cassia is superior to Avon for green fodder production as well as grain recovery and ungrazed grain yeild. It is also considerably more resistant to frost and grazing damage. Cassia is resistant to all races of oat smut occurring in New South Wales and has also shown field tolerance to stem rust.

Cassia has tall and strong straw of fine texture and matures about 5 days later than Avon. It is not suitable for milling purposes because of its relatively small grain size. The grain is of light creamy yellow colour, medium in husk percentage and bushel weights are generally high.

Cassia is a variety well adapted to a wide range of planting dates and various intensities of grazing management.

For the first time in the New South Wales history of oat breeding a cross combination of two American introductions produced a recommended variety.

Hankkija-773

M. P. Rekunen

Hankkija-773 is a new white oat variety released in 1973 for Finland by The Hankkija Plant Breeding Institute. This variety is a selection from the cross Eho/Blenda and it is intended to be a replacement for Hannes. It has been tested under various conditions in 1964-72 at 16 experimental stations in southern and central Finland.

Hankkija-773 outyields Hannes up to 5 percent, it is slightly later in ripening and the straw is about the same length and strength as that of Hannes. The grain is considerably larger than that of Hannes, and Hankkija-773 is classified with the largest-grained varieties. The husk percentage is rather low and the crude protein content is slightly higher than in Hannes. Hankkija-773 is more suitable to combine harvesting than Hannes because of its very minor tendency to dehulling. This new variety is recommended for general cultivation in southern and central Finland.

Hudson

R.I.H. McKenzie

Hudson (the explorer after whom Hudson Bay was named) is a variety of spring oats developed by the Oat Rust Area Project Group at the Winnipeg Research Station. It has been tested since 1967, under the accession number RL 2887 and OT 186.

Hudson is a 4 way cross with the last cross made in February 1965. The resultant F4 line was bulked in August 1966.

The parentage of Hudson is: [CCI 6792-Rodney x OT 174) x RL 2877] x (Pendek x Lodi).

Hudson is a strong strawed, high yielding variety that should respond well to good management. Yields are generally very good. It has three genes for stem rust resistance (Pg2, Pg4 and pg9) which give moderate to good resistance to all the races present in Western Canada. It has moderate field resistance to crown rust but some biotypes can attack it. Hudson appears to have the Victoria smut resistance but is susceptible to the races now appearing that can attack this resistance.

Hudson is a late maturing variety. The kernel type of this variety is not as plump as Rodney and the bushel weight is below that of most other varieties. Protein content of the grain is low and oil content medium.

Hudson appears to be best adapted to the prairie park belt area because of its good straw strength and particularly to Manitoba because of its better rust resistance. It was licensed in January 1974 and about 1600 bushels of pedigreed seed was available for distribution to seed growers for planting in the spring of 1974.

"INIAP-67"

This spring oat variety is a selection from the cross - Bt-SF- x Ck/ CI.5919-S/Mo.811, that was done by genetics of ICA-Colombia. Selections from this cross were made at Santa Catalina Experimental Station of INIAP - Ecuador. This Station is located near Quito at 3,058 meters above sea level.

"INIAP-67" is a double purpose variety, for human food and animal feed (silage). It has been selected for earliness (89 days from planting to flowering and 195 days to maturity), lenght of panicle (26.9 centimeters), resistance to lodging and for good tillering. Crain yields ranged from 2,250 kg/ha to 6,110 kg/ha, with an average of 2,645, during the period from 1963 to 1968. The forage production, when cutted in "milk stage' is about 41 m.ton/ha. "INIAP-67" variety is moderately - resistant to stem and crown rusts, the average coefficients of infection are 15.4% and 12.7% respectively.

In Ecuador, "INIAP-67" is cultivated in highlands from 2,800 to 3,300 meters above sea level.

Moiwa

T. Kumagi

A new spring variety Moiwa was developed by the Hokkaido National Agricultural Experiment Station at Sapporo in cooperation with the Hokkaido Prefectural Agricultural Experiment Stations. Moiwa is originated from the cross between S.84 and Miford received from Welsh Plant Breeding Station, and Zenshin, a leading variety in Hokkaido. The first cross, S.84 x Milford, was made in 1960 and the second cross, (S.84 x Milford) x Zenshin, was made in 1961. The selection word began in 1963. Moiwa is recommended as a replacement for Zenshin in Hokkaido. It is expected to replace most of oat varieties. Moiwa, compared to Zenshin, has somewhat smaller kernels, is about the same in culm length and about two days earlier in maturity. Moiwa, compared to Zenshin, has somewhat smaller kernels, is about the same in culm length and about two days earlier in maturity. Moiwa as a rule has outyielded most of oat varieties grown in Hokkaido. The average yield of Moiwa in tests at Sapporo since 1969 exceeds that of Zenshin by 48 kilogram per 10 acre. Litre weight is a little higher than for Zenshin and straw stronger, Moiwa has good straw strength, but it is somewhat less than Ohōtsuku, a very stiff-strawed variety. Hull percentage is lower. Hull color is white. Moiwa is susceptible to crown rust. The feeding value seems to equal Zenshin and other varieties. Moiwa may be best adapted to the central parts of Hokkaido.

Noble

H. W. Ohm

'Noble' spring oats (Avena sativa L.), Purdue 6215A2-1-2, CI9194 was developed cooperatively by the Purdue Univesity Agricultural Experiment Station and the Agriculture Research Service, U. S. Department of Agriculture. Breeder seed of Noble was shared with other north central states for planting in the spring of 1973.

Noble is the result of a combination of 10 different parents in a series of 14 crosses. It derives important characteristics from 'Tippecanoe', CI7676, 'Putnam 61', 'Albion' and 'Clintland 64'. Noble is essentially a Tippecanoe type with improved yielding ability and resistance to the virus disease, yellow dwarf. The final selection was made in the F_4 generation following the final cross which was made in 1962. Breeder seed was in the F_{12} generation in 1973. Noble has been tested in replicated yield trials in Indiana since 1968 and in the Uniform Midseason Oat Performance Nursery since 1969.

The new variety has outstanding yielding ability and excellent resistance to pre-ripe and post-ripe lodging. Noble is moderately tolerant to the yellow dwarf virus. It is resistant to races of loose smut currently prevalent in Indiana. Noble has resistance to most of the older races of crown rust and stem rust but is susceptible to the newer predominant races. Groat protein content of Noble is moderately high (17.5 to 18.5%) subject to enenvironment and fertility level. The lemma is brownish-yellow, and does not fluoresce. Grains are distinctly short and plump, well-filled, and have a relatively low percentage of hull.

"SANTA CATALINA"

This spring oat variety was obtained by selection from the cross Sac-HJ Fla/L at Santa Catalina Experimental Station of INIAP - Ecuador. "Santa Catalina" is a variety for human food; it is a medium-short plant (149 centimeters), early (198 days from planting to harvest), the straw is moderately strong, panicle medium large - (19.7 centimeters) and has good tillering.

In regional trials conducted over years (1963-1968), "Santa Catalina" oat gave an average yield of 3,960 kg/ha with a maximum of 2,430 kg/ha.

"Santa Catalina" is moderately resistant to rust, with 11.4% average coefficient of infection for stem rust and 12.7% for crown rust. It is recommended to be planted in highlands of Ecuador, from 2,600 to 3,300 meters above sea level.

Stout

H. W. Ohm

'Stout' Spring oats (<u>Avena sativa</u> L.), Purdue 5939B1-3-9-3-5, CI9195 was developed cooperatively by the Purdue University Agricultural Experiment Station and the Agriculture Research Service, U. S. Department of Agriculture.

Stout is the result of a series of 12 crosses involving 11 different parents. It derives important characteristics from 'Milford', 'Clintland 64', 'Shield' sib, PI174544 and 'Ukraine'.

The final selection was made in the F_7 generation following the final cross which was made in 1959. Breeders seed, distributed to other north central states for planting in the spring of 1973, was in the F_{16} generation. Stout has been tested in replicated yield trials in Indiana since 1967 and in the Uniform Midseason Oat Performance Nursery since 1969.

The new variety has uniquely short, stiff straw and a compact panicle. It has shown a yielding ability equal to or better than 'Clintford'. It produces plump grain with good test weight. The groat protein content is usually 17.0 to 18.0% subject to fertility level and environment. Reaction of Stout suggests it has the B and D genes for resistance to stem rust. It has resistance to crown rust from PI174544-3. It is resistant to races of loose smut currently prevalent in Indiana. It is moderately susceptible to the yellow dwarf virus. Stout is similar in flowering date and is 7 to 8 cm shorter than Clintford. Seed glumes are very light brown to white and are fluorescent.

TAM O-301 and TAM O-312

M. E. McDaniel

TAM O-301, C.I. 9198. Previously described as 71C3090 in 1972 Oat Newsletter. Registered, Crop Science Society of America (Reg. No. 256). (Crop Sci. 14:127-128, 1974)

TAM O-312, C.I. 9199. Also previously described in 1972 Oat Newsletter under 71C3098 designation. Registered, Crop Science Society of America (Reg. No. 257). (Crop Sci. 14:128, 1974)

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VIII. MAILING LIST

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