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OAT NEWSLETTER

Vol. 21

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July 1, 1971

Sponsored by the National Oat Conference

1970

OAT NEWSLETTER

Volume 21

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.

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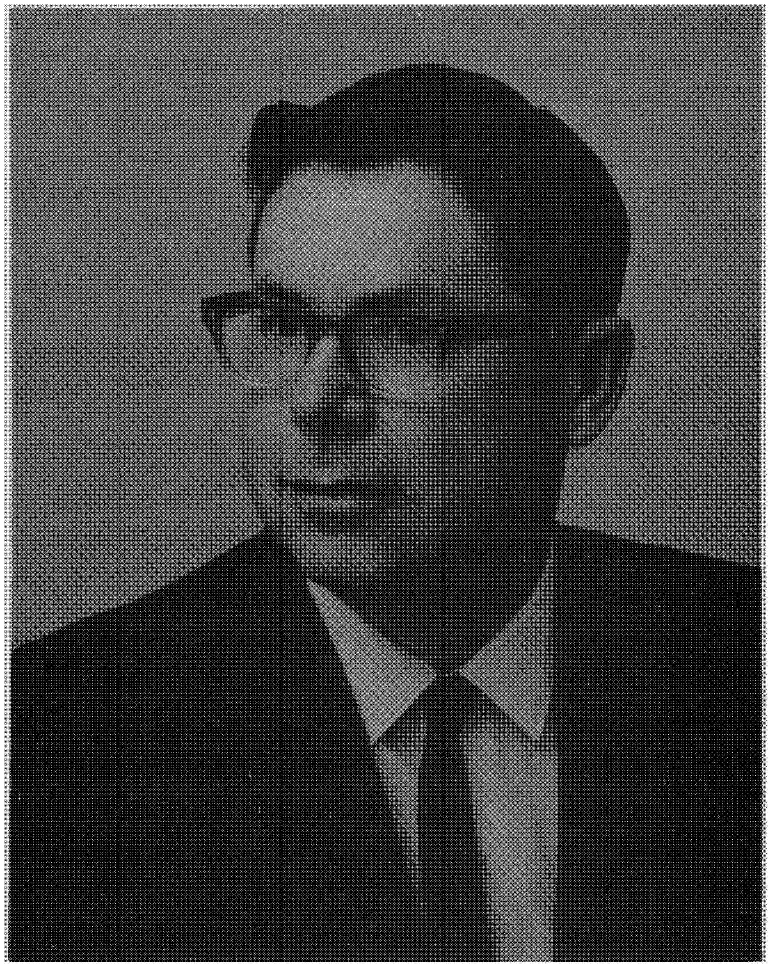
Sponsored by the National Oat Conference

J. Artie Browning, Editor



DR. ALVIN THOMAS WALLACE, 1921-1971--IN MEMORIAM

Dr. A. T. Wallace, Assistant Dean for Research with the Florida Agricultural Experiment Stations, and a scientist of international reputation, died April 18 following a long illness.

Dean Wallace was born near Millen, Georgia. He entered the University of Georgia after serving in the U. S. Navy from 1940 to 1942, graduating with a B.S.A. in 1946 as the valedictorian of his senior class. He continued his career at North Carolina State University receiving the Ph.D. in 1950, with a major in plant breeding and genetics and minors in statistics and botany. Dr. Wallace took post-doctoral training in statistics at Virginia Polytechnic Institute and in radiation biology at the Argonne National Laboratory, Chicago. Since 1950 he served as a teaching and research professor at the University of Florida, beginning as an Assistant Agronomist in the Agronomy Department and advancing to professor in 1958. He served as professor of the University's Plant Science Section for six years, and as head of the University's cross-discipline genetics program before being named Assistant Dean of the Agricultural Experiment Stations in October 1968.

In his professional career, Dr. Wallace made many significant contributions to agronomic science, as exemplified by authorship or joint authorship of more than seventy publications. His scientific accomplishments include: significant contributions to development of five major improved varieties of oats, rye, tobacco, and lupines; the first estimate of genetic variance and genotypic correlations of quantitatively inherited characteristics in oats; the first estimates of induced mutation rates at specific locus in higher plants; first person to relate the induced mutation rate at a vital locus with lethal mutations in higher plants; and taught students who contributed to both applied and theoretical genetics. His special research was with oats in the field of mutation genetics.

Most of this was accomplished while in an administrative position from 1958 to 1968, when he operated a sophisticated research program in mutation genetics, the cobalt-60 gamma radiation source, taught two graduate and undergraduate courses, directed graduate students, consulted with the Atomic Energy Commission and represented agriculture on University wide policy making committees.

Dr. Wallace was active in many organizations. He was elected a fellow in both the American Society of Agronomy and American Association for the Advancement of Science; was an officer in the Genetics Society of America; Associate Editor, Crop Science; one of three American scientists who took part in international genetics meetings behind the Iron Curtain in East Germany in 1967, and received the Gamma Sigma Delta Senior Faculty Award in 1968. He was also a member of the Florida Soil and Crop Science Society, Sigma Xi, Gamma Sigma Delta, Alpha Zeta, numerous National Technical Committees, the Gainesville Kiwanis Club, and the University United Methodist Church.

Dean Wallace was dedicated to the highest calibre of scientific endeavor. His energy and enthusiasm backed by a perceptive and inquiring mind resulted in significant contributions to national agriculture. He had an insatiable desire for new knowledge and new ideas. This desire usually culminated in lively conversations and discussions initiated by a deliberate statement to raise a question. Often his answer to a statement was "What do you mean by that?" He was a vigorous administrator whose influence was felt in every facet of Florida agriculture and many aspects of the national program. He had a real balance between a broad and extensive repertoire of technical knowledge and a compassion for people. These characteristics plus total unselfishness account, in part, for his tremendous success as a scientist and administrator.

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I. CONFERENCE AND REGIONAL NOTES

ORGANIZATION OF THE NATIONAL OAT CONFERENCE

EXECUTIVE COMMITTEE

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

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Western Region -	C. F. Konzak, D. M. Wesenberg
Cereal Crops Research Branch -	P. J. Fitzgerald
Oat Investigations -	L. W. Briggle

*Non-voting.

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 "New Varieties." We would like to make the "New Varieties" section as complete and useful as possible.

PLEASE DO NOT CITE THE OAT NEWSLETTER IN PUBLISHED BIBLIOGRAPHIES

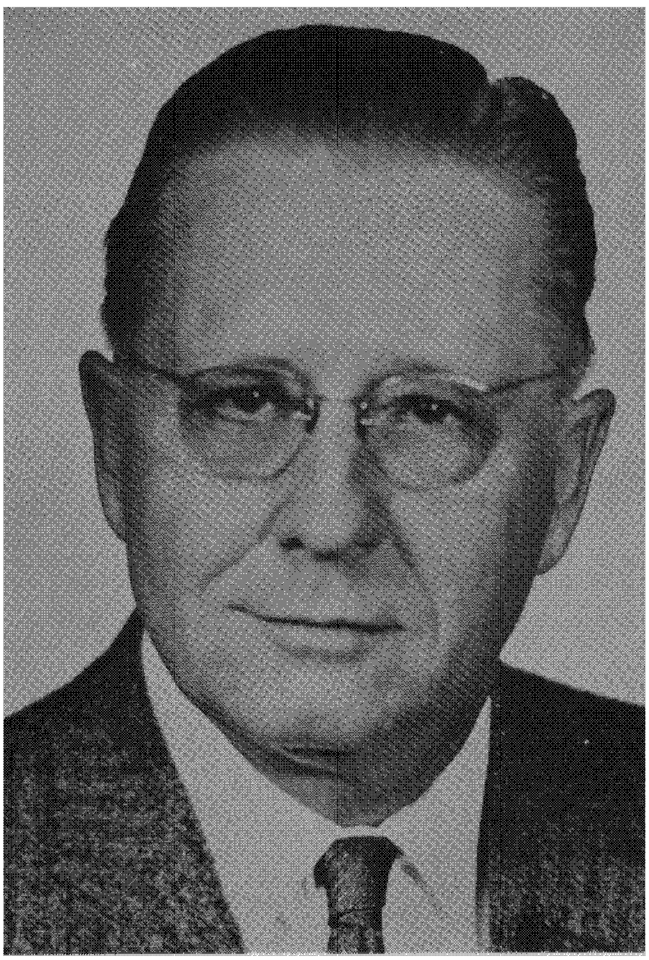
Citation of articles or reports of Newsletter items apparently is causing some concern. The policy of the Newsletter, as laid down by the oat workers themselves and later reiterated, is that this letter is to serve as an informal means of communication and exchange of views and materials between those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

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

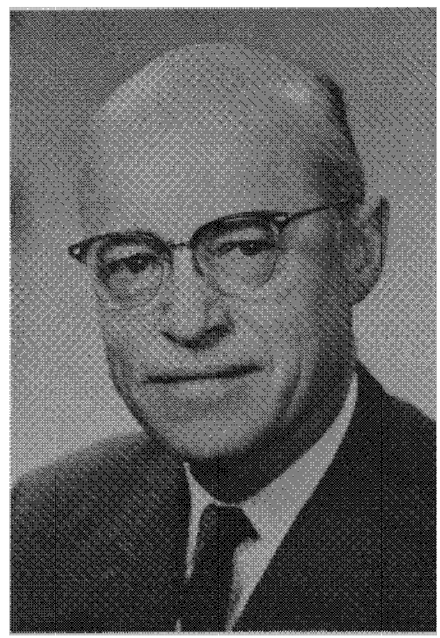
Certain agencies require approval of material before it is published. Their approval of material which goes into the Newsletter is a different evaluation from approval for publishing. Abuse of this informal relationship by secondary citation could well choke off the submission of information. One suggestion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

AWARD FOR DISTINGUISHED SERVICE
TO OAT IMPROVEMENT

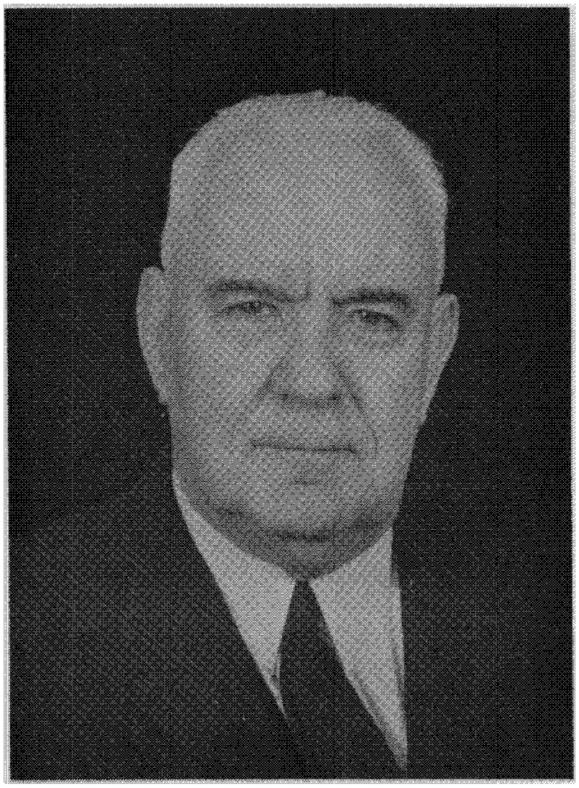
At the 1966 meeting of the National Oat Conference in East Lansing, Michigan, a decision was made to honor selected persons for "recognition of their outstanding research contributions and/or meritorious service toward making oats a successful agricultural crop species." (See 1966 Oat Newsletter 17: 1-2). At the 1970 meeting in Raleigh, North Carolina, those in attendance elected I. M. Atkins, R. M. Caldwell, F. A. Coffman, H. K. Hayes, G. K. Middleton and D. E. Western to be the first to be recognized for "Distinguished Service to Oat Improvement." The Oat Newsletter is pleased to announce the names of those honored, to publish their photographs and brief biographies, and to extend its most sincere CONGRATULATIONS!



I. M. Atkins



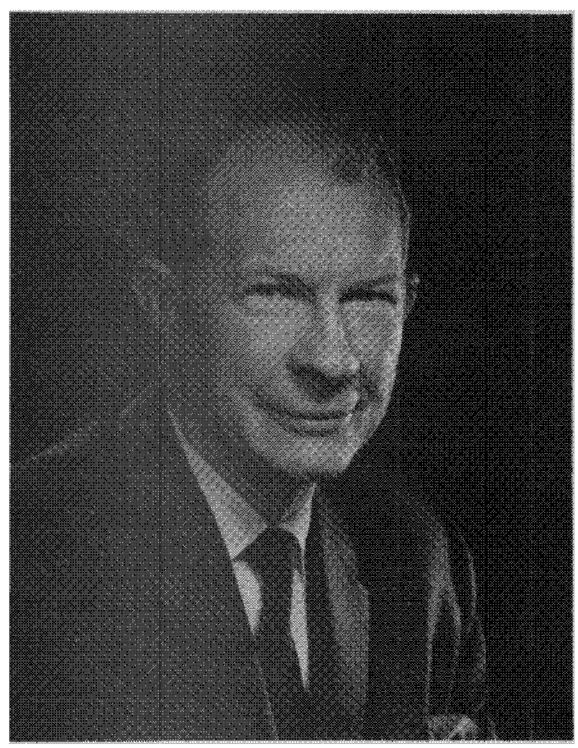
R. M. Caldwell



F. A. Coffman

H. K. Hayes

G. K. Middleton



D. E. Western

I. M. Atkins

Dr. Irvin Milburn Atkins, now retired from the staff of Texas A&M University, has left an indelible mark upon Texas agriculture. He began his career in 1928 as a Junior Agronomist with the U.S. Department of Agriculture (USDA) and concurrently served as Assistant Superintendant of the San Antonio Field Station, San Antonio, Texas. In 1930 he became an Associate Agronomist with the USDA and Assistant Superintendant of the Texas Agricultural Experiment Substation at Denton, Texas. Dr. Atkins was promoted to the rank of USDA Agronomist in 1946 and in 1954 he was transferred to Texas A&M University at College Station, Texas, where he became Professor and Small Grains Section Leader. Since retirement in 1968 Dr. Atkins has served as a Consultant with Texas Seed Companies.

Dr. Atkins is author or co-author of 134 publications of various kinds. He was directly involved in development and release of 11 oat varieties, eight wheat, four barley, and four flax varieties. Of particular importance was the winter hardiness of Texas oat varieties Bronco, Mustang, and Norwin which assured production of winter oats in northern sections of the State, thus adding needed winter forage for livestock in addition to grain. Prior to development of those hardy varieties, only spring-sown oats could be grown. Crown rust tolerance of New Nortex made it one of the most popular varieties of oats in Texas and other southern States. Development of such oat varieties as Houston, Norwin, Coronado, and Cortez represent improvement in specific crown rust resistance, straw strength, test weight, seed size and quality, and forage production. Among the improved wheat varieties were those which represented a 20 bushel per acre increase in yield under irrigation and a 2 to 3 bushel increase on dry land in the High Plains of Texas, when compared to the varieties Turkey and Mediterranean, grown in 1930. In North Central Texas the improved varieties produced approximately 10 bushels more per acre on dry land. Some of the same wheat varieties were two pounds per bushel heavier in test weight.

Dr. Atkins is a member of Alpha Zeta, Gamma Sigma Delta, Phi Kappa Phi, and Sigma Xi. He is a member of the American Phytopathological Society, the American Association for the Advancement of Science, and is a member and Fellow of the American Society of Agronomy. He was recognized as Man of the Month in August 1954 by the Southern Seedsman, received the Seedsman Digest Award in 1956, and was cited for contributions to the Southwest Wheat Industry in 1968 with receipt of the Lone Star Cereal Chemistry Award.

Dr. Atkins was born July 24, 1904, at Corning, Kansas. He received a B.S. degree in 1928 and an M.S. degree in 1936 from Kansas State University, and a Ph.D. degree from the University of Minnesota in 1945.

R. M. Caldwell

Dr. Ralph Merrill Caldwell, Professor of Botany and Plant Pathology at Purdue University, has made many contributions to his profession, one of which was the organization of one of the most progressive small grain improvement projects in the nation. His first professional assignment was that of State Leader for Barberry Eradication in Wisconsin from 1928 to 1930. He joined the staff of Purdue University as a U.S. Department of Agriculture Pathologist in September 1930, and took charge of the Small Grain Disease Control Project. Dr. Caldwell was appointed Head of the Department of Botany and Plant Pathology in 1937. He held this position until 1954 when he resigned to devote full time to research in small grain improvement. He is scheduled to retire from the Purdue University staff in June, 1971.

Dr. Caldwell was co-developer of two winter oat varieties and 13 spring oat varieties at Purdue University. In the winter varieties, spring oat by winter oat crosses were utilized to improve the straw strength, disease resistance, and winter hardiness of winter types. In the spring oat varieties, improvements were made for disease resistance, strong and shorter straw, plump grain, and adaptation to the southern corn belt. During his active tenure in the Purdue University-USDA Small Grain Breeding Program, 14 outstanding soft red winter wheat varieties and four barley varieties were released. The wheat varieties, particularly Knox, Monon, and more recently Arthur, have occupied leading acreages in the Eastern Soft Wheat Region.

Dr. Caldwell made notable contributions to our knowledge of leaf rust and Septoria of wheat. His research with crown rust of oats established the concept of tolerance to rusts and the relative economic importance of tolerance, and called world-wide attention to the phenomenon. His research with crown rust also formed the basis for recognition of the "slow rusting" phenomenon and its value as a type of general resistance to disease. Through judicious selection and manipulation of germ plasm from many distantly related sources, he and his co-workers developed wheat varieties with an unparalleled combination of disease resistance, insect resistance, grain quality, and high yield.

Dr. Caldwell directed the research of many outstanding graduate students. He is the author of numerous research papers and Purdue University Agricultural Experiment Station Bulletins. He holds membership in Alpha Zeta, Gamma Alpha, and Sigma Xi honorary societies. He is a Fellow of the American Society of Agronomy, The American Phytopathological Society, and The American Association for the Advancement of Science.

Dr. Caldwell was born June 27, 1903, at Brookings, South Dakota. He attended public school at Brookings, and obtained a B.S. degree from South Dakota State University in 1925. In 1927 he was awarded the M.S. degree and in 1929 the Ph.D. degree from the University of Wisconsin.

F. A. Coffman

Mr. Franklin Arthur Coffman, retired U.S. Department of Agriculture Agronomist, is well known for his research achievements in winter oat improvement and in initiating uniform oat testing nurseries. His first professional position was that of Station Superintendant in the Office of Agronomy, Philippine Bureau of Agriculture. On the stations superintended by Mr. Coffman, corn, rice, sugar cane, grain sorghums, and various forage and fiber crops were grown. He went to the Philippines in 1914 and upon his return to the U.S. in 1916, he taught classes in Botany and Plant Physiology at Kansas State University while doing graduate work. He began service with the U.S. Department of Agriculture in 1917 as Field Assistant in charge of cereal experiments at Akron, Colorado. In 1918 he became Scientific Assistant and in 1922 Assistant Agronomist. In 1924 Mr. Coffman was promoted to Associate Agronomist and transferred to Arlington, Virginia, where he conducted winter oat experiments and initiated our present Uniform Oat Performance Nursery and Oat Winterhardiness Nursery programs. In 1937 he became Agronomist and in 1943 Senior Agronomist. He assisted in the overall oat breeding program administered by the Oat Investigations Leader, but gave particular emphasis to programs in the South. During this period he was transferred from Arlington, Virginia, to the Plant Industry Station, Beltsville, Maryland. Mr. Coffman was assigned responsibility for winter oats in 1951 and in 1957 became Principal Agronomist. He retired in 1962 but has remained active as a U.S. Department of Agriculture Collaborator. He is presently involved in writing a Department Technical Bulletin on the classification, history, and description of oat varieties.

Mr. Coffman originated the Uniform Oat Winterhardiness Nurseries in 1926. These Nurseries have played an important role in accomplishing and measuring remarkable progress in increasing the winterhardiness of oats. He produced in his own hybridization and selection program the most winterhardy oats available at that time. He had sole responsibility for the Uniform Oat Performance Nurseries from 1924 through 1946. With rare exceptions, all oat varieties released in the U.S. during the last 35 years were tested in one or more Uniform Nurseries before release. Since 1917 Mr. Coffman had the major responsibility for developing 34 oat varieties. Representative varieties among this group occupied a major portion of the U.S. oat acreage for many years. He was editor and a major contributor to the American Society of Agronomy monograph "Oats and Oat Improvement." He has published more than 100 scientific papers.

Mr. Coffman is a member of Sigma Xi, Phi Kappa Phi, Gamma Sigma Delta, American Genetic Association, Washington Botanical Society, and is a Fellow of the American Society of Agronomy and the American Association for the Advancement of Science. He received the U.S. Department of Agriculture Superior Service Award in 1962.

Mr. Coffman was born December 30, 1892, at Jewell, Kansas. He obtained a B.S. degree in 1914 and an M.S. degree in 1922 from Kansas State University, and did further graduate work in the U.S. Department of Agriculture Graduate School from 1924 to 1926.

H. K. Hayes

Dr. Herbert Kendall Hayes, Professor Emeritus of agronomy and plant genetics at the University of Minnesota, has been a leader in plant improvement since the early years of this century. Receiving his Doctor of Science degree under the eminent Harvard Geneticist Dr. E. M. East in 1921, Dr. Hayes pioneered in most of the important developments in plant breeding. He played a major role in developing modern concepts of corn breeding, contributing heavily through his supportive research on heterosis, quantitative inheritance, and combining ability. He established the use of hybridization and pedigree selection in the improvement of self-fertilized crops. In collaboration with his long-time associate, Plant Pathologist Dr. E. C. Stakman, he demonstrated the efficacy of breeding for disease resistance in economic plants. Many high-yielding, disease-resistant varieties and hybrids were developed in projects which came under his purview. In the closing years of his active professional career, Dr. Hayes gave special service to oat improvement.

He contributed in earlier years in selection of the old "pure line" varieties Minota and Gopher, the latter of which was grown widely in Minnesota and surrounding areas for many years. Anthony and Minrus were developed by hybridization and selection with the specific intent of achieving resistance to crown rust, to stem rust, and smut, respectively. Bonda, Mindo, Zephyr, and Andrew were released in the mid and late forties. Each combined the best levels of resistance to crown rust, stem rust, and the smuts that were available at the time, and in addition all were resistant to Victoria blight. Bonda in particular was widely popular and was one of those varieties that made significant progress toward stiffer straw. To counter changes in the race population of the two rusts, the Landhafer gene for resistance to crown rust was combined with additional genes for resistance to stem rust and the varieties Minland, Minhafer, and Minton were produced. The last three were released after Dr. Hayes' retirement, but he had planned the original crosses and had done the early selection which led to these varieties.

During his most active years Dr. Hayes was in great demand around the world as an authority in plant breeding. He traveled and lectured in many countries and attracted large numbers of students from all corners of the globe. He was senior author of very successful text books on plant breeding as well as a book tracing the development of hybrid corn. His scientific articles number more than 200. He has made an indelible mark on the field of plant science.

Dr. Hayes was born at Granby, Connecticut, on March 11, 1884. He received his B.S. degree from Massachusetts State College in 1908, M.S. from Harvard in 1911, and D.Sc. from Harvard in 1921. After a few years at the Connecticut Agricultural Experiment Station (1908-1915) he joined the staff of the University of Minnesota as Associate Professor of Plant Breeding. He rose to Professor in 1918 and to Chief of the newly organized Division of Agronomy and Plant Genetics in 1928, a position he held until retirement in 1952.

G. K. Middleton

Dr. Gordon Kennedy Middleton, Plant Breeder with the McNair Seed Company, Laurinburg, North Carolina, is a retired Professor of North Carolina State University. He began his career as a Teacher and Plant Breeder at the Kaifeng Baptist School in Kaifeng, China, in 1920. The next six years have remained among the most gratifying of his life, because of his benevolent concern for his fellow man. A variety of wheat developed during that period by Dr. Middleton was still making superior yields for Chinese farmers in 1960, according to a book published in Vienna, Austria. After returning to the U.S. in 1926, he taught vocational agriculture in North Carolina the next two years. In 1929 he served at North Carolina State University as an Extension Specialist in seed improvement. During the next six years that he worked with this program, he helped organize the North Carolina Crop Improvement Association. In 1936 he was transferred from the Extension Service to the North Carolina Agricultural Experiment Station and placed in charge of corn, peanut, and small grain breeding. As the staff expanded, he gave up work with corn in 1940 and peanuts in 1944, after helping organize both programs. He directed the Small Grain Breeding Program from 1936 to 1961, as well as serving as Director of the North Carolina Crop Improvement Association from 1939 to 1945, and Head of the Field Crops Section, Department of Agronomy, from 1939 to 1948. In 1955 Dr. Middleton obtained a two-year leave of absence to be an Agricultural Advisor to the Government of Thailand. In the fall of 1960 he spent three months in Peru as part of North Carolina State University's mission to that country. He retired from the North Carolina State University Staff in 1961, returned for a three-year period with the North Carolina Crop Improvement Association, and has since been employed by the McNair Seed Company.

In the 25 years that Dr. Middleton headed the Small Grain Improvement Program, he was responsible for developing five varieties of wheat, seven of barley, and three of oats. He cooperated with the U.S. Department of Agriculture in developing two additional wheats, one barley, and three oats. Development of these small grain vareities has done more than increase the income of North Carolina farmers -- it has helped stabilize small grain production in the State. Of particular significance was the development of Atlas 50 and Atlas 60 soft wheats. They have served as a source of increased protein content in hard red winter wheat breeding programs.

Dr. Middleton has served as Chancellor of a local Alpha Zeta Chapter, and as Chairman of the Agronomy Section, Southern Agricultural Workers Association. The North Carolina Crop Improvement Association presented him with their Distinguished Service Award. He has been a teacher and a staunch leader in his local Baptist Church.

Dr. Middleton was born October 28, 1895, near Warsaw, North Carolina. He attended public school and a Baptist High School in North Carolina. He obtained a B.S. degree from North Carolina State University in 1917, served in the Army in 1918 and 1919, received his M.S. degree from Cornell University in 1920, and his Ph.D. from Cornell in 1930.

D. E. Western

Mr. Dallas Ernest Western, Director of Grain Research and Development, The Quaker Oats Company, has long been a staunch supporter of research on oats and other grains. He has been untiring in his efforts to encourage and support legislation which finances research on oat breeding, pathology, and physiology in the Agricultural Experiment Stations, both Federal and State. In addition to Mr. Western's individual efforts, The Quaker Oats Company established and now maintains several graduate assistantships at State Universities.

Mr. Western was a Vocational Agricultural Instructor at Jesup, Iowa, from 1929 to 1933 and a County Extension Agent at Independence, Iowa, from 1933 to 1939. During his tenure as County Agent, he was one of those remarkable leaders who foresaw the benefits of Rural Electrification and was directly responsible for establishment of R.E.A. in his County. He has been with The Quaker Oats Company since 1939. He served as Agriculturalist from 1939 to 1948, as Director of Grain Development and Agricultural Relations from 1948 to 1967, and as Director of Grain Research and Development from 1967 to the present time. During each growing season over a period of several years he prepared a crop progress report. This report was in great demand by farmers, elevator operators, grain buyers, milling executives, food processors, and others.

Mr. Western is a member and Fellow of the American Society of Agronomy, and received the Society's Agronomic Service Award in 1963. He is a member of Gamma Sigma Delta. In 1964 he received the Iowa State University Club Service Key. Kansas State University named him as recipient of "The Distinguished Service in Agriculture Award" in 1967. Iowa State University presented him with an Alumni Merit Award in 1967. The Quaker Oats Company established the Dallas E. Western Assistantship in Agriculture at Iowa State University in 1968 in recognition of his numerous significant contributions to progress in agriculture.

Dallas Western's many activities included a term as President of the Student Council at Iowa State University in 1928; President of the Agricultural Council of the Chicago Association of Commerce in 1948; member of the American Farm Bureau Federation from 1929 to the present; President of the Grain Improvement Council in Minneapolis, 1953-54; member of the Agricultural Business Committee, Illinois State Chamber of Commerce from 1944 to the present; member of the U.S. Department of Agriculture Advisory Committee for Grain and Marketing Research, 1958-62 (Vice-Chairman 1961, Chairman 1962); member of the Agricultural Relations Council from 1958 to the present time; member of the Agricultural Advisory Committee of The Grocery Manufacturers of America from 1946 to the present (Chairman 1959-62); trustee of the Renner Research Foundation in Texas; and other assignments.

Mr. Western was born September 1, 1907, at Creston, Iowa. He attended Creston High School, Simpson College at Indianola, Iowa, and Iowa State University at Ames, Iowa. He received a B.S. degree from Iowa State University in 1929.

II. SPECIAL REPORTS

Ceirch du Bach: A Disease-Resistant Oat

Franklin A. Coffman

In 1961 McKenzie (4) reported that he obtained progenies from a Garry x Ceirch du Bach oat cross that were resistant to crown rust races 264, 279 and 290. Despite that report no entries in any U.S.D.A.-State Agriculture Experiment Station, cooperative oat yield nurseries included a Ceirch du Bach derivative prior to 1969. That year Briggle (1) listed the Michigan oat (Mich. 4-132-20-21-23) derived from the cross Ausable^{3}3 x Hajira-Jeanette 2 x Ceirch du Bach x Garry in the Uniform Midseason Oat Nursery, grown in northern United States. This oat was grown on 19 experiment stations in 1969. It was one of 35 entries included.

This oat was a tall, late maturing, weak-strawed entry that ranked comparatively high in average yield for the 19 stations reporting. However, the average of this entry at 3 points in North Dakota was very good. At those stations it produced an average yield of 129.5 bu./acre of grain, testing 35.0 pounds/bu.

M. D. Simons reported that at Ames, Iowa this oat was resistant to crown rust races 203, 216, and 290, but susceptible to races 264 B and 326. However, in 8 field-test nurseries grown in 1969 only 6 of the 35 entries included appeared more resistant. Few reports as to the disease resistance of this oat to other diseases were received, but it ranked high in resistance to both stem rust and BYDV and low in resistance to smut.

<u>History of Ceirch du Bach</u>

The history of Ceirch du Bach was published by Jones (3). In 1920, head selections were made from the variety at Cardiganshire and Pembrokeshire, Scotland. The seed was sown in head rows in 1921. The selections were apparently grown in nursery yield rows and later in field plots. Each year the number was reduced until at the end of the 1928 season only 2 remained. These were designated S 79 and S 80. Jones indicated the former was about one week earlier to head than the latter. In the U.S.D.A. World Oat Collection, S 79 is C. I. 2922 and S 80 is C. I. 2923. McKenzie (4) does not indicate which of the two he used as a parent in his crosses. As both came from the same source we might assume they are similar as to disease resistance. This could be incorrect.

On the basis of the above C. I. numbers and my memory of the assignment of C. I. numbers, these two oats have been included in the collection for some 40 years. However, no mention of these oats has been found in the late Dr. Stanton's classification (5), prepared during the 1940-1955 period.

On receiving a copy of McKenzie's paper, I obtained seed of C. I. 2923, overlooking the fact that C. I. 2922 also existed, and planted it in the oat classification nursery at Aberdeen Substation, Aberdeen, Idaho. That nursery was seeded rather late in the season, so late in fact that such winter oat varieties as Winter Turf, Dubois, etc., failed to head before it was necessary for me to leave for Beltsville. Consequently, it was necessary to grow the oats at Beltsville in order to obtain a full set of notes. Such were obtained by growing the oats in pots, left outside the greenhouse well after the advent of winter weather at Beltsville.

Description of Ceirch du Bach (C.I. 2923)

Description: Juvenile growth very decumbent; culm midstout, pubescence slight to absent on leaf and sheath; leaf midwide, medium dark green.

Adult plant: late; midtall to tall (130-140 cm); culms 3-4, midslender, pubescense absent above and few below node; leaf midwide, ligule present, medium dark green; pubescence slight to absent on leaf and sheath; panicle equilateral, long (25-27 cm) and wide (16-20 cm); rachis slender, recurved at tip; nodes 7-8, false node absent; branches (17-25) midlong to long (8-10 cm), slender; straight to drooping; spikelets 53-74; glumes yellowish-white, midlong (21-22 mm), medium coarse in texture; florets 2; lemma black, short to midlong (15-16 mm); nerves 7, obscure; palea narrow, black; spikelet separation by fracture, basal scar absent to obscure, basal pubescence few to numerous; short to midlong; floret separation by fracture, distal to slightly heterofracture; awns numerous on primary florets, subgeniculate to straight; kernel midslender; rachilla segment midlong (2.50-2.75 mm), midwide and nonpubescent; no hairs on back of lemma.

Discussion

The juvenile growth type and heading date of Ceirch du Bach may well indicate the oat possibly has genes for winter-hardiness not present in our winter oats. In many other morphologic characters the oat is objectionable; especially as a spring oat parent for use in crossing. It has black, rather short, slender kernels, many twisted awns, and somewhat of a "sucker-mouth." It is a tall, weak-strawed, very late oat when spring sown.

From the disease resistance standpoint, it is of considerable interest. From Canadian and Iowa reports it has resistance to crown rust races 203, 216, 264, 279, and 290, but not to races 264 B nor 326. Judged by station reports, its hybrids have considerable resistance also to the BYDV. Its resistance to smut is likely low.

The few reports mentioned apparently indicate it may transmit yielding ability. I have observed (2) that unfortunately most of the morphologic characters present in Ceirch du Bach depend genetically on 2 or more factors. This suggests use of backcrossing.

One thing should be checked: which oat, C. I. 2922 or C. I. 2923, was used by McKenzie and what about the other one?

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NATURAL CROSSING IN SPRING OATS (Avena sativa L.) PLANTED IN THE FALL IN ARIZONA

A. D. Day, R. K. Thompson, E. B. Jackson, and F. M. Carasso[1]

Oats are naturally self-pollinated. Two types of oats, based on time of planting, are grown in the United States. Spring oats are planted in the spring and harvested in the late summer of the same year. Winter oats are planted in the fall and harvested in the summer of the following year. When commercial cultivars of spring and winter oats were grown under the foregoing conditions, cross-pollination between adjacent rows ranged from 0.19 to 6.62% (1, 2, 3).

In the southwestern United States, spring oats are planted in the fall and harvested in the summer of the following year. Natural crossing in spring oats planted in December in Arizona was studied from 1962 through 1967. Equal quantities of seed from oats with light colored glumes and seed from oats with black glumes were mixed. The light colored seed was from the cultivar 'Curt,' an oat well adapted to Arizona. The black seed was a mixture of equal quantities of seed from 30 black oats in the World Oat Collection with flowering dates corresponding to that of Curt in Arizona. The light and black seed mixture was planted at the rate of 84 kg/ha in rows 31 cm apart in 8.4 m^2 plots at Yuma, Mesa, Tucson, and Safford, Arizona in December, 1961, 1962, and 1963. Light colored seed from the Curt plants were harvested at each location in June, 1962, 1963, and 1964. Average temperature and precipitation at each location during oat pollination (March and April) are given in Table 1. In 1967, light colored seed harvested at each location, each year, was space-planted 31 cm apart in rows spaced 102 cm apart. At maturity, plants with black seed were counted and the percent natural crossing at each location, each year, was calculated. Since black glume color was dominant to the lighter color, black seed produced on plants grown from light colored seed must have resulted from natural crossing.

Natural crossing percentages observed in spring oats planted in December and harvested in June at Yuma, Mesa, Tucson, and Safford, Arizona in 1961-62, 1962-63, and 1963-64 are reported in Table 2. No natural crossing occurred at Tucson during the three years studied. Average natural crossing at Yuma, Mesa, and Safford was 1.37, 0.16, and 0.43%, respectively. These data indicate that less than 2% natural crossing would be expected in Curt oats planted in December and harvested the following summer in Arizona. The amount of natural crossing varies between geographical locations within the state.

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Table 1. Average minimum, maximum, and mean temperature and precipitation during oat pollination (March and April) at Yuma, Mesa, Tucson, and Safford, Arizona for the three-year period 1962 through 1964.

Location	Temperature			Total
	Minimum	Maximum	Mean	precipitation
	(C)	(C)	(C)	(cm)
Yuma	8	28	18	1.5
Mesa	7	25	15	0.7
Tucson	4	25	15	1.4
Safford	4	23	14	0.8

Table 2. Natural crossing in spring oats planted in the fall at Yuma, Mesa, Tucson, and Safford, Arizona in 1961-62, 1962-63, and 1963-64.

Location	Percent natural crossing			
	1961-62	1962-63	1963-64	3-year average
Yuma	1.85	1.15	1.10	1.37
Mesa	0.00	0.49	0.00	0.16
Tucson	0.00	0.00	0.00	0.00
Safford	0.18	0.79	0.32	0.43

Progress in Studies Toward International Standardization In Crop Research Data Recording

C. F. Konzak

Although severe funds limitations restricted the progress possible in certain aspects of the studies, some particularly significant advances were made. Through the kind cooperation of numerous experts from many parts of the world, a set of standardized disease data recording scales were prepared for use in a manual describing a uniform data recording and data processing system for cereals. The set includes a generalized disease data scale based largely upon concepts described earlier by W. Q. Loegering* and used currently for recording data in the International Rust Nursery program of the USDA. However, the general scale and the scales developed for recording infection types of the stem, leaf and stripe rusts deviate slightly from the methods of the International Rust Nursery in a clearly defined manner especially in the approach used for recording variability in disease symptoms and signs. The final design of the scales was suggested by Dr. R. F. Line, Research Plant Pathologist, Cereal Disease Laboratory, Washington State University. Infection types may be recorded according to either a 0-9 numerical or a standard alphabetic scale. All severity data are recorded as percentages. Mr. Wayne Tate, Washington State University Statistical Services, has applied what we consider as an ingenious scheme to allow severity data ranging from 00 and .01 percent to 99 percent to be entered in just two columns of a data field, both in field books and in computer cards. This allows flexibility and space-saving. The method involves substitution of a decimal (.) in the first of two columns when recording trace severity data in the range .1 to .9, and substituting a minus (-) in the first column for trace severity data in the range .01 to .09. The scheme is most valuable for epidemiological experiments in phytopathology.

Wide acceptance of the disease scoring scales already has been indicated, though this is only a first step. More accurate illustrations of symptom and sign classes are yet needed to serve as recording guides both for the rusts and for other diseases.

The manual was a joint effort by staff of Montana and Washington State Universities who developed the basic data management system which is currently used for data from the USDA Western Regional Cereal Grains Nurseries. Dr. F. H. McNeal, USDA, ARS, Cereal Crops Section, Plant and Soil Science Department, Montana State University, Bozeman, Montana, coordinator of the Western Wheat Nurseries is senior author of the manual which is currently in press.

In studies on the management of information on genetic resources, methods were developed for computer processing data on the reaction of wheat to races of bunt, caused by *T. caries* and *foetida* and *T. controversa*. The computer processing system for bunt data (coordinated by Dr. J. A. Hoffman, Research Plant Pathologist, Cereal Disease Laboratory, Washington State University) was

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*Loegering, W. Q., 1968. Problems of storing plant disease data for retrieval by automatic data processing machines. Washington Agricultural Experiment Station Bulletin 705. 6 pp.

designed to serve as an example for the linkage of the data generating and processing components with the information storage and retrieval portions of a model system for managing information on genetic resources. A paper describing aspects of the concept of the model system and the experiments was presented at an NSF-Japanese-U.S. joint symposium at the American Society of Agronomy meetings, Tucson, Arizona, August 1970. The paper is soon to be published in Seiken Ziho.

The TAXIR information retrieval system used in the above-mentioned studies was developed by Dr. David Rogers' taximetrics group at the University of Colorado in Boulder. The TAXIR units used for our research were converted at Washington State University for use on the IBM 360-67 and during the past year the system was improved to permit access to peripheral data banks. The recent changes extend the ability of the system to access very large data banks. A report describing use of TAXIR to manage data and to facilitate services provided by a germ plasm resource center has been prepared for publication in Economic Botany by L. W. Hudson et al. The report describes experiences and shows examples on the application of TAXIR to manage data, to process information and to select materials requested from among the nearly 6,500 accessions in the USDA Phaseolus Collection maintained by the Western Regional Plant Introduction Station. Descriptive information on more than 3,500 stocks of the collection is currently available in the data bank. Records on the remaining accessions will be added as sufficient data become available.

Descriptive information about the accessions in the USDA World Pisum Collection are currently being prepared for application to TAXIR by Dr. F. J. Muehlbauer, Geneticist, Agricultural Research Service, USDA (Bean and Pea Investigations), Vegetable and Ornamentals Branch, Pullman, Washington. Once the Pisum information retrieval system is operational, a copy of the records will be sent to Dr. D. D. Dolan, Coordinator of the Collection, Northeastern Regional Plant Introduction, NE-9, Geneva, New York. Dr. W. H. Skrdla, North-central Regional Plant Introduction Station, NC-7, Ames, Iowa, has recently initiated work to place on TAXIR the accumulated information about the USDA and Tomato Genetics Cooperative Collections of Lycopersicon.

Work on the application of TAXIR to records on the larger USDA World Wheat Collection has been slowed considerably due to the lack of funds, but considerable information has been accumulated, much of which has been made machine readable. It is hoped that somehow it will be possible to have the system operational on wheat during the coming year.

A program tape and accompanying descriptive literature, which will enable others to adapt the Washington State University version of the TAXIR system to their own needs, is available from the WSU Computing Center Library. Persons desiring to get this material should supply a blank tape to the WSU Computing Center Library for this purpose.

An assessment of the available genetic resources of the major food plants and of the gaps and limitations of the major world collections, the general availability of the various world collections of germ plasm stocks and of information management systems required to meet current and potential future needs is in progress as a joint International Biological Program effort involving FAO, the USDA and the Rockefeller Foundation through CIMMYT.

Characteristics Related to Lodging Resistance

T. Kumagai and S. Tabata

The genetic associations among characters related to lodging resistance were investigated to see if specific characteristics can be related to lodging resistance. The data used in this study were obtained from 35 and 48 test entries, composed of varieties and lines under later generation. The ratios of the lodging area to the whole experimental plot were measured in every lodging angle and was shown in per cent. The indexes of 0-1 were given in an increasing order of the lodging angle. The indexes of angles were multiplied by the ratios of lodging area and then the products were added. The values obtained were determined as the lodging index. The results obtained in the study are summarized as follows:

Heritabilities of the characters related to lodging resistance and genetic associations among the characters were estimated on the basis of the components of variance and co-variance. The heritabilities of the length of internode, the lodging index, and the culm length were higher, while the heritabilities of panicle weight, the number of culms, and the breaking strength were lower.

The close correlations of lodging indexes with some characters were found. The following four characters had a close relation with lodging in both populations; the number of internodes, the length (L_3, L_4) of internodes, and the breaking strength. L_3 and L_4 mean the third and the fourth internode by counting downward from the base of the panicle. The results showed that the oats with fewer number of internodes, shorter L_3 and L_4, and more breaking strength of L_1 tended to have higher lodging resistance. The correlations of lodging index with the ratios of length of internodes to culm length were negative in L_1, while positive in L_3 and L_4. The ratios of length of internodes to culm height may be worthy of note as a selection criterion for the characters concerned with lodging resistance.

Grouping of Oat Varieties

K. L. Mehra, P. R. Sreenath, Bhag Mal, M. L. Magoon and D. S. Katiyar

The diversity of parents is an important prerequisite in any hybridization program aiming at the improvement of a particular trait. Genetically diverse parents are likely to give desirable recombinants in the progenies of their crosses. Therefore, the quantitative assessment of the genetic divergence would help the plant breeder to choose suitable parents for hybridization either to exploit heterosis or to select desirable segregates.

Data obtained for nine characters viz., days to 50% bloom, plant height, tiller number, stem girth, leaf number, leaf length, leaf width, leaf-stem ratio, and fodder yield on 25 varieties of oats grown in a replicated trial at Jhansi, were subjected to the D^2 - analysis. The relative contribution of each character was ranked from 1 (maximum) to 9 (minimum) according to its magnitude based on the D^2 values (D^2 - being the square of Mahanalobis generalized distance). The days to 50% bloom and leaf number contributed towards the divergence in 94 (31.33% cases) and 84 comparisons (28.00% cases), respectively, and they together accounted for about 59% of the total divergence in the material studied.

The twenty-five varieties were grouped into five clusters based on the D^2 values (Table 1). This study revealed that the indigenous and exotic varieties did not form purely separate groups. Cluster II was the largest, having 11 varieties, and cluster V was the smallest with only one variety. Clusters I, II, and IV possessed 5, 2, and 6 varieties, respectively. The inter-cluster divergence was maximum (D = 15.046) between clusters I and II, and minimum (D = 5.879) between clusters II and III (Table 1). The relative importance of the nine characters in the intra-cluster divergence was variable. The important contributors towards the divergence were the days to 50% bloom (D^2 = 3.595) and fodder yield (2.422) in cluster I; leaf length (4.966) and stem girth (3.157) in cluster II; days to bloom (5.172) and leaf number (3.154) in cluster III; and leaf number (10.139) and leaf width (5.330) in cluster IV. Thus, different characters contributed in different degrees towards genetic divergence within the four clusters. It is recommended that varieties representing the different clusters should be utilized as parents in the hybridization program aimed at the improvement of fodder oats.

The group constellations were also independently derived, using the canonical analysis, to verify the grouping obtained by using the D^2-statistic. Since the first two canonical roots accounted for 57.3% and 34.5%, respectively, of the total variation, a two-dimensional representation of the relative positions of the varieties was considered adequate. The varietal grouping based on the canonical analysis confirmed the results obtained through the application of the D^2 - statistic.

The first two canonical vectors, Z_1 and Z_2, supplying the best two linear functions indicated that the days to 50% bloom, leaf number, leaf width, and stem girth made important contributions towards the genetic divergence between the oat varieties studied.

Table 1. Intra and inter-cluster average D^2 and (D) in 25 varieties of oats.

Cluster No.	I	II	III	IV	V
I	10.255 (3.202)	226.390 (15.046)	133.217 (11.542)	196.082 (14.003)	49.665 (7.047)
II		18.789 (4.335)	34.564 (5.879)	186.669 (13.626)	106.434 (10.310)
III			112.335 (3.512)	117.707 (10.849)	51.438 (7.172)
IV				31.959 (5.653)	128.369 (11.330)
V					0.000 (0.000)

Amino Acid Composition of Oat Groats

G. S. Robbins (USDA), Y. Pomeranz (USDA), and L. W. Briggle (USDA)

Preliminary analyses indicate that oats have the highest protein content and the highest protein quality (nutritional) of the cereal grains. A total of 289 oat varieties and lines were analyzed for protein content and for 17 amino acids. All varieties grown commercially in the U.S. and Canada during the period 1900-1970 were included in the group tested. Seed analyzed was produced at Aberdeen, Idaho, in 1965, from a spring planting.

Protein content (on a moisture free basis) averaged 17.1% and ranged from 12.4% to 24.4% (Table 1). The two high-protein varieties, Yancey and Florad, are winter oat varieties and did not yield much grain from the spring planting -- thus the abnormally high protein readings. When evaluating protein content, one has to keep in mind the yield level involved.

Lysine content averaged 4.2% of total protein (Table 1). The high value was 5.2% for Mo. 0-200 and the low value was 3.2% for Fulwin. Threonine content averaged 3.3% of total protein and ranged from 3.5% to 3.0%, Methionine averaged 2.5% of total protein and ranged from 3.3% to 1.0% (Table 1). Those varieties highest in lysine content are listed in Table 2, those highest in threonine are listed in Table 3, and those highest in methionine are listed in Table 4.

A negative correlation between lysine and protein content was previously reported. The two were negatively correlated in this study also, but to a lesser degree. Perhaps increased protein in oats need not be accompanied by a decreased lysine concentration in the protein. Unfortunately, however, correlations between protein and the other limiting amino acids (threonine and methionine) as well as between protein and the sum of lysine, threonine, and methionine, were highly negative. Consequently, the oat breeder must pay strict attention to not only protein content and percent lysine, but also the maintenance of a satisfactory level of the second and third limiting amino acids (threonine and methionine). In fact, levels of threonine and methionine may be more critical than lysine. A rather low coefficient of variation found for threonine levels indicates that a marked increase in level of threonine through breeding would be difficult to obtain. Genetic variability within a population is a prerequisite for progress through selection for that characteristic. Hopefully, Avena germ plasm other than that represented in this series may provide more opportunity for increase in threonine.

All data from the analyses conducted on the 289 oat samples are based on one seed sample grown one year at one location. Results must be considered preliminary and evaluated accordingly. Variability for any one characteristic, for example lysine content, represents that attributed to environment as well as genetics, and there is no way (in this test) to separate the components. Carefully designed experiments must be conducted before the potential for improvement of any one characteristic through breeding can be established. Research with this goal in mind is planned.

Table 1. Maximum value (Max.), minimum value (Min.), mean, standard deviation (s), and coefficient of variability (CV) for crude protein and amino acid composition of 289 oat samples.

Protein and Amino Acid	Max.	Min.	Mean	s	CV	Mean + 3s	Mean - 3s
Percent protein (PcP)	24.4	12.4	17.1	2.010	11.7	23.2	11.1
Lysine (Lys)	5.2	3.2	4.2	.324	7.6	5.2	3.3
Histidine (His)	3.1	1.2	2.2	.316	14.1	3.2	1.3
Ammonia (NH_3)	3.0	2.5	2.7	.079	2.9	3.0	2.5
Arginine (Arg)	7.8	6.2	6.9	.231	3.3	7.6	6.3
Aspartic Acid (Asp)	9.9	8.3	8.9	.278	3.1	9.8	8.2
Threonine (Thr)	3.5	3.0	3.3	.098	2.9	3.6	3.1
Serine (Ser)	4.8	3.8	4.2	.187	4.4	4.9	3.7
Glutamic Acid (Glu)	26.9	21.9	23.9	.938	3.9	26.8	21.1
Proline (Pro)	5.8	3.8	4.7	.416	8.7	6.0	3.5
Half Cystine (Cys)	2.6	0.6	1.6	.442	26.8	3.0	0.3
Glycine (Gly)	5.5	4.4	4.9	.210	4.3	5.6	4.3
Alanine (Ala)	5.5	4.2	5.0	.187	3.7	5.6	4.4
Valine (Val)	5.7	4.9	5.3	.106	2.0	5.7	5.1
Methionine (Met)	3.3	1.0	2.5	.347	13.9	3.5	1.5
Isoleucine (Ile)	4.1	3.4	3.9	.088	2.2	4.2	3.7
Leucine (Leu)	7.8	4.8	7.4	.205	2.8	8.0	6.8
Tyrosine (Tyr)	4.4	2.3	3.1	.232	7.4	3.8	2.4
Phenylalanine (Phe)	5.7	4.9	5.3	.138	2.6	5.8	5.0
Sum of Lys + Thr + Met (SLTM)	11.1	8.2	10.0	.487	4.9	11.5	8.6

Table 2. High lysine oat varieties.

C.I. No.	Variety Name	Protein (%)	Lysine Content (% of protein)
4626	Mo. 0-200	17.1	5.2
1242	Cornellian	18.6	5.0
3417	Ranger	17.1	4.9
3611	Vicland	15.8	4.9
6980	Ballard	15.8	4.9
7769	Blount	16.1	4.9
1883	Garton No. 473	20.1	4.8
2194	Gold Rain	17.8	4.8
3910	Benton	16.9	4.8
3916	Cody	15.8	4.8
7107	Portage	16.3	4.8
7706	Sierra	14.2	4.8
7811	Orbit	15.4	4.8

Table 3. High threonine (Thr) oat varieties.

C.I. No.	Variety Name	Protein (%)	Thr Content (% of protein)
273	Culberson Winter	17.3	3.5
459	Kherson	16.6	3.5
560	Victory	13.2	3.5
729	Albion	16.4	3.5
787	Richland	16.4	3.5
1154	State Pride	15.6	3.5
1606	Golden Giant	13.4	3.5
1876	Monarch	17.6	3.5
1882	North Finnish	16.9	3.5
1888	Awnless Probsteier	17.2	3.5
1898	Early Gothland	17.8	3.5
1904	Lincoln (Etheridge)	17.1	3.5
2024	Iogren	13.3	3.5
2026	White Cross	15.9	3.5
2343	Rusota	13.1	3.5
3057	Garton	13.4	3.5
3058	Eagle	13.2	3.5
3656	Huron	12.6	3.5
5332	Craig	15.0	3.5
5336	Climax	13.9	3.5
7801	Pendek	15.3	3.5

Table 4. High methionine (Met) oat varieties.

C.I. No.	Variety Name	Protein (%)	Met Content (% of protein)
2143	Anthony	13.4	3.3
2144	Minrus	13.6	3.3
2027	Gopher	15.6	3.2
2147	Patterson	15.2	3.2
2053	Markton	12.9	3.1
2054	Brunker	13.6	3.1
2142	Upright	16.6	3.1
2146	Keystone	18.0	3.1
2242	Forward	15.6	3.1
2245	Miami	17.6	3.1
2343	Rusota	13.1	3.1
2345	Rainbow	14.6	3.1
2378	Carleton	14.1	3.1
2042	Lee	15.3	3.0
3259	Ukraine	15.6	3.0

Severe Outbreak of Oat Stem Rust in 1970

Alan P. Roelfs, Paul G. Rothman, Donald M. Stewart

Stem rust was first reported in southern Texas on March 17 and by late May, was present in light amounts on the nearly mature winter oats in northern Texas and in trace amounts in southern Oklahoma. By late June, scattered amounts of oat stem rust had been reported in Kansas and Iowa; and by July 14, the prevalence and severity had increased rapidly spreading throughout Iowa, southern Minnesota, and the eastern Dakota's. The majority of the oat crop at this time was in the dough stage and thereby escaped damage, but damage did occur in late fields in this area and northward into Canada, where scattered fields suffered heavy losses. This was the worst outbreak of oat stem rust in years. If the initial outbreak in the major production areas had occurred a week earlier, the losses would have greatly increased.

Scattered oat crown rust infections were found in Texas and southern Oklahoma by late May. A single pustule also had been reported in a field in central Illinois. During June, light amounts of crown rust were observed in Kansas and Nebraska, and several direct spreads from Buckthorn were reported in Wisconsin. By the middle of July, crown rust had spread throughout the oat growing areas of Minnesota and the eastern Dakota's where it caused light to moderate losses. However, losses were heavy in late fields in the south and in some northern parts of the area. Estimated losses in the major production areas of Minnesota and the Dakota's varied from 1 to 20%.

Biweekly reports on the progress of the cereal rust epidemics were made by the Cooperative Rust Laboratory in the Cereal Rust Bulletin.

We identified 1391 single pustule isolates of *Puccinia graminis* f. sp. *avenae* from 537 collections received at the Cooperative Rust Laboratory during 1970. Race 6AF made up approximately 90% of these isolates. Some of the other races found were 7F (3%), 6AFH (2%), 6F (2%), 7AF (1%), and 7AFH (1%). Unfortunately, the response observed in the differential hosts used in these greenhouse tests for identifying physiological races of oat stem rust can differ in their field response, due to the temperature-sensitive nature of the genes involved. Many isolates of the race 7 group were from collections made from wild oats (*Avena fatua*). A single collection from an Idaho oat nursery yielded the only race 8 found in the survey.

In addition to the above, 453 single pustule isolates from 185 collections were identified from the International Rust Nursery growing in the immediate vicinity of several rusted *Berberis* bushes at Pennsylvania State University. From these collections, 6AH (42%) and 6AFH (31%) were the predominate races. Races 6AF (7%), 6A (4%), 8AH (2%), 1H, 2A, 2H, 4AH, 7F, 8A, 8AFH, 13A, and 13AH (all less than 2%) comprised the greatest proportion of the remaining isolates.

A Unique Approach to Crown Rust Resistance

D. D. Stuthman and M. B. Moore

The development of this approach centered around two concepts. The first was the switch in emphasis from genes to resistances. Secondly, it appeared desirable to combine diverse sources and/or reactions when attempting to develop crown rust resistance. In addition to these points, consideration of two observations frequently made also seemed appropriate. First, most good sources of crown rust resistance are agronomically quite undesirable and secondly, upon crossing these sources to superior agronomic lines, the resistance, if broadly based (presumably polygenic) is diluted.

Briefly, our approach is: 1) isolate different sources of resistance and/or reactions using the diverse inoculum provided by our buckthorn nursery, 2) cross these lines to several superior agronomic lines, 3) isolate superior agronomic and resistance lines from the progeny and 4) intercross these lines in an attempt to combine resistances in a satisfactory agronomic background. Our ultimate goal is genotypes which can provide a more permanent resistance.

In what follows we attempt to describe the specifics of our program. A series of crosses involving selected plants from the presumed cross Black Mesdag X S.P. 101 (obtained from F. A. Coffman) were made in 1959 and 1960. These selected plants were crossed to several lines from the Minnesota breeding program: LMHJA/Clinton//Rodney, LMHJA/Andrew//Rodney, LMHJA/Clintland//Rodney, LMHJA/CI 5960 and Rodney//Santa Fe/Clinton among others.

The progeny were grown in the buckthorn nursery and selections were made using a pedigree system. Several different types of reactions as well as different levels of resistance were isolated. Presumably most of the resistance was donated by the B.M. X S.P. 101 plants; however, some resistance genes could have been contributed by Landhafer, Rodney, and Clintland and others. In addition, Mindo, Andrew and Clinton all possess the Bond gene.

The second phase was initiated in 1965 by choosing selections for a crossing program. Two lines which give an HR reading, 65B 252-6 and 65B 1362, one line with an MR-MS reaction, 65B 2363, one line, 65B 1286, characterized as a slow ruster (few small pustules which were slow to develop) and gave an MR reading and a line 65B 1313, which formed teliospores very quickly (early telia) were selected. In addition two other lines of different origin were also included: a selection from Florad/58-7 (originally obtained from the Coker Pedigreed Seed Company) with an HR reaction, 65B 663, and a line from F. A. Coffman with the pedigree CI 7575/Ab. 5042//CI 7578/R.L. 524.1 and variable reaction, 65B 2417. It should be noted that Ab. 5042 is also from B.M. X S.P. 101.

Because of the relatively poor agronomic type of these seven lines, each was crossed to Tippecanoe and Lodi. The progeny were evaluated in the buckthorn nursery and selections for further crossing were made. In the third phase, two lines were isolated from most crosses, 1) the best agronomic line with at least a predetermined minimum crown rust resistance (P_A) and 2) the most resistant line with certain minimum agronomic characteristics (P_R). In a few cases a P_{AR} line was chosen because it was resistant and superior agronomically.

The fourth phase of the program was initiated in the fall of 1969 and in early 1970 by making a number of crosses among the P_A, P_R and P_{AR} lines. Emphasis was placed on combinations involving original resistant lines which produced superior resistance when intercrossed. In addition most combinations were within Tippecanoe- and within Lodi-derived lines. Progeny of these combination (F_4, F_3 and F_2) will be evaluated in the buckthorn nursery in the summer of 1971. Greenhouse facilities were used to advance generations in all phases when appropriate.

The Oat Quality Laboratory

V. L. Youngs (USDA)

The Oat Quality Laboratory, located in the Agronomy Building, University of Wisconsin, Madison, is now in limited operation. The laboratory contains about 800 square feet of space, and has typical, good quality chemistry laboratory fixtures. Equipment that has been installed so far includes micro and macro Kjeldahl units, Udy protein analyzer, ultracentrifuge, refrigerated centrifuge, Goldfisch fat extractor, freeze dryer, seed counter, spectrophotometer, pH meter, ovens, a dishwasher, and the usual chemical and glassware supplies. An amino acid analyzer is in operation, but is located in the Barley and Malt Laboratory.

The Oat Quality Laboratory will eventually take over the management of commercial protein analysis of oat breeders' samples that is currently being handled at Beltsville. Also, a limited number of Kjeldahl and Udy protein analyses will be performed in the laboratory.

Amino acid analyses are conducted almost continuously at the Barley and Malt Laboratory. A majority of the oat samples analyzed thus far are from the Oat World Collection. A limited number of breeders' samples will be accepted for analysis in the near future.

A program of basic research on oat quality is now underway. Currently, two projects cooperative with the University of Wisconsin are in progress, and the first phase of a third project conducted entirely in the Oat Quality Laboratory is nearing completion. These projects are all related to oat protein quality.

You are invited to visit the laboratory any time.

III. CONTRIBUTIONS FROM OTHER COUNTRIES

Oat Varieties in Victoria, Australia

H. J. Sims

The area sown to oats in Victoria for the 1970 cropping season was approximately 1.5 million acres, compared with an average of 1.372 million acres for the previous five years. This increase is to some extent due to lower wheat acreages consequent on lower production quotas for the 1970-71 season.

During the five-year period to 1969-70, about 68% of the oat acreage was harvested for grain, 19% cut for hay and the remainder (13%) grazed throughout the season by stock. In addition, quite a number of the crops harvested for grain or for hay were grazed during the winter, but data concerning the area so grazed are not collected.

The latest varietal statistics currently available are for the 1969-70 season, when 58.5% of the total oat area was sown to Avon. The other varieties in the leading five were: Irwin 9.2%, Orient 8.4%, Algerian 7.1% and Kent 4.0%. Avon has excellent yielding ability and general adaptation under Victorian conditions.

Little work on oat breeding has been undertaken in recent years, but there has been a change in this situation following the appointment of Mr. J.B. Brouwer to work on feed grains at the State Research Farm, Werribee. The main objectives of the oat breeding program are for the improvement of yield, standing ability, grain quality as indicated by grain size and groat percentage, and disease resistance, especially to rust and barley yellow dwarf virus. These objectives are common in many breeding programs. A vigorous hybridization program has already been initiated.

Oat Production and Diseases in Western Canada in 1970

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

A total of 280 million bushels of oats were harvested from 5,260,000 acres in the Prairie Provinces in 1970. The acreage was down by 340,000 acres but the total production was up by 4 million bushels from the previous year. Yield averages were very good in Alberta (57.1 bu/acre) and Saskatchewan (56.4 bu/acre) but lighter in Manitoba (42.1 bu/acre). A late spring delayed seeding over a large area of Manitoba until June and was partly responsible for the heaviest disease losses in many years.

Harmon continued to be the leading variety grown on the Prairies with 32.7% of the acreage, up 3.7% over the previous year.[1/] Rodney was second with 24.6% of the acreage, down 3.4% from 1969, followed by Garry (13.9%) and Kelsey (5.8%). Other varieties grown included Russell, Sioux, Glen, Pendek, Grizzly, Victory and Eagle.

1/ Seedtime and Harvest No. 96, Federal Grain Ltd., Winnipeg 1, Manitoba.

Crown rust caused losses of 4.6 million bushels in Manitoba, primarily in late-sown fields in the eastern, central, and south-central parts of the province. Races 264, 295, 325 and 326 comprised nearly 85% of the crown rust isolates identified in Western Canada. An increase in the number of isolates virulent on Landhafer, Santa Fe, Trispernia and Bondvic was noted again in 1970. The crown rust population of Western Canada attacks all the differential oat varieties, except the diploid Saia, to such an extent that their value has been completely undermined. A new set of differentials composed of single gene lines with resistance from Avena sterilis is expected to be in use in Canada in 1971.

Late seeding and abundant inoculum in Manitoba combined to produce the heaviest stem rust epidemic since the early fifties causing losses of 4.7 million bushels. Physiologic race C10 (Pg 9/1, 2, 3, 4, 8) continued to predominate (67% of all isolates) in Western Canada; race C20 (/Pg 1, 2, 3, 4, 8, 9), previously found only in trace amounts in 1966, and C23 (Pg 2, 4, 9/ 1, 3, 8) first found in 1969, comprised 17 and 11%, respectively, of all isolates from this region. Races C3 (Pg 2, 8/1, 3, 4, 9) and C5 (Pg 4, 9/1, 2, 3, 8), once dominant, have almost disappeared. Virulence on the new pg 13 resistance was found in field isolates for the first time in 1970. Virus and leaf spot diseases caused an estimated 0.6 million bushel loss for a total loss due to diseases of almost 10 million bushels in Manitoba.

India: Two New Rust-Resistant and High Yielding Strains of Oats

S. T. Ahmad

Promising rust resistant lines have emerged from the cross made at Simla (240 M, a.s.l.) between Gopher (resistant to stem rust and susceptible to crown rust). The fixed lines, namely Gc-3(IG-68-3021) and Gc-6(IG-68-3026) are medium tall, erect, and medium maturing with larger and broader leaves. These are resistant to oat stem and crown rusts. In the fodder yield trials at 50 per cent flowering stage, these were found 30 to 40% superior to local variety Kent at the hills and plains.

The other resistant lines obtained as a result of crosses between Punjab local (susceptible to rusts) and Ag 331 (resistant to rusts with genotype Landhafer x (Mindo x Hajira-Joanette) x Andrew). The strain S-2 (IG-68-3008) and S-10 (IG-68-3018) are resistant to oat rusts, with erect habit and greater number of tillers. These were found 25 to 30 % superior to control variety Kent in the multilocational fodder yield trials.

Performance of Elite Oat Selections for Fodder Yield (India)

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

The large scale evaluation of oat germplasm obtained from different countries for use as fodder resulted in the selection of 19 elite lines. These lines comprised high yielding strains, donors for important fodder attributes, resistant types against various diseases and pests, and parents for use in the intervarietal hybridization program. Prior to their use as direct introductions or as parents in the hybridization program, these lines were grown in strip plot replicated design, using the variety Kent as control, to test their performance for single and multi-cut management systems.

In the single-cut management system, the varieties were cut at the 50% bloom stage. The green fodder yield ranged from 300 to 521 q/ha and these differences were significant (Table 1). Five selections yielded 14.4 to 27.5% higher green fodder than the variety Kent which produced 409 q/ha green fodder. These selections also had higher dry matter content than that of the variety Kent.

In the multi-cut management system, three cuttings were taken at 70, 105, and 145 days, respectively, after the date of the sowing of the trial. The green fodder yield of the varieties tested ranged from 65 to 250 q/ha in the first cutting, 76 to 188 q/ha in the second cutting and 67 to 120 q/ha in the third cutting (Table 1). The cumulative green fodder yield of these varieties ranged from 332 to 429 q/ha. The varietal differences in the green fodder yield were significant in the first and second cuttings. However, such differences in the third cutting and the cumulative yield of all three cuttings were not significant. Thus, there is a scope to select oat types suited to specific cutting requirements. Three selections gave fodder yield in both the single and multi-cut management systems.

Table 1. Fodder yield of 20 oat selections in single cut (50% bloom stage) and multi-cut management systems.

Selections	Days to 50% bloom	Single cut system Green fodder yield q/ha	Multi-cut system Green fodder yield q/ha I cut	II cut	III cut	Total
IG 68 - 3026	106	521	227	150	111	488
IG 68 - 3018	103	517	225	139	111	475
IG 68 - 3021	103	491	187	176	101	465
IG 68 - 3014	102	491	174	170	120	463
IG 68 - 3009	106	467	210	119	107	437
IG 68 - 3008	105	441	250	103	83	436
IG 68 - 3010	102	441	154	188	87	429
IG 68 - 3020	106	414	220	108	97	425
IG 68 - 2636	96	411	198	138	85	421
Kent	91	409	183	150	88	421
IG 68 - 3017	102	394	147	175	89	410
IG 68 - 2674	104	384	146	153	110	408
IG 68 - 2688	107	371	183	146	78	407
IG 68 - 2692	122	371	187	123	88	398
IG 68 - 3022	112	364	163	143	67	373
IG 68 - 3007	103	364	170	109	77	356
IG 68 - 3006	101	344	175	76	99	350
IG 68 - 2643	99	338	101	134	107	342
IG 68 - 3024	102	307	65	182	79	326
IG 0 - 6	97	300	80	139	77	296
F value =		2.69	3.86	2.50	1.39	2.01
C.D. at 5% level =		148.20	72.10	52.90	N.S.	N.S.

Correlations and Factor Analysis of Fodder Yield and its Components in Oats

(India)

Bhag Mal, K. L. Mehra, P. R. Sreenath, M. L. Magoon and D. S. Katiyar

Character associations:

With a view to study the associations between various quantitative characters contributing towards fodder yield, the phenotypic, genotypic, and environmental correlations were worked out in 25 varieties of oats. The environmental correlations between most of the characters were lower than their phenotypic and genotypic correlations. Significant positive genotypic and phenotypic correlations were observed between the green fodder yield, plant height, stem girth, leaf length, and leaf width. The green fodder yield showed significant negative genotypic and phenotypic correlations with days to bloom and leaf number. The genotypic correlation between the tiller number and green fodder yield was significant and negative, while their environmental correlation was significant but positive. The tiller number showed negative correlation with all the characters studied except the days to bloom with which it exhibited a low positive correlation.

The correlation studies suggest that the selection for plant height, stem girth, leaf length, and leaf width in oats is likely to improve its fodder yield.

Factor analysis:

The environmental correlation matrix of nine characters was subjected to the centroid method of factor analysis, to understand the character associations in terms of a few causative influences (factors) in a multiple cause-and-effect system. This approach helps in revealing and evaluating the unidentified sources of common variation of a set of characters which would not have been otherwise suspected. Two factors together accounted for most of the inter-correlations of the characters studied. The common factor 1 affected positively the tiller number (0.615), leaf length (0.630), leaf width (0.464) and fodder yield (0.707) while, on the contrary, the factor 2 affected positively the leaf number (0.428) and leaf-stem ratio (0.592) and negatively the plant height (-0.462) and fodder yield (-0.351). The factors 1 and 2 were significantly negatively associated (r = -0.5652).

It seems that the improvement in tiller number, leaf length, and leaf width (affected by factor 1) is expected to increase the fodder yield in oats but may reduce its quality, while attempts to increase the leaf number and leaf-stem ratio (affected by factor 2) is likely to have an unfavorable effect on the yield but shall improve its quality. Therefore, a critical balance would have to be maintained in selecting the fodder yield components in the breeding program aimed at the development of high quality and high fodder yielding varieties of oats.

IV. CONTRIBUTIONS FROM THE UNITED STATES

ARKANSAS

F. C. Collins and J. P. Jones

Production. The Crop Reporting Service estimated Arkansas oat acreage in 1969-70 to be 88,000 acres. The state average yield was 64.0 bu/acre, down from the 67.0 bu/acre established the previous year. Since diseases, particularly crown rust, were not a problem this year, the reduction may have been partly due to prolonged dry weather during May.

Spacing Studies. A study was conducted to evaluate the effect of two row spacings on forage and grain yield. The spacings were the conventional 7 in. used by farmers and the 12 in. spacing commonly used in small grain testing. In a forage test at Fayetteville consisting of three rye, three wheat, and two oat varieties clipped six times, forage yield was much greater from the 7 in. spacing. There was a highly significant interaction between row spacings and varieties. In tests conducted at Fayetteville and two delta locations where grain yield was collected, there was not a significant interaction between row spacings and varieties. However, yields were significantly higher from 7 in. spacings in the Fayetteville wheat test and the oat yields at the 7 in. spacings tended to be higher at Fayetteville. The tests were composed of ten oat and nine wheat varieties. The seeding rates for both spacings were equal for each entry.

A preliminary study on the effects of population and spacing was conducted at Fayetteville last year. Nora and an experimental line, 3F-4, were planted in a spoked-wheel design replicated three times. There were 23 hill plots on each spoke. Distance between plots increased by one inch increments beginning at the 2.5 in. hill and terminating at the 24.5 in. hill. Plot width varied from two in. at the 2.5 hill to 24 in. at the 24.5 hill. Plants per hill were thinned to two per hill for the low population and four per hill at the high population. Four adjacent spokes were used per variety per population and the two center hills from each spacing were used for measurements.

Grain yield ranged from 140 to 37 bu/acre as spacing increased from the 2.5 to the 24.5 hill. Population and variety had no effect on yield. The 18.5 in. hill was equal to the state average yield of 64 bu/acre. For number of stems per square inch, there were significant differences between varieties and among spacings; the low population tended to have a greater number of stems per square inch than did the higher population which also occurred in a similar wheat test. Stem number ranged from 0.45 to 0.05 stems per square inch. In the case of 1000 seed weight, differences were found between populations and varieties and among spacings. Heavier seed were obtained from Nora and the lower populations. Seed weight from the various spacings varied from 33 to 37 per 1000 seed. Average number of seed per culm increased from 16 to 40 for Nora and 17 to 35 for 3F-4 as spacings increased.

FLORIDA

R. D. Barnett and W. H. Chapman

Approximately 12,000 acres of oats were harvested in 1970 with an average yield of 47 bushels per acre in comparison to 14,000 acres in 1960 with an average yield of 32 bushels per acre. Most of the acreage is used for winter pasture; however, the amount involved in the 150,000 acres of small grain for winter pasture is not known.

Florida 500 and Florida 501 continue to produce excellent grain and forage yields in commercial production but have been moderately affected by crown rust in the Quincy nurseries. Several lines from numerous crosses of diverse germ plasm were highly resistant to crown rust at Quincy. These involved A. sterilis, Red Rustproof X Indio or Florad, and (Southland X Minn. 19-11) Silva. In the 1969-70 oat yield nurseries 5 of the 60 lines tested yielded above 100 bushels per acre. Several advanced lines having the slow-rusting character of the Red Rustproof types performed better than Florida 501, the most widely grown variety in the State.

The acreage of oats planted does not warrant as intensive breeding program as in the past but the importance as a source of winter forage justifies considerable continuing work. Present recommended varieties are performing quite satisfactorily; however, if it were necessary, high yielding disease resistant lines with diverse sources of crown rust resistance could be made available to the farmer rather quickly.

R. D. Barnett completed the Ph.D. degree under Dr. Fred Patterson, Purdue University, and joined the small grain breeding program at the Agricultural Research and Education Center, Quincy, Florida, in April of 1970.

IDAHO

Darrell M. Wesenberg (USDA) and Ralph M. Hayes (USDA)

Idaho's oat production was estimated at 5.8 million bushels for 1970. The 1970 harvested acreage was estimated at 105,000 acres by the Idaho Crop and Livestock Reporting Service --- an increase of five percent over the previous year.

The three highest yielding entries in the 1970 Uniform Northwestern States Oat Nursery at 20 locations were Cayuse, 62Ab5280-7 (CI 5345 x Zanster), and 63Ab5100-1 (Clinton x^2 Overland 2x Sauk x Simcoe). 62Ab5280-7 averaged about six bushels per acre more than Cayuse at Aberdeen.

Twenty-seven Cayuse x Orbit F_5 selections were first included in yield trials in 1970. Fourteen of the selections averaged higher in yield than Cayuse, but none of the 14 exceeded Cayuse in test weight. The highest yielding selection, 69Ab443, averaged 205.8 bushels per acre or nine percent more than Cayuse.

A study has been conducted during the past three seasons to evaluate the effect of rate and time of nitrogen application on yield and protein content. The 1970 study involved four varieties or selections and eight treatments. The treatment in which 90 pounds of N was applied at about heading averaged 187.9 bushels per acre for the four entries compared to 156.5 for the checks. Protein content ranged from 14.2 percent for the checks to 17.1 percent for the treatment in which 90 pounds of N was applied at the seedling stage plus 45 pounds of N at about heading. The latter treatment averaged 173.3 bushels per acre. Test weight, groat percentage, and kernel weight were similar for all treatments.

INDIANA

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

Diana Distributed. The Diana spring oat was distributed to seedsmen in Indiana in March, 1971. It is described in the new variety section of this newsletter.

Slow Rusting. Research continues on the slow rusting phenomena in oats. Seventeen lines were submitted to the 1970 Uniform Oat Rust Nursery (entries 48-59 and 61-65) which have been observed to be slow rusting and/or resistant to crown rust in Indiana. We solicit your observations on the relative performance of these lines for slow rusting in your nurseries.

High Protein. Research continued on the diallel analysis of high protein content of *A. sterilis* lines CI8326, CI8327, CI8329, CI8336, CI8338, and CI8339. In 1970 the *A. sterilis* lines ranged 24.2 to 26.4% protein and from 4.7 to 6.4 grams protein per hill as compared to 18.4% protein and 7.4 grams/hill for Diana.

A preliminary protein yield trial consisting of 140 lines and parents with single 8-ft. rows replicated twice was conducted from materials selected from crosses distributed by H. C. Murphy. This material is in advanced generations and has good type. Parents included are Diana, Portal, Jaycee, Clintford, Garland, Fla. 500, several Purdue lines and CI8320.

The data below represents a breakdown of the number of lines in certain classes of percent protein and the number of lines in various classes of protein yield.

Number of lines	Protein (%)	Number of lines	Protein yield (gm per plot)
56	below 18.5	65	below 48.5
66	18.6-20.0	54	48.6-54.9
13	20.1-21.0	17	55.0-59.9
5	21.1-22.0	4	60.0-63.3
Diana	19.0	Diana	51.4
Clintford	16.7	Clintford	48.2
Grand mean	18.5	Grand mean	48.5

A large population of F_4 and pairs of F_5 lines from a cross of Clintford X CI8320 were grown in hill plots and replicated three times.

The range in percent protein is from 17 to 25. Several lines have 23 to 25% protein. These are being backcrossed for type.

Weed Control. A summary of 6 years of research on the herbicidal control of grasses and broad-leaf weeds for oat nurseries was published (See Schreiber, Patterson, and Schafer in publication list). The pre-emergence treatment with "Ramrod" at 2 lb/A and "Dicamba" at 1/4 lb/A gave excellent grass and weed control without injury to spring oats. Some other crops, such as soybeans and Crambe, have been damaged by drift of "Dicamba."

IOWA

J. Artie Browning, K. J. Frey, and M. D. Simons

An average yield of 56 bushels per acre was obtained from 1.73 million acres of oats harvested for grain in Iowa in 1970, according to the Iowa Crop and Livestock Reporting Service. Total production was estimated at 96.88 million bushels, placing Iowa fifth in oat production behind Minnesota, North Dakota, Wisconsin, and South Dakota.

Seeding of oats was started and completed earlier in 1970 than in 1969. Conditions remained favorable for oat culture until several days of hot, dry weather in late June and early July. Heading was about 10 to 14 days earlier than in 1969, and generally occurred between June 7 and 14 in central Iowa. Favorable conditions enabled oat harvest to be completed about 10 days ahead of that in 1969. Dry weather, wind, and some hail in July reduced yields in some areas. Thus, yield estimates of the Iowa Crop and Livestock Reporting Service dropped from 58 bushels per acre in July to 56 in September. Crown rust occurred over much of Iowa in 1970, except for the drier western counties, and was the most severe in central Iowa for several years. Oat stem rust was general north of U. S. Highway 30, but it built up late and caused little yield reduction. Other diseases were not significant.

KANSAS

E. G. Heyne and E. D. Hansing

The oat acreage in Kansas has declined continually the past twenty-five years and may have reached a low plateau since 1965, varying around 200,000 harvested acres per year. The 1970 harvested acreage was 250,000 with a record high yield of 41 bushels per acre exceeding the previous high of 39 bushels in 1883. The good field performance of oats in 1970 indicated lack of serious production problems. Crown rust developed fairly heavy in some locations but too late to cause much damage. In performance trials, late maturing cultivars performed well in comparison to early types, reflecting the help of rains in June.

No selection work is being carried on at the present time but several winter oat bulk populations are being grown in southern Kansas and several spring oat bulk populations in northeastern Kansas. Selections will be made in these bulks in the next several years.

CI7698, Improved Garry/5/Landhafer/3/Mindo//Hijara/Joanette/4/Andrew was named Trio and released by the Kansas and Nebraska Experiment Stations for seeding in the spring of 1971. Each state had about 200 bushels of seed for release. Its principal character was high yield performance over a wide range of environments. It will be competitive with Andrew in Kansas.

Ethyl and methyl mercurial fungicides have effectively controlled oat smuts for about 35 years. Registration for these fungicides was cancelled December 31, 1970. The status of phenyl mercurial fungicides is currently being reviewed, although they add the same amount of mercury to the soil and they are only partially effective for control of oat smuts.

Systemic fungicides applied as seed treatments compared with methyl mercurial fungicides, have given equal or better control of oat smuts in every year tested: Vitavax 1966 to 1970, and Benlate 1967 to 1970. In addition, several other experimental fungicides provided equal control during 1970. General registration may be obtained for one or more of these seed treatments during 1971.

MINNESOTA

D. D. Stuthman and M. B. Moore

1970 Season. The 1970 season was particularly unfavorable for oat production in Minnesota. Planting was delayed considerably in the Red River Valley (northwest). June was a hot and dry month in much of the state. Oats were seeded on 3.6 million acres and 3.4 million acres were harvested for grain. The average yield for the state was 49 bu/acre resulting in a total production of 167 million bushels.

Varieties. The recommended varieties continue as Garland, Otter, Portal, Sioux and Lodi. Froker and Diana are new varieties which appear to have potential in Minnesota.

"Daylength Insensitivity". We have apparently incorporated the "daylength insensitivity" characteristic into progeny of several commercial varieties (page 67, 1969 newsletter). (We are defining this daylength insensitivity as the ability to head relatively early when planted in the fall at Obregon, Sonora, Mexico). F_4 plants derived from insensitive F_2 selections (made in March 1970 at Obregon) were 80% headed three months after seeding (October 1970).

Personnel. Dr. O. D. Smith left us on July 1, 1970 to join the staff at Texas A & M to conduct research on peanuts. Dr. D. M. Stewart is on an assignment with FAO in Eygpt for until June 1971. Three graduate students arrived in the last year; Robert Steidl from Illinois in Agronomy, Larry Singleton from Oklahoma and Howard Schwartz from Nebraska in Plant Pathology. William Rice from Illinois via Missouri will join us in June and concentrate on our *A. sterilis* program.

MISSOURI

Dale Sechler, J. M. Poehlman, P. Weerapat, and Leo Duclos

The 314,000 acres seeded to oats represented, in 1970, an increase of 20% over the very low 1969 acreage. Yields averaged 41 bu/A on the harvested acres but many acres were abandoned due to the adverse weather conditions at harvest time.

Crown rust was present in oat fields and infection was very heavy in some cases. Rust came in late but no named varieties were resistant to the race complex present. Loose smut was frequently seen in oat fields and BYDV severely damaged susceptible varieties in some areas. The season was characterized as wet and cloudy in the northern part of the state and plants were rather tall with lodging a common occurrence.

Jaycee and Pettis were the top yielders statewide. Although both rusted in variety trials they were very tolerant of the BYDV problem.

Interest in winter oats is very limited in Missouri but some effort is devoted to finding winter hardy types of desirable agronomic type. A Dubois X Nysel selection, 05145, appears to offer some improvement and a small seed increase is being made.

NORTH CAROLINA

C. F. Murphy, D. M. Kline (USDA), T. T. Hebert

Production. North Carolina has had record state average oat yields for six of the last seven years. Much of this increase can be attributed to the publicity received by the new type wheats and a spin-off effect resulting in more adequate fertilization of the oat crop.

Breeding. Major emphasis is being placed upon breeding for short, stiff straw. A dwarf mutant from a line derived from the cross Carolee x Fulgrain is being used extensively as a parent. This line, N. C. 2469-3, was grown at Clayton, N. C. in 1970 with up to 500 lbs. of nitrogen per acre, and very little lodging. Its yield was depressed at such high nitrogen levels, however.

Pathology. Southern corn leaf blight, incited by *Helminthosporium maydis*, was widespread and destructive in 1970. A study was begun to determine whether Race T of *H. maydis* constitutes a threat to oat seedlings grown in fields where corn blight had been a problem. Seedling tests were initiated in the greenhouse.

Twenty-three isolates of *H. maydis*, including both Races O and T, were tested for capacity to incite seedling blight or leaf spot in oats. A suspension of spores and mycelial fragments was sprayed onto leaves of 3- to 5-leaf seedlings of Carolee. The inoculated seedlings were incubated in a moist chamber for 48 hours, and then moved to a greenhouse maintained at 20-25°C. Disease ratings were recorded 7 days after inoculation. Cultures were established from spores isolated from leaf lesions.

Fourteen isolates (9 of Race O, and 5 of Race T) induced small necrotic lesions on oat seedlings. Nine isolates (8 of Race O, and 1 of Race T) did not incite lesions. All isolates were pathogenic on corn seedlings and induced either lesions or blight symptoms characteristic of Race O or Race T. The extent of lesion development on oat seedlings was essentially the same for all 14 pathogenic isolates; however, the number of lesions varied. Limited sporulation was observed and cultures established from isolated spores proved to be *H. maydis*.

To determine whether inoculum in the soil would affect seedling growth, untreated seed of the variety Carolee was sown in soil infested with mycelium of *H. maydis*. Emergence and vigor of oat seedlings grown in pots which contained one of four isolates of the fungus did not differ from that of seedlings in control pots which were either free of *H. maydis* or contained *H. turcicum*. Corn seedlings in pots infested with *H. maydis* isolates were killed by the fungus prior to emergence, or seedlings were blighted and killed. Presence of *H. maydis* isolates in the soil did not cause seedling blight or root rot of oats. These data indicate that at present this fungus is apparently no threat to oat production.

OHIO

Dale A. Ray

1970 Production. Oat acreage and production in Ohio declined an estimated 8% in 1970 in comparison with the 1969 figures. Cool, wet conditions in the early spring undoubtedly influenced some reduction in acreage seeded. Generally excellent temperature and soil moisture prevailed through most of the growing season. The state average yield of 58 bu/acre in 1970 equaled the 1969 average. Oat diseases were relatively light, and although cereal leaf beetle damage was evident in Central Ohio, the center of infestation appeared to have shifted to the eastern section of the state.

Oat Varieties. Clintford, Clintland 60, Garland, and Jaycee varieties are currently recommended for grain production in Ohio, with Rodney recommended for green-chop and forage use. Clintford was the predominant variety in the 1970 Certified Seed acreage. In a replicated yield trial of 16 varieties at two locations and of ten varieties at six additional locations, Clintford and Orbit were the outstanding varieties in yield performance.

Oat Breeding. Several selections obtained from Clintland 60 x Rodney x Putnam 61 gave good performance in preliminary yield tests and will be continued in more extensive evaluation. Promising selections were collected from a head-row planting with high-protein lines screened from bulk populations of *Avena sterilis* x common oat variety crosses. Studies on the effect of fertilization on oat protein were initiated. Screening of winter oat materials for increased winterhardiness was continued with evidence of some progress in obtaining early-maturing, winterhardy lines for further testing.

OKLAHOMA

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

Production. A crop of 7.4 million bushels of oats was produced in 1970 from 185,000 acres. This compares with 6.5 million bushels from 158,000 acres in 1969 and 4.5 million bushels from 132,000 acres in 1968. This season's yield of 40.0 bushels per acre was exceeded only by last year's yield of 41.0 bushels per acre.

New Variety. Chilocco, C.I.8183, was released by the Oklahoma Agricultural Experiment Station in 1970. Chilocco originated from the cross Wintok Early Selection X LeConte made in 1955 at the Oklahoma Station. Chilocco has averaged slightly more in yield than Cimarron and 2.6 bushels per acre more than Forkedeer. The test weight of Chilocco averaged 34.2 pounds per bushel in Oklahoma tests. It ranked first in test weight among all entries grown in the Uniform Northern Winter Oat Nursery for three years. Chilocco is mid-season to early in maturity. It heads about six days earlier than Forkedeer but three days later than Cimarron. It has much better lodging resistance than Cimarron or Forkedeer even though it is intermediate in height to these varieties. Chilocco is superior to all currently grown varieties in Oklahoma for winterhardiness. In regional tests, it survived 1.7% less than Norline and 1.1% less than Wintok.

Other Varieties. Cimarron remains the predominant variety in Oklahoma. It is preferred because of its early maturity and high level of winterhardiness. Ora and Nora are also popular varieties especially in Eastern Oklahoma. They are susceptible to winterkill in Western Oklahoma. Checota, released in 1969, should replace much of the oat acreage formerly planted to Forkedeer and Bronco.

Spring vs. Fall Seeding. Oats may be seeded either in the Fall or in the Spring in Oklahoma. Best yields are usually obtained by planting adapted winter oats in the Fall. If winter oats are planted early in the Spring, they usually out-yield true spring oats.

However, in our 1970 Spring Seeded Oat Nursery, Montezuma and Tonka (both spring oats) ranked first and third in yield with 109.0 and 79.5 bushels per acre respectively. Ora ranked second with a yield of 95.1 bushels per acre. Nora, Checota, and Cimarron yielded less than 77 bushels per acre in the same nursery.

PENNSYLVANIA

H. G. Marshall

Conditions were generally favorable for oat production during 1970 with adequate rainfall. The oat acreage continued to decline slowly, and 435,000 acres were harvested for grain. However, the estimated yield was a record high of 57 bushels per acre. No serious disease problems occurred, but lodging was serious in some areas because of severe rainstorms. Production figures are based on spring oats since no estimates are made for winter oats. However, some winter oats are grown in southeastern Pennsylvania, and results apparently were good during 1970. A foundation field of 'Pennlan' produced a yield of slightly over 100 bushels per acre at a Lancaster County location.

Winter Oat Research. The cooperative USDA-Pennsylvania program to develop varieties with improved winter hardiness and straw strength was continued. The experimental variety C.I. 8312 (Pa. 64-18-1099: Dubois x Sel 5037 2x Ballard) has continued to be outstanding for winter hardiness and yield under Pennsylvania conditions. It also has been slightly superior to 'Norline' in USDA uniform nurseries over the past 3 years. A preliminary seed increase is underway, and the variety will be considered for release in the near future. The winter survival of Pa. 822-7538 (Milford 2x Wintok Sel x Hairy Culberson 3x Nysel 2x Wintok Sel x Hairy Culberson) also has been exceptional, and hopefully may represent a badly needed increase in winter hardiness. This variety had a survival of 82% in the 1970 Uniform Elite Hardy Oat Nursery compared to 58% for Norline. It has been entered in the Uniform Winter Hardiness Nursery for 1971.

Natural selection has been effective in changing the winter hardiness of segregating populations in my program. Winter hardiness changes in nine F_6 bulk composites were determined during 1970, and all populations showed positive increases. The average increase was 25%, and the average survival of all populations exceeded that of the variety Norline. Unfortunately, nearly all selections extracted from these populations have been weak strawed and late in maturity. Under Pennsylvania conditions, we have found that there is a rapid increase in the frequency of genes conditioning these undesirable characteristics. We are presently space planting several bulk populations with water-soluble tape to minimize elimination of the less competitive short, early genotypes, and to facilitate the application of selection pressure. The tape planting technique is described elsewhere in this report.

The control of winter annual weeds has been a problem in our winter oat nurseries. Late fall application of certain herbicides has helped with the weed problem, but we have been suspicious that herbicide treatments may increase the winter injury of oats. This proved to be true during 1970 in experiments with the variety Pennlan. Although applications in mid-November were at the recommended rate and below, the average survivals for treatments with Brominal, Brominil-M, and Igram were 34, 71, and 10%, respectively, compared to 90% for the untreated checks. The amount of winterkilling increased as the application rate was increased. There was no apparent injury from the same herbicides when applied in the spring.

A major project objective is to increase the lodging resistance of hardy winter oats. One problem has been a lack of satisfactory parents, but we are especially optimistic about the North Carolina dwarf variety C.I. 8447 (NC 2469-3) which has very short, stiff straw and a compact panicle. The dwarf characteristic apparently is modified by other genes since our F_2 populations have had a wide range for plant height and panicle type. A high positive correlation occurred between plant height and panicle length, and the relationship was linear. The parental compact panicle always occurred on dwarf straw and the parental open panicle never occurred on dwarf straw. Most of the increase in plant height resulted from internode elongation rather than an increase in the number of internodes.

SOUTH DAKOTA

D. L. Reeves

The oat acreage increased to over 2.5 million acres for South Dakota this year. However, the total production was down due to lower yields. Dry weather began before the oats were headed and in many areas continued throughout the rest of the growing season. The average yield was down over 5 bu/acre due primarily to the extended dry weather.

Only a trace of crown rust was present prior to heading. In the east central part of the state the rust infection increased very rapidly. Some fields had losses estimated at 10% due to crown rust. Stem rust was not a serious problem this year.

LeRoy Spilde completed his M.S. degree and is now at North Dakota working toward a Ph.D. Crosses between *Avena sterilis* and *A. sativa* were generally intermediate between the parents for phenotypic characters, and yield componets. Panicle internode length was the only character studied which was greatest in the crosses. High protein was associated with the *A. sterilis* phenotype. The mean protein percent of the crosses was skewed toward the low parent, *A. sativa*.

TEXAS

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

Production. The 1970 Texas oat crop was estimated to be 2,383,000 acres seeded and 764,000 acres harvested. For the third consecutive year, both seeded and harvested acreages increased appreciably (12% and 8% respectively in 1970). Grain production in 1970 was estimated to be 29 million bushels or 38 bushels per acre, which is one of the highest yield levels ever reported for the state. The following table shows Texas oat production trends for the last five crop seasons and 1966-70 and 1961-70 averages for comparison.

Texas Oats: Seeded and harvested acreages and grain yield levels 1966-1970.

Year	Acreage: Planted 1,000 acres	Acreage: Harvested 1,000 acres	Grain production 1,000 bushels	Yield per harvested acre bushels
1966	1,635	630	17,640	28
1967	1,357	315	6,615	21
1968	1,628	583	19,822	34
1969	1,937	670	25,460	38
1970	2,383	764	29,032	38
1966-70	1,788	592	19,713	32
1961-70	1,929	686	19,601	28

Breeding. Avena sterilis derivatives from the Texas oat breeding program had outstanding crown rust resistance in 1970 tests in Lajas and Mayaguez, Puerto Rico and Beeville and College Station, Texas. Several hundred pure lines from A. sterilis crosses are in preliminary yield tests in 1971. The fall and winter of the 1970-71 season have been unusually mild in South Texas. Many A. sterilis derivatives appear to be less photoperiod-sensitive than their cultivated parents and some lines headed in mid-January. The juvenile growth habit of many A. sterilis derivatives also is more upright than expected. North Texas tests have shown that the hardiness of A. sterilis derivatives usually is not equal to that of the cultivated backcross parents. This relationship is not absolute, and a good number of prostrate, winter hardy types have been observed.

Greenbug Studies. Greenbug tolerance studies continue at Denton. Many lines previously rated as tolerant did not show appreciable tolerance in 1970 tests. A few lines still appeared promising, but none were as good as the greenbug-resistant barley check.

WASHINGTON

C. F. Konzak, E. Donaldson, K. J. Morrison, P. E. Reisenauer and M. A. Davis

The variety Cayuse had generally the best overall yield performance throughout Washington State and the northwestern states regional nurseries in 1970. The Pullman nursery sustained rather severe (9-70%) shattering from a hail storm which passed across Spillman Farm during July when the oats were beginning to ripen. Yellow dwarf (red leaf) was unusually prevalent at Pullman and there appeared to be rather wide differences in the extent of coloring among the varieties at Pullman. The selection OA 123-33 showed 63% discolored leaves while 63AB7868 showed only 1 to 3%, 65AB4547, 5-8%, Fraser 5-8% and Harmon (C.I. 7989) 6-8%. Cayuse had 35-40% leaf discoloring but apparently has an ability to yield well in spite of yellow dwarf infection. The reactions of those varieties showing lower yellow dwarf readings will need to be confirmed by further testing and therefore should only be considered as indications of possible tolerance to the disease.

Over 500 reselections from among an F_4 population of yellow dwarf tolerant material will be evaluated both at Davis and at Pullman in 1971. In addition, about 20 F_5 lines from the cross Cayuse/CI 2874 selected for their greater yellow dwarf tolerance seed plumpness will be yield tested in 1971. These lines were selected from among several hundred evaluated for yellow dwarf tolerance through the kind collaboration of Dr. C. O. Qualset, Davis, California.

WISCONSIN

H. L. Shands, R. A. Forsberg, and R. D. Duerst

Wisconsin State Oat Yields and Variety Performance

The 1970 growing and harvest season was favorable for small grain production in Wisconsin. According to the Wisconsin Statistical Reporting Service, the state average yield of oats reached an all time high of 62 bushels per acre or one bushel above the previous high that was reached several times in recent years. Most of the small grain acreage was seeded in April in contrast to other years when a considerable amount is planted in May. Less than usual lodging was observed. Low soil moisture in July and low rainfall provided conditions for bright grain with good test weight per bushel.

Crown rust appeared in early June in the Madison nursery and became severe enough to spray with Manzate to reduce further rust build-up. This is the first time that the regular yield trial was sprayed for rust control. Consequently, susceptible selections were favored over what might have happened if rust had been allowed to multiply.

Crown rust was found in many fields in southern Wisconsin. Fortunately, the level of infection was variable, causing appreciable yield losses and lowered bushel weights occasionally; yet average yields remained high.

Froker Performance for Seed Growers

There were 134 growers of certified Froker seed in Wisconsin in 1970. Returns from a questionnaire sent to the growers by Reuben James indicated generally good acceptance of the new Froker variety. Their yield results, presented below, showed that Froker averaged 76 bushels per acre to 75 for Holden and Orbit. Using paired comparisons of the same grower (usually on different fields), Froker yields exceeded those of other varieties except for 1 bushel less in the Froker-Orbit comparison. Comments on Froker grain weights were usually favorable.

Search for high groat protein percentage continues with some intra *A. sativa* selections giving promise of increased protein and acceptable agronomic type.

Personnel Items

Paul Lyrene, who worked with segregates of *A. sativa* x *A. sterilis* from M.S. thesis material, is in the armed forces and is located at Fort Meade, Maryland. Roberto Ritter returned to Brazil and joined the Agronomy faculty at the University at Santa Maria in Rio Grande do Sul. E. S. Oplinger joined the Agronomy Department in June 1970. He will spend considerable time with small grain extension work.

OAT QUALITY LABORATORY

Dr. Vernon L. Youngs came to Wisconsin in September 1970 and is in charge of the Oat Quality Laboratory located in the Agronomy Building. The Oat and Barley and Malt Laboratories are coordinated by Dr. Y. Pomeranz.

Wisconsin growers of certified seed reports of their oat yields. 1970.

Variety	Number reports	Bu. per/A average	Variety	Number reports	Bu. per/A average
Beedee	38	70	Jaycee	9	72
Froker	63	76	Lodi	44	72
Garland	20	71	Orbit	35	75
Garry	25	69	Portal	24	70
Holden	42	75	Rodney	16	67

Paired comparison of several varieties

Variety compared	Number pairs	Bu. per acre	Variety compared	Number pairs	Bu. per acre
Beedee	33	67.8	Orbit	14	74.0
Froker		80.4	Portal		70.5
Froker	40	77.6	Holden	15	71.6
Holden		74.6	Portal		68.9
Froker	31	75.4	Lodi	18	71.3
Orbit		76.4	Portal		73.2
Froker	40	78.8	Holden	29	73.5
Lodi		72.2	Lodi		72.6
Froker	24	74.0	Beedee	26	68.6
Portal		69.5	Holden		73.2
Holden	20	72.1	Beedee	28	69.2
Orbit		77.6	Lodi		72.7
Lodi	23	72.0	Beedee	21	70.5
Orbit		77.8	Orbit		77.2
			Beedee	16	64.3
			Portal		72.2

V. NEW OAT VARIETIES

A. Alphabetical List

Name	C.I. No.	Origin	Described on page:
Chilocco	8183	Oklahoma	36
Diana	7921	Indiana	42
Elan	8443	Georgia	43
ICA-Gualcalá		Colombia	43
ICA-Soracá		Colombia	44
Random		Canada	44
Ryhti		Finland	44
Trio	7698	Kansas and Nebraska	32

B. Descriptions

Diana

The Diana spring oat, CI7921, was distributed to seedsmen in Indiana in March, 1971. Diana has been produced commercially in Brazil, South America. It was approved for release by the Purdue University Agricultural Experiment Station and the Crops Research Division, U.S. Department of Agriculture in June, 1966. At this time it was distributed in germ plasm amounts to breeders in the United States and was made available to governmental agencies and interested people in Brazil where it had been highly resistant to crown rust and stem rust and had performed well in cooperative international nurseries. Subsequent tests in Indiana have indicated that Diana has somewhat higher yield than Clintland 64 (currently our most rust resistant variety in production), better test weight, and shorter, stiffer straw.

Diana resulted from a final cross in 1959 between two selected lines Purdue 549B3-1-1 and Purdue 543C2-132P completing the crossing of selected parents in the following scheme:

Clintland/3/Clinton*2/Ark 674/2/Milford/6/Roxton/3/Victoria/2/Hajira/Banner/4/Ajax/3/Victoria/2/Hajira/Banner(Ottaw 3928-5-8)/5/Clinton/Bond/2/PI174544-3

The new variety was selected by the modified pedigree method with plant selections in the F_1, F_2 and F_3 generations. Breeders seed consisted of the compositing seed of 162 plant progeny rows in F_{10} (1967) uniform for maturity, height, and crown rust resistance. The breeders seed distributed in 1970 was in the F_{12} generation.

Diana is an early oat being about one day later than Jaycee, one day earlier than Clintford or Tippecanoe, and four days earlier than Clintland 64. Diana is best adapted to conditions favoring an early oat which occur most frequently in central Indiana. The test weight of Diana is good, being similar to Jaycee and Tippecanoe, and generally higher than Clintland 64. The grain is plump with a moderately large kernel and a higher than average groat protein. The kernel color is generally a very light brown ranging in different seasons from an almost copper color to a medium brown. Diana has good straw strength at the preripe stage and good resistance to straw breakage after ripening. Diana is moderately short, similar to Clintford and Jaycee.

Diana has the mature-plant crown rust resistance derived from PI 174544-3 and has been resistant to the newer races of crown rust currently occuring in Indiana. Diana has the A and B genes for resistance to stem rust and possibly the H gene from Ukraine. Diana is moderately susceptible to the barley yellow dwarf virus disease being less susceptible than Clintland 64, Tippecanoe and Holden. It does not possess the resistance levels of Clintford and Jaycee. Diana has been highly resistant to the smuts occuring in Indiana. It is moderately susceptible to Septoria leaf blotch.

ELAN OATS

By Darrell D. Morey, Acton R. Brown, Morris J. Bitzer

Elan, CI-8443, is a short oat with strong straw adapted to the Coastal Plain and Piedmont areas of Georgia. Elan has given high yields of grain during 4 years of testing and has good disease resistance. The Elan variety (T-6161) was bred, developed and released from the Georgia Coastal Plain Experiment Station, Tifton, Georgia.

Pedigree and History

Elan oats, CI-8443, was selected from the cross (Suregrain-LMHJA x Coker 57-11) x Florida 500. The first cross of Suregrain x LMHJA was made in 1953. LMHJA was a rust resistant oat selection received from the Minnesota breeding program and known as Landhafer-Mindo-Hajira-Joanette x Andrew; M-2 and CI-6958. An F_6 selection from the first cross which had strong straw and disease resistance was hybridized with Coker 57-11 in 1958. Coker 57-11 was designated Arlington-Delair-Trispernia x Woodgrain, CI-7294. Selections from this second cross were noted for winter hardiness and disease resistance. The best one of these selections was hybridized with Florida 500 in 1962 to complete the pedigree.

Elan is resistant to races 203, 216, 290 and 326 of crown rust and to races 7AF and 8AF of stem rust. Foundation seed of Elan oats will be available from the Georgia Seed Development Commission, Whitehall Road, Athens, Georgia 30601.

ICA-Gualcalá

By Reinaldo Reyes

This new oat variety was selected from the cross (Clinton x Landhafer) x (Clinton x Landhafer)(Richland x Bond). A very stiff-strawed variety, it was released for its high yields and adaptability in Nariño and Boyacá. Gualcalá is a spring-type variety similar to Bacatá in growth characteristics. It is resistant to crown rust, "enanismo", red leaf, and it has tolerance to some races of stem rust It has large, plump, light yellow kernels. Protein content of the grain and forage are 15.7% and 16.6%, respectively.

ICA-Soracá

By Reinaldo Reyes

Soracá is a spring oat selection released by ICA in August 1970. It is a selection from the cross (Clinton x Landhafer) x (Clinton x Landhafer) (Richland x Bond). Soracá is similar to Bacatá in height, heading date and maturity date. It is moderately resistant to stem rust, and resistant to crown rust and the BYDV. It is well adapted to a large area of Cundinamarca, Boyacá, and Nariño. Soracá exhibits vigorous vegetative growth with a characteristically erect habit. Protein content of the grain and forage are 13.5% and 16.1%, respectively. Preliminary milling tests suggest Soracá to be a suitable milling oat. It is expected to replace much of the forage variety, Bacatá, as it is more productive, has better quality, stronger straw, and gives higher grain yields.

RANDOM

Random was licensed for sale in Canada early in 1971. It was developed at the Lacombe Research Station by the random method (see 1965 Oat Newsletter, p. 22) from the cross Glen x Pendex made in 1960. Random has short straw and excellent lodging resistance, and a remarkable yield capacity, in western Canada, for a variety of its maturity. A day or two later than Glen or Pendek, Random outyielded Pendek anywhere from 3 to 11 percent in regional and co-operative trials, depending on the testing zone. Random has a larger kernel than Pendek and is an inch or two taller. It has shown fairly good resistance to shattering. It is moderately resistant to crown rust but is susceptible to the smuts and stem rust. It has good resistance to grey speck. The reaction to other diseases is unknown. About 2,000 bushels were released to Seed Growers and the Seed Trade for seeding in 1971. Breeder Seed will be retained by the Lacombe Research Station.

RYHTI OATS

By O. Inkilä

Ryhti (Jo 0793) is a new spring oat variety released in 1970 by the Agricultural Research Center, Department of Plant Breeding, Jokioinen, Finland. It is derived from a cross Jo 2395 (an X-ray induced mutant from the Finnish Sisu oats) x (Blixt, Svalöf. Certified Breeders Seed will be maintained by the Jokioinen Seed Center.

Ryhti is a high yielding variety of medium maturity. Straw is very stiff and fairly long. Ryhti has good quality of grain. Hectolitre weight is high. Grain is moderately large-sized and well-formed, kernel content is high. Crude protein content is high. Milling characteristics are good. Hüll color is white. Ryhti has proved more resistant against smut than other commercial varieties in Finland.

VI. GERM PLASM MAINTENANCE

The Plant Gene Resources of Canada

Canada is to establish a National Advisory Committee on the Plant Gene Resources of Canada. This development is the outcome of discussions involving the Research Branch of the Canada Department of Agriculture, Canadian Universities, the Canadian Society of Agronomy, the Canadian Society for Horticulture Science and other departments, to develop effective means to catalogue, preserve, and utilize the plant gene resources of the country.

The Research Branch has already made a start in the program by appointing Dr. Roland Loiselle, a plant breeder and botanist, as permanent secretary of the new National Advisory Committee. He will be responsible for, among other duties, the organization and operation of a comprehensive catalogue of the Plant Gene Resources of Canada, and of similar resources in foreign countries if they relate to Canadian requirements.

International exchange of genetic material is also a major responsibility of the permanent secretary of the Committee. Requests for plant material should be sent to:

Dr. Roland Loiselle
The Plant Gene Resources of Canada
Ottawa Research Station, Central Experimental Farm
Ottawa 3, Ontario, CANADA

USDA Small Grains Collection

J. C. Craddock

Obtaining Avena germplasm is a responsibility of the Agronomist in charge of the Small Grains Collection. One very important source of oat germplasm is the contributions received from oat breeders. With these valuable contributions of previous years in mind, I again ask you to review your oat selections for those that are outstanding but are no longer of interest to your program and to submit them to the collection. Your contributions may help other oat breeders achieve their goals. This can be accomplished by simply providing me with a 10-200 gram sample and a statement that the accession is open-stock. The statement is required since all materials in the collection are distributed without restriction for experimental use. Any additional information such as pedigree and outstanding characteristics that you may provide would be helpful in documenting the accession.

During the past two years there has been no contribution to the Oat Gene Bank. In order for the bank to serve its function a continuous supply of new materials is needed. Will you please review your inventory for surplus seed from F_1 and F_2 plants and make your contribution.

Cereal Investigation (C.I.) numbers were assigned to 632 oats during the past year. These numbers are listed on the following pages. Among these oats is a collection of feral oats (C.I. 8459 through C.I. 9004) contributed by I. M. Atkins.

C. I. NUMBERS ASSIGNED IN 1970
(* - pedigree given on last page of listing)

C.I. NUMBER	NAME OR DESIGNATION	SOURCE
8445*	GRUNDY	Idaho
8446*	OA-123-33	Canada
8447*	NC 2469-3	N. Carolina
8448*	Coker 66-22	S. Carolina
8449*	Coker 67-22	S. Carolina
8450	13/69	Yugoslavia
8451*	T-5199	Georgia
8452*	Okla S-64201-63	Oklahoma
8453*	Minn 70B1991-1998	Minnesota
8454*	Minn 70B2203-2205	Minnesota
8455*	Minn 70B1243-1244	Minnesota
8456*	Minn 70B2148-2160	Minnesota
8457*	Wisc X1588-2	Wisconsin
8458*	Minn 70B1985-1988	Minnesota
8459	64-FO-1	Texas
8460	64-FO-2	Texas
8461	64-FO-3	Texas
8462	64-FO-4	Texas
8463	64-FO-5	Texas
8464	64-FO-6	Texas
8465	64-FO-7	Texas
8466	64-FO-8	Texas
8467	64-FO-9	Texas
8468	64-FO-10	Texas
8469	64-FO-11	Texas
8470	64-FO-12	Texas
8471	64-FO-13	Texas
8472	64-FO-14	Texas
8473	64-FO-15	Texas
8474	64-FO-16	Texas
8475	64-FO-17	Texas
8476	64-FO-18	Texas
8477	64-FO-19	Texas
8478	64-FO-20	Texas
8479	64-FO-21	Texas
8480	64-FO-22	Texas
8481	64-FO-23	Texas
8482	64-FO-24	Texas
8483	64-FO-25	Texas
8484	64-FO-26	Texas
8485	64-FO-27	Texas
8486	64-FO-28	Texas
8487	64-FO-29	Texas
8488	64-FO-30	Texas
8489	64-FO-32	Texas
8490	64-FO-33	Texas
8491	64-FO-34	Texas
8492	64-FO-35	Texas
8493	64-FO-36	Texas
8494	64-FO-39	Texas
8495	64-FO-40	Texas
8496	64-FO-41	Texas
8497	64-FO-42	Texas
8498	64-FO-43	Texas
8499	64-FO-44	Texas
8500	64-FO-45	Texas
8501	64-FO-46	Texas
8502	64-FO-47	Texas
8503	64-FO-48	Texas
8504	64-FO-49	Texas

C.I. NUMBER	NAME OR DESIGNATION	SOURCE
8505	64-FO-50	Texas
8506	64-FO-51	Texas
8507	64-FO-52	Texas
8508	64-FO-53	Texas
8509	64-FO-54	Texas
8510	64-FO-55	Texas
8511	64-FO-56	Texas
8512	64-FO-57	Texas
8513	64-FO-58	Texas
8514	64-FO-59	Texas
8515	64-FO-60	Texas
8516	64-FO-61	Texas
8517	64-FO-62	Texas
8518	64-FO-63	Texas
8519	64-FO-64	Texas
8520	64-FO-65	Texas
8521	64-FO-66	Texas
8522	64-FO-67	Texas
8523	64-FO-68	Texas
8524	64-FO-69	Texas
8525	64-FO-70	Texas
8526	64-FO-71	Texas
8527	64-FO-72	Texas
8528	64-FO-73	Texas
8529	64-FO-74	Texas
8530	64-FO-75	Texas
8531	64-FO-76	Texas
8532	64-FO-77	Texas
8533	64-FO-78	Texas
8534	64-FO-79	Texas
8535	64-FO-80	Texas
8536	64-FO-81	Texas
8537	64-FO-82	Texas
8538	64-FO-83	Texas
8539	64-FO-84	Texas
8540	64-FO-85	Texas
8541	64-FO-86	Texas
8542	64-FO-87	Texas
8543	64-FO-88	Texas
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8735	64-FO-302	Texas

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9014	CD 2050	Canada
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9065	CD 8087	Canada
9066	CD 8088	Canada
9067	CD 8168	Canada
9068	CD 8169B	Canada
9069	CD 8170	Canada
9070	CD 8171	Canada
9071	CD 8262	Canada
9072	CD 8263	Canada
9073	CD 8264	Canada
9074	CD 8265	Canada
9075	CD 8266	Canada
9076*	-	Canada

* PEDIGREE

8445	Clintland / Garry Sel 5
8446	CD 3820 2*/ Victory
8447	Carolee / Fulgrain
8448	Coker 62-35 / CI 7762
8449	Sumter /2/ Florad / Coker 58-7
8451	Fairfax / Florida 500
8452	Arlington / Wintok /2/ Cimarron
8453	Tippecanoe /4/ LMHJA / Clinton /2/ Rodney /3/ BM / Ab 101?

* PEDIGREE

8454	Tippecanoe /5/ LMHJA /3/ Roxton / RL 1276 /2/ Ajax / RL 1276 /4/ Black Mesdag / Ab 101?
8455	Coker Sel /4/ LMHJA / Clinton /2/ Ajax /3/ Black Mesdag / Ab 101?
8456	Lodi / PI 267989
8457	Vtra /2/ Hj / Bnr /3/ Ftx /4/ IH /5/ Cnk/ EC
8458	Tp /4/ LMHJA / Ctn /2/ Rdy /3/BM /Ab101?
9076	CD 3820 / CI 2515

VII. EQUIPMENT AND TECHNIQUES

Technique for Inoculating Primary Leaves with Several Races of Rust

The Oat Newsletter has received inquiries about techniques for multiple inoculation of oat leaves. Interested persons are referred to these references:

Geis, J. R., M. C. Futrell and W. N. Garrett. 1958. A method for inoculating single wheat leaves with more than one race of Puccinia graminis f. sp. tritici. Phytopathology 48: 387-388.

Miah, M. A. J. and W. E. Sackston. 1967. A simple method for inoculating individual leaves of sunflowers and wheat with several races of rust. Phytopathology 57: 1396-1397.

Additionally, Mr. Matt Moore at the University of Minnesota designed a multiple inoculator for this purpose. Interested persons could write him. (See address list).

A Technique for the Emasculation of Oats Used in Conjunction with the Approach Method of Crossing

Methods of making approach crosses in Oats were described by McDaniel, Kim, and Hathcock (Crop Sci. 7:538-540, 1967) and an adaptation of the system to meet Scottish conditions has proved highly successful.

The entire operation is carried out in the glasshouse, and, for ease of manipulation, the plants destined for use as female parents are sown at intervals over a period of about twenty days, while the male parents are sown in the middle of this period. A panicle is ready for emasculation when the terminal spikelet emerges at the ligule and the only instrument required is a pair of needle-pointed forceps.

The leaf sheath is slit lengthways and pulled apart to expose the entire panicle and, working from the top downwards, each spikelet is emasculated in turn. First, the glumes and all secondary florets are removed and, with one of the sharp forceps points, the lemma is pierced just below the point of attachment of the awn and slit upwards to the tip. The critical part of the operation now follows, as rough handling at this stage can unseat the ovary. The floret is firmly held by the tip of the palea while the two halves of the lemma are peeled off in a sideways and downwards direction. Finally the anthers, now easily accessible, are picked off. Should the basal spikelets on the panicle be too tender to handle easily they are either removed or left for one or two days for later emasculation.

Plants emasculated in this way have been exposed to random pollen in the course of building composite cross populations while others have been bagged with the pollen parent to obtain particular crosses. On average, there are about twenty emasculated florets per panicle and 10-15 hybrid kernels is a normal expectation. These kernels are small and shrivelled by comparison with normal oat kernels but germination on filter paper, followed by pricking out into pots, ensures at least 98% survival.

The International Association on Mechanization of Field Experiments

E. H. Everson, Professor of Crop Science, Michigan State University (Currently Visiting Professor, Institute of Farm Crops, Agricultural College of Norway)

The International Association on Mechanization of Field Experiments (IAMFE) was established by the First International Conference on Mechanization of Field Experiments held at Vollebekk, Norway in 1964. 71 research workers and officials from 16 countries participated in the Conference.

The objectives of the Association as stated in the Constitution are as follows:

The aim of the Association is to promote the research, development and cooperation in the mechanization of field experiments in order to contribute to the progress of agricultural and horticultural production on a world-wide scale. The Association shall be a non-profit organization.

One of the major objectives in any mechanization program must certainly be to increase the efficiency and accuracy of field experimentation. At the present time, probably no other facet of the experimental approach in agronomy, horticulture or plant breeding is in more need of attention. Our modern technology has taken us to the moon, we have developed sophisticated laboratory equipment and computer hardware, and industry has developed efficient field machinery for large scale commercial production, but we lag miserably in the development and production of equipment for efficient and accurate field experimentation. Even more critical is the need of similar equipment on the small 3 to 5 acre farms in subsistence agriculture.

Currently the IAMFE with its modest income from memberships is accomplishing its objectives in the following ways:

1. The Association is arranging international conferences and exhibitions on mechanization of field experiments for members and associate members.

2. The Association is operating the international Information Center on Mechanization of Field Experiments. This Center compiles and distributes to its members information, reports and other technical and scientific publications on field plot and laboratory equipment and techniques used in field experiments. The Center publishes the International Handbook on the Mechanization of Field Experiments in English. The Handbook is divided into 20 groups of research equipment: tool carriers or power units, seed drills, fertilizer equipment, pesticide applicators, forage harvesters, binders, threshing machines, combines, deawners and dehullers, seed cleaners, graders and separators, sifters, laboratory mills, seed counters, seed dispensers, potato planters, potato harvesters, potato analysis equipment, root crop harvesters, plant lifters, and miscellaneous equipment. Currently there

are not leaflets published in all 20 groups. The information provided on each piece of equipment includes: the name of the unit, purpose, designer, main specifications, capacity, journal reference article where it was originally described, whether or not plans or brochures are available, approximate price, and manufacturer. The Handbook is a loose leaf system and additions and revisions will be sent out to members of IAMFE.

3. The Association is helping producers of research equipment to improve their equipment.

4. The Association is encouraging the designers of good research equipment to put it into production and to make it available to research workers throughout the world.

5. The Association has been helpful in introducing field plot equipment to developing countries to increase the efficiency and accuracy of field experimentation through mechanization.

As the membership continues to grow and the financial base increases, the Association plans to publish the International Journal on Mechanization of Field Experiments.

If the Association can find the financial backing in the future, a proposed IAMFE Research and Development Center for Field Plot Equipment could be initiated. This Center would not only assemble and distribute ideas and information, but would conduct research and develop systems utilizing these ideas. Furthermore, the Center could become an important sector of the campaign against world hunger. Scientists from the developing nations, as well as the more affluent developed countries, could spend study or training sessions at this Center. The proposed IAMFE Center could solve technical problems of world-wide interest through the development of small, efficient, and accurate equipment for field plot research and for the cultivator or farmer of small acreages.

The International Association on Mechanization of Field Experiments is directed by an Executive Committee composed of a president, a vice president and three members. Mr. Egil Øyjord is currently the President as well as the non-paid Executive Secretary of the Association. IAMFE is located in the Institute of Agricultural Engineering at the Agricultural College of Norway, 1432 Vollebekk, Norway.

Mr. Øyjord is a member of the Institute of Agricultural Engineering and is responsible for mechanization of field plot research in Norway. He has developed an excellent precision seed distributor with variable openings so that by a simple housing change, the distributor can be used to plant 2, 3, 4, 5, 6, 7, 8, 10, 12 or 14 rows. Several models of plot drills have been developed for field plot research including both self-propelled and those pulled by a tractor with a 3-point hitch. Current research by Mr. Øyjord centers on development of a seed magazine system which will accompany the distributor system. His planters are easily adjusted for varying plot lengths. Being responsible for the mechanization of field experiments in Norway and during travels in Europe and the U.S.A., he saw the need for an organization such as IAMFE, and through his efforts the organization was founded and has been guided.

International Conferences have been held in Vollebekk, Norway - 1964, and Braunschweig, Federal Republic of Germany - 1968. In 1972, the Third International Conference on Mechanization of Field Experiments will be held in Brno, Czechoslovakia, July 10-15.

Membership in IAMFE is $10 for individuals and $40 for research institutions. Your membership request, contribution of ideas on mechanization and experimental machinery descriptions for the Handbook should be sent to Mr. Øyjord, IAMFE Secretariat, 1432 Vollebekk, Norway.

Improved Methods for Planting and Harvesting Oat Plots in North Dakota

David C. Ebeltoft

North Dakota cooperated with Minnesota in growing a special nursery of early generation material at Fargo from which Dr. Stuthman wanted additional data. The project was unique in that the entire experiment was planted in six-row blocks with six-inch row spacings. These plots were sown with a six-row cone planter, which was one of the two planters designed by Dave Ebeltoft and included features that enabled better soil compaction after seeding to facilitate planting of seeds such as oats without interference from wind or blockage. The individual blocks were trimmed to eight feet and then harvested by straight combining with an Austrian combine known as the "Wintersteiger". The seed was forced-air dried at a very moderate temperature. The results were highly satisfactory and a similar experiment will be carried out in 1971.

Planting Innovations

H. G. Marshall

Seed Tape. Over the past 2 years we have space-planted several bulk populations with a water-soluble plastic film tape (polyethylene oxide). The tape dissolves in 60 to 90 seconds when placed in soil with adequate moisture for germination. The seed tape is wound on spools, and we have been planting the tapes with a modified Planet Jr. seeder. In the fall of 1970, two men planted 4,620 feet of tape in 47 minutes. At two seeds per foot, this amounted to over 9,000 spaced seeds for 94 man-minutes. In contrast, it took 34 man-minutes to hand drop and cover approximately 200 seeds. On this basis, the seed tape was about 16 times more efficient than opening rows and dropping seed by hand.

Seedling emergence with seed tape has been excellent. The estimated germination in our plots during the fall of 1970 was 96%. One problem, however, is the occurrence of two plants at a site, and the number of doubles has ranged from 10 to 23% depending on the tape sampled. This has not concerned us in our bulk populations where we are primarily interested in minimizing the elimination of short, early genotypes.

The seed tapes were prepared by Creative Agricultural Systems of Salinas, California, at a cost of approximately $2.00 per 1,000 feet. At the present time, about 1-pound lots of seed are required for each population.

Plot Seeder. We have recently constructed a small grain plot seeder with the following features:

1. The carrier for the planter is a 14 h.p. crawler-type tractor with 12-inch wide rubber tracks. This essentially eliminates soil compaction since the unit operating pressure is under 1 pound per square inch.

2. The planting unit consists of five double disc openers which are mounted on the rear of the tractor and lifted hydraulically. The row width may be varied from about 5 to 12 inches. Planting depth is controlled by continuous pressure and depth bands.

3. The cone design is unique in that seed from a single packet is dispensed through five slots in the base plate. The cone only rotates one-fifth of a revolution per plot. Seeding is continuous, and alleyways are established later by mowing or cultivation.

4. The cone unit is mounted independently of the planter unit, and may be interchanged with multiple cone units for single-row plots.

The performance of our planter was excellent during the fall of 1970. We especially appreciated the reduced labor for packeting compared to a multiple-cone unit, and the need for only two men to operate the planter.

Test Weight Determination in Early Generations

D. M. Wesenberg and H. L. Shands

Weight per bushel or test weight is a commonly used criterion of oat grain quality; however, early generation evaluations are often difficult to complete because of limited seed supply. A 100 ml container approximately 40 mm in diameter and 80 mm in depth was constructed from heavy guage pipe to obtain test weights for F_3 and F_4 lines. Gram weight of the 100 ml sample was converted to test weight in pounds by multiplying by a factor of 0.777.

Eleven oat varieties and selections grown at Madison, Wisconsin in 1965 and 1966 were used to compare test weights obtained from use of the 100 ml sample with those from the standard one-pint measure. Test weight in pounds based on a 100 ml volume of grain averaged 35.0 pounds in 1965 for the 11 entries compared to 35.7 pounds through use of the standard one-pint measure. The 1966 11-entry mean was 35.2 pounds for the 100 ml determinations and 35.4 pounds for the standard one-pint determinations. Correlation coefficients between test weight determinations by the two methods were .98 for each year.

An experiment designed as a split-plot was used to evaluate the two test weight sample sizes. Varieties (factor A) were considered whole plots and sample sizes (factor B) were sub-plots. Test weight data and summaries of the analyses of variance are given in Tables 1 and 2, respectively.

Table 1. Average test weight per bushel for two sample sizes of 11 oat varieties grown at Madison, Wisconsin, in 1965 and 1966.

	Test Weight (lbs/bu)[1/]	
Variety	(100 ml)	(Std. Pint)
Beedee	37.3	37.8
Brave	35.5	36.3
Clintland 64	34.7	35.3
Garland	35.9	36.1
Garry	34.9	35.0
Goodfield	37.0	37.2
Lodi	35.4	35.5
Orbit	33.1	33.8
Ped. 7	32.9	33.0
Sauk	35.2	35.8
Tyler	34.7	35.2
1965 Mean	35.0	35.7
1966 Mean	35.2	35.4

1/ Two-replicate average.

Table 2. Summary of analyses of variance for test weight per bushel of 11 oat varieties grown in 1965 and 1966. (Factor A = Varieties and Factor B = Sample Sizes.)

1965

Source of Variation	df	SS	MS	F	.05	.01
Blocks	3	1.437	0.479			
Varieties, A	10	130.757	13.076	15.33**	2.16	2.98
Error a	30	25.580	0.853			
Sample Size, B	1	9.230	9.230	45.02**	4.14	7.47
Interaction, AB	10	1.554	0.155	0.76ns	2.13	2.92
Error b	33	6.762	0.205			
Total	87	175.320				

C.V.(a) = 2.6%
C.V.(b) = 1.3%

Standard Errors

Two variety means	0.46 pound
Sample size means	0.10 "
Sample size means in the same variety	0.32 "
Two variety means for the same sample size	0.52 "

1966

Source of Variation	df	SS	MS	F	.05	.01
Blocks	3	3.203	1.068			
Varieties, A	10	303.964	30.396	11.99**	2.16	2.98
Error a	30	76.069	2.536			
Sample Size, B	1	0.423	0.423	3.25ns	4.14	7.47
Interaction, AB	10	3.136	0.314	2.42*	2.13	2.92
Error b	33	4.286	0.130			
Total	87	391.081				

C.V.(a) = 4.5%
C.V.(b) = 1.0%

Standard Errors

Two variety means	0.80 pound
Sample size means	0.08 "
Sample size means in the same variety	0.26 "
Two variety means for the same sample size	0.82 "

Analysis of variance for the 1965 data showed a highly significant difference in test weight for varieties and sample size. The difference between sample size means for the 11 varieties and selections in 1965 was only 0.7 pound. The maximum difference for a single entry was 1.0 pound for 'Clintland 64'. 'Goodfield' had the same test weight for the two sample sizes and the mean test weight of five of the 11 entries differed by 0.6 pound or less for the two sample sizes. The interaction F value was not significant at the .05 level.

Analysis of variance for the 1966 data showed a highly significant difference in test weight for varieties, but not for sample size. The F value for interaction exceeds the .05 level of significance, but not the .01 level. The difference between sample size means for the 11 entries in 1966 was only 0.2 pound. The maximum difference for a single entry was 0.8 pound for 'Brave'. The mean test weight of ten of the 11 entries differed by 0.6 pound or less for the two sample sizes and five differed by 0.2 pound or less. Although the standard one-pint sample size is presumably more accurate, the 100 ml volume of grain permitted a very satisfactory determination of test weight per bushel and can be very useful in evaluating early generations.

The closeness of threshing influences test weight to a considerable extent. Test weight determinations were made for 441 replicated F_3 entries involving five crosses using both "rubbed" and "unrubbed" grain. The entries were all grown in 1965 at Madison. The unrubbed samples were of well threshed grain directly from a small plot thresher, whereas the grain of the rubbed samples were subjected to uniform vigorous rubbing within a rubber inner-tube. Test weight averaged 32.9 pounds per bushel for the 441 unrubbed entries compared to 37.6 pounds after rubbing. Correlation coefficients between rubbed and unrubbed determinations ranged from .78 to .90 for the five crosses. The coefficients were all significant at the .01 level. Estimates of heritability and expected genetic advance were similar for both determinations as were the coefficients of variability and standard errors. (See Table 3.)

Table 3. Summary of estimates of heritability and expected genetic advance and other statistics for test weight (TW1 = unrubbed and TW2 = rubbed) of F_3 lines of certain oat crosses grown in 1965.

Cross 1/	No. Lines	Mean Test Wt. TW1	Mean Test Wt. TW2	Heritability TW1	Heritability TW2	Genetic Advance TW1	Genetic Advance TW2	C.V. (%) TW1	C.V. (%) TW2	Standard Error TW1	Standard Error TW2
Q x Bde	100	34.1	38.1	.81	.82	1.67	1.67	1.9	1.6	0.64	0.62
Q x C	121	31.4	35.7	.86	.88	2.75	2.54	2.8	2.0	0.88	0.72
Q x RL 2123	100	32.7	38.5	.84	.75	1.98	1.63	2.0	2.0	0.66	0.77
X1248 x Q	20	33.2	38.1	.65	.77	1.14	1.32	2.4	1.6	1.01	0.80
Gld x CI 7674	100	33.6	38.6	.76	.82	1.64	1.84	2.2	1.7	0.75	0.67

1/ Q = Q-0-30-28; Bde = Beedee; C = Coker 61-13; RL 2123 = RL 2123.38; X1248 = Wisconsin X1248; and Gld = Garland.

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