N. F. Jensen

# 1971

# OAT NEWSLETTER

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# OAT NEWSLETTER

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May 1, 1972

Sponsored by the National Oat Conference

J. Artie Browning, Editor

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# I. CONFERENCE AND REGIONAL NOTES

## ORGANIZATION OF THE NATIONAL OAT CONFERENCE

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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. Volume 21 was issued in December 1971. Sent by surface mail, it would not have been received by some until well into 1972. Write the editor if your copy was not received.

## PLEASE DO NOT CITE THE OAT NEWSLETTER IN PUBLISHED BIBLIOGRAPHIES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", in accordance with the rules of the journal concerned.

# Report of Committee on Oat Gene Nomenclature

M. D. Simons and N. F. Jensen

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

Descriptions of genes initially recognized were published in 1966 (Simons, Zillinsky, and Jensen, 1966). The list was brought up to date in 1970 (Simons and Jensen, 1970). Genes recorded since, and the references for them, are shown below.

Pc-45. Fleischmann, et al. (1971a). Dominant gene in *Avena sterilis* F-196 for resistance to *Puccinia coronata*.

Pc-46. Fleischmann, et al. (1971a). Dominant gene in *A. sterilis* F-290 for resistance to *P. coronata*.

Pc-47. Fleischmann, et al. (1971b). Dominant gene in C.I. 8081A for resistance to *P. coronata*.

Pc-48. Fleischmann, et al. (1971b). Dominant gene in *A. sterilis* F-158 for resistance to *P. coronata*.

Pc-49. Fleischmann, et al. (1971b). Dominant gene in *A. sterilis* F-158 for resistance to *P. coronata*.

Pc-50. Fleischmann, et al. (1971b). Dominant gene in *A. sterilis* CW-486-1 for resistance to *P. coronata*.

Pc-51. Browning. (1972). Dominant gene in *A. sterilis* Wahl #8 (C.I. 8079), and also in Iowa Mid-Season Isoline X-270 and Early Isoline X434, for resistance to *P. coronata* (Singh, 1972).

Pc-52. Browning. (1972). Cominant gene in *A. sterilis* Wahl #2, and also in Iowa Mid-Season Isoline X-421, for resistance to *P. coronata*.

Browning, J. A. 1972. Unpublished data. Department of Botany and Plant Pathology, Iowa State University, Ames, Iowa 50010.

Fleischmann, G., R. I. H. McKenzie, and W. A. Shipton. 1971a. Inheritance of crown rust resistance in *Avena sterilis* L. from Israel. Crop Sci. 11: 451-453.

Fleischmann, G., R. I. H. McKenzie, and W. A. Shipton. 1971b. Inheritance of crown rust resistance genes in *Avena sterilis* collections from Israel, Portugal, and Tunisia. Can. J. Genet. Cytol. 13: 251-255.

Simons, M. D. and N. F. Jensen. 1970. Report of committee on oat gene nomenclature. 1969 Oat Newsletter 20: 45-46.

Simons, M. D., F. J. Zillinsky, and N. F. Jensen. 1966. A standardized system of nomenclature for genes governing characters of oats. Crops Research Division, ARS 34-85, U. S. Dept. of Agric. 22 pp.

Singh, B. P. 1971. Characterization in isogenic lines of oat crown rust resistance genes from four sources. Ph.D. Thesis. Iowa State University, Ames, Iowa.

## II. ABSTRACTS OF PAPERS PRESENTED AT THE NORTH CENTRAL OAT CONFERENCE, St. Paul, Minn., January 31-February 1, 1972. (In alphabetical order by senior author).

### Self-sterility, cross fertility, and chromosome constitution of 6x-amphiploid x *Avena sativa* substitution lines

R. A. Forsberg and G. Ladizinsky

While cytoplasmic male sterility, coupled with a suitable restorer system, has been used to produce $F_1$ hybrids in both corn and wheat, cytoplasm-genome relationships which result in male sterility have not yet been discovered in *Avena*. A genetic, chromosomal, chemical, or cytoplasmic system which would lead to the commercial production of $F_1$ oat hybrids would have great value. That heterosis for yield exists in $F_1$ oat hybrids has been demonstrated by several workers.

In wheat, cytoplasmic male sterile lines have been developed by substituting *Triticum aestivum* genomes into tetraploid *T. timopheevi* cytoplasm. In 1966, steps were initiated to substitute genomes of *Avena sativa* C.I.6936 into 6x-amphiploid cytoplasm by continuous backcrossing (BC). The amphiploid was developed from an *A. abyssinica* (2n=28) x *A. strigosa* (2n=14) cross so in a sense, the *sativa* genomes were substituted into tetraploid cytoplasm. $A_9$-$A_{12}$ amphiploid plants were utilized as female parents in the initial cross.

Two consecutive generations were grown each year, one in the greenhouse and one in the field. In the field, sister plants in BC $F_1$ lines were grown in three series: (1) a hand-crossing series, (2) an open pollination block, and (3) a series isolated from other oats. The open pollination blocks were 30'x30' with the BC $F_1$ plants in the center, surrounded by C.I.6936. The desired performance among BC $F_1$ plants was high cross (female) fertility in hand crosses, low self-fertility when bagged, and high fertility (female) under open pollination.

In the first through fourth backcross generations, the degree of sterility within lines was reasonably uniform. However, in later backcross generations within-line variability for sterility increased, e.g., from less than 5% to over 50% self-fertility among sister plants, and it was hypothesized that the sterility was chromosomal and not cytoplasmic.

Self-fertility in nonbagged panicles in the three $BC_9F_1$ series ranged from 3 to 68%. Seed set in nonbagged panicles of $BC_9F_1$ plants in the isolation series equalled or exceeded that of their sister plants in the open pollination block. This latter demonstration of both female and male fertility was a further indication that the sterility encountered was chromosomal in nature.

Seed set in bagged panicles was considerably reduced, a common result in aneuploid grasses. Eleven of 13 $BC_9F_1$ plants had seed sets of less than 5% in bagged panicles.

Examination of meiosis in 14 $BC_9F_1$ plants revealed chromosome numbers of 39 (one plant), 40 (six plants), and 42 (seven plants). The most frequent configurations were $19_{II} + 2_I$ and $20_{II} + 2_I$. The relatively good vigor of the 2n=40 plants ($19_{II}+2_I$), plus the expectation that the male gametes of the recurrent sativa parent carried the normal chromosome complement of n=21, led to the conclusion that $19_{II}+2_I$ plants were double monosomics, rather than nullisomic for a specific pair of chromosomes with nonhomology between members of a second pair. In the 2n=42 plants ($20_{II}+2_I$), one sativa chromosome did not have a homologous mate. The plant with 39 chromosomes ($18_{II}+3_I$) was very probably a triple monosomic, a conclusion supported by the fact that the plant was moderately vigorous. Plants with $21_{II}$ were not found, confirming the aneuploid cause of sterility.

Seed set in hand crosses was relatively high after the $F_1$ generation. Among $BC_9F_1$ plants, the average seed set in crosses on six $19_{II}+2_I$ plants was 35%, on five $20_{II}+2_I$ plants--45%.

## Grain Yield and Adaptation Reactions of Oat Isolines

K. J. Frey

**Two groups of oat isolines (an early and a midseason) developed via backcrossing were yield-tested in 15 experiments that had a range of productivity indexes from 25.6 to 42.2 q per ha. Isolines within a group were compared for mean grain yields and the regression stability parameter.**

**The isolines in a group were quite homogeneous for appearance, plant height, heading date, and seed traits. However, for grain yield, 3 isolines in the early and 4 in the midseason group produced grain yields that were significantly deviant from the respective recurrent parents. Two were negative and 5 were positive. The regression value for neither recurrent parent was significantly different from 1.0, but 5 midseason and 4 early isolines had b values significantly different from unity. Generally, if one isoline of a pair (i.e., one early and one midseason) with crown rust resistance from the same donor cultivar had a negative deviation for b, the other one had a positive deviation.**

## Breeding for High Protein in Oats

K. J. Frey

Increasing the protein percentages in oat caryopses of adapted cultivars is being attempted via 3 avenues -

1. Transfer of genes for high protein percentage from *Avena sterilis* collections to *A. sativa* lines.

2. Search in *A. sativa* populations for high protein lines.

3. Inducing mutations for high protein percentage.

Crosses between *A. sterilis* and *A. sativa* lines have indicated that the differential protein percentages between lines is inherited rather simply and that one chromosome may bear loci with major effect on protein percentage. To date, 10 *A. sterilis* lines have been used in the Iowa program.

The variation among oat lines from breeding populations of *A. sativa* for protein percentage has been greater than expected (up to $\overline{30.0\%^{+}}$). Standard unit heritabilities between protein percentages for seeds from single plants and seeds from bulked progenies from these plants have ranged from 35 - 48%.

To date, 2 sets of mutagen-derived lines (from Clintland and Goodfield) and comparable sets of check lines have been analyzed and in both cases, the range of protein percentages in the grain have been expanded by the mutagen treatment. Most protein-mutant lines produce low yields, however.

## Morphological, Ecological, and Cytogenetical Characteristics of *Avena prostrata* (2n=14)

Gideon Ladizinsky

*Avena prostrata* is a recently discovered oat. Morphologically, it is close to the diploid forms of *A. strigosa* but can be distinguished from them by its prostrate habit and by the relatively short (2-4 mm) bristles at the tip of the lemma.

*A. prostrata* was collected in eight different locations in the arid zone of southeast Spain between Lorca and Granada, where it is apparently common. Morphologically, these collections are rather similar and the hybrids between them are fertile with normal meiosis (Table 1). In its type locality, *A. prostrata* thrives on relatively shallow soil in undisturbed as well as secondary habitats. It grows along roadsides, dry water course, and on limestone and metamorphic hills, from sea level up to 500 m altitude. Similar to all other species of oat, *A. prostrata* sets seed upon bagging and can be regarded as a self-pollinated species. However, at the beginning of the blooming season, the anthers shed their pollen largely outside the floret. Seed set in these instances is conspicuously low.

A. prostrata was easily crossed with A. strigosa (2x) and A. longiglumis, but the hybrids were completely sterile. It is apparently cross incompatible with the other diploid oats, namely, A. clauda and A. ventricosa. So far, crosses in these combinations have not yielded any hybrid seed.

Karyomorphologically, A. prostrata and A. strigosa (2x) differ mainly in respect to a chromosome with a subterminal centromere. This chromosome is more symmetric in A. prostrata than in A. strigosa (2x). Arm ratios are 0.43 and 0.28, respectively. The equivalent chromosome in A. longiglumis has almost entirely symmetrical arms. At least in respect to this chromosome A. prostrata is an intermediate form between the other members of this species aggregate. More peculiar are the chromosome relationships in meiosis in the hybrids involving A. prostrata and the other two related species. The A. longiglumis x A. prostrata hybrid showed fairly regular meiosis with 7 bivalents in about 30% of the P.M.C., but frequently up to 6 univalents were observed. A single translocation was rarely detected (Table 1). Contrarily, the A. strigosa x A. prostrata hybrid showed tremendous meiotic irregularity with very frequent occurrence of trivalents, quadrivalents, pentavalents, and even a hexavalent (Table 1). These chromosome configurations indicate that the hybrid is heterozygous for five different translocations, a situation very similar to what has been found in A. longiglumis x A. strigosa diploid hybrids.

The morphological similarity between A. prostrata and A. strigosa (2x) from one hand, and the close cytogenetical relationships with A. longiglumis from the other hand suggest that the mode of speciation in this species aggregate is rather complex. It is reasonable to assume that the extensive chromosomal repatterning we envisage today in this group rests on some yet unveiled, intermediate links. The discovery of three new species of oat in the last 4 years leaves great hope that such hypothetical units still exist in the Mediterranean basin, the home land of the Avena species. An appropriate effort and further exploration have a good chance to provide us with more new species in the future.

Table 1. Meiotic behaviors of diploid hybrids involving A. prostrata

| Combination | No. cell | I | Rod II | Ring II | Tot. II | III | IV | V | VI | Assoc/chr |
|---|---|---|---|---|---|---|---|---|---|---|
| prostrata x prostrata | 30 | | 1.20 (0-4) | 5.80 (3-7) | 7 | | | | | 1.82 ± 0.17 |
| hirtula x prostrata | | | | | | | | | | |
| NV4 x DI4 | 150 | 1.32 (0-4) | 1.52 (0-3) | 0.06 (0-2) | 1.59 (0-4) | 1.70 (0-3) | 0.42 (0-2) | 0.43 (0-2) | 0.09 (0-1) | 1.26 ± 0.09 |
| 6541 x DI4 | 60 | 2.13 (0-7) | 1.53 (0-4) | 0.04 (0-3) | 1.57 (0-4) | 1.60 (0-3) | 0.27 (0-2) | 0.53 (0-2) | 0.03 (0-1) | 1.13 ± 0.12 |
| longiglumis x prostrata | 100 | 2.10 (0-6) | 3.06 (1-6) | 2.68 (1-4) | 5.74 (3-7) | 0.06 (0-1) | 0.06 (0-1) | | | 1.22 ± 0.14 |

# Prevalence of Oat Stem Rust in 1971

A. P. Roelfs and P. G. Rothman

Oat stem rust, *Puccinia graminis* Pers. f. sp. *avenae* Frasier & Led. was first reported in 1971 on March 17 in a nursery at College Station, Texas. Severities at this time of 40-80% were reported (personal communication M. E. McDaniel). Stem rust was severe in nurseries in east central Texas and southern Louisiana. However, only light amounts were found in commercial fields due to a severe drought during the early part of 1971. Traces of stem rust were reported on oats in northeastern Nebraska on June 22, and in Iowa on June 25. During early July, stem rust spread in trace amounts across Minnesota. Although the initial incidence of oat stem rust occurred about the same time as in 1970, the infection density was lower, and the oats were more mature resulting in only trace amounts of loss.

Oat stem rust occurred throughout the major oat growing areas in 1971, though only in trace amounts. Race 31 comprised 63% of the 937 isolates from 338 collections received at the Cooperative Rust Laboratory. Other races frequently isolated were race 7 (12%), 87 (7%) and 32 (5%) of the total isolates. Race 87 was frequently isolated from uninoculated nurseries in Ontario, Canada; in the barberry nursery at Center County, Pennsylvania; and in an inoculated nursery at St. Paul, Minnesota. Race 7 was an important portion of the identified population from *Avena fatua* and from varieties without genes *Pg* 4 and *pg* 8 in the northern oat growing area. Race 32 comprised 88% of the isolates from the few commercial fields sampled in southern Texas.

# Distribution of Races of *Puccinia graminis avenae* Identified from Collections Made in the 1971 Uniform Oat Rust Nursery

P. G. Rothman and A. P. Roelfs

Fifty-four uredial collections from entries in the 1971 UORN were received by the Cooperative Rust Laboratory. From these collections, 153 selected single pustule isolates were identified. The data are summarized below.

| | Number Isolates Per Race | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Source | 6 | 7 | 6A 20 | 7A 21 | 6AF 31 | 7AF 32 | 7F 61 | 6AH 87 | 7AH 88 | 13AH 93 | 6AFH 94 | 13AFH 97 |
| Iowa | | | | | 6 | | | | | | | |
| La. | | | | | | 3 | | | | | | |
| Minn.* | | 14 | | | 20 | | | 10 | | | | |
| N.D. | | 2 | | | 3 | | | | | | | |
| Pa.** | | 7 | 1 | | 3 | | 5 | 11 | | 3 | 1 | 2 |
| Texas | | | 2 | 1 | 27 | 2 | | | 2 | | | |
| Canada | 1 | 3 | 1 | | 13 | | | 9 | | | | |
| TOTAL | 1 | 26 | 4 | 1 | 72 | 5 | 5 | 30 | 2 | 3 | 1 | 2 |
| PERCENT | 1 | 17 | 3 | 1 | 47 | 3 | 3 | 20 | 1 | 2 | 1 | 1 |

*inoculated nursery races 31 and 87 ** barberry nursery

Race 31 continued to be the most prevalent race, a position it has held since 1965. The high prevalence of race 87 is weighted by the inoculum pressure exerted by the presence of barberry in the Pennsylvania nursery and the inoculation of the Minnesota nursery with this race. Race 7, which predominated in the rust population during the 1950's, made a sudden reappearance after a complete absence for the past five years. The entire old race 7 group warrants attention, and the need for the continual utilization of gene Pg 2 should not be overlooked in the breeding programs.

## Reaction of Abd 101 Crown Rust Resistance Gene in Hexaploid Oats

K. Sadanaga

C18 is a dark-seeded, hexaploid oat derived from crossing Abd 101 (C.I. 7232) and *A. sativa*. It carries gene Pc-15, conferring resistance to crown rust races 264 and 290, of C. D. 3820, the resistant diploid parent of C.I. 7232. Although the standard karyotype of hexaploid oat includes 4 pairs of metacentric and 7 pairs of subtelocentric chromosomes, C18 has 5 and 6 pairs of metacentric and subtelocentric chromosomes, respectively. In rust tests with race 290, the $F_2$ segregation in hybrids between C18 X susceptible hexaploids and Monosomic 3 (metacentric chromosome 3) X C18 fit a simplex trisomic ratio of 2 resistant:1 susceptible. Resistance in the progenies of the monosomic hybrid was not associated with the presence or absence of the M3 chromosome. However, resistance was tightly linked to dark kernels in $F_2$ progenies.

X117, a hexaploid oat with 2 small fragments, also carries Pc-15 of C.D. 3820. The association of resistance and dark kernels has been broken in this line. Rust tests with race 290 showed, that in the $F_2$ generation of crosses between susceptible varieties and X117, only seedlings with the fragment were resistant. Pc-15, therefore, is located on the fragment. In hybrids between the two resistant lines C18 and X117, the fragment did not pair with the homologous segment in C18 and, consequently, susceptible seedlings segregated in the $F_2$ generation.

## Some Observations of Oat Groats

H. L. Shands and R.D. Duerst

More than 10,000 samples of oat groats have been observed during five years of breeding for increased protein content at Madison, Wisconsin. Samples were those obtained by dehulling by hand, wringer, and the Quaker Oats centrifugal machine. The greatest part of dehulling has been with the impact method, (centrifugal machine). A groat score has been recorded for most of the samples, with a number ranging from 0 - 10 at .5 intervals on a subjective desirability scale. Plus or minus (+ or -) values have been used in an attempt to refine the readings. Only a few have been given a value of 5 or below; most have been 8 or above, with a word comment added to the description. Some of the words referring to gross morphology are short, medium, long, narrow, wide, and thick. Additional words refer to the exterior appearance, or color, such as bright, dull, dirty, light. The word "slightly" is used in modifying certain other words.

Detailed measurements as to length, width, thickness, depth or width of crease have not been made; nor have groat weights been determined systematically. These may be desirable, yet time seems to be a limiting factor. Estimates of germ-endosperm ratios have not been attempted. Other workers have written on geometry of the caryopsis and grain. In a study of $F_4$ selected progenies groat grade and protein had an insignificant r value of +.154. Natural staining of portions of the caryopsis, especially the crease, and sometimes the germ result in the "dirty" description. Since there are different levels of dirtiness, more recently we have given a grade such as 9-, 2d. This means more dirtiness than 1d but less than 3d which could cover both intensity for individual groats and the proportion of groats showing this characteristic. Thus far, there has been a tendency for the "dirty" samples to have higher proteins.

Often caryopsis filling is deficient in A. sterilis selections and progenies of A. sativa and A. sterilis. Some of these progenies with a low groat grade and undoubtedly low caryopsis weight, have high protein percentages that are reduced when better filled in subsequent generations.

Some color slides of groat types primarily of A. sativa origin were projected on the screen, illustrating points raised in the discussion. Financial support in part by the Quaker Oats Company.

## Crown Rust Race Situation

M. D. Simons

The most important development in the crown rust race situation is the steady increase of race group 264B. This race group first appeared in quantity in 1966, when it made up about 4% of the total isolates identified; in 1971, it made up about 70%. It appears to be rather closely related to race group 290, differing only in its greater virulence toward Trispernia and Bondvic. Reaction of certain supplemental differentials clearly show the distinction between race group 264B and the old race group 264A. It is not always possible to clearly distinguish between race groups 264B and 290.

A comparison of races identified from material collected from oats with material collected from buckthorn suggests that changes in prevalence of the major race groups on buckthorn follow, rather than lead, changes that occur in material collected from oats.

The use of new sources of resistance as supplemental differentials has shown that certain sources are resistant to almost all isolates. The annual survey is now being geared for closer cooperation with the Iowa and Manitoba oat breeding programs. This will include a better evaluation of the potential values of isogenic lines produced by these programs.

## Crown Rust Tolerance Transferred from *Avena sterilis* to Cultivated Oats

M. D. Simons

*Avena sterilis* growing wild in Israel is often heavily infected with crown rust, but seed quality doesn't seem to be seriously affected. A study was undertaken to determine whether this "tolerance" (if it exists) could be transferred to cultivated oats. Three strains of *A. sterilis* having no visually detectable resistance were crossed with the highly susceptible cultivar Clinton and Richland. Segregates morphologically similar to cultivated oats were tested in $F_6$ and $F_7$ for tolerance to crown rust as measured by depression in yield and seed weight due to infection. Seed weight of all segregates from the Richland crosses and most segregates from the Clinton crosses was significantly less affected by rust than was seed weight of the respective parents. Yield of most segregates from the Richland crosses was less affected than was the yield of Richland, but no difference could be shown between yield depression of most of the segregates from Clinton and the yield depression of Clinton.

## Protein Distribution in the Oat Kernel (*Avena sativa* L. and *A. sterilis* L.)

V. L. Youngs and D. M. Peterson

Five cultivars and two experimental lines of *Avena sativa* L. (common oats), grown at Madison, with a wide range of protein were studied. Percent groats, groat and hull protein, 1000 kernel weight, and bran thickness of the groats were measured. Groats from each variety were hand-dissected into the embryonic axis, scutellum, bran (aleurone layer included) and starchy endosperm. The embryonic axis accounted for 1.1-1.4% of the total groat weight; scutellum, 1.6-2.6%; bran, 28.7-41.4%; endosperm, 55.8-68.3%. Analysis of each groat fraction for protein showed the greatest concentration in the embryonic axis, with a range of 26.3-44.3%; scutellum next, 24.2-32.4%; followed by the bran, 18.5-32.5%; and endosperm 9.6-17.0%. Both the bran and endosperm protein concentrations increased as the total groat protein increased. Since most of the groat weight is in the bran and endosperm, these fractions contained the greatest portion of the total groat protein. Bran thickness was measured on 12 different varieties (range 0.058-0.101 mm), and varied directly with groat protein (r = 0.90).

Because of the present interest in using lines of high protein *Avena sterilis* in oat breeding programs, a similar study was conducted on 20 varieties from the 1969 Cooperative Elite *A. sterilis* Nursery, compared with *A. sativa* (Markton, 17.8% protein, dry basis), all grown at Aberdeen, Idaho. All varieties of *A. sterilis* contained groat protein concentrations in excess of 21% (d.b.), and all were considerably lower in groat yield and 1000 kernel weight than Markton. There was a range of 0.061-0.101 mm in bran thickness among the 20 varieties, with no correlation between bran thickness and percent groat protein as there was in the previous study. The range in weight distribution of the groat fractions was embryonic axis, 0.8-1.9%; scutellum, 1.0-

2.4%; bran, 33.0-48.1%; endosperm, 49.5-64.0%. Although values for Markton were within these ranges, the weight of each fraction was generally lower in the *A. sterilis* lines because of the lower 1000 kernel weight. Range in protein concentration was embryonic axis, 30.2-47.2%; scutellum, 22.0-45.1%; bran, 30.1-37.9%; endosperm, 14.6-22.9%. However, with one exception (C.I. 8288, endosperm fraction) the actual amount of protein (mg per groat fraction) was lower in all 20 varieties than the corresponding fraction in Markton. Most of the protein appeared in the bran and endosperm, and as the total groat protein increased, so did the protein in each of these fractions.

## III. SPECIAL REPORTS

### The Eradication Effect of Resistant Oat Varieties on Oat Stem Eelworm (*Ditylenchus dipaci*)

D. Cameron

The cultivation in Scotland of a resistant oat variety on land heavily infested by Oat Stem Eelworm brings about a substantial reduction in the level of attack in a succeeding susceptible variety. The eradication is not complete and a further succeeding susceptible oat is again heavily attacked.

This was clearly demonstrated in an experiment in which various sequences of (R) resistant (Selection E.29) and (S) susceptible (Craigs Afterlea) material was grown in successive years.

Twelve plots were isolated from each other by bands of lawn turf on land which had previously been artificially infested with large numbers of eelworm larvae, and on which a heavy rate of attack was ensured each year by watering to supplement the natural rainfall. Weeds which are alternative hosts for the parasite were eradicated.

The cropping succession was as follows:

| Year | Plot 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | S | S | S | S | S | S | S | S | S | S | S | S |
| 2 | R | S | S | R | R | S | S | R | R | S | S | R |
| 3 | S | R | S | R | R | R | S | R | S | R | S | R |
| 4 | S | S | R | S | S | R | R | R | S | R | S | R |
| 5 | S | R | S | R | S | S | R | S | R | R | S | R |
| 6 | S | S | S | S | S | S | S | S | S | S | S | S |
| 7 | S | S | S | S | S | S | S | S | S | S | S | S |

At no time did any of the R plots show signs of attack by the stem eelworm, and observations made on S plots in earlier years were confirmed in years 6 and 7.

In year 6, a susceptible variety was sown on all plots as a means of bioassay of the level of infestation. On inspection, all plants in Plots 1 and 11 were seen to be affected and had a high mortality rate. Plots 3, 5, 6, and

8 were little better, and indistinguishable from each other, while 2, 4, 7, 9, 10 and 12 showed only slight signs of attack. Again it was not possible to distinguish one from the other.

In year 7, when again a susceptible variety was sown throughout, all plots were heavily attacked and no distinction was attempted.

Under the conditions of the experiment it was concluded that a resistant variety did have an eradicatory effect on the Stem Eelworm population in the soil, that the eradication was not complete even after four consecutive years of resistant cropping, and that the eradicatory effect is undone by growing susceptible variety only one year.

It is appreciated that continuous oat cropping is not normal practice, and one can only speculate as to the effect of, say, four successive resistant crops over a period of some 20 years. In the case of a parasite which has as alternative hosts many of the weeds of cultivation, as well as other crops such as field beans, total eradication may well prove an unattainable ideal.

## Genetics of Naked Oats

G. Jenkins

We have found that the expression of the Avena nuda character-complex of naked grain, multiflorous spikelets, and elongated rachillae is greatly influenced by the environment. In particular, short days increase the proportion of multiflorous spikelets. However, the proportion of husked grains in A. nuda varieties is a much more constant characteristic.

Control of the A. nuda characters has usually been attributed in the literature to a single incompletely dominant gene, although modifiers have frequently been invcked to account for the perplexing $F_2$ ratios that are sometimes obtained. Our recent work does not support this view.

Instead of grouping $F_2$ segregates into somewhat arbitrary categories defined by the proportion of naked grains or multiflorous spikelets, we adopted only two classes: those plants having any naked grains and those with none. Five A. nuda varieties or selections were inter-crossed and also crossed onto the same A. sativa tester line, the Institute selection AJ 13/111. The $F_2$ segregation of the five test crosses provides good evidence for the determination of the A. nuda characters by two complementary dominant genes.

$F_2$ Segregation in A. nuda x A. sativa crosses

| Cross (Reciprocals combined) | Numbers of plants classified as:- A. nuda | A. sativa | $\chi^2$ (9:7) | P |
|---|---|---|---|---|
| Caesar x AJ 13/111 | 123 | 111 | 1.29 | 0.50-0.20 |
| Nuprime x AJ 13/111 | 195 | 181 | 2.94 | 0.10-0.05 |
| Chimensis x AJ 13/111 | 179 | 144 | 0.09 | 0.95-0.50 |
| Manu x AJ 13/111 | 194 | 166 | 0.82 | 0.50-0.20 |
| AJ 86/2/1 x AJ 13/111 | 161 | 147 | 1.98 | 0.20-0.10 |

This result is explicable if it is assumed that the *A. sativa* line, AJ 13/111, is the double recessive, whereas in previous accounts the *A. sativa* parent used possessed one of the genes in a dominant condition. This hypothesis is being tested further.

## Breeding for Race Specific Resistance against Scandinavian Oat Stem Rust

James MacKey and Bengt Mattsson

The classical quadripartite race key based upon genes *Pg*1 (D), *Pg*2 (A), *Pg*3 (E) and *Pg*4 (B) for resistance to oat stem rust (*Puccinia graminis* Pers. f. sp. *avenae* Eriks. et Henn.) has shown races 1, 1A, 2, 2A, 3, 3A, 4, 4A, 6, 6A, 7, 7A, 8, 8A, 11, and 11A to occur in Scandinavia. These 16 races represent all possible recombinations of four matching genes for virulence in the studied rust population. Race 6A, which is one of the more common races in Scandinavia, carries the *v*1, *v*2, *v*3 and *v*4 genes for virulence but representatives of this race might, in addition, carry any other gene for virulence not detectable by the limited key.

In the search for new genes for resistance, 3,586 entries of oats were screened with the oat stem rust isolate Leijerstam 6AB 26-59. Most of this oat material was kindly supplied by Dr. J. C. Craddock, USDA World Collections. Twelve resistant entries were found. Among those five belong to the diploid *A. strigosa* oats, i.e. Saia (CI 4639, CI 6954, CI 7010, PI 186606) and Turkey (CI 6858). Attempts were made to transfer this type of resistance to 6x *A. sativa* oats cv. Sol II but have so far failed. The other seven resistant entries belong to the hexaploid *A. sativa* oats, i.e. S 81 (CI 3369, CI 4107, CI 4895, PI 193094), S 172 (CI 4223), S 225, Milford (CI 5039), and Winter Turf (CI 1570). They all have proved to possess one and the same dominant - semi-dominant gene giving resistance to the concerned rust isolate. This new gene, tentatively called *N*, gives infection type 1-2 and is easily broken down by other Scandinavian 6A-isolates.

Observations, mainly by Dr. B. Leijerstam, indicate that genes for virulence are also available in the Scandinavian oat stem rust population to match resistance genes *pg*8 (F), the American gene G, *pg*9 (H), *pg*11, and the non-H gene of the oat 'Rosen's mutant'.

It is theoretically interesting but for practical plant breeding very disturbing that a parasite population like that of oat stem rust in Scandinavia maintains so many genes for virulence. In the concerned region, which offers a fairly good geographical isolation under rather extreme ecological conditions, the population of oat stem rust apparently has never been subjected to the differentiating effect of race-specific resistance present in the crop plant host. The present study really gives no support to the idea that virulence should be associated with decreased vitality and thus tend to disappear when not needed.

## Frequency of Stem Rust Epidemics on Oats and Wheat

J. B. Rowell, P. G. Rothman, and A. P. Roelfs

Since 1918, yearly estimates of losses in wheat and oat yields caused by Puccinia graminis have been compiled from many states by personnel of the Department of Plant Pathology and the Cooperative Rust Laboratory at the University of Minnesota. Although these annual estimates encompass many uncertainties, a high estimated loss for a state indicates that factors of host susceptibility, pathogen virulence, inoculum abundance, and weather suitability favored development of stem rust epidemics on the crop. The table compares the number of years that stem rust caused losses of at least 1% with the number of years that these losses exceed 5% in oats and wheat. This separates the years in which the incidence of stem rust might be considered inocuous from the years which might be considered epidemic years.

Generally losses were incurred more frequently in wheat than in oats. Severe oat stem rust epidemics occurred with greatest frequency in the north-central states of North Dakota, South Dakota, and Minnesota. In these states, estimated losses of 5% or more from oat stem rust invariably coincided with severe epidemics of wheat stem rust. In these epidemics, however, the proportionate loss in yields of oats were never as great as of wheat. Thus, some major difference exists between the two crops in the parameters for the two epidemics.

Since 1955, losses of 5% or more were recorded in 5 years on wheat crops in one or more of these three states, but never on oats. The commercial oat varieties are susceptible to race 31 (6AF), the predominant race of oat stem rust since 1965. Thus, the factors for host susceptibility, pathogen virulence, and weather suitability favorable for epidemics of oat stem rust apparently have existed repeatedly during these years. Presumably, the absence of any recent epidemics of oat stem rust since 1955 in the north-central states must be ascribed to insufficient primary inoculum from sources in southern states.

Table 1. Number of years that stem rust caused estimated losses of 1% or more in oat and wheat yields from 1919 to 1970.

| | No. of years losses were: | | | | | |
|---|---|---|---|---|---|---|
| | ≥5% | | | ≥1% | | |
| State | Oats | Wheat | Both | Oats | Wheat | Both |
| N. D. | 8 | 18 | 8 | 17 | 26 | 13 |
| Minn. | 7 | 17 | 7 | 21 | 23 | 15 |
| S. D. | 6 | 17 | 6 | 21 | 28 | 17 |
| Tex. | 4 | 3 | 2 | 19 | 18 | 14 |
| Ia. | 4 | 9 | 2 | 12 | 19 | 8 |
| Mich. | 4 | 3 | 1 | 11 | 13 | 5 |
| Ill. | 3 | 2 | 0 | 11 | 16 | 7 |
| Kan. | 3 | 5 | 0 | 10 | 11 | 6 |
| Neb. | 3 | 13 | 1 | 7 | 18 | 4 |
| Wisc. | 2 | 10 | 2 | 14 | 23 | 11 |
| Okla. | 1 | 0 | 0 | 9 | 12 | 6 |
| Pa. | 1 | 1 | 0 | 6 | 5 | 2 |
| Va. | 0 | 5 | 0 | 17 | 31 | 17 |
| W. Va. | 0 | 6 | 0 | 6 | 31 | 6 |
| Ohio | 0 | 1 | 0 | 6 | 17 | 6 |
| Mo. | 0 | 2 | 0 | 6 | 11 | 3 |
| Ind. | 0 | 2 | 0 | 6 | 7 | 1 |
| Mont. | 0 | 3 | 0 | 3 | 10 | 3 |
| Wyo. | 0 | 4 | 0 | 1 | 10 | 1 |
| Colo. | 0 | 3 | 0 | 1 | 12 | 1 |

# Oat Classification in the United States

Franklin A. Coffman

## Historical

Numerous papers that include some morphologic data on oat varieties in the United States have been received. However, to date only two oat classifications have been published: Etheridge, W. C. 1916. A Classification of the Varieties of Cultivated Oats. New York (Cornell) Agricultural Experiment Station Memoir 10, pp. 77-172, and Stanton, T. R. 1955. Oat Identification and Classification. USDA Technical Bulletin 1100, pp. 1-206.

An examination of Etheridge's publication reveals he lists more than 410 oats, many only by C.I. (Cereal Investigation) numbers. However, he presented morphologic information on only some 50 named oats and 4 others identified by C.I. numbers.

In Stanton's publication close to 500 oats are included. Of that total he listed some 215-220 as of most importance. Thus, well over 150 more varieties than were accorded special mention by Etheridge are included in Stanton's bulletin.

The date of publication of Stanton's bulletin is misleading. It appeared in 1955 or nearly 40 years after the work of Etheridge. However, one might incorrectly conclude Stanton's publication is today only some 17 years out of date. Examination reveals Stanton's "cut off" date was 1940-41; actually over 30 years ago. Stanton included only one Bond derivative; Camillia, C.I. 4079. As numerous Bond derivatives; Clinton, Andrew, etc. were released in the early to middle 1940's, one realizes how misleading the publication date of Stanton's work is. An explanation of why this took place is necessary.

World War II resulted in drastic cuts in USDA funds for field work and travel. This situation did not terminate with that War's end, but continued in the Cereal Division of the USDA for some 10 years, or until about 1950-51.

A second disaster to Dr. Stanton's classification work was that he developed his "heard condition", limiting both travel and field work for some years, or up to close to his retirement in the early 1950's.

Fortunately for those interested in oats he completed and published in 1955 his classification. He alone had much of that information he included, otherwise it would not be available to oat workers today. His bulletin was printed after he had retired.

## More Recent Efforts

At the request of Dr. Stanton, I made a study of oat varieties at Aberdeen, Idaho. from 1935-40. These efforts were terminated by World Warr II and the War curtailed travel for years afterward.

In 1955 the late Dr. H. C. Murphy, who knew of these previous efforts in oat classification encouraged me to renew such studies. They were continued during the period 1955-1962, at Aberdeen, Idaho, and throughout the decade since at Plant Industry Station, Beltsville, Maryland. Data on field grown plants; plant specimens and seed for growing the plants for study were supplied by Dr. Murphy until his death in 1968. Since then Dr. L. W. Briggle, Murphy's successor, has continued to do so.

In addition Dr. J. C. Craddock, In Charge of World Collections of Small Grains, USDA, and his assistants have been most helpful in supplying seed and plant specimens.

Others helpful in this endeavor have been Mrs. Karen Linthicum and R. T. Smith of the Beltsville Oat Investigations staff, Harland Stevens and Dr. Frank Petr at Aberdeen, Idaho, and scores of Agronomy workers at State Experiment Stations of the U.S. and Canada.

## Mission "Nearing Completion"

As a result of efforts begun in 1935, with a 13 year, (1941-1954) break this attempt to classify oats is nearing completion and presumably about ready for USDA editors and the printers.

As prepared it will include the history of oats in North America since early in the 1600's. The histories of and names of persons involved in producing the varieties will be included, together with the morphologic description of each oat. It should be of interest to oat men that such information will be available on well over 200 oat varieties released since Stanton's bulletin was prepared.

# "High Protein" Oats from the World Collection

L. W. Briggle and R. T. Smith

Entries in the Oat World Collection up to the year 1965 have been sampled and analyzed for protein content. Accessions after 1965 have not yet been systematically tested. Not all those analyzed for protein have been sampled adequately. Of those tested over a minimum of three years, 3 entries averaged 23.0 or more percent protein, 9 averaged 22.0 to 22.9 percent protein, and 50 averaged 21.0 to 21.9 percent protein. Another 35 entries had 20.0 to 20.9 percent protein.

In reviewing pedigrees of these "high protein" entries, it became evident that the variety Santa Fe occurred in many of them, especially those highest in protein content. At first glance one could believe that Santa Fe was a donor of high protein. Progenies from the crosses Santa Fe x Benton, and Santa Fe x Zephyr, or their reciprocals, were particularly evident among those entries high in protein.

Unfortunately, we have very little yield data on entries grown in the Oat World Collection. The Collection is grown generally in single rows each time it is propagated, and the rows are not replicated. In order to obtain a critical evaluation of protein content of a genotype, one _must_ have a measure of yield capability. We are planning to grow a replicated yield test in 1972 of those Oat World Collection entries rating high in protein content over a period of three or four years. Yield nurseries will be grown at Aberdeen, Idaho, and possibly at one more location, hopefully in the North Central Region.

The explanation for high protein content in many of these oat lines can be low yield at Aberdeen. Many _Avena byzantina_ types, including Santa Fe, are not well adapted to Idaho, nor are many of the Clinton type _Avena sativa_ varieties, including Benton.

Oat World Collection Lines Highest in Protein Based on 3-4 Years Data
Seed Grown at Aberdeen, Idaho

| C.I. or P.I. No. | Identification | Source | Mean % Protein |
|---|---|---|---|
| 6200 | Santa Fe x Benton | USDA | 23.4 |
| 6208 | Santa Fe x Benton | USDA | 23.3 |
| 6210 | Santa Fe x Benton | USDA | 23.0 |
| 5916 | Santa Fe x Clinton | Florida | 22.6 |
| 6596 | Florida 167 x Santa Fe-Clinton | Florida | 22.5 |
| 285583 | Zielony | Poland | 22.4 |
| 285586 | K-38 | Poland | 22.4 |
| 6369 | Zephyr x Santa Fe | USDA | 22.4 |
| 5598 | (Lee-Victoria) x Fulwin x ($Clinton^2$ x Santa Fe) | USDA | 22.3 |
| 5549 | Appler x ($Clinton^2$ x Santa Fe) | USDA | 22.2 |
| 6366 | Zephyr x Santa Fe | USDA | 22.2 |
| 7073 | $Clinton^2$ x Ark. 674 | Indiana | 22.2 |
| 5546 | Appler x ($Clinton^2$ x Santa Fe) | USDA | 21.9 |
| 5556 | Appler x ($Clinton^2$ x Santa Fe) | USDA | 21.9 |
| 6209 | Santa Fe x Benton | USDA | 21.9 |
| 285559 | Najwczesniejazy Niemierczanski | Poland | 21.8 |
| 285553 | Bialy Sielecki | Poland | 21.8 |
| 2001 | Mammoth (Storm King) | Canada | 21.8 |
| 5588 | Wintok x ($Clinton^2$ x Santa Fe) | USDA | 21.8 |
| 5726 | Zephyr x Santa Fe | USDA | 21.8 |

Con't.

| C.I. or P.I. No. | Identification | Source | Mean % Protein |
|---|---|---|---|
| 5831 | Trispernia x (Clinton$^2$ x Santa Fe) | USDA | 21.8 |
| 6201 | Santa Fe x Benton | USDA | 21.8 |
| 6801 | Clinton$^2$ x Santa Fe | Wisconsin | 21.8 |
| 5757 | Benton x Santa Fe | USDA | 21.7 |
| 7730 | Floriland | Fla. (Idaho) | 21.7 |
| 7741 | Floriland Sel. | Fla. (Idaho) | 21.7 |
| 5745 | Benton x Santa Fe | USDA | 21.6 |
| 6373 | Zephyr x Santa Fe | USDA | 21.6 |
| 285560 | Pomorski Zloty | Poland | 21.6 |
| 2185 | Mich. 55500 | Michigan | 21.5 |
| 4120 | Burke 0.120 | Australia | 21.5 |
| 5759 | Benton x Santa Fe | USDA | 21.5 |
| 6207 | Santa Fe x Benton | USDA | 21.5 |
| 1382 | Storm King | Pennsylvania | 21.4 |
| 5547 | Appler x (Clinton$^2$ x Santa Fe) | USDA | 21.4 |
| 5764 | Benton x Santa Fe | USDA | 21.4 |
| 6277 | Benton x Santa Fe | USDA | 21.4 |
| 6375 | Zephyr x Santa Fe | USDA | 21.4 |
| 7420 | Florad | Florida | 21.4 |
| 3329 | Monota x Bond | Iowa | 21.3 |

## Protein and Amino Acid Yields of High Protein Oats

R. T. Smith and L. W. Briggle

A group of 23 Avena sativa x A. sterilis derivatives was grown in a replicated yield test at Aberdeen, Idaho, in 1969. Garland was included as a check variety, and OA 123-33 (A. strigosa$^2$ x Victory) was added as a high protein oat variety. Grain yield, percent protein, and a few other characteristics were reported on page 15 in the 1969 Oat Newsletter. Amino acid analyses were recently provided by the National Oat Quality Laboratory at the University of Wisconsin, Madison, Wisconsin. Analyses were based on groat samples drawn from bulks over replications for each of the 25 entries. Bulks were used to minimize labor and expense. One has to assume that negligible replication x protein interaction occurred. Analysis of variance and comparison of means were used to evaluate protein yields and amino acid yields. Actual yields were estimated from the following formulae:

Groat protein yield = (grams per plot whole grain) (% protein) (1.00-% loss in dehulling)

Amino acid yield = (groat protein yield) (% amino acid)

Questions of interest were:

1. Was there diversity among lines from the same cross?
2. Did some A. sativa x A. sterilis derivatives yield more protein or more of a specific amino acid than Garland or OA 123-33?

Actual grams of protein produced and grams of lysine, threonine, and methionine (the three amino acids reported as limiting in oats) are listed in the following table. Also included are grams of glutamic acid and glycine because of their importance in many metabolic roles. In suboptimal protein level diets it is conceivable that inadequate amounts of precursors may limit synthesis of glutamic acid and glycine, which would adversely affect metabolic reactions.

Within each cross there are lines which differ significantly in protein yield or in yield of at least one of the amino acids. This degree of variability is encouraging in a plant breeding sense, however, we do not know what part of this variability is related to environment and what part is genetic. Some lines from each cross compare favorably with Garland in at least one attribute. The Canadian line OA 123-33 excells in yield of protein, lysine, threonine, glutamic acid, and glycine but is low in methionine. Progenies involving Florida 500 and Diana performed poorly except for one Florida 500 line which is high in methionine, and one Diana line which is high in protein, lysine, threonine, glutamic acid, and glycine.

Although these results are preliminary in nature, variability occurring among lines within a cross is of primary interest.

PROTEIN AND SELECTED AMINO ACID YIELDS OF HIGH PROTEIN OAT LINES
GROWN IN 1969, ABERDEEN, IDAHO

| Identification | | Yield (grams)/2 x 5' plot | | | | | |
|---|---|---|---|---|---|---|---|
| | | Protein | Lysine | Threonine | Methionine | Glutamic | Glycine |
| 401 | A. strigosa[2] x Victory | 116.2 VH* | 4.53 VH | 3.88 VH | 1.16 L | 26.6 VH | 5.57 VH |
| 402 | Garland | 80.6 | 3.22 H | 2.65 | 2.01 VH | 17.6 | 4.10 H |
| 403 | Garland x A. sterilis | 89.3 H | 3.38 H | 3.03 H | 2.05 VH | 20.1 H | 4.30 H |
| 404 | " x " | 89.9 H | 3.41 H | 3.04 H | 1.88 H | 20.3 H | 4.40 H |
| 405 | " x " | 85.8 H | 3.43 H | 2.91 H | 1.79 H | 20.0 H | 4.11 H |
| 406 | " x " | 57.2 L | 3.11 L | 1.94 L | 1.14 L | 13.2 L | 2.80 L |
| 407 | " x " | 54.0 L | 1.99 L | 1.83 L | 1.29 L | 12.3 L | 2.69 L |
| 408 | " x " | 71.8 | 2.58 | 2.43 | 1.43 | 16.8 | 3.44 |
| 409 | " x " | 71.6 | 2.64 | 2.25 L | 1.64 | 16.3 | 3.43 |
| 410 | " x " | 67.4 L | 2.48 L | 2.22 L | 1.61 | 15.7 | 3.23 L |
| 411 | A. sterilis x Florida 500 | 72.3 | 2.74 | 2.52 | 1.37 | 16.5 | 3.47 |
| 412 | " x " | 67.0 L | 2.67 | 2.20 L | 1.47 | 15.2 L | 3.21 L |
| 413 | " x " | 75.5 | 2.78 | 2.33 | 2.18 VH | 17.5 | 3.39 |
| 414 | " x " | 76.7 | 2.98 | 2.60 | 1.68 | 17.4 | 3.67 |
| 415 | Portal x A. sterilis | 85.3 H | 2.90 | 2.90 H | 1.87 H | 19.7 H | 4.26 H |
| 416 | " x " | 63.7 L | 2.22 L | 2.16 L | 1.14 L | 14.9 L | 3.12 L |
| 417 | A. sterilis x Diana | 53.7 L | 1.98 L | 1.82 L | 1.01 L | 12.6 L | 2.68 L |
| 418 | " x " | 67.9 L | 2.57 | 2.23 L | 1.49 | 15.3 L | 3.25 L |
| 419 | " x " | 58.2 L | 2.09 L | 1.97 L | 1.21 L | 13.3 L | 2.79 L |
| 420 | " x " | 64.4 L | 2.31 L | 2.18 L | 1.41 | 14.7 L | 3.08 L |
| 421 | " x " | 95.1 H | 3.61 H | 3.23 H | 1.61 | 22.3 H | 4.46 H |
| 422 | C.I. 7920 x A. sterilis | 64.4 L | 2.37 L | 2.25 L | 1.34 | 14.7 L | 3.21 L |
| 423 | " x " | 77.6 | 3.10 H | 2.63 | 1.47 | 17.1 | 3.79 H |
| 424 | " x " | 84.9 H | 3.13 H | 2.96 H | 1.86 H | 18.9 | 4.24 H |
| 425 | " x " | 76.9 | 2.99 | 2.61 | 0.84 L | 17.6 | 3.84 H |

* Means followed by same letter are similar via Duncan's at .05 P. Three classes; VH=very high, H=high, L=low.

# Consumption and Response of Voles (*Microtus pennsylvanicus*) Fed Isonitrogenous Diets Containing Barley, Corn, and Oat Varieties

R. T. Smith and F. C. Elliott

An attempt was made to evaluate the nutritional values of proteins of three oat varieties (OA 123-33, Roanoke, and Portal - the latter from two sources), four barley varieties (Ingrid, Kristina, Birgitta, and Barsoy), and two corn varieties (a normal and a high lysine line).

The diets were formulated on an isonitrogenous (7.2% protein), iso-grain protein and isocaloric (1500 K/lb) basis. Thirty-three percent of the protein was contributed by the varieties and 66% by soymeal. The 7.2% protein level was adequate for growth in efficiency ratios with vole weanlings. All diets were supplemented with methionine to give a level in excess of 0.7% total sulfur amino acids to effect stress on the biological availability of the next limiting amino acid.

Five voles from different litters were individually weighed (initial weight) and assigned to each diet. The voles were individually caged and fed *ad libitum* for five days with free access to water. Final weights were recorded and weight gain used as the test for nutritional value. A total analysis of grain components was obtained in order to relate gain to grain component consumption.

Varieties used in the diets are listed in Table 1. Average gain and grain components are presented. Amino acid profiles were also obtained but are not shown for sake of brevity.

The diet containing the oat variety OA 123-33 excelled over all other diets for gain. Ingrid was the better barley. The two corn diets did not perform well. The high lysine-high xanthophyll-opaque-2 line did have a slight advantage over the normal corn. The Roanoke oat is high in lipid content (7.1%). The OA 123-33 oat had the highest whole grain protein content (17.8%). Hemicellulose content of the barleys (Ave. 19.3%) exceeded that of the other two crops. The hemicellulose content of Portal oats (20.29%) grown in North Dakota exceeded that of Portal (15.92%) grown in Wisconsin by 21.5%. The hemicellulose content of high lysine-high xanthophyll-opaque-2 corn (13.22%) exceeded that of normal corn (8.2%) by 38%. The oats contained more cellulose and lignin than the barleys and corns. Little insight into cause and effect can be obtained from Table 1 since minimal degrees of freedom limit reliable mathematical manipulations. Since varieties were added to the diets on an iso-protein basis, varieties containing more protein add less to the diet on a total weight basis than varieties having less protein. This situation creates a balance in protein contributed but an imbalance in other components.

Because of the disproportionality of other grain components in the diets, Table 2 was constructed to evaluate relationships between weight gained and actual grain components consumed. Individual vole gain and consumption for each crop provided further information.

Regression of gain on amounts consumed of each grain component were calculated. Percent variation of vole gain (g) explained by variation in consumption of each component was expressed as a coefficient of determination ($r^2$) in percent. It is worth noting that all simple correlations over the entire experiment were positive for gain vs. each component consumed.

In evaluating the effects of each component consumed in Table 2 one can consider methionine as a reference point since stress was not placed on this amino acid. Components having $r^2$'s larger than methionine may have affected gain. Barley gains were related to both methionine ($r^2$=51.6%) and lysine ($r^2$=51.4%). This may indicate that methionine is less available in barley than in oats or corn. Other unwanted disturbing factors in barley are the large $r^2$ values for lipids ($r^2$=53.4%), hemicellulose ($r^2$=50.1%), and cellulose ($r^2$=53.8%).

The oats are more variable than the barleys. Glutamic acid ($r^2$=68%) is not considered essential but lack of precursors in the diet for in vivo synthesis may accentuate its importance. Glutamic acid is probably the most important amino acid in most living systems. Proline ($r^2$=68.7%) has recently been found essential for chickens and perhaps a similar condition exists for voles.

No single component of corn was related to gain (in comparision to oats and barley). As in barley, lipids ($r^2$=10.3%) are relatively important. The uniformity of $r^2$ values for most amino acids only serves to emphasize what is not known about the biological availability of grain components.

Table 1. Gain (g) of voles fed diets containing barley, oats, and corn and whole grain components in percent.

| Crop in Diet* | Average Gain (g) | Lipid | Protein | Hemi-cellulose | Cellulose | Lignin | Ash | Sugar & Starch |
|---|---|---|---|---|---|---|---|---|
| OATS | | | | | | | | |
| OA 123-33 | 4.00 | 4.10 | 17.8 | 14.94 | 11.41 | 3.47 | 3.56 | 36.81 |
| Roanoke | 2.04 | 7.10 | 12.0 | 14.88 | 9.01 | 2.59 | 2.16 | 43.92 |
| Portal (Wisc.) | 2.30 | 4.10 | 12.9 | 15.92 | 11.39 | 2.82 | 3.58 | 41.15 |
| Portal (N. D.) | 2.22 | 4.79 | 14.1 | 20.29 | 10.43 | 2.69 | 3.67 | 36.00 |
| BARLEY | | | | | | | | |
| Ingrid | 3.03 | 2.40 | 12.1 | 20.70 | 5.07 | 1.08 | 2.61 | 47.37 |
| Kristina | 2.26 | 2.06 | 12.8 | 17.41 | 5.61 | 1.14 | 3.24 | 49.31 |
| Birgitta | 1.22 | 1.98 | 14.1 | 18.97 | 4.46 | 0.75 | 2.73 | 48.69 |
| Barsoy | 2.51 | 2.16 | 14.3 | 20.12 | 6.18 | 1.63 | 2.60 | 44.36 |
| CORN | | | | | | | | |
| Normal | 1.95 | 3.80 | 10.3 | 8.20 | 2.81 | 0.54 | 1.55 | 63.86 |
| High lysine ... | 2.23 | 4.60 | 9.4 | 13.22 | 3.61 | 1.21 | 1.35 | 55.03 |

*7.2% protein diets, 5 voles/diet

Table 2. Percent variation of vole gain (y) explained by variation in consumption of each grain component for barley, oats, and corn.

| | Coefficient of Determination in Percent | | |
|---|---|---|---|
| Grain Components | Barley | Oats | Corn |
| Lipids | 53.4 | 1.4 | 10.3 |
| Hemicellulose | 50.1 | 9.9 | 7.9 |
| Cellulose | 53.8 | 33.0 | 9.7 |
| Lignin | 38.3 | 58.1 | 6.0 |
| Ash | 39.1 | 24.0 | 3.2 |
| Sugar & Starches | 45.5 | 11.3 | 3.0 |
| Protein | 46.1 | 65.1 | 5.4 |
| Lysine* | 51.4 | 61.3 | 8.8 |
| Histidine* | 45.5 | 64.2 | 9.5 |
| Arginine* | 49.2 | 63.2 | 9.8 |
| Aspartic Acid | 47.9 | 65.5 | 9.9 |
| Threonine* | 44.1 | 57.9 | 7.9 |
| Senine | 44.7 | 62.6 | 8.3 |
| Glutamic Acid | 41.4 | 68.0 | 2.9 |
| Proline | 38.7 | 68.7 | 4.3 |
| Cystine | 45.4 | 53.6 | 9.6 |
| Glycine | 46.6 | 58.9 | 9.6 |
| Alanine | 50.6 | 66.4 | 1.8 |
| Valine* | 48.3 | 63.4 | 7.9 |
| Methionine* | 51.6 | 58.8 | 0.3 |
| Isoleucine* | 43.9 | 63.0 | 4.0 |
| Leucine* | 48.1 | 65.6 | 0.5 |
| Tyrosine | 33.1 | 52.2 | 0.1 |
| Phenylalanine* | 39.0 | 66.0 | 3.9 |
| Number voles fed | 20 | 20 | 10 |

*Essential for human nutrition

# REPORT ON PROGRESS TOWARD INTERNATIONAL STANDARDIZATION IN CROP RESEARCH DATA RECORDING

C. F. Konzak

Although the progress of this program has been greatly hampered by the lack of significant funding, it has been possible to make some important advances in concepts and methods. The description and procedures for the cereal data processing system now in use for wheat and other research in the Western U. S. was finally published[1] as was an additional paper in the field[2].

The writer spent the month of June at the Agricultural Research and Introduction Center (ARIC) in Izmir-Karsiyaka, Turkey, advising FAO and ARIC on methods of computerizing the documentary information on the several thousand field collections of various crops currently being maintained by the Center. During this time the proposed standard field collection record form was revised and 100 "books" of 100 pages each were printed by Ege University staff for use on individual collections. Dr. Kjellqvist, FAO project manager, was able to test the forms extensively in the field during the late summer and fall of 1971 and reported satisfaction in their use. The information entered on the forms can be transferred directly to machine readable cards, stored also on tape or discs and processed or retrieved as needed.

In October, Mr. Lothar Seidewitz, from the planned Western European Gene Bank in Braunschweig, Germany, spent most of the month working with the writer on the development of an illustrated dictionary concept for the form in which general and crop specific data might be recorded. The main aspects of the general records were slightly revised from previous attempts, with a major standardization approach applied to the crop-specific data, using wheat as the prime example. To test the broad applicability of the concept, preliminary work was initiated on potatoes and on barley.

The completed revised version of TAXIR is now operable on an IBM 360-65 at Michigan State, East Lansing, and on the CDC 6400 at the University of Colorado, at Boulder. An abstract retrieval system called SOLAR was completed at Washington State University in collaboration with the U. S. Forest Service. This system appears to offer certain advantages in flexibility and opportunity for direct dialogue with the data bank. Tests using the kinds of data recorded on germ plasm stocks will be made of this system during the next several months. SOLAR is available from the Computing Center, Washington State University.

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[1]McNeal, F. H., C. F. Konzak, E. P. Smith, W. S. Tate, and T. S. Russell
A Uniform System for Recording and Processing Cereal Research Data
ARS 34-121, August, 1971, USDA

[2]Konzak, C. F., W. E. Walden and F. P. Sousa
Problems and Progress in the Management of Information on Genetic Resources, SEIKEN ZIHO Report of the Kihara Institute for Biological Research, No. 22, June, 1971

# Fertility Requirements of Oats

J. R. Webb and John Pesek

In 1963 five experiments were started in Iowa to study the fertility needs of the oat crops. The test sites were located on the Carrington-Clyde, Clarion-Webster, Galva-Primghar, Shelby-Grundy, and Howard County Experimental Farms. The Howard County experiment was discontinued in 1968 and will not be discussed in this report. These tests were designed to obtain information regarding the requirement of oats for nitrogen (N), phosphorus (P), potassium (K) and limestone ($CaCO_3$) and to study the interacting effects among these nutrients. Oats are grown each year on the experimental areas to permit evaluation of treatment effects on this crop alone, without any confounding effect from other crops which might be included in a sequence of several crops.

The soils on all of the sites initially tested very low in available P, ranged from very low to low-medium in K, and varied in pH from about 5.5 to 6.5. Past management had varied but in general had been at a rather low level.

All experiments involve 25 combinations of N, P, K, and limestone, with each variable applied at 5 different rates. The treatments are applied annually to the same plots, with the P, K, and limestone plowed under in the fall and the N disked in prior to planting in the spring. The Dodge variety of oats was grown in 1963 and Garland has been planted at all sites since that time.

The experimental treatments and average grain yields for the 1963-71 period are shown in Table 1. Yields have varied widely from season to season but the averages level off at all sites at about 75 to 80 bushels. These are respectable yields for that period of time but do not appear to be as high as should have been attained under the prevailing conditions.

At all sites the oat crop has responded to N and P fertilization, with the latter giving the largest response at 3 of the 4 locations. A strong interaction between N and P responses has been observed, that is, both have been required for maximum yields. Responses to K and limestone applications have been small or nil.

The 30-pound N rate, when applied with sufficient P, seems to have been adequate for top yields at all except the Shelby-Grundy site. The latter site has continued to respond up to about the 90-pound level, but the last 30-pound increment would not have been economically practical. The 30-pound rate is less than half the quantity of N which is removed annually in the grain and straw and is less than normally would be recommended for a small grain crop grown without a meadow seeding. A continuous oat culture results in the soil being fallow from the middle of July through the remainder of the growing season and sufficient soil N may be mineralized to supply much of the N needed for the following oat crop. The higher N rates have not caused much lodging but have created an increasing seed problem.

All sites have responded to P fertilization, with increases ranging from 8 to 20 bushels. The 20-pound (46 pounds $P_2O_5$) rate has produced nearly mazimum responses. This quantity is probably more P than is removed each year

Table 1. Effect of rates of nitrogen, phosphorus, and potassium fertilizer and limestone on grain yields of oats

| Pounds per acre annually[1/] | | | | Average yields - 1963-71 | | | |
|---|---|---|---|---|---|---|---|
| N | P | K | $CaCO_3$ | Carrington-Clyde | Clarion-Webster | Galva-Primghar | Shelby-Grundy |
| 0 | 0 | 0 | 0 | 58 | 51 | 56 | 48 |
| 0 | 20 | 30 | 220 | 73 | 65 | 64 | 48 |
| 30 | 10 | 15 | 110 | 74 | 65 | 76 | 59 |
| 30 | 10 | 15 | 330 | 72 | 65 | 74 | 62 |
| 30 | 10 | 45 | 110 | 78 | 62 | 74 | 65 |
| 30 | 10 | 45 | 330 | 77 | 66 | 75 | 66 |
| 30 | 30 | 15 | 110 | 81 | 70 | 82 | 63 |
| 30 | 30 | 15 | 330 | 80 | 69 | 81 | 66 |
| 30 | 30 | 45 | 110 | 79 | 71 | 81 | 63 |
| 30 | 30 | 45 | 330 | 75 | 75 | 77 | 69 |
| 60 | 0 | 30 | 220 | 70 | 51 | 63 | 66 |
| 60 | 20 | 0 | 220 | 76 | 66 | 80 | 71 |
| 60 | 20 | 30 | 0 | 80 | 65 | 82 | 73 |
| 60 | 20 | 30 | 220 | 81 | 68 | 78 | 74 |
| 60 | 20 | 30 | 440 | 77 | 71 | 79 | 69 |
| 60 | 20 | 60 | 220 | 81 | 71 | 78 | 69 |
| 60 | 40 | 30 | 220 | 82 | 70 | 81 | 68 |
| 90 | 10 | 15 | 110 | 76 | 64 | 74 | 71 |
| 90 | 10 | 15 | 330 | 75 | 62 | 76 | 75 |
| 90 | 10 | 45 | 110 | 77 | 67 | 75 | 72 |
| 90 | 10 | 45 | 330 | 78 | 63 | 74 | 75 |
| 90 | 30 | 15 | 110 | 78 | 64 | 78 | 72 |
| 90 | 30 | 15 | 330 | 74 | 68 | 80 | 69 |
| 90 | 30 | 45 | 110 | 81 | 70 | 79 | 74 |
| 90 | 30 | 45 | 330 | 78 | 69 | 77 | 74 |
| 120 | 20 | 30 | 220 | 77 | 66 | 75 | 72 |

[1/] P x 2.3 = $P_2O_5$, K x 1.2 = $K_2O$.

by the crops and has increased the available P in the soil as measured by soil tests. It is approximately the rate currently recommended for a small grain crop grown on a soil testing very low in P.

The oat crop is normally not very sensitive to soil K levels and responses to this element have been small. Once the N and P requirements have been met, K applications appear to have given 3 to 5 bushels increase at the Carrington-Clyde and Clarion-Webster sites, both of which initially tested very low in K.

Limestone applications have not had any measurable effect on oat yields. However, the Carrington-Clyde site was the only one initially testing below pH 6.0 and the rates of limestone being applied have only increased the soil pH about 0.2 of a unit in the 9-year period of study.

Soil samples are annually collected from each site to measure the effect of treatments on soil test levels. These values indicate that when P fertilizer rates exceed crop removal, available P levels rapidly increase in the soil. At all sites the two top rates of P have raised soil test readings into the medium and high categories. Soil K tests have also increased but the changes have been smaller and more variable with sites.

Results to date indicate that on the soils under study top oat yields have mainly been associated with proper N and P fertilization. Response to these elements have varied some with initial soil tests and past management of the sites. Smaller responses to N fertilization than anticipated is thought to be a reflection of the continuous oat culture being followed. The yield results have not been analyzed from an economic standpoint but it is obvious that proper fertilization of oats has provided an excellent return on investment.

# More on the Diallel Selective Mating Breeding System

Neal F. Jensen

A cereal breeding colleague remarked to me that one would have to be a Philadelphia lawyer to understand the diallel selective mating system for cereal breeding (see: Jensen, N. F. A diallel selective mating system for cereal breeding. Crop Sci. 10:629-635. Nov.-Dec. 1970). Since I have also had three meetings with our graduate students to discuss this topic I recognize some truth in this comment. It would be a pity, in my opinion, if a belief that this method is too complex would act as a deterrent to its use. From my experience I can say that quite the opposite has been true: the use of the DSM system has significantly simplified all aspects dealing with the making of hybrids and handling of early generations in my programs. I would like here to go beyond the formal paper and discuss implementation considerations.

For needed procedural background the principal implementing objective of the DSM is to form a broad germplasm hybrid population, the $P_2$, which then either selfs to head selection time or, alternatively, also serves as a population for intrapopulational selective mating to form additional hybrid composites ($P_3$ etc.). The $P_2$ is formed in the second of two stages: 1) the making of a series of hybrids among parents chosen in view of the objective and 2) the use of these hybrids as parents in a diallel crossing scheme. Thus, in the second stage the new hybrid seeds from the diallel are composited to form the $P_2$ (and the first stage hybrids after serving their function as parents are composited to form the $P_1$). At this point the breeder has two composites--the $P_2$ being the more important--to work with, and may elect if he wishes to stop at this point and practice his normal selection and testing procedures up to and including line selection.

The simplest way to forming the $P_2$ is to deal exclusively with simple (2-parent) crosses in the first stage (more complex or sophisticated use deals with basic parent series crosses of various kinds: backcross, 3- and 4-way crosses, etc.). In the greenhouse the basic parent series hybrids are set up in this way to get the $P_2$ seeds: 1) choose the basic set you are going to use, for example, we might select 28 hybrids from all the crosses made the previous year; 2) take 1 seed from each and plant, thus a group of 28 pots in the greenhouse. Treat this group as a date of planting unit and 3) plant additional units as frequently as time and labor for crossing permit, 4) intercross any plants as they flower within each group and also between groups excluding, for example, Entry 3 x Entry 3 which would of course be the same as a self. 5) Composite seeds of new hybrids to form $P_2$.

I use small jewelers tags to tell me later how close I am coming to a full diallel: a tag marked 1-18 x 3-12 indicates entry 18 of first planting was crossed with entry 12 of third planting. The dates of planting sets get away from assortative mating since it is possible to cross the latest flowering of a set with any maturity from a later planted set. Thus, at the start of the crossing season I take no notice whatsoever of what combinations are being made. Later in the season I may begin to notice that certain entries are below desired in getting into crosses: attention can then be given to crossing these. From one year's program of crossing, all seeds end up in one of the two composites $P_1$ or $P_2$.

Let me underline this: <u>don't insist on a perfect diallel</u>! Or, upon equal numbers of seeds from each cross to go into the $P_2$. For most objectives, other than a small diallel, insistence on a complete diallel will result in delay since it is unlikely that all combinations can be obtained in one attempt. Do the best you can and any reasonable diligence will produce a $P_2$ of significant diversity. As the hybrid seeds mature and are harvested I like to count and record them before tossing them into the composite: I do this out of interest to know how broad is the composite gene base and how close we came to a complete diallel. The larger the diallel the larger will be the $P_2$; a recently completed $P_2$ (wheat) had over 5,200 hybrid seeds and I am now working on one where we hope to get 10,000 seeds.

Generally, all of the $P_2$ $F_1$ should be grown, space planted. Thereafter, only aliquots are practical, for example, the 5,200 seed composite above produced in the $F_1$ 77 pounds of $F_2$ seed.

If one contemplates selective mating in any generation of the $P_2$ the seeds must be space planted to allow working with individual plants. We do this using autoclaved seeds, planting rates, varying row widths and so forth to get a desired random machine spacing---very simple and no hand work involved in field planting.

Should one selectively mate promising individuals and start new composites? We are dealing with all kinds of heritabilities phenotypically masked by heterozygous condition effects. Some of our most important unanswered questions lie in this area of the efficiency of early selection. Nevertheless, there is a high enough ratio of fire to smoke here so that I as a plant breeder want to practice my talents even if I do so---forming thus only 1 additional population---only once with any particular objective. One can think of different characters of such over-riding importance to the end product as to make selective mating desirable. An example is short height which can be overwhelmed in a densely sown composite after several years; another is disease resistance.

We mass select to fit the situation, that is, special seed processing for increasing test weight. In general, more than one mass selection scheme is practiced on a particular composite: one may be mass selecting in the field simultaneously for disease resistance, short straw and lodging resistance.

I often use the cook's privilege of varying the $P_2$ recipe: we frequently will add a small amount of bulked seed from the basic parents for the diallel (the $P_1$). This seed is one generation advanced over the $P_2$ but I look on this as unimportant since they still contain the desired genes in recombination in a simpler hybrid form. Thus, we might add 10% $P_1$ seeds to a newly formed $P_2$ e.g. 500 $F_2$ seeds to the 5,000 $F_1$ seeds of the $P_2$, and the $P_2$ thus is a mixture of $P_2$ $F_1$ and $P_1$ $F_2$.

Of course, convincing evidence of a new method must await the test of experience. In time we will have the answer at Cornell when new varieties come out of the DSM projects. Please note my preference for <u>when</u> rather than if!

# IV. CONTRIBUTIONS FROM OTHER COUNTRIES

## Breeding for Rust Resistance in New South Wales

E. P. Baker

Stem and particularly crown rust are of considerable economic importance in the coastal areas. Certain established cultivars, although agronomically satisfactory, have declined in popularity on account of their susceptibility and Saia (Avena strigosa) is included among the recommended cultivars because of its resistance to stem and crown rust. However, strains of both rusts capable of attacking Saia are becoming more prominant annually.

In a program designed to incorporate rust resistance into established cultivars, Algerian was selected and backcrossed five or six generations to incorporate separately stem rust resistance from Minnesota Ag. 334 (with the closely linked resistance genes A and D) and crown rust resistance separately from Bond, Victoria, Sante Fe, and Trispernia. Strains capable of attacking the crown rust resistance genes singly have been detected in the field, but no stem rust strain rendering Minn. Ag. 334 susceptible, has been recorded. At the completion of the backcrossing programs, stem rust resistance together with combined crown rust resistances are being incorporated into the recurrent parent with the aid of appropriately virulent strains.

## Oat Production and Research in Western Canada 1971

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

In 1971, 5,282,000 acres of oats were harvested for grain in the 3 prairie provinces and yielded an average of 54.3 bushels per acre (note the Canadian bushel is 34 lbs.). Although acreages have declined in the past 10-15 years, yields have been increasing, so that total production has been stable. In addition, another 1 million acres are grown for hay, silage or are pastured by livestock.

Harmon, the leading variety, was grown in 1971 on 39% of the total acreage while Rodney and Garry occupy 20% and 10%, respectively. Rust susceptible varieties such as Victory and Eagle are grown extensively in Alberta where rust is unimportant.

Crown rust development on commercial oats grown in Manitoba in 1971 progressed very slowly during the summer and as a result losses were minimal and confined exclusively to very late fields. This was in striking contrast to the previous two seasons during which severe crown rust epidemics caused serious yield reductions, particularly in the Red River basin.

The bulk of crown rust isolates identified consisted of races 295 and 326. In contrast to the large population of race 264 isolated in 1970, only 5 isolates of this race were identified in 1971. The decrease in race 264 is reflected in the first reduction of virulence on Trispernia and Bondvic since 1966.

Preliminary results with the "C" set, which consists of 10 isogenic lines of Pendek each containing a single different Pc gene isolated from Avena sterilis, indicate a very high level of resistance to most cultures of crown rust isolated in Manitoba. Among these 10 crown rust resistant genes are the 7 distributed to Texas, Iowa and Winnipeg under regional deployment. These Pc genes were resistant to almost all the isolates identified in Canada.

Oat stem rust appeared very late in 1971 and was found only in occasional fields near maturity. Losses were negligible. This is in sharp contrast to 1970 when losses from oat stem rust were recorded in the millions of bushels. Race C10 (6AF) was again the most common race found. In western Canada, a number of collections of race C23 (7) were isolated from Avena fatua. In eastern Canada, race C9 (6AH) was again found frequently.

The finding in Manitoba of a new race C24 (7AH) virulent on pg 13 in 1971, along with the continued presence of C23, points up the importance of retaining Pg 2 in the breeding program.

Studies of lines with high oil content obtained initially from C. M. Brown indicate that high oil content should be easy to breed for. Contents of 9% on a hulled basis or 12% on a dehulled basis already are available in genetic stocks. Lines from the breeding program with moderately high oil contents combined with high yield have been developed. Thus, negative associations between yield and oil content have not occurred. The high energy potential of these oats must still be thoroughly evaluated in feeding trials before high fat oats become a commercial reality for livestock feed.

## Oats and Oat Diseases at Indian Grassland and Fodder Research Institute, Jhansi, U. P., India

S. T. Ahmad, M. L. Magoon and K. L. Mehra

In India, the cultivation of oats for fodder gained importance during the last decade due to its profitable use in the fast expanding dairy industry. Presently more than 80,000 hectares of land are under oat cultivation in India. At the Central Research Farm, Jhansi (78 E Long., 25° N lat. and 275 m alt.), the oat improvement program was started in 1968. This included: (1) Testing of large numbers of varieties and lines from both early and recent exotic sources; (2) selection of the most promising material based on desirable attributes; (3) building up of selection indices based on genetic parameters; (4) hybridization, to incorporate disease resistance and other desirable attributes in otherwise high fodder yielding varieties. Twenty promising cultivars, including the derivatives of crosses involving Gopher x Curt (GC), Ag 331 x Punjab local (S), and Landhafer x Punjab local (LH) received from Plant Pathological Research Station, Simla, were found superior in one or more characters contributing towards high fodder yield. During 1970, plant pathological studies aimed at observing the disease situation and the performance of the selected cultivars against the most prevalent diseases were initiated.

I. Disease situation: Of the major diseases viz., rusts, smuts, mildews, leaf blight, foot rot, and red leaf, known to occur in India, the following were observed at Jhansi:

1. Covered smut and loose smut in traces on the few local varieties left for seed production.

2. Leaf blight was more prevalent and attacked 31 out of 98 cultivars during 1970-71 and 18 out of 195 cultivars during 1971-72.

3. Red leaf has been noticed since the inception of the program. The relative prevalence of the disease during this year was much lower as compared to the previous year.

4. Leaf blotch, caused by <u>Purenophora avenae</u>, was first noticed at Jhansi during 1970-71. This appears as the first record of this disease from India. The fungus infected 3 out of 98 cultivars grown in the previous year; however, in this year, it infected 16 out of 165 cultivars.

II. <u>Performance of selected cultivars</u>: Oat cultivars (20) were screened against leaf blight, red leaf, and leaf blotch in the field during 1970-71 and 1971-72. The cultivars were earlier tested with crown and stem rust in glasshouses at Simla. The reactions of these cultivars are given in Table 1.

Table 1. Performance of selected cultivars to crown rust, stem rust, leaf blight, red leaf, and leaf blotch.

| S. No. | Introduction number | Name of cultivar | Crown rust | Stem rust | Leaf blight | Red leaf | Leaf blotch |
|---|---|---|---|---|---|---|---|
| 1 | I.G. 6 | Brunker | S | S | S | S | R |
| 2 | I.G. 77 | Kent | S | S | S | S | S |
| 3 | I.G. 2636 | Flaming Gold | S | S | S | S | R |
| 4 | I.G. 2643 | II-51-9 | S | S | S | S | R |
| 5 | I.G. 2674 | Dale | S | S | S | R | S |
| 6 | I.G. 2688 | Markton | S | S | S | R | R |
| 7 | I.G. 2692 | Norton | S | S | S | S | R |
| 8 | I.G. 3006 | S-1 | R | R | R | S | R |
| 9 | I.G. 3007 | S-1a | R | R | R | S | R |
| 10 | I.G. 3008 | S-2 | R | R | R | S | R |
| 11 | I.G. 3009 | S-3 | R | R | R | S | R |
| 12 | I.G. 3010 | S-4 | R | R | R | S | R |
| 13 | I.G. 3014 | S-7 | R | R | R | S | R |
| 14 | I.G. 3017 | S-9 | R | R | S | R | R |
| 15 | I.G. 3018 | S-10 | R | R | R | R | R |
| 16 | I.G. 3020 | GC-2 | R | S | R | R | R |
| 17 | I.G. 3021 | GC-3 | R | S | S | R | R |
| 18 | I.G. 3022 | GC-8 | R | S | S | R | R |
| 19 | I.G. 3024 | LH-2 | R | S | S | R | R |
| 20 | I.G. 3026 | GC-6 | R | S | S | R | R |

Table 1 shows that all the hybrid derivatives with serial numbers 8 to 20 were resistant to crown rust, and those from 8 to 15 were resistant to both rusts. Six out of 8 cultivars belonging to the S series were resistant to rusts, leaf blight and leaf blotch; of the remaining, one was susceptible only to leaf blight and the other (S-10) was resistant to all the diseases. Two cultivars were susceptible to leaf blotch, while Kent was susceptible to all the diseases.

In varietal trials involving the 20 promising cultivars given in Table 1, two cultivars viz., I.G. 3026 (GC-6) and I.G. 3018 (S-10) yielded more than 500 quintals per hectare (compare to control variety Kent that yielded 408 q/ha) when cut at 50% flowering stage. The varietal differences were significant. In another varietal trial in which three cuttings were taken at 70, 105, and 145 days, respectively, from the date of sowing, the cumulative green fodder yield of three cuts were more than 470 q/ha in I.G. 3026 (GC-6) and I.G. 3018 (S-10) as compared to the control variety Kent that yielded 419 q/ha. The varietal differences were not significant. Cultivar I.G. 3018 (S-10) was resistant to all five diseases while I.G. 3026 (GC-6) was resistant to crown rust, red leaf, and leaf blotch.

The cultivars that showed resistance to all diseases or susceptibility to only one of them are being used in the breeding program through planned hybridization, to incorporate the resistance into other cultivars possessing desirable fodder yield attributes.

## Oat Improvement Work in Japan

T. Kumagai and S. Tabata

The 1971 Hokkaido oat crop was estimated to be 28,000 hectares harvested. The season was not unfavorable for most crops in Hokkaido. During the period of June and the middle and late July, the weather was much cooler than average. Rice, soybeans, and Azuki beans suffered serious damage due to the cooler weather. But oats showed high stability in spite of such adverse weather conditions. The yield of oats at our nursery showed 38.1 kg/are in 1971, an increase of 1.8 kg/are over the 1958-70 average.

Our main breeding objectives are to improve the lodging resistance of our varieties and to combine earliness with high yielding ability. In addition, improvement works for forage use in southern Japan have been conducted. Hybridization of 44 combinations was carried out in the greenhouse, and most of the $F_1$ seeds were sown in the greenhouse in September and harvested in February. The selections with the most promise in grain yield tests are from the cross of (S.84-Milford) X Zenshin. Those two promising selections are in the final stages of testing before possible release to growers. The selections yielded 12% more than Zenshin, the highest yielding variety in Hokkaido, in the replicated tests and they also showed excellent agronomic type. The selections are also being tested at 5 locations throughout Hokkaido. Seven selections having good forage production are being tested at Miyazaki and Yamaguchi prefecture in the southern parts of Japan.

The test weight of seed of 70 varieties, including American varieties, was investigated. Most Japanese varieties, although they were medium among the varieties tested, showed test weights lower than some American varieties. Test weights varied in different cultural managements. Test weight showed a decrease both with later seeding and heavy manuring, while it tended to increase with light manuring and with dense seeding. It was also revealed that the test weight was associated largely with the plumpness per kernel and the days from heading to maturity. Heritability estimates of test weight in the broad sense were higher than those of grain yield and panicle number. It can be seen that improvement in test weight is not so difficult, and it is very necessary to give much attention to improvement of test weight of oat seeds.

## Daylength Insensitivity Important if Oats Are to Reach Their Full Potential as a Forage Crop in Mexico

F. J. Zillinsky

Experiments on oats CIANO in the Yaqui Valley of Sonora, Mexico, indicate that this crop shows promise as a forage crop in Northern Mexico during the winter months. It appears that oats produce more tons of high quality forage, and recover more rapidly after cutting than other cereal grains. A major problem in the use of oats as a crop in Mexico is the difficulty in producing good quality seed. Most strains are daylength sensitive and require more time to mature, grow taller and are thus more susceptible to lodging than the shorter statured wheat and barley varieties. Another serious problem is susceptibility to stem rust. The inoculum for this disease is initiated and spread on wild oats which are prevalent in Northern Mexico.

Strains of oats which reproduce seed quite well under short days have been obtained from Dr. Fred Elliott, Michigan State, and Dr. Vern Burrows, Ottawa Research Station, Canada. The source of daylength insensitivity used in the original crosses from which these strains were selected was Med 147, a strain of *A. byzantina* collected in the Mediterranean area.

## Some Brief References to Portuguese Oat Problems

Miguel Mota

An area of approximately 380,000 hectares is annually dedicated to the oat crop in Portugal. The mean grain yield per hectare is not only dramatically low but also extremely oscillating. Many reasons are responsible for this situation. We can consider as the most decisive ones: poor technique, poor soils, low market prices, and wrong crop rotations.

The prices of the major cereal crops are:

| | Price of 1 kg | |
|---|---|---|
| Crops | Escudos | U.S. Dollars |
| Wheat | 3 $ 50 | 13.4 ct |
| Malting barley | 3 $ 50 | 13.4 ct |
| Maize | 2 $ 50 | 8.7 ct |
| Oats | 1 $ 80 | 6.3 ct |

The grain yields per hectare are ridiculously low and erratic. The mean yields oscillate generally between 350 kg/ha to 600 kg/ha. However, a good farmer with advanced technology and well chosen varieties can obtain 3,000 kg/ha of oats.

Oats are usually sown in the middle of November. Oat fields reach the heading stage in the two first weeks of April and the ripening stage at the end of May.

As a rule oats is grown after wheat.

Southern Portugal is the most important oat-producing area. Avena byzantina types are grown almost exclusively but A. sativa varieties are grown, too.

In our indigenous flora we can find very easily an interesting genetic variation on wild species.

Puccinia graminis avenae, Puccinia coronata avenae, and Ustilago avenae are perhaps the most important pathogens. Leaf blotch, powdery mildew, root rot, some viruses, are also very common diseases.

Oat improvement in Portugal started 30 years ago at the Plant Breeding Station located at Elvas.

By using selection methods of oat improvement similar to those of NILSSON-EHLE, four improved varieties were selected and released to farmers in former times. More recently, two selected varieties named 'S. José' and San Mamede', as well as the variety 'Viadeira' from the cross (S. Francisco x Glenn Innes) are grown by the farmers.

Both Argentinean and Australian germplasms are generally well adapted under our agro-ecological conditions, and last year we released the Australian variety 'Avon'.

The main goals of our oats breeding program are:

- Yielding ability
- Agronomic adaptation
- Earliness
- Lodging resistance
- Positive response to nitrogenous fertilizers
- Resistance to crown rust, stem rust, smuts, leaf blotch, powdery mildew and other more minor diseases.

## Oat Research in Southeastern Yugoslavia

A. Popović, B. Kostić, T. Tešić and D. Maksimović

Oat research in southeastern Yugoslavia comprises breeding of new varieties and study of disease and pest problems.

In 1968-1971, advanced lines ($F_{10}$-$F_{12}$) of winter oats were studied in small-plot trials. These lines originated from crosses of well known American winter cultivars 'Winter Oat 32' and 'Wintok' (C.I. 3424) with the Yugoslav the winter-hardy cultivar 'Novosadski 2'.

Line 13/1-280 (Novosadski 2 x Winter Oat 32) was the best one. The average yield of this line for four years was 42.16 mc/ha. It outyielded Winter oat 5364 by 5.61 mc/ha. Its straw is short and it is good for intensive growing.

Lines 11/1-235, 10/5-164, and 3/1-41, in regard to yield capacity, are similar to standard (check) varieties. The most winter-hardy oat, Line 10/5-176, has a little higher straw and a lower yield. All these lines have to be tested in different locations and under various climatic conditions and rate of fertilizers. The main characteristics of the lines are shown in Tables 1 and 2.

Table 1. Yield of oat lines grown in small-plot trials (1968-1971).

| Line | Cross | Average for 4 years: Yield mc/ha | Weight of 1000 kernels | Hektoliter weight | Deviation from the standard |
|---|---|---|---|---|---|
| 13/1-280 | Novosadski 2 x Winter oat 32 | 46.99 | 33.00 | 46.12 | + 5.61 |
| 11/1-238 | Novosadski 2 x Winter oat 32 | 41.94 | 29.32 | 47.84 | + 0.56 |
| 10/5-164 | Novosadski 2 x Winter oat 32 | 41.82 | 29.62 | 45.59 | + 0.44 |
| 10/5-176 | Novosadski 2 x Winter oat 32 | 40.99 | 28.96 | 48.25 | - 0.39 |
| 8/1-12 | Novosadski 2 x Winter oat 32 | 39.75 | 26.60 | 48.10 | - 1.63 |
| 3/1-41 | Wintok 3424 x Novosadski 2 | 42.14 | 29.68 | 47.72 | + 0.76 |
| 5/2 | Wintok 3424 x Novosadski 2 | 40.75 | 31.03 | 47.57 | - 0.63 |
| Winter oat 5364 | | 41.38 | 32.16 | 46.35 | |
| Wintok 3424 | | 40.47 | 32.23 | 46.04 | |

LSD 5% = 4.40 mc/ha
1% = 5.98 mc/ha

Table 2. Frost resistance and some other characteristics of investigated lines.

| Line | Cross | Height cm | Vegetation period days | Lodging % | Frost resistance -15$^{o}$C 6 hours |
|---|---|---|---|---|---|
| 13/1-280 | Novosadski 2 x Winter oat 32 | 102.1 | 187 | 3.7 | 62.9 |
| 11/1-238 | " | 106.2 | 187 | 2.5 | 98.3 |
| 10/5-164 | " | 104.0 | 183 | 2.5 | 33.3 |
| 10/5-176 | " | 108.0 | 183 | 3.7 | 100.0 |
| 8/1-12 | " | 101.0 | 182 | 5.0 | 5.1 |
| 3/1-41 | Wintok 3424 x Novosadski 2 | 104.0 | 178 | 7.5 | 84.6 |
| 5/2 | " | 103.0 | 179 | 7.5 | 83.8 |
| Winter oat C.I. 5364 | | 108.0 | 186 | 3.7 | 72.7 |
| Wintok C.I. 3424 | | 109.0 | 185 | 3.3 | - |

The work in oat pathology, as in previous years, is in the following areas:

- Oat disease survey,
- Stem rust race identification, and
- Testing with rusts in a search for resistance.

In 1970 and 1971, vast hilly and mountainous areas in the southeastern part of the country were included in the disease survey. Not many pathogens were found on oat plants. Disease severity varied from area to area and from field to field. Higher disease attack was established on the vigorously growing crop being given fertilizers either before sowing or at some stage of plant development.

Crown rust was the most frequent and the most severe of all the oat diseases. It was followed by stem rust. In recent times powdery mildew has been severe more frequently than in the years back. Fusarium spp. were sporadically found. The same was true for Helminthosporium spp. Loose smut and covered smut, countrywide oat diseases, were of low severity and caused no great losses.

In 1970 and 1971, several uredosamples of stem rust were collected on the survey trips. Analysis of 1971 collection has not been finished yet. In 1970, the only races of stem rust found in the southeastern part of the country were races 2, 6, and 8, in order of their prevalence.

In the rust nursery at Kragujevac, 80 oat populations were artificially inoculated with Puccinia graminis avenae and P. coronata avenae. They proved to be very susceptible.

The International Oat Rust Nursery for 1971 was sown at Zlatibor, in the highland area. Notes on stem rust, crown rust, and powdery mildew were taken on 101 entries.

In the last three years the most important insects on oats were found to be aphids, cereal leaf beetle and frit fly. Aphids were rather common on oats, but they were the most dangerous in highland areas and especially on spring oats. Cereal leaf beetle was very common too, but on the contrary, it caused much more damage on the crop grown in lowland areas. Frit fly was spread all over the oat growing region. The generation of the fly that laid its eggs in oat panicles did the greatest devastation to the crop. Results of a frit fly attack in the locations of Zlatibor and Rudnik are shown in Table 3.

Table 3. Results of a frit fly attack on oat entries at Zlatibor and Rudnik.

| Location | Year | Number of entries | Infestation in Percent |
|---|---|---|---|
| Zlatibor | 1969 | 210 | 0.7-46.8 |
| Zlatibor | 1970 | 210 | 0.2-41.3 |
| Zlatibor | 1971 | 101 | 0.6-35.3 |
| Rudnik | 1969 | 210 | 3.4-60.0 |
| Rudnik | 1970 | 210 | 0.2-46.5 |

# V. CONTRIBUTIONS FROM THE UNITED STATES

## ARKANSAS

F. C. Collins and J. P. Jones

An average yield of 54 bu./A was produced in 1971 on 59,000 acres in Arkansas according to the Crop Reporting Service. Both figures represent a decrease from previous years which was probably due to late planting in the fall and dry weather in early spring.

Diseases were minimal in the state, for the second year in a row, with even crown rust almost absent. Barley yellow dwarf development was also negligible in the production areas but was very severe in the Fayetteville nursery with many oat entries producing little or no seed. BYDV has been severe at this location for the past several years, a situation that permits the screening of large populations for resistance.

Seed treatment tests at Fayetteville with the systemic fungicides carboxin and benomyl showed both to control covered smut of oats at rates of 4 and 6 ounces per hundredweight of seed.

## FLORIDA

R. D. Barnett, H. H. Luke and W. H. Chapman

A recent survey by the extension service indicated that 45,000 acres of oats were grown in Florida in 1970-71. The yield of the oats harvested for grain was 65 bushels per acre. The breakdown on uses of the oats expressed as a percentage of the total acreage was as follows: 44% for grazing only; 33% for grain only; 18% for a combination of grazing and grain; 5% for hay, silage or as a green manure crop. The breakdown of the total acreage seeded to various varieties was as follows: 50% Florida 501, 28% Florida 500, 10% Suregrain, and 12% other or unknown varieties.

Varieties recommended for grain production in 1971-72 in order of preference were: Florida 501, Coker 67-22, Nora, Coronado, and Cortez. Florida 501, Florida 500, Coker 67-22, Floriland, and Suregrain were recommended for late winter and spring grazing and Red Rustproof 14 for late spring grazing.

A one-half acre increase block of the advanced oat line FL67Ab113 (C.I. 8425) was planted in view of a possible release within the next two years. This line has the following pedigree: Southland/Minn. 19-11//Silva/3/Florida 500. The pedigree of Minn. 19-11 we think is the following: Hajira/Joanette// Mindo/3/Landhafer/4/Forkedeer. FL67Ab113 had the eighth lowest average coefficient of infection for leaf rust (5.1) among 129 entries in the 1970 International Oat Rust Nursery.

It has been noted that oats can be planted successfully about one month earlier in the fall than the other small grains. Preliminary research indicated that there is a significant difference in cultivars of oats in their ability to germinate, grow, and withstand the attack of seedling diseases which are enhanced by the warm weather of early fall. Additional research is planned in screening for varieties that will grow well when planted early. Through the use of selective fungicides, we are also attempting to determine what disease organisms are responsible for early seeding stand losses.

Seventy groat samples from our 1971 oat yield tests were submitted to the National Oat Quality Laboratory for protein analysis. Protein content ranged from 12.9% to 20.2% with a mean of 16.3%. A correlation coefficient of -.20 was obtained when grain yield was correlated with protein content of the groats. Twenty-five samples of oat groats were submitted for amino acid analysis. None of the selections were superior in amino acid profile to the check (Florida 501).

## GEORGIA

Acton R. Brown (Athens), Lloyd R. Nelson (Experiment),
Darrell D. Morey and Robert H. Littrell (Tifton)

In 1971, approximately 3 3/4 million bushels of oats were produced on about 80,000 harvested acres for an average yield of 48 bushels per acre. A 7% increase in oat acreage is forecast for Georgia in 1972. Only about 40% to 50% of the oat acreage is harvested for grain, the remaining acreage is harvested as green forage, turned under as green manure, or hogged-off in the field.

The most popular varieties in the Piedmont area are Coker 66-22, Moregrain 211, Ora, Nora and Jefferson. Varieties for the Coastal Plain area include Florida 501, Coker 67-22, Elan, Ora and Nora. Besides the usual grain yield tests, forage clipping trials are conducted at Athens, Experiment and Tifton to select the best varieties for both grain and forage production.

The Elan oat variety was released in Georgia in 1970 as a disease resistant variety with short, strong straw and a high grain yield record.

Ga. 7199 oats were released in 1971 as a disease resistant replacement for the popular forage varieties Jefferson and Fairfax (see new varieties).

Lloyd R. Nelson, a native of Wisconsin, completed his Ph.D. degree at Mississippi State University under Dr. Gene Scott (ARS, USDA) and replaced Dr. Morris Bitzer as small grain breeder at the Georgia Experiment Station, Experiment, Georgia. Dr. Bitzer assumed the positon of Extension Specialist in Grain Crops at the University of Kentucky in June, 1971.

## IDAHO

D. M. Wesenberg and R. M. Hayes

Idaho's oat production was estimated at 3.9 million bushels for 1971 by the Idaho Crop and Livestock Reporting Service --- a decline of 33 percent compared with the previous year.

The Aberdeen and Twin Falls oat nurseries were severely damaged by trifluralin residues. Research recently reported in the literature indicates that damage of this nature is reduced or eliminated by fall plowing; however, the fields where the damage occurred were prepared only with a disk and harrow.

The Cayuse x Orbit and Cayuse x Glen selections entered in the 1971 Uniform Northwestern States Oat Nursery were promising for yield, however, at certain locations they were low in test weight. The three high yielding entries at 21 locations were Cayuse, 68Ab644, and 68Ab710. The two selections are from Cayuse x Orbit. Selection 68Ab644 averaged higher than Cayuse in yield at eight locations in 1971. It averaged 114.8 bushels per acre over 21 locations compared to 115.4 for Cayuse. 68Ab644 averaged only 32.9 pounds per bushel in test weight compared to 34.9 for Cayuse.

Protein determinations were recently received from the Oat Quality Laboratory for samples involving 1371 $F_2$ and 150 parental plants. Protein content ranged from 12.9 to 24.6 percent for the $F_2$'s compared to a parental range of 12.8 to 26.4. The maximum within parent range was 6.1 percent; however, the average was only 2.1 percent for 16 parents. A few $F_2$'s exceeded the parental extremes in protein content.

## ILLINOIS

C. M. Brown and H. Jedlinski

### 1971 Season

Illinois farmers planted 1,197,000 acres of oats, an increase of 28 percent over the 1970 plantings. Most of this increased acreage was diverted feed grain acres, consequently the harvested acreage was only 600,000 acres, 2 percent less than in 1970. The reported state average yield was 60 bushels per acre, 4 bushels above 1970, but slightly lower than in 1969. Hot, dry weather from the late-boot stage through the flowering stage throughout the oat-producing area appeared to reduce test weight and yield.

The incidence of Barley Yellow-Dwarf Virus disease was very low especially in the northern and central parts of the state for the second consecutive year. Crown rust and stem rust were observed late in the season but they were not a limiting factor in production. Oat smut was severe in some fields with incidence as high as 25 percent.

### Varieties

Garland and Jaycee continue to be the most widely used varieties in Illinois. Garland accounted for 22%, Jaycee 19%, and Newton 12% of the acreage. No other single variety accounted for more than 5% of the acreage.

Illinois 66-2287A, C.I.9086 is being increased in Illinois and several other north central states for release to seed growers in 1973. This selection resulted from a cross of Albion x Newton 2x Minhafer 3x Jaycee. 66-2287A has been quite similar to Jaycee in most characteristics except that it has superior lodging resistance and superior Barley Yellow Dwarf Virus tolerance. It also may have somewhat wider adaptation than Jaycee. The selection has not been named. A more complete description will be presented in the 1972 *Newsletter*.

## INDIANA

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

Breeding for high protein. The most advanced lines from crosses of Garland, Florida 500 and Diana, each X CI8320 and lines from Clintland 64 and Purdue 5711G3-3-5 each X PI267989.

Fifty lines from a total of 340 lines have been selected for further testing. Data from experiments in 1970 and 1971 are summarized in Table 1. In 1970, plots consisted of single rows 2.44 m long with plots spaced 30.5 cm apart. Plots in 1971 consisted of 2 rows 2.44 m long and spaced 30.5 cm apart.

Table 1. Mean percent protein and protein yield of 50 advanced high-protein lines averaged over two years.

| Entries | | Groat protein, % | Protein yield, lb/acre |
|---|---|---|---|
| 33 lines from crosses with CI8320 | Average | 19.8 | 576 |
| | Range | 17.7-21.4 | 440-729 |
| 17 lines from crosses with PI267989 | Average | 18.9 | 595 |
| | Range | 17.7-19.6 | 477-693 |
| Clintford | | 16.5 | 666 |
| Diana | | 18.0 | 628 |

Generally, lines with a high percent protein yielded less than lines with a lower percent protein, although four lines with over 20.0 protein yielded relatively well. One line with 20.8% protein yielded 729 pounds of protein on an acre basis. Of the 50 lines, 3 had less than 18.0% groat protein, 26 had 18.0 to 19.5%, 11 had 19.6 to 20.5% and 10 lines had 20.6 to 21.4% groat protein averaged over 1970 and 1971.

Test weights (pounds/bu) were generally in the high 20's and low 30's. Clintford and Diana had test weights of 34.5 and 33.9 lb/bu, respectively. Test weights for the "high-protein" lines were probably reduced due to the presence of pubescence on the lemmas and the generally longer kernels of many of the lines compared to Clintford and Diana. Average weights of 200 kernels (with hull) ranged from 4.11 to 7.10 gm.

Clintford and Diana had 200-kernel weights of 5.78 and 5.19 gm, respectively.

Several $F_5$ lines from a cross of Clintford X CI8336 have been selected for further yield and protein testing. CI8336 is a large-seeded, high-protein, _A. sterilis_ introduction. Several good-yielding lines have 20 to 22 percent protein with groat weights greater than Clintford (based on a one-year test with two replicates).

Many backcrosses of selected high-protein lines with adapted varieties have been made to improve plant type and disease resistance in the high-protein lines. Several hundred of these $F_2$ populations will be grown in 1972.

Billie Fagala, with an M.S. degree from the University of Arkansas, has joined the oat project as a graduate assistant on the Quaker Oat Company assistantship.

## IOWA

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

Oat grain production in Iowa in 1971 total 93 million bushels harvested from 1.6 million acres that yielded 59 bushels per acre. Oat seeding was completed early, the crop developed rapidly and grain yields and test weights were good. Crown and stem rust were present in a few fields in Iowa in 1971, but these diseases caused no measurable yield reductions.

The oat breeding research in Iowa has been expanded considerably into 2 areas -

1. Research on protein content in grain and straw of oats - A grant from the Quaker Oats Company has provided for hiring a technician to handle the greenhouse, field, and laboratory duties associated with the protein research. This position is occupied since September, 1971 by George Patrick. Two graduate students, Dumrong Tiyawalee and Apinya Tantivit, currently are conducting protein research for their thesis projects. Mr. Tiyawalee, a Ph.D. candidate, is searching for linkages of high-protein loci with crown-rust reaction loci, and Miss Tantivit, an M.S. candidate, is investigating the potential of cytoplasmic inheritance of high-protein content in oat grain.

   A general summary of the protein research at the Iowa station is presented in the NCR-15 report section.

2. Locating crown-rust reaction loci - The 14 monosomic lines derived by K. Sadanaga are being used to identify the chromosomes on which major crown-rust reaction loci are located. The loci to be tested are those being used in the Multiline E and Multiline M cultivars. Ron Skrdla, a new research associate since May, 1971, is responsible for this research project.

## KANSAS

E. G. Heyne and E. D. Hansing

Oats remains about a seven million dollar crop in Kansas and with the continued squeeze on research funds less research on this crop is being carried on. The yield per acre in Kansas in 1971 was the highest on record, 45.0 bushels per acre and was the second largest crop since 1964. Favorable moisture and temperature in late May and June is the major factor for this good production. No serious hazards to production occurred, such as rust, lodging or drought but there was a 25% abandonment of the seeded acreage.

Andrew is perhaps the leading cultivar in the state but the seed shipped in from outside Kansas consists largely of the Cherokee-Bonkee types.

Trio oats, CI 7698, described in the 1970 newsletter, was distributed to Kansas farmers simultaneously with Nebraska. This perhaps represents the last cultivar in which F. A. Coffman had an important part in its development.

The Kansas program is essentially a testing program, including the uniform early oat test and uniform midseason test. Performance trials in Kansas are conducted at five locations in eastern Kansas in nursery plots. Spring oat bulk hybrids involving *A. sterilis* are being grown as well as a winter oat bulk with the intent to make selections at a later date.

Systemic fungicides applied as seed treatments, compared with volatile mercurial fungicides, have continued to give equal or better control of oat smuts. They may be used singly or in combination with protective fungicides. Systemic fungicides with trade names and years in which they have been tested for oats are as follows: Vitavax 1966 to 1971, Benlate 1967 to 1971, Benlate-Thiram 1970 and 1971, Vitavax-Captan 1970 and 1971, and Vitavax-Thiram 1970 and 1971. In addition several other experimental fungicides have controlled oat smuts comparable to volatile mercurial fungicides.

## MINNESOTA

D. D. Stuthman and M. B. Moore

Approximately 3 million acres of oats were harvested in 1971 in Minnesota, a decrease of over 10% from 1970. Conditions were generally favorable for oat production resulting in an average yield of 59 bushels per acre. That average yield was second only to the all-time record of 60 bushels per acre recorded for 1968.

Disease incidence generally was very light. However, the occurrence of ergot was more than for any year in recent history. One sample of oats submitted to the Plant Pathology Disease Clinic contained 0.9% ergot. Occasional ergot bodies were observed in our breeding nurseries, especially in material containing *Avena sterilis* parentage. Ergot was unusually heavy in wheat, rye, and barley as well.

Lodi and Garland continue to be widely grown varieties. Newer varieties such as Froker, Portal, Otter and the Iowa Multi-lines are increasing in acreage. Recommended varieties are Lodi, Garland, Sioux, Portal, Otter, Diana and Froker.

Dr. D. M. Stewart continues to work on a project with FAO in the United Arab Republic while on leave from the USDA. Dr. A. P. Roelfs now conducts the oat rust survey in cooperation with Dr. P. G. Rothman. Gary A. Bald is a new technician assisting Dr. Rothman in the Stem Rust Lab.

Mr. Mike McMullen will be joining us as a graduate student in agronomy. Mike is a native of Illinois and is now completing his M.S. at Colorado State.

## MISSOURI

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

1971 Production. The 1971 season was quite favorable for oat production in most areas of the state resulting in a record yield of 47 bu/acre. Harvested acreage was also up by 10% over 1970, resulting in an increase of 23% in total production. Acreage of oats had declined until 1969 but has shown a 40% increase over this low in the past 2 years.

Varieties. The suggested spring oat varieties are Pettis, Jaycee, and Nodaway 70 with Jaycee being the most widely grown. Norline and Compact are suggested winter varieties but only a few winter oats are grown in the southern part of the state.

Diseases. BYDV was the most widespread and damaging disease, if varieties were susceptible, in 1971. Smut was also quite prevalent. Crown rust was damaging in some areas and a little stem rust was observed late in the season.

Breeding. Major emphasis is placed on high yield and improved plant type. Other important considerations are disease resistance and quality. In addition, winter hardiness is of concern in the winter types. Selections showing improved resistance to BYDV are being obtained from crosses between the more tolerant varieties such as Jaycee and Pettis. In winter types, improved agronomic type from a number of sources is hopefully being combined with the hardiness level of Dade and Mo. 05145

Personnel. Praphas Weerapat completed his studies and returned to his position as a rice breeder in Thailand. Dr. Weerapat studied vector-host relationships as well as the inheritance of resistance to the BYDV disease.

## NEBRASKA

John W. Schmidt

Oat acreage in Nebraska the past few years has fluctuated between 500,000 and 700,000 acres. Acreage harvested for grain has been slightly above the 500,000 mark. In 1971, the 517,000 acres harvested for grain produced an average of 51 bushels per acre. This is an all time record per-acre yield. Disease was not a factor in 1971 production.

The Trio cultivar released by the Kansas and Nebraska Agricultural Experiment Stations in 1971 had good but not outstanding performance in 1971. Cultivars later in maturity were favored. Trio has been a very stable cultivar during this testing period, and this factor should favor its future production in Nebraska.

In the 1969 Oat Newsletter, Graham, Morton, and Kingsland of Clemson, described a device for trimming plots to proper length. After reading this, we built one and used it in 1971 with very satisfactory results. It is really a time- and labor-saving device and quite inexpensive to build.

In our barley and wheat work, we have used a single head thresher and a head row seeding attachment for our plot drill that has allowed us to seed a much larger head row nursery without a much greater financial outlay. While we have not used this on oats, we believe that it could be used. Both were built by Precision Machine Co., Lincoln, Nebraska.

## NEW YORK

N. F. Jensen

ASTRO. C. I. 9160, is N.Y. selection 5279-105, a full sib of Orbit. For further information see under new varieties section.

Environmental Growth Chamber. The cereals project has obtained a walk-in growth chamber (our first) for its use. This will be used predominantly, but not exclusively, for oat research. It is a welcome addition: in recent years we have been unable to obtain seed set in oat crossing under greenhouse conditions (while excellent sets are obtained in the growth chamber).

Crown Rust Resistance Mass Selection Project. This project, conducted annually under buckthorn hedges at Aurora, N.Y. in cooperation with Dr. George C. Kent, completed its third cycle in 1971. Approximately 2 acres of wide germplasm source oats were grown (sown from the processed survivors of 1970). The crown rust infection was heavy. The underlying basis of this project is that under epiphytotic conditions only individuals with some degree of general or specific resistance will mature heavy solid kernels. Seed processing after harvest reduced approximately 60 bushels to 6 bushels for the 1972 planting.

## NORTH CAROLINA

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

North Carolina has recorded its seventh record state average yield in eight years. The 1971 average of 56 bu/acre was up four bushels from 1970 and the harvested acreage increased seven percent.

Leading varieties are still Carolee, Yancey, Coker 66-22 and Coker 242. Roanoke is still grown for its forage production and winter hardiness.

The search for productive stiff-strawed types continues to be a high priority item in the breeding program. While promising material is available, we have been somewhat disappointed that the stiff-strawed material tends to be low in seeds/panicle and panicles/plant. Our newer "dwarf" and "semi-dwarf" material is quite encouraging, however, as we are seeing a nice combination of early maturity and increased production of seeds/panicle.

## OHIO

Dale A. Ray

Production. The cool, wet early spring weather in Ohio again caused a reduction in oat acreage planted in comparison with the intended acreage. The 520,000 acres harvested represented an increase of 5,000 acres over the 1970 harvest. With an excellent combination of growing conditions in midseason, the state average yield of 67.0 bushels per acre set an all-time record and contributed to a 16.6 percent increase in production. Most of the common oat diseases were evident in minor incidence and although the cereal leaf beetle infestation was heavy for a short period of time, yields were not seriously affected.

Oat Varieties. The varieties Clintford, Clintland 60, Garland, and Jaycee were continued in recommendation for grain production. Some interest continues for the use of oats as a green-chop feed for livestock, for which Rodney is the principal variety used. Orbit and Otter had the highest average yields in the combine-harvested yield trial grown at eight locations. Clintford ranked highest for test weight and had the best score for resistance to lodging among the fifteen varieties compared in the test. About 90 percent of the Certified seed acreage of oats in the state consisted of the varieties Clintford, Clintland 60 and Garland. Illinois 66-2287A and Dal have appeared particularly promising in Ohio nurseries and probably will be added in recommendation for 1973 planting.

Oat Breeding. The most promising Ohio lines in preliminary nurseries continue to be from Clintland 60-Rodney x Putnam 61. The material from *Avena sterilis* x common oat varieties was reduced to about 100 selections on the basis of protein percentage and desirable agronomic plant type. As seed supply becomes adequate, these selections will be compared in a preliminary yield nursery. The winter oat nurseries and selections retained for observation were completely winter killed at Columbus. Interest by farmers continues for the availability of an adapted winter oat variety, and evaluation of new breeding lines with promise of improvement in winter survival will be continued.

## OKLAHOMA

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

### Production

A crop of 4.3 million bushels of oats was produced in 1971 from 139,000 harvested acres. This compares with 7.4 million bushels from 185,000 acres in 1970 and 6.5 million bushels from 158,000 acres in 1969. The yield per acre in 1971 averaged only 31 bushels per acre. The low production and yield per acre in 1971 was partially due to a severe drought in much of the state. Much of the planted acreage was abandoned or grazed out.

### Oat Varieties

Checota and Chilocco appear to be gaining in acceptance by Oklahoma farmers. The acreage of these varieties is still small because of limited seed supplies. However, their performance records continue to be good under Oklahoma conditions. Ora and Nora continue to be popular varieties especially in Eastern Oklahoma. They are susceptible to winter-kill almost every year in Western Oklahoma. Cimarron still remains the predominant variety in Western Oklahoma; however, Chilocco should replace much of the Cimarron acreage as seed becomes available.

Oat Breeding

Several advanced lines involving germ plasm from Cimarron, Bronco, Arlington, and Wintok have exhibited good yield records in our Advanced Performance Nursery. One of these lines, C.I.8452, has excellent winterhardiness, early maturity, and high yields under Oklahoma conditions. Crosses are being made to incorporate greenbug resistance from P.I.186270 into an adapted winter oat.

Disease Evaluation

Following an evaluation of the data from 3 years of yield testing and 4 years of observation and selection it appears that progress toward selection for crown rust tolerance has been made. Certain of the most tolerant lines were, therefore, planted at Beeville, Texas, for further yield testing. In addition, selections from $F_3$ populations of crosses between these more tolerant lines were also planted at Beeville for observation and evaluation. Further crosses will be made following these tests, since the complicating factor of specific resistance to portions of the rust population (therefore appearing as "slow-rusting" types) must be eliminated.

Personnel Notes

Mr. H. Pass assumed the oat breeding research at Oklahoma in 1971.

## PENNSYLVANIA

H. G. Marshall

Production. The oat acreage continued to decline slowly in Pennsylvania during 1971, and only 431,000 acres were harvested for grain. However, conditions were generally favorable for oat production, and the estimated average yield was 54 bushels per acre. Production figures are based on spring oats since no estimates are available for winter oats. The recommended varieties are 'Garry,' 'Pennfield,' 'Orbit,' 'Russell,' 'Clintford,' and 'Jaycee' spring oats; and 'Norline' and 'Pennlan' winter oats

Winter Oat Research. A cooperative USDA-Pennsylvania program to develop varieties with sufficient winter hardiness and straw strength for northern areas of winter oat production was continued. Winter survival was good in nurseries at three locations in Pennsylvania and at Warsaw, Virginia. C.I. 8312 (Pa 418-1099:Dubois x Pa 5037 2x Ballard) again performed well under Pennsylvania conditions, and a decision regarding release will be made during March of 1971. A backcrossing program is underway to combine dwarf straw from the North Carolina variety C.I. 8447 with a high level of winter hardiness. The winter-hardy recurrent parents in use are C.I. 8310, C.I. 8312, and Pa. 822-7538. The desirable segregates for backcrossing are easily recognized since there is a high positive correlation between short straw and a compact panicle type. Unfortunately, late maturity has accompanied dwarfness in our material to date.

Collections of *Avena fatua*, *A. sterilis*, and *A. ludoviciana* with high combining ability for freezing resistance also have been crossed with the winter-hardy varieties mentioned above. The segregating generations will be screened for transgressive winter hardiness and elite progeny will be intercrossed within populations. A backcrossing program also has been initiated to transfer winter hardiness genes from the above wild oat species into a spring oat background. This approach should facilitate transfer of the desired genes into a cultivated oat background, and the derived lines will then be crossed to elite winter oat varieties.

Cytological Studies. Dr. D. S. Chaugale, an Indian student under the U.S.A.I.D. program, completed his Ph.D. research during 1971. He completed cytological studies of interspecific hybrids between various *Avena* species and the autotetraploids (*A. brevis* x *A. hirtula*)4x and (*A. hirtula* x *A. strigosa*)4x. Hybrids with *A. barbata* showed significant self-fertility, and an average of 85 percent of the chromosomes were involved in pairing configurations. Hybrids with various *Avena* hexaploids were self-sterile and only 53.5 percent of the chromosomes were involved in simple or complex pairing associations. These pentaploid hybrids have been backcrossed to the hexaploid parent. Unfortunately, crosses between the autotetraploids and diploids with the $A_s$ genome were not obtained, and additional work must be done to fully ascertain the value of the autotetraploids as bridging species. An *A. magna* x *A. longiglumis* hybrid also was studied. Average chromosome pairing was 12.48 I + 3.18 II + 0.72 III indicating some homologies between chromosomes in the $A_1$ genome and those of the two genomes in *A. magna*.

## SOUTH DAKOTA

D. L. Reeves

Production. A record high yield of 54 bushels per acre resulted in oat production being 23 percent above last year. Total production was 125.7 million bushels compared to 102.3 million bushels last year. This production was achieved in spite of a severe outbreak of crown rust in the eastern edge of the state and dry weather over most of the state.

Varieties. A new variety, Chief, C.I. 9080 was released. Yields of Chief in South Dakota have been good.

Personnel. Harbens S. Sraon joined the project in June 1971 as a graduate student.

# 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 1971 season was disastrous for oat production in Texas. A protracted drouth before and after seeding prevented germination and emergence in many locations in South Texas and severely limited growth in Central Texas and in the Rolling Plains region. The Beeville Nursery in the Coastal Bend Area of South Texas was dry-planted in November and did not emerge until late March - early April. Commercial fields in South Texas, planted primarily for winter grazing by livestock, provided little or no forage. Only 222,000 acres of the estimated 2,359,000 planted acres were harvested. This represents only 9.3% of the planted acreage. Approximately 35-40% of the oat acreage usually is harvested.

Rusts. Crown rust infection did not occur until relatively late in the growing season and only a light to moderate epidemic developed at College Station. The low incidence of crown rust probably was caused by the severely limited oat production in the South Texas crown rust "hotbed". The physiologic races of 40 isolates of *Puccinia coronata* f. sp. *avenae* collected in Texas were determined by Dr. Marr Simons. Races 264B and 325 continued to predominate. These races occurred in equal frequency and together comprised 85% of all Texas isolates identified. Races 290, 327, 202, and 321 also were identified from the Texas collection.

Stem rust in contrast to crown rust was the most severe we have witnessed in many years. Stem rust became established in early February and "peaked" in mid-March on early-maturing lines. Later maturing selections were attacked less severely. Samples of *P. graminis* f. sp. *avenae* were sent to the Cooperative Rust Laboratory for physiologic race identification. Almost half of the isolates were identified as race 31 (6 AF), and races 61 (7F) and 32 (7 AF) also were frequent. Races 20 (6A), 21 (7A) and 77 (2H) also were identified from the Texas collections.

Breeding. Crown rust resistance is being transferred into commercial varieties from approximately 35 *Avena sterilis* sources from the U.S.D.A collection. Good seedling and adult-plant resistance have been observed in cultivated derivatives having *A. sterilis* resistance genes from many of these sources. In some cases, the degree of dominance of *A. sterilis* resistance genes appears to shift in different commercial-variety recurrent-parent backgrounds. The genetics of these unusual reactions are being investigated.

Photosynthetic efficiency studies are being conducted on oat varieties and hybrids. The effect of crown rust on photosynthetic efficiency of oats also is being investigated.

Personnel. M. E. McDaniel spent six months on a study leave at the C.D.A. Research Station at Winnipeg, Manitoba, Canada during the summer and fall of 1971. The study leave was devoted to extensive crown rust studies conducted in cooperation with Dr. George W. Fleischmann, C.D.A. Crown Rust Pathologist.

## TEXAS

I. M. Atkins, Grain Research Associates

A new research organization has been formed by four Texas seed companies whose major business is seed of small grain crops, forage crops, and grain sorghum. These companies are Harpool Seed Incorporated, Denton; George Warner Seed Company, Hereford; McGregor Milling and Grain Company, McGregor; and Douglas King Seed Company, San Antonio. The last two are among the oldest seed companies in Texas, the McGregor company having been in business since 1907. Although facilities and trained personnel are limited in all these companies, we shall be doing testing and some breeding in all of the small grain crops; and, I hope to assist in keeping them informed on new developments in commercial, state, and federal agencies.

We are giving major emphasis to forage characteristics in the small grains as this is a repeat business of somewhat local adaptation. We are exploring forage production in hybrid wheats, strain cross ryes, triticales, mixtures of species or varieties as well as in the three major crops. In recent years only one-third of the Texas oat crop has been harvested for grain, the remainder has been grazed off. In 1971, only 222,000 acres were harvested from 2,359,000 seeded, the above trend being accentuated by the severe spring drouth. One member of our company sold 50,000 bushels of New Nortex oats in each of the past two years for exclusive forage use by one grower.

We are doing limited selection work from bulk hybrids and gene bank materials available from public agencies which are available to any breeder. We do not have facilities for extensive breeding or disease testing in oats.

## UTAH

R. S. Albrechtsen

The oat acreage in Utah has stabilized somewhat in the past ten years, following a rather significant decline for many years previous. Yield per acre has increased, but the state-average yield of 55 bushels per acre was far below yields obtained in our nursery plantings. This indicates a need for improved cultural and management practices in order to utilize the yield potential of available varieties.

Oat breeding and testing work was discontinued at our station when Dr. R. W. Woodward retired in 1965. We resumed growing of the Uniform Northwestern States Oat Nursery at Logan in 1971. Some of the selections from Aberdeen, Idaho performed well. The top-ranking entry averaged 208.6 bushels per acre. Cayuse was the highest yielding named variety, at 204.2 bushels per acre. Park was intermediate in yield. Overall average yield for the nursery was 183.9 bushels. Diseases were of no consequence. Lodging was minimal with only trace amounts in some of the older tall varieties. We anticipate a continued program of variety testing and possibly some involvement in oat breeding in the future.

# OATS IN WASHINGTON STATE

C. F. Konzak, M. A. Davis, G. W. Bruehl,

E. Donaldson, and K. J. Morrison

Oat yields in 1971 were generally higher than usual, due largely to the benefit of summer rains. Cayuse was again the high average yielder in the Uniform Northwestern Regional irrigated nurseries, but dropped to sixth place in the non-irrigated stations being excelled in particular by a number of Cayuse/Orbit lines. The unusual adaptability of Cayuse is evidently transmitted to its progeny.

Cayuse, Park, and Harmon were grown in replicated Washington State Agronomy and Extension Service trials at 14 locations varying widely in yield potential. The yield data demonstrated that Cayuse was most consistent and highest in overall performance. This was true in spite of the fact that at some locations Orbit, Park, or Harmon yielded as well or better than Cayuse, indicating that these latter varieties differ in their genetic ability to respond to yield potential of widely varying environments.

The only breeding work being done is for BYDV tolerance. $F_6$ progenies of Cayuse/CI2874 and reciprocal were grown at Pullman and at Davis, California. Through Dr. C. O. Qualset's cooperation, a number of lines having significantly better BYDV tolerance than Cayuse were selected. These lines varied considerably in test weight, plant height, and date of maturity. Most of the selections to be yield tested in 1972 should carry improvements in test weight and plant height.

# WISCONSIN

## Report from the Oat Quality Laboratory

Y. Pomeranz, G. S. Robbins, J. T. Gilbertson, and I. B. Sachs

Amino acid analyses included surveys of plant breeders' samples, material from uniform nurseries, and several research projects designed to elucidate the effects of gross composition, environmental and cultural practices, and genetic variations on amino acid composition and nutritional value.

A total of 950 oat samples was received and processed for analysis (1,000 kernel weight, moisture, protein, and amino acid composition).

The detailed structures of the lemma, palea, rachilla segment, pericarp, aleurone layer, and starchy endosperm of the oat kernel were studied by electron scanning microscopy. The presence of microorganisms in the crease area of the caryopsis and adjacent palea were illustrated.

# VI. NEW OAT CULTIVARS

## A. Alphabetical List

| Name | C.I. No. | Origin | Described on page: |
|---|---|---|---|
| Astro | 9160 | New York | 58 |
| Chief | 9080 | South Dakota | 58 |
| Chihuahua | | Mexico | 59 |
| Cuauhtemoc | | Mexico | 59 |
| Ga. 7199 | 8541 | Georgia | 59 |
| Grundy | 8445 | Iowa | 59 |
| Maris Osprey | | England | 60 |
| Taiko | | New Zealand | 60 |
| Windsor | 9140 | Virginia | 61 |

B. Descriptions of New Cultivars

## ASTRO

The Cornell University Agricultural Experiment Station plans the release of N.Y. 5279-105 spring oat under the name ASTRO (C.I. 9160). This oat is a full sib of Orbit from the cross: Almo 4x Garry Sel. 5 (C.I. 6589) 3x Goldwin 2x Victoria x Rainbow.

Information on the performance of Astro is to be found in the 1969, 1970 and 1971 reports of the USDA Uniform Midseason Spring Oat Nurseries, where it ranked first in yield every year. Astro has an approximate 3 bushel per acre advantage over Orbit, the dominant variety in New York. It is also superior in lodging resistance. With the exception of kernel size---significantly smaller than Orbit---the other attributes of Astro generally coincide with those of Orbit.

Astro will be on a limited generation seed sequence (same as for Orbit of Breeder, Foundation and Certified; there will be no Registered generation). Production plans are for approximately 40 acres in 1972, so seed supplies will not be ample until after the 1973 harvest. Other states wishing to use Astro may do so under the same arrangements as for Orbit, that is, either obtain Breeder Seed and maintain own Foundation program or purchase Foundation Seed from New York: inquiries for information on these points are invited.

## CHIEF

Chief, C.I. 9080, is a spring oat selection released by the South Dakota Agricultural Experiment Station in December 1971. It originated as a single $F_2$ plant from a Clintland 64 x Garland cross which was tested as SD B65 PROI-1541. The $F_3$ generation was reselected for crown rust resistance and plant type. Chief is a yellow oat which has about two percent white kernels which fluoresce under ultra violet. It was grown in the Midseason Nursery in 1968-1971.

Crown rust ratings have shown Chief to be resistant to current predominating races including 264B. Chief, as released, has about two percent of the plants which do not possess as much crown rust resistance as the other plants.

Chief is a midseason oat being similar to Garland in respect to heading date and one to two inches taller. Straw strength is good. Protein content of the grain is good being slightly above Garland.

## CHIHUAHUA

Chihuahua is a sister variety to the Cuauhtemoc oat. Tests were also made on this oat in Cd. Cuauhtemoc where it was seeded in July on dryland and in Cd. Delicias where it was seeded in January on irrigated land. Chihuahua oat is slightly earlier than Cuauhtemoc, maturing in about the same time as Burt (92 days). Chihuahua is slightly shorter than Cuauhtemoc and therefore more for use on irrigation land than Cuauhtemoc. In other aspects such as plumpness, yield ability, lodging resistance, resistance to stem rust, it is similar to Cuauhtemoc oats.

## CUAUHTEMOC

This spring oat, Cuauhtémoc, was released for sale in Mexico in 1968. It is a selection from the cross AB-177 x Putnam 61. The cross was made by geneticists of INIA. Selections from this cross were made in Celaya, Roque, Guanajuato and Cd. Cuauhtémoc. The selection that became Cuauhtemoc and others were then tested for yield in Cd. Cuauhtémoc and Cd. Delicias. Cuauhtémoc oat was selected for earliness, resistance to lodging, yield ability and height. It matures in about 95 days, three days later than Burt, the variety that is commonly grown here. It also outyields Burt 1.16 to 1.54 times, with yields ranging from 115 bushels per acre in 1968 to 33 bushels per acre in 1969. It is only moderately resistant to stem rust, but it is much more resistant to this rust than is Burt. Because oats is still cut with a binder here, the height of this oat, two to four feet, is of importance to the farmer.

## Ga. 7199

Ga. 7199, C.I. 8541, is a new oat variety released in Georgia in 1971. It is a forage variety intended as a replacement for Fairfax and Jefferson oats in the Piedmont and Coastal Plain areas. Ga. 7199 is from a cross of Fairfax x Florida 500 made by Dr. U. R. Gore at Experiment, Georgia in 1962. The final selection was made at the Coastal Plain Experiment Station, Tifton, Georgia in 1967.

Ga. 7199 has the good forage production of Fairfax combined with the disease resistance of Florida 500. It is resistant to most races of crown rust, but is susceptible to race 264A. It is winter hardy except in the Mountain areas. Foundation seed of Ga. 7199 oats will be available from the Georgia Seed Development Commission, Whitehall Road, Athens, Georgia 30601.

## GRUNDY

Grundy (C.I. 8445) cultivar, released by the Iowa Agricultural Experiment Station in 1972, was derived from the cross Clintland x Garry-5. It is early in maturity, medium short, and produces medium-size yellow seeds. It has semi-compact panicles and its straw is very strong. Grundy plants produce short, upright, dark green leaves. This strain is tolerant to many races of crown rust, carries the *Pg* 2 and *Pg* 4 genes for stem rust resistance, and is susceptible to the barley yellow dwarf virus.

## MARIS OSPREY

Maris Osprey is a new variety of winter oats which has been added to the Recommended List of the National Institute of Agricultural Botany for 1972. This variety has been included in the official Index of Plant Varieties and has also been awarded Plant Breeders' Rights. It was selected at the Plant Breeding Institute, Cambridge, England from the cross Manod x Penrhyn.

In 23 national trials conducted over the years 1967-70, Maris Osprey gave an average yield of 105% of the mean of the control varieties, Maris Quest and Peniarth. It is a short strawed variety which stands better than Peniarth but not as well as Maris Quest. Its maturity is similar to that of Peniarth.

The resistance to powdery mildew of Maris Osprey is superior to that of Maris Quest but its winter hardiness is slightly inferior. It has larger grain than Maris Quest and the kernel content is also higher.

## TAIKO

G. M. Wright

Taiko, a new spring oat bred at the Crop Research Division, DSIR, New Zealand, was released in 1971. It is a black oat selected from the cross S172/Royal Scot/2/99.01/3/99.01/Onward 63, in which 99.01 was a low-yielding black oat selected from an $F_3$ plot of Sun II/Onward/2/Milford/Sun II, and presumably the result of a natural cross with a black oat in the collection, grown adjacent to the $F_2$.

Single-plant selections were made in $F_2$ and $F_3$, and only black lines were selected from the first yield trial. One of these, after four seasons of yield trials and one of block sowings on farms, was released from a reasonably uniform $F_9$ crop, and the 1974 release from the Department of Agriculture will be the first composite of pedigree lines selected as $F_9$ plants.

Taiko is a short-strawed, mid-season variety, with a dense unilateral panicle. It is resistant to lodging and straw break, and probably to mosaic, mixed in reaction to crown rust, and fairly susceptible to stem rust and BYDV. It produces fairly high yields of plump grain, outyielding other black oats grown in New Zealand and having a much higher grain/straw ratio. The straw is coarse, however, and the grain has a thick husk and a low oil content.

# WINDSOR OATS

by T. M. Starling, C. W. Roane and H. M. Camper

'Windsor', C.I.9140, was selected from the cross of Victorgrain 48-93 x Cimarron and was tested under the experimental designation of Va.65-32-21. The cross was made by the late S. J. Hadden, Coker Pedigreed Seed Company, Hartsville, S. C. and $F_2$ seed were shared with Virginia researchers in 1955. The original selection from which Windsor developed was made from an $F_3$ population grown at the Eastern Virginia Research Station, Warsaw and the final selection was made from the original selection in the $F_7$ generation.

Windsor is being released as a replacement for the 'Roanoke' variety. Compared with Roanoke, Windsor is slightly more winter hardy, approximately 10 inches shorter in height, about a week earlier, stiffer strawed, higher in yield, and similar in weight per bushel. In 17 tests conducted in Virginia from 1965 through 1970, Windsor has had an average yield of 105 bushels per acre with 19% lodging while Roanoke has yielded 92 bushels and lodged 40%. Windsor and Roanoke have been grown in 23 tests in the Coastal Plains and Piedmont regions of North Carolina with comparative yields per acre of 116.5 and 82.7 bushels, respectively.

Windsor is susceptible to crown rust and is moderately susceptible to soil-borne mosaic; however, neither of these diseases is normally a problem on fall-planted oats in Virginia.

Foundation seed of Windsor will be available from the Foundation Seedstocks Farm, Virginia Crop Improvement Association, Amelia, Virginia.

# VII. GERM PLASM MAINTENANCE

## The Plant Gene Resources of Canada

Roland Loiselle

Results from a survey to determine the location and species content of cultivar and genetic stock collections in Canada have established that at least 159 individuals or institutions maintain plant and/or seed collections. A total of more than 86,000 cultivars and genetic stocks are included. Oat and other Avenas number about 12,900. They are maintained by 21 individuals.

A comprehensive catalogue of plant gene resources in Canada is being prepared using a fully computerized system. It will contain available information on pedigree, synonymy, origin, agronomic or horticultural data, insect and disease reactions, etc. Work on the Hordeum section of the catalogue has been initiated. Work on the Avenas will be started in a year or two.

## USDA Small Grains Collection

J. C. Craddock

There were 87 oats assigned Cereal Investigation (CI) numbers and added to the collection during 1971. Seed of these accessions will become available for general distribution as soon as an increase can be obtained. In previous years valuable contributions of Avena germ plasm have been obtained from oat workers. Will you take the time to review your breeding stocks for lines with outstanding characteristics and consider contributing them to the collection? Particular attention should be given to those lines that are no longer of value to your project but may be useful to other workers. All that is required to have your accessions become a part of the collection is a statement declaring the entries open stock and submit a sample (10-200 grams) of each entry. Information such as pedigree, varietal description and/or outstanding characteristics would be helpful, however, in making our records more complete.

The Oat Gene Bank is in dire need of contributions. No seed has been added to this bank since 1968. During the past year 21 pounds were distributed. If this trend continues oat breeders will soon lose an important source of germ plasm. Contributions of seed from $F_1$ and $F_2$ plants would be greatly appreciated.

The CI numbers assigned to the oats during 1971 are listed.

## C. I. NUMBERS ASSIGNED IN 1971
(* - pedigree given on last page of listing)

| C.I. NUMBER | NAME OR DESIGNATION | SOURCE |
|---|---|---|
| 9077* | Minn 67113 | Minnesota |
| 9078 | Purdue 6316A2-4-1 | Indiana |
| 9079* | Minn 67231 | Minnesota |
| 9080* | CHIEF | S. Dakota |
| 9081* | RANDOM | Canada |
| 9082 | RED ALGERIAN | |
| 9083 | BICKNELL (Black) | New York |
| 9084 | BICKNELL (Grey) | New York |
| 9085 | BICKNELL (Typical) | New York |
| 9086* | Ill 66-2287A | Illinois |
| 9087 | CW 53 | Canada |
| 9088 | CW 56 | Canada |
| 9089 | CW 60 | Canada |
| 9090 | CW 246 | Canada |
| 9091 | CW 257 | Canada |
| 9092 | CW 277 | Canada |
| 9093 | CW 278 | Canada |
| 9094 | CW 304 | Canada |
| 9095 | CW 405 | Canada |
| 9096 | CW 406 | Canada |
| 9097 | CW 407 | Canada |
| 9098 | CW 470 | Canada |
| 9099 | CW 505 | Canada |
| 9100 | CW 542 | Canada |
| 9101 | CW 544 | Canada |
| 9102 | CW 548 | Canada |
| 9103 | CW 553 | Canada |
| 9104 | CW 554 | Canada |
| 9105 | CW 555 | Canada |
| 9106 | CW 556 | Canada |
| 9107 | CW 557 | Canada |
| 9108 | CW 558 | Canada |
| 9109 | CW 559 | Canada |
| 9110 | GA 23 | Canada |
| 9111 | GA 29 | Canada |
| 9112 | GA 33 | Canada |
| 9113 | GA 35 | Canada |
| 9114 | GA 44 | Canada |
| 9115 | GA 58 | Canada |
| 9116 | GA 74 | Canada |
| 9117 | 4 VC | Canada |
| 9118 | 5 VC | Canada |
| 9119 | 6 VB | Canada |
| 9120 | WPG 2498 | Canada |
| 9121 | WPG 2502 | Canada |
| 9122 | WPG 2503 | Canada |
| 9123 | WPG 2504 | Canada |
| 9124 | WPG 2506 | Canada |
| 9125 | D203 | Canada |
| 9126 | K 5104 | Canada |
| 9127 | Calif 1953 | Canada |
| 9128 | ELS 6409-1 | Ethiopia |
| 9129 | ELS 6409-2 | Ethiopia |
| 9130 | ELS 6409-3 | Ethiopia |
| 9131 | ELS 6409-4 | Ethiopia |
| 9132 | ELS 6409-5 | Ethiopia |
| 9133 | ELS 6409-6 | Ethiopia |
| 9134 | ELS 6409-7 | Ethiopia |
| 9135* | GOLDEN MUTANT | Maryland |
| 9136* | Ky 67-695 | Kentucky |

| C.I. NUMBER | NAME OR DESIGNATION | SOURCE |
|---|---|---|
| 9137* | Ky 63-1935 | Kentucky |
| 9138 | ROANOKE (High PER Sel) | Maryland |
| 9139* | Minn 711262-72 | Minnesota |
| 9140* | WINDSOR | Virginia |
| 9141 | KM 14928-2 (Col. 23-2) | Israel |
| 9142 | Jain 1 | California |
| 9143 | Jain 2 | California |
| 9144 | Jain 3 | California |
| 9145 | Jain 4 | California |
| 9146 | Jain 5 | California |
| 9147 | Jain 6 | California |
| 9148 | Jain 7 | California |
| 9149 | Jain 8 | California |
| 9150 | Jain 9 | California |

* PEDIGREE

| | |
|---|---|
| 9077 | Lodi / Portage |
| 9079 | Garland / Burnett |
| 9080 | Clintland 64 / Garland |
| 9081 | Glen / Pendek |
| 9086 | Alb / Nwt /2/ Mhf /3/ Jaycee |
| 9135 | Ctn *2/ Ark 674 /4/ (D69 / Bond /3/ Hj / Jt /2/ Vtra) |

| C.I. NUMBER | NAME OR DESIGNATION | SOURCE |
|---|---|---|
| 9151 | Jain 10 | California |
| 9152 | Jain 11 | California |
| 9153 | Jain 12 | California |
| 9154 | Jain 13 | California |
| 9155 | Jain 14 | California |
| 9156 | Jain 15 | California |
| 9157 | Jain 16 | California |
| 9158 | Jain 17 | California |
| 9159* | DAL | Wisconsin |
| 9160 | NY 5279-105 | New York |
| 9161 | CLIMAX (Alaska strain) | Alaska |
| 9162* | CEAL | Alaska |
| 9163* | TORAL | Alaska |

* PEDIGREE

| | |
|---|---|
| 9136 | Dubois /4* LeConte |
| 9137 | Ky 56-302 / CI 4897 |
| 9139 | CI 8377 / Kyto |
| 9140 | Victorgrain 48-93 / Cimarron |
| 9159 | Trispernia / Belar (X660) /2/ Beedee |
| 9162 | CI 9161 / Eaton (CI 3908) |
| 9163 | Orion III (PI 197839) / Tatrzanski |

# VIII. EQUIPMENT AND TECHNIQUES

## Shading Greenhouses with Woven Fabric Material

J. Artie Browning

There is more than a little truth in the statement, "Anyone can heat a greenhouse; the problem is to cool one." The so-called "greenhouse effect" is well known and well named. It describes the buildup of heat in a greenhouse, automobile, or other structure with considerable glass when the structure is closed and exposed to insolation. Short wave lengths enter the structure and, in the course of bouncing around, are converted to long wave lengths that cannot escape and so accumulate as heat. Vents, blowers, evaporation coolers, etc., help. But the greenhouse effect is of such a magnitude on long, hot days that nothing helps much unless the short wave lengths are intercepted before they enter the glass. Intercepting enough sunlight decreases the heat load sufficiently that vents, blowers, etc., can do the rest of the job of keeping a greenhouse usable.

The classical way of intercepting insolation by shading a greenhouse with "whitewash" is handy and economical, but seldom satisfactory. Whitewash material usually is too thick and uneven when first applied, then deficient after some weathers away. Later, in fall and early winter, any residual whitewash provides unwanted and unneeded shade.

To overcome these objections to whitewash, greenhouses at several stations now are shaded part of the year with woven fabric. At Iowa State University, our Plant Pathology Research Greenhouses are covered with woven polypropylene "Prop-A-Lite" Cloth Fabric No. 5186509 that produces 55% shade. This is manufactured by the Chicopee Manufacturing Co., Cornelia, Ga. 30531, USA, and is available from them and greenhouse supply companies.

We have used our shade fabric from April through September for five years and it appears to be good for several more. Thus, at about 7¢/ft$^2$ initial cost, covering large greenhouses is not unreasonable. The 55% shade is excellent for oats, soybeans, and other field crops. Certain horticultural crops may require more shade. This shade fabric enables evaporation-type coolers to keep unvented greenhouses at about 85 F or below even on long, hot, high-humidity Iowa summer days.

Our shade fabric was purchased in pieces 20 x 32-1/2 feet. It is mounted as follows: Each end is sandwiched between two pices of 1" x 4" lumber, each 19 feet long. (There is a one-foot overlap of the fabric, but not of the lumber.) The "sandwich" is made by placing the fabric between the boards, around a piece of 1/4" nylon line, then back again. The boards are screwed together securely, and the nylon line prevents the fabric from pulling through. Edges of the lumber should be sanded to prevent snagging the fabric, and snags on the greenhouse roof should be attended to. Holes are drilled through the lumber near each end. Then the fabric is unrolled over the greenhouse roof, the 1 x 4's coming to the eve line. The assembly is secured with nylon line that is tied through the holes in the 1 x 4's on one end, and to eye-bolts in lead anchors in the greenhouse foundation on the other. The two exposed long edges (along the 32-1/2-foot length) are factory edges and thus do not require hemming with reinforcing tape. Securing the fabric as we have circumvents need for reinforcing tape and grommets that would greatly increase costs. Our installation has withstood winds in excess of 80 mph without damage.

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