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Varietal Trials of Farm Crops

H. K. Hayes, E. R. Ausemus,
J. O. Culbertson, J. W. Lambert,
and R. G. Robinson

Agricultural Experiment Station
UNIVERSITY OF MINNESOTA

CONTENTS

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A LIST of recommended varieties of farm crops for Minnesota is drawn up annually at a meeting of workers in the Minnesota Agricultural Experiment Station, including subject-matter specialists in Agronomy, Plant Pathology, Agricultural Extension, Soils, and Agricultural Biochemistry at University Farm, and representatives of the branch experiment stations at Waseca, Morris, Crookston, Grand Rapids, and Duluth. To be eligible for recommendation, a variety must have been tested in experimental trials for at least three years. These comparative trials are conducted at the central and branch stations, in southwestern Minnesota in cooperation with several county organizations, and in certain cases on farmers' fields. Reaction to important diseases is tested in specially conducted disease nurseries at the central station in cooperation with the Division of Plant Pathology. Tests for quality are made by the Division of Agricultural Biochemistry or in cooperation with the Northwest Crop Improvement Association. So far as possible, the trials include new varieties of promise developed by other workers.

A list of recommended varieties of farm crops is published annually, as a rule, in Folder 22, Agricultural Extension Service. This folder includes a brief statement of the origin of each variety, a summary of desirable and undesirable characters, and special regions of adaptation in Minnesota.

The present summary includes comparative agronomic data on varieties under trial in field plots, a brief summary of disease reaction taken largely from Folder 22, and a brief history of varieties that were not included in Folder 22, but which were grown in the 1948 trials for barley, flax, oats, rye, spring wheat, winter wheat, and soybeans. For a history and short summary of the characters of varieties included in the recommended list, consult Folder 22.

The individual crop summaries were prepared by the project leaders in Agronomy who are responsible for the varietal improvement studies with various crops. Cooperators from the Division of Plant Pathology include E. C. Stakman, J. J. Christensen, M. B. Moore, and M. F. Kernkamp. Cooperators in the Division of Agricultural Biochemistry include W. F. Geddes, R. A. Bottomley, and J. A. Schricker. Cooperators at the branch experiment stations include R. E. Hodgson at Waseca, A. W.

Edson and R. O. Bridgford at Morris, T. M. McCall and O. C. Soine at Crookston, D. L. Dailey and C. H. Griffith at Grand Rapids, and M. J. Thompson at Duluth. Varietal trials are also conducted in southwestern Minnesota in cooperation with various counties under the direction of R. G. Robinson and the project leaders at University Farm. Certain phases of varietal improvement are in cooperation with crops research workers of the United States Department of Agriculture.

While relatively favorable for farm crops, the 1948 growing season deviated considerably from normal in precipitation and temperature at several locations during a considerable part of the growing season. There was distinctly less rainfall than normal at St. Paul and Waseca during May, June, and July and somewhat less than normal at Morris. These deficiencies for these three months totaled —5.0, —4.3, —2.3 inches, respectively, at the three stations.

Mean monthly temperatures during the growing season from April 1 to August 31 were 2.7° F. higher than normal at University Farm, 1.3° F. higher at Waseca, 0.4° F. higher at Morris, and 1.4° F. higher at Worthington in southwestern Minnesota. While rainfall was somewhat lower than normal in May at Crookston and Worthington, both of these stations had higher precipitation than normal for May, June, and July, totaling 2.5 inches heavier at Crookston and 2.1 inches heavier at Worthington.

While most small grains had a satisfactory germination, height of plant was greatly reduced over normal at University Farm, but not noticably so at Waseca. On an average, the crops in all trials were generally less affected by plant diseases than they often are, and differences in performance between varieties were somewhat less than usual.

BARLEY

J. W. LAMBERT

Yield Comparisons

Comparative average yield data are given in table 1 for 1946-48 at University Farm, Waseca, Morris, Crookston, and southwestern Minnesota, and for 1945-48 at Grand Rapids and Duluth. Table 2 shows averages for 1947-48 at all seven of these locations.

Seed for the trials was treated with New Improved Ceresan. The new varieties Montcalm, Moore, Feebar, and Plains have been tested in field plots only two years.

Over the three-year period 1946-48, Mars excelled both Barbless and Kindred in yield at University Farm, but yielded less than these two varieties at Waseca and Morris and in southwestern Minnesota. In this same period Kindred, O.A.C. 21, and Tregal were all superior to Mars and Barbless in yield at Crookston. During the four years 1945-48, Tregal averaged somewhat higher in yield than Mars and considerably more than Barbless and Kindred at Grand Rapids. In this same four-year period, Barbless and Tregal were outstanding in yield at Duluth.

The two-year yield averages at University Farm show the early varieties

Table 1. Yield of Barley in Bushels per Acre in Field Plot Trials at University Farm, Waseca, Morris, and Crookston and in Southwestern Minnesota for 1946-48; and at Grand Rapids and Duluth for 1945-48

Variety	1946-48					1945-48	
	University Farm	Waseca	Morris	Crookston	Southwestern Minnesota	Grand Rapids	Duluth
Barbless	53.8	50.9	48.0	42.6	49.2	36.6	47.0
Mars	58.0	44.9	42.2	44.6	44.8	40.6	41.4
Kindred	49.2	47.4	48.0	49.2	50.3	36.2	40.5
O.A.C. 21	.....	.....	44.5	47.3	.....	.....	.....
Tregal	.....	.....	.....	48.1	.....	44.8	45.7

Plains, Feebar, and Mars to be rather outstanding. Differences were small among the other four varieties. Yield differences were not great among the seven varieties at Waseca and Morris, although Mars, Kindred, and O.A.C. 21 averaged somewhat below the others at Morris. O.A.C. 21 and Kindred gave the highest average yields at Crookston. Moore was notably low in yield at Crookston. Trebi and Tregal were the highest yielding varieties at Grand Rapids, while Trebi and Barbless yielded most at Duluth. Although the range in yields in southwestern Minnesota was small, Mars was lowest and Feebar highest.

Other Agronomic Characters

Comparative data on agronomic characters are given in table 3. Averages for 1947-48 at the four locations University Farm, Waseca, Morris, and Crookston, and for the same period at Grand Rapids and in southwestern Minnesota, give a reliable picture of differences in date of heading, plant height in inches, and weight per bushel.

Plains was the earliest variety, heading two to three days earlier than Mars and Feebar. Kindred was only slightly later than Mars. Barbless, Montcalm, and Moore headed about the same time, averaging three or four days later than Mars.

Barbless, Montcalm, and Moore were about the same in height at the four locations, averaging five inches taller than Mars. They were only slightly taller than Mars at Grand Rapids. Montcalm was two or three inches taller than Barbless and Moore in southwestern Minnesota. Feebar and Plains were consistently the shortest varieties in all of the trials.

Mars, Plains, and Peatland were outstanding in bushel weight. Feebar was

Table 2. Yield of Barley in Bushels per Acre in Field Plot Trials at University Farm, Waseca, Morris, Crookston, Grand Rapids, Duluth, and in Southwestern Minnesota for 1947-48

Variety	University Farm	Waseca	Morris	Crookston	Grand Rapids	Duluth	Southwestern Minnesota
Barbless	57.1	50.8	44.1	43.7	40.4	50.3	44.2
Mars	64.2	48.9	40.8	48.5	35.4	40.0	42.0
Kindred	56.4	45.9	41.8	50.2	37.6	41.4	45.2
Montcalm	55.9	47.6	45.6	45.8	36.2	43.7	46.2
Moore	58.2	48.8	45.4	36.7	39.6	48.5	46.8
Feebar	67.0	48.1	48.4	45.3	38.3	46.5	48.2
Plains	70.9	51.8	45.5	45.6	40.9	39.1	46.4
O.A.C. 21	.....	.....	41.5	51.0	.....	.....	.....
Tregal	.....	.....	.....	47.6	46.2	47.3	.....
Trebi	.....	.....	.....	.....	46.4	53.1	.....
Peatland	.....	.....	.....	.....	38.0	43.6	.....

Table 3. Averages for Date of Heading, Plant Height in Inches, and Weight per Bushel in Pounds at Four Stations: University Farm, Waseca, Morris, and Crookston, in 1947-48; for the Same Characters at Grand Rapids in the Same Period; and for Plant Height and Weight per Bushel in Southwestern Minnesota in the Same Period

Variety	Average Four Stations			Grand Rapids			Southwestern Minnesota	
	Date heading	Height	Weight per bu.	Date heading	Height	Weight per bu.	Height	Weight per bu.
		Inches	Pounds		Inches	Pounds	Inches	Pounds
Barbless	6-29	36	45.9	7-7	29	42.2	33	46.1
Mars	6-25	31	49.0	7-3	28	46.3	31	50.1
Kindred	6-26	34	47.5	7-3	30	43.6	34	47.6
Montcalm	6-28	36	46.5	7-6	29	43.2	36	47.2
Moore	6-29	36	45.2	7-7	30	42.3	34	45.9
Feebar	6-25	29	43.7	7-4	24	38.8	27	44.6
Plains	6-22	29	48.1	7-1	25	45.2	28	48.3
Tregal	.....	.....	.....	7-4	26	44.2	.....	.....
Trebi	.....	.....	.....	7-3	24	43.0	.....	.....
Peatland	.....	.....	.....	7-7	30	46.1	.....	.....

much lower in bushel weight than the rest.

Mars, Peatland, Plains, and Feebar have very good strength of straw. Moore and Tregal rate fairly high in this respect, while Montcalm, Trebi, O.A.C. 21, and Barbless have a considerable tendency to lodge. Kindred has very weak straw.

Trebi, Plains, and Feebar have large to very large kernels. Mars and Peatland have small seeds. The other varieties are intermediate.

Disease Reaction

All varieties are susceptible to scab, although Peatland is less affected by scab than other varieties.

Barbless is moderately resistant to barley stripe, moderately susceptible to spot blotch, and susceptible to loose smut, and stem and leaf rusts.

Mars is resistant to stem rust and moderately resistant to spot blotch, but is susceptible to loose smut and leaf rust.

Kindred is resistant to stem rust and moderately susceptible to spot blotch.

Montcalm is susceptible to stem and leaf rusts, loose smut, mildew, and spot blotch.

Moore is moderately resistant to stem rust, and in Wisconsin tests it has shown moderate resistance to spot blotch. It is susceptible to leaf rust, barley stripe, and loose smut. It has also shown unusual susceptibility to net blotch, particularly at Crookston.

Feebar and Plains are resistant to stem rust, but susceptible to leaf rust, loose smut, and spot blotch.

O.A.C. 21, Tregal, and Trebi are all susceptible to stem and leaf rusts. Tregal and Trebi are resistant to some races of loose smut.

Peatland is resistant to stem rust and moderately resistant to spot blotch and loose smut.

Malting Quality

At present Barbless and Kindred are readily accepted by the malting trade. Mars, Feebar, Tregal, Trebi, and Peatland are all classified as feed barleys. O.A.C. 21 and Montcalm are blue aleurone barleys and are rated very high by Canadian maltsters. Some American maltsters buy O.A.C. 21 readily at malting barley prices. Montcalm is coming into American markets for the first time this season. How generally these

two Canadian barleys will be accepted in the United States remains to be seen. In preliminary tests, Moore has exhibited good malting quality and will probably be accepted by the American malting trade.

New Varieties Not So Extensively Tested

Several new strains of barley developed by the Minnesota Experiment Station appeared in the field plot trials for the first time in 1948. In previous testing in rod rows they gave promise of having certain advantages over existing varieties. Since, however, they have been tested only one year and that year was a very unusual one from the standpoint of distribution of rainfall, they will receive only passing mention.

Vantage is a high-yielding, stiff-strawed feed barley which was developed at Brandon, Manitoba. It is resistant to stem rust, but appears to be susceptible to scab and to certain leaf diseases. It matures at about the same time as Barbless.

FLAX

J. O. CULBERTSON

Yield Comparisons

Table 4 gives average yields in bushels per acre for the four-year period 1945-48 at University Farm, Waseca, Morris, and Crookston, and for the three-year period 1946-48 at Grand Rapids and southwestern Minnesota.

Dakota, Koto, and Redwing have yielded well at University Farm for the last four years; Minerva has averaged about 2.0 bushels less; and the average of Crystal has been considerably lower than all other varieties. The lower yield of Crystal has been due, in part, to its susceptibility to late wilt at University Farm. Koto, Dakota, Crystal, and Redwing have given the best average yields at Waseca, with Minerva and Bison yielding somewhat less. At Morris, the highest average yield was produced by Dakota, followed closely by Royal and Crystal, Koto, and Minerva. Bison produced the lowest average yield at Morris. B5128, Royal, Dakota, Bison, Koto, and Minerva were highest in yield at Crookston, while Crystal and Redwing were poorest. The average yield of Dakota was particularly good at Grand Rapids, where it was 2.4 bushels above Koto, the second highest-yielding variety. Minerva, Crystal, and Redwing were intermediate in yield at Grand Rapids, while Bison was lowest. In southwestern Minnesota, Koto and Dakota had the highest average yield, followed closely by Crystal. Redwing and Minerva produced intermediate yields, while Bison gave the lowest yield.

Royal and B5128 are not included in the list of varieties recommended for Minnesota. Both of these varieties

Table 4. Yield of Flax in Field Plot Trials at University Farm, Waseca, Morris, and Crookston for 1945-48 and at Grand Rapids and Southwestern Minnesota for 1946-48

Variety	University Farm	Waseca	Morris	Crookston	Grand Rapids	Southwestern Minnesota
Bison	17.6	17.9	19.5	14.2	14.8	17.2
Redwing	19.4	19.3	20.5	11.0	16.0	18.8
Crystal	14.4	19.9	22.0	12.2	16.3	20.1
Koto	20.1	20.3	21.4	14.0	17.1	21.0
Minerva	17.8	18.0	21.2	12.8	16.4	18.6
Dakota	20.4	20.0	23.5	14.7	19.5	21.0
B5128	.....	.....	.....	15.0	.....	.....
Royal	.....	.....	22.4	16.0	.....	.....

produce oil of low drying quality. The straw of Royal is somewhat weak and B5128 is susceptible to pasmo.

Other Agronomic and Quality Characters

Data given in table 5 include date ripe, plant height, weight per 1000 seeds, oil content, and iodine number for eight varieties of flax tested in field plots. The data for date ripe, plant height, and weight per 1000 seeds are averages for the three-year period 1946-48 for six locations. Oil content and iodine number of the oil are averages for 1945-47. B5128 and Royal were not grown in all tests, and the data for these varieties have been adjusted so that they are comparable with those of the other varieties.

The average date of ripening of Redwing, the earliest variety, is only six days earlier than Minerva, B5128, and Royal, the latest varieties. Koto, Dakota, Bison, and Crystal fall between the extremes in maturity. All varieties are of essentially the same height, the greatest difference being only one inch.

The seed of Redwing is definitely smaller than that of the other varieties. All the other varieties shown in the table are classed as having medium-sized seeds, although B5128 has seed appreciably larger than Koto.

Minerva has outstanding oil content, with an average 2.5 per cent higher than Bison. Royal, B5128, and Crystal are about equal to Bison in oil content; Redwing and Dakota are definitely lower; and Koto about the same as Bison.

Oil from the seed of Redwing, Minerva, Crystal, Koto, and Dakota has excellent drying quality, as indicated by the relatively high iodine number. Bison, B5128, and Royal are lower in oil quality than the other varieties.

Disease Reaction

Of all the varieties, Bison is the most susceptible to rust. All others have some degree of resistance. Crystal and B5128 are immune to races of rust commonly found in the United States. Dakota is resistant to rust, while Koto is resistant to most races, but susceptible to a few races. Minerva and Royal are moderately resistant, while Redwing is moderately susceptible.

All varieties tested have some resistance to wilt. Koto, Dakota, and Bison are highly resistant; Minerva and Redwing are moderately resistant; while B5128 and Royal are somewhat more susceptible than Redwing. Crystal has been susceptible to late wilt at University Farm, but has not been injured seriously by wilt in other trials in Minnesota.

None of the varieties is resistant to pasmo, although there are variations in the degree of susceptibility. Minerva

Table 5. Average Date Ripe, Height of Plant, Weight per 1000 Seeds, Oil Content, and Iodine Number for Flax Varieties Grown in Field Plots in 1946-48

Variety	Date ripe	Height	Weight per 1000 seeds	Oil content[2]	Iodine number[2]
	August	Inches	Grams	Per cent	
Bison	9	23	6.2	38.9	178
Redwing	5	22	4.6	37.3	186
Crystal	9	23	6.1	38.9	185
Koto	7	23	5.3	38.5	185
Minerva	11	22	6.0	41.4	186
Dakota	7	22	5.9	37.5	185
B5128[1]	11	23	6.7	39.0	177
Royal[1]	11	23	5.7	39.0	180

[1] Not grown at all stations. Data for these varieties have been adjusted so that they are comparable with other varieties.

[2] Oil content and iodine numbers not available for 1948 crop. Averages shown are for 1945-47.

and Crystal are moderately resistant; Redwing and B5128 are susceptible; all the other varieties listed are moderately susceptible.

New Varieties Not So Extensively Tested

Two selections from a cross of B5128 x Redson were grown in field plot yield trials for the first time in 1947. These have been given Minnesota numbers 217 and 218. They have yielded well in rod row tests, and No. 218 has averaged well for the two-year period 1947-48. Both varieties have high oil content and iodine number; they are resistant to rust and wilt, but moderately susceptible to pasmo.

Sheyenne was included in the field plot yield trials in 1948. As an average for seven tests, it yielded 91 per cent of the yield of Dakota. It is resistant to rust and wilt, matures early, and has seed of good oil content and quality.

OATS

H. K. HAYES and R. G. ROBINSON

Yield Comparisons

Comparative average yield data are given in table 6 for 1945-48 at the central and branch stations; for 1946-48 in southwestern Minnesota; and in 1945-48 on sandy soil trials (five locations in 1945 and four each in 1946-48, inclusive). The sandy soil trials were made in Dakota, Meeker, and Stearns counties in 1945, and in Meeker and Stearns counties in 1946-48, inclusive.

Seed for the trials was treated with New Improved Ceresan. Vicland which is susceptible to *Helminthosporium victoriae,* yielded less than Gopher in all locations on the average, although the differences were not very large at Grand Rapids and Duluth. In earlier years, prior to 1946, Vicland greatly outyielded Gopher.

On an average, none of the varieties were greatly superior in yield to Gopher in 1948. As an average for the four-year period Gopher yielded equal to, or more than, the other varieties at Morris. However, all varieties except Vicland yielded considerably more than Gopher at University Farm and Waseca. Ajax and Andrew yielded more than Gopher or other varieties at Crookston. The three highest yielding varieties at Grand Rapids were Ajax, Clinton, and Andrew; while Zephyr and Ajax were the highest yielders at Duluth. For the period 1946-48, Clinton and Ajax excelled in yield in southwestern Minnesota trials. Although they were not greatly superior

Table 6. Yield of Oats in Bushels per Acre in Field Plot Trials at the Central and Branch Station for 1945-48, in Southwestern Minnesota for 1946-48 and on Sandy Soil for 1945-48

Variety	1945-48						1946-48	1945-48
	University Farm	Waseca	Morris	Crookston	Grand Rapids	Duluth	Southwestern Minnesota	Sandy Soil
Gopher	81.5	67.6	99.7	68.7	71.8	74.3	78.6	.....
Vicland	77.8	64.1	89.3	61.2	68.8	70.5	68.4	48.8
Bonda	89.8	75.4	84.8	71.7	64.9	74.5	77.9	50.1
Mindo	93.4	76.8	92.9	69.3	72.1	75.9	77.9	.....
Clinton	90.7	78.4	92.3	74.9	75.5	78.6	86.3	52.6
Andrew	93.6	74.2	92.9	77.6	73.6	76.4	80.9*	.....
Zephyr	92.7	75.7	98.4	72.0	70.9	82.0	82.8*	52.9
Ajax	93.8	74.3	99.2	81.2	77.8	80.6	85.8	56.4
Bond x Rainbow No. 844	.....	.....	.....	.....	.....	.....	.....	53.5
Minrus	.....	.....	.....	.....	.....	.....	.....	53.5

* 1947-48 average; adjusted to be comparable to 1946-48 averages.

to Andrew and Zephyr, which were grown only in 1947-48, they were distinctly superior to Bonda and Mindo. Differences in yielding ability on sandy soil trials were not very great. Ajax, on the average, yielded several bushels more than any other variety.

Other Agronomic Characters

Comparative data on agronomic characters are given in table 7.

Averages for date of heading for 1945-48 at the four stations University Farm, Waseca, Morris, and Crookston show Mindo and Andrew two to four days earlier in heading than Bonda and Clinton. Gopher and Zephyr averaged one day later in heading than Clinton, and five days later than Mindo, the earliest variety to head. Ajax headed two days later than Zephyr. Ajax was two inches taller, on the average, than Bonda and Zephyr, and the other varieties were five to eight inches shorter than Ajax.

The varieties selected from Bond crosses excelled in weight per bushel, with Bonda in the lead, averaging 37.0 pounds per bushel. Zephyr and Bonda have large grains, while Andrew is somewhat intermediate in grain size. All varieties have somewhat heavier grains, on the average, than Gopher and Vicland.

Andrew and Clinton excel in having a low percentage of hull, while Vicland and Ajax are somewhat inferior in this respect. Bonda and Mindo averaged lower in hull percentage than Gopher, while Zephyr averaged slightly higher.

In southwestern Minnesota, comparative height of plant was similiar to that at other stations. Clinton and Ajax, which excelled in yield in southwestern Minnesota, gave a considerably better weight per bushel than in the other trials.

Height of plants was considerably less on sandy soil trials than on heavier soils. Minrus, Ajax, and Zephyr were somewhat taller than other varieties. All varieties excelled Minrus in weight per bushel, although Ajax and Vicland had a lower bushel weight than other varieties.

Table 7. Averages for Date Heading, Plant Height in Inches, and Weight per Bushel in Pounds at Four Stations, University Farm, Waseca, Morris, and Crookston 1945-48; Weight per 200 Kernels in Grams and Hull Percentages at the Same Four Stations 1945-47; Plant Height in 1947-48 and Weight per Bushel in 1946-48 in Southwestern Minnesota; and Plant Height and Weight per Bushel on Sandy Soil 1945-48

Variety	Four Stations					Southwestern Minnesota		Sandy Soil	
	1945-48			1945-47					
	Date heading	Height	Weight per bu.	Weight of 200 kernels	Hull percentage	1947-48 height	1946-48 weight per bu.	1945-48 height	1945-48 weight per bu.
		Inches	Pounds	Grams		Inches	Pounds	Inches	Pounds
Gopher	6-29	36	33.1	4.4	29.0	35	35.7	.....	.....
Vicland	6-26	34	33.2	4.6	30.9	30	33.9	25	33.1
Bonda	6-27	40	37.0	6.0	28.3	39	38.5	31	37.0
Mindo	6-24	35	35.2	5.0	28.2	33	35.7	.....	.....
Clinton	6-28	36	35.6	4.9	25.7	36	37.5	30	36.1
Andrew	6-25	37	35.0	5.5	25.1	36	35.8*	.....	.....
Zephyr	6-29	40	34.7	6.4	29.4	38	35.9*	32	35.0
Ajax	7-1	42	33.2	4.8	29.8	40	36.5	33	33.7
Bond x Rainbow No. 844	.....	.....	.....	.....	.....	.....	.....	29	37.6
Minrus	.....	.....	.....	.....	.....	.....	.....	32	31.5

* 1947-48 average; adjusted to be comparable to 1946-48 averages.

Disease Reaction

During the period of trials reported (1945-48, inclusive) stem and crown rust were of no great importance. Infections were so low that no readings were taken in 1948. Gopher and Ajax, which are susceptible to stem rust and crown rust, gave considerable infection with crown rust in 1945 and showed considerable infection in 1947. Even in these two years, however, this infection did not cause marked reduction in yield.

Vicland is susceptible to *Helminthosporium victoriae* which may cause reduction in stands, premature ripening, and a lowering of yielding ability.

Bonda, Mindo, Clinton, Zephyr, and Minrus are resistant to a group of races of stem rust, including race 8, and gave a resistant reaction in all trials. Andrew and Ajax are also resistant to a group of races, but susceptible to race 8. They showed this susceptibility in several trials during this period but were not noticeably reduced in yield in these trials.

All of the varieties except Gopher, Minrus, and Ajax, carry the Bond type of high resistance to many physiologic races of crown rust. All are susceptible to certain races of crown rust, including race 45 which in Iowa has increased in prevalence in recent years. All of the varieties selected from Bond crosses are usually resistant to smuts.

Other Varieties Not So Extensively Tested

Benton, a Bond x D69 cross increased in Indiana, has been tested for a three-year period at University Farm, Waseca, Morris, and Crookston. It has yielded somewhat less than the better yielding varieties at each station and does not warrant further trial.

Eaton, a new variety from a cross of Bond x Iogold, distributed by the Michigan station has been tested at all stations in 1947-48, inclusive. It has yielded about as well as the other recommended varieties. Shelby, a Bond x Anthony cross from Iowa, was tested in 1947 in rod row trials and in 1948 in plot trials. It has performed well in these tests. Both Eaton and Shelby are resistant to stem rust, crown rust, and the smuts. Shelby is resistant to race 8 of stem rust, while Eaton is susceptible.

Several oats that are grown to some extent have been tested previously and were not grown in the trials in 1948. These include Forvic, a selection from Wisconsin that is susceptible to *Helminthosporium victoriae,* and which has not yielded well in Minnesota trials. Two Canadian varieties—Beaver, selected from a cross of Vanguard x Erban; and Exeter, selected from a cross of Victory x Rusota—have given good yields in rod row trials, but are not superior to recommended varieties. Because they are more susceptible to crown rust than the recommended varieties, they do not seem desirable in Minnesota.

A considerable group of selections from Bond crosses have been tested only in rod row trials. Data obtained in these tests give no reason to conclude that these varieties are superior to those that are on the recommended list. Further information is needed before reaching a more definite conclusion.

A brief statement regarding these varieties may be of interest. Cherokee, CI 3846, is a selection from a cross of D69 x Bond which is being increased in Kansas. Berry probably is very similar to Cherokee. Nemaha, CI 4301, is a selection from a cross of Victoria-Richland x Morota-Bond which is being increased by the Kansas and Nebraska stations.

Bonham, CI 4676, is a mass selection made in Michigan from CI 3664, a cross of Bond x D69. It was increased and named by the Michigan station.

Colo, CI 3972, is a cross of Hancock x Morota-Bond.

RYE

H. K. HAYES and R. G. ROBINSON

Three varieties of rye have been tested for many years. There has been little difference in winter injury. The following is a brief description of these varieties.

DAKOLD. Mixed seed color. Developed in North Dakota.

EMERALD. Relatively uniform in green seed color. Produced at University Farm by selection for pure seed color in self-pollinated lines and their combination.

IMPERIAL. Uniform colorless seed. Developed at the Wisconsin station.

Tests at University Farm were discontinued in 1948 and at Waseca in 1947. The trials at Morris were severely injured by drought in the fall of 1947, and yields in 1948 were very low. The stand of Imperial was so low that it was not harvested in 1948. Yields given in the table do not include the 1948 crop season at Morris.

Table 8 gives averages for many years for yield at five stations. In general, Imperial and Emerald are somewhat superior to Dakold in yield.

Trials at the experiment stations have been made, as a rule, on relatively good soil, although rye is somewhat better adapted to sandy soil than are the other small grain crops. For this reason, trials on sandy soil were initiated in the fall of 1946 at two locations, one each in Anoka and Stearns counties. Five trials were made on sandy soil in 1948, two in Anoka, and one each in Stearns, Sherburne, and Wright counties. Only the three recommended varieties were tested in 1947, while a local variety was grown in each of the trials in 1948. (Table 9)

In these trials Emerald gave somewhat better yields than any other variety. At several locations Imperial was more severely injured by winter killing in 1948 than Emerald or Dakold.

Table 8. Yield of Rye in Bushels per Acre in Station Trials

Location	No. Years Tested	Dakold	Emerald	Imperial
University Farm	10	39.2	39.0	41.8
Waseca	11	37.4	40.0	41.4
Morris	10	28.5	30.5	32.4
Grand Rapids	12	34.0	39.4	39.6
Duluth	9	17.6	22.0	22.1

Table 9. Yield of Rye in Bushels per Acre on Sandy Soil Trials, 1947-48

Variety	Averages 1947 (2 locations)	Averages 1948 (5 locations)	Average 1947-48 (7 locations)
Dakold	15.5	12.5	13.4
Emerald	19.7	14.0	15.6
Imperial	17.5	11.9	13.5
Local Variety	.....	11.5	.....

SPRING WHEAT

E. R. AUSEMUS

Yield Comparisons

Comparative average yield data are given in table 10 for two different periods, 1943-48 and 1946-48, for the six experiment stations, and for 1946-48 in southwestern Minnesota.

Seed for the trials was treated with New Improved Ceresan. On the average, the recommended bread wheat varieties Mida, Pilot, and Rival gave higher yields than Thatcher and Cadet. At Waseca, Rival excelled in yield and is probably the most desirable variety for southern Minnesota. Rival was highest yielding also at Morris during both periods and at Crookston

Table 10. Yield of Bread Wheats and Durum Grown in Field Plot Trials at Six Experiment Stations During Two Periods, 1943-48 and 1946-48, and in Southwestern Minnesota During 1946-48

Variety	University Farm		Waseca		Morris		Crookston	
	1943-48	1946-48	1943-48	1946-48	1943-48	1946-48	1943-48	1946-48
Bread Wheat								
Thatcher	28.5	28.9	20.7	24.5	31.1	32.0	29.3	30.8
Pilot	31.4	32.5	23.1	26.2	32.6	32.9	28.9	29.2
Rival	30.3	30.6	23.9	28.8	34.1	35.3	30.3	31.4
Mida	30.6	30.9	22.7	26.2	32.3	31.1	31.0	30.8
Cadet	28.4	28.0	21.2	23.6	30.3	31.5	29.2	29.8
Henry	32.8	33.8	25.2	29.4	34.6	35.7	33.9	34.7
Mida x Pilot 2763	.....	31.8	.....	29.2	.....	34.9	.....	34.8
Hope x Timstein 2776	.....	35.2	.....	25.7	.....	34.2	.....	32.5
Redman	.....	30.9	.....	.....	.....	34.0	.....	26.6
Durums								
Mindum	31.9	32.5	.....	.....	34.9	35.2	32.6	32.6
Carleton	29.2	30.2	.....	.....	33.2	34.3	31.9	29.8
Stewart	30.2	30.4	.....	.....	36.1	36.0	33.8	34.8

Variety	Grand Rapids		Duluth		Southwestern Minnesota
	1943-48	1946-48	1943-48	1946-48	1946-48
Pilot	.....	.....	.....	.....	26.8
Rival	21.6	21.1	21.3	21.4	26.8
Mida	22.1	21.9	18.3	17.7	27.7
Henry	.....	21.3	.....	18.7	30.5
Hope x Timstein 2776	.....	21.2	.....	18.7	.....

during the shorter period 1946-48. Mida yielded slightly higher at Crookston during the longer period of the test, 1943-48. Mida produced a lower yield in all the tests in 1948, apparently injured by the heat, lack of moisture, and by the loose smut disease.

On the average, Henry yielded more than the recommended varieties at University Farm, Waseca, Morris, and Crookston. It has not been recommended because of its inferior milling and baking qualities.

During the three-year period, the two new hybrid wheats, Mida x Pilot (Minn. No. 2763) and Hope x Timstein (Minn. No. 2776) have yielded about as well as or better than Rival, Pilot, or Mida at Crookston, Morris, and University Farm. At Waseca No. 2776 yielded distinctly less than Rival, while No. 2763 gave a good yield. Redman gave good yields at University Farm and Morris, but low yields at Crookston. Mida and Henry excelled in yield in the tests in southwestern Minnesota.

Mindum and Stewart were the highest yielding durums.

Other Agronomic Characters

Comparative data on agronomic characters are given in table 11.

Averages for 1946-48 at the four stations University Farm, Waseca, Morris, and Crookston, indicate the differences in date of heading, plant height in inches, and weight per bushel. For date of heading, Hope x Timstein (Minn., No. 2776) was the earliest bread wheat, while Redman was one day later. The other bread wheat varie-

Table 11. Averages for Date of Heading, Plant Height in Inches, and Weight per Bushel for Four Stations, University Farm, Waseca, Morris, and Crookston, Minn., in 1946-48

Variety	Date Heading	Height	Weight per Bu.
		Inches	Pounds
Bread Wheats			
Thatcher	6-27	35	58.2
Pilot	6-28	37	57.3
Rival	6-28	38	58.9
Mida	6-27	38	60.2
Cadet	6-30	38	56.5
Henry	6-27	38	59.0
Mida x Pilot (2763)	6-29	37	60.5
Hope x Timstein (2776)	6-25	33	59.5
Redman	6-26	38	57.9
Durums*			
Mindum	6-30	43	60.6
Carleton	7-1	44	60.3
Stewart	7-1	45	60.6

* Averages for U. Farm, Morris, and Crookston.

ties were two to five days later than the earliest variety. Cadet and Mida x Pilot (Minn. No. 2763) were the latest bread wheat varieties. Rival, Mida, Cadet, Henry, and Redman were the tallest varieties. Hope x Timstein (Minn. No. 2776), and Thatcher were the shortest varieties. Mida, Mida x Pilot (Minn. No. 2763), and Hope x Timstein (Minn. No. 2776) excelled in weight per bushel.

The durum variety, Mindum, was one day earlier than Carleton and Stewart. Stewart was the tallest durum variety, while Mindum and Stewart excelled in weight per bushel.

Quality

All the recommended varieties of bread wheats tested for a six-year period are acceptable to the trade in milling and baking characters. The two newer varieties—Redman and Minn. No. 2776—have appeared satisfactory in preliminary quality tests. Henry and Minn. No. 2763 are classified as undesirable in milling and baking characters.

All three of the durums are accepted by the trade for the making of semolina products.

Disease Reaction

All varieties of the bread wheats and the two durums, Carleton and Stewart, are moderately resistant to stem rust. Only one bread wheat variety, Hope x Timstein (Minn. No. 2776) and the three durums, Mindum, Carleton, and Stewart, are moderately resistant to leaf rust.

Mida and Hope x Timstein (Minn. No. 2776) were moderately susceptible to loose smut. The other varieties were moderately resistant to this disease. Mida, Rival, Pilot, Mida x Pilot (Minn. No. 2763), Hope x Timstein (Minn. No. 2776), and Redman are moderately resistant to bunt. Carleton and Stewart are moderately susceptible to bunt.

All the varieties are susceptible to scab, although Rival appears to be somewhat less susceptible than the others. If spring wheat follows corn in the rotation in southern Minnesota, it is often severely injured by scab.

New Varieties Not Extensively Tested

Six new hybrid varieties have been tested for one or two years, and all six varieties are moderately resistant to stem rust. Four Timstein derivatives are moderately resistant to leaf rust. Two of these, Hope x Timstein (Minn. No. 2789 and 2796), and Merit[2] x Thatcher (Minn. No. 2791) and Mida x Cadet (Minn. No. 2799) have given good yields and appear satisfactory in milling and baking characters in preliminary trials.

WINTER WHEAT

E. R. AUSEMUS

Yield Comparisons

Table 12 gives comparative average yield data for 1945-48 at University Farm, Waseca, and Grand Rapids. There was a crop failure at University Farm and Waseca in 1948, and at Grand Rapids in 1946 because of winter killing.

Seed for the trials was treated with New Improved Ceresan. Average yields were higher at Grand Rapids than at the other two stations. The new variety Minter, released to approved seed growers in the fall of 1948, yielded higher than Minturki or Blackhawk at University Farm and Grand Rapids, about the same as Minturki and more than Blackhawk at Waseca.

Other Agronomic Characters

Comparative data on agronomic characters are given in table 13.

Averages for the two stations, University Farm and Waseca, in 1945-48, give a reliable index of differences in date of heading, plant height in inches, percentage of winter injury, and weight per bushel. Marmin was the earliest heading variety, Minter and Minturki were a day or two later, and Blackhawk was the latest.

The average height of three of the varieties is the same, with Minter being two inches shorter. Minter had the least winter injury and Blackhawk the highest. Minter excelled in weight per bushel and Blackhawk was the lowest, although the test weight of all varieties was excellent.

Table 12. Summary of Yields in Bushels per Acre of Winter Wheat Varieties Grown at University Farm, Waseca, and Grand Rapids in 1945-48*

Variety	University Farm	Waseca	Grand Rapids*
	1945-48	1945-48	1945-48
Minturki	27.2	19.4	27.6
Marmin	29.2	17.7	25.6
Minter	28.3	19.6	32.4
Blackhawk	27.6	18.4	24.9

* Crop failure at University Farm and Waseca in 1948 and at Grand Rapids in 1946.

Table 13. Averages for Date of Heading, Height of Plant in Inches, Percentage of Winter Injury, and Weight per Bushel at University Farm and Waseca in 1945-48*

Variety	Date Heading	Height	Winter Injury	Weight per Bu.
		Inches	Per cent	Pounds
Minturki	6-20	40	14	61.0
Marmin	6-18	40	15	60.8
Minter	6-19	38	12	61.3
Blackhawk	6-22	40	23	60.7

* Complete winter killing at University Farm and Waseca in 1948.

Disease Reaction

Minter and Blackhawk were moderately resistant to leaf rust, while Marmin and Minturki were susceptible. Minter was moderately resistant to stem rust. The other three varieties, Minturki, Marmin, and Blackhawk, were susceptible.

Quality

Minter and Blackhawk were superior to Marmin and Minturki in milling and baking characteristics. Minter had a whiter crumb color and a lower carotinoid pigment content than Minturki.

New Varieties Not Extensively Tested

Seven new hybrid varieties were tested in 1947-48. These are selections from crosses between Hope or H-44 and their derivatives with Minturki or Marmin. Each of these varieties has been moderately resistant to stem rust, and in preliminary milling and baking

Table 14. Summary of Maturity of Succotash Trials of Wheat, Oats, and Barley, Grown in Rod Rows at University Farm, Waseca, Morris, and Crookston, Minn., in 1946-48

Crop and Variety	University Farm					Waseca					Morris					Crookston				
	1946	1947	1948	1946-48	1947-48	1946	1947	1948	1946-48	1947-48	1946	1947	1948	1946-48	1947-48	1946	1947	1948	1946-48	1947-48
Wheat																				
Rival	7-20	8-5	7-18	7-25	7-27	7-26	8-11	7-26	7-31	8-3	7-30	8-2	7-26	7-30	7-30	8-2	8-10	8-13	8-8	8-12
Mida	19	4	17	24	26	25	9	25	30	2	29	2	26	30	30	1	9	13	8	11
Pilot	20	5	17	24	27	26	10	24	30	2	29	3	25	29	30	2	9	13	8	11
Henry	20	5	14	23	25	27	11	24	31	2	29	3	25	29	30	1	9	13	8	11
Hope																				
Timstein (2776)	.....	.....	16	.....	.....	.....	.....	23	.....	.....	.....	.....	23	.....	.....	.....	.....	10	.....	.....
Oats																				
Gopher	.....	8-4	7-13	.....	7-24	.....	8-7	7-21	.....	7-30	.....	7-31	7-21	.....	7-26	.....	8-6	8-7	.....	8-7
Bonda	7-20	8-3	7-16	7-23	7-25	7-20	8-13	7-23	7-29	8-2	8-3	8-1	7-20	7-29	7-26	7-26	8-6	8-7	8-3	8-7
Mindo	16	7-31	13	20	22	17	7	20	25	7-29	2	7-30	17	27	24	25	7-30	5	7-30	2
Clinton	18	8-4	14	22	25	17	8	22	26	30	3	31	21	29	26	25	8-5	4	8-1	5
Benton	19	4	14	23	25	21	15	21	29	8-3	2	31	18	27	25	27	7	7	3	7
Ajax	.....	5	13	.....	25	.....	7	20	.....	7-29	.....	8-1	20	.....	26	.....	5	6	.....	6
Andrew	.....	7-31	14	.....	23	.....	13	27	.....	8-5	.....	7-31	20	.....	26	.....	6	8	.....	7
Zephyr	21	8-5	14	24	25	22	17	28	8-2	7	6	8-3	7-24	7-31	7-29	29	7	10	5	9
Barley																				
Mars	7-13	7-25	7-10	7-16	7-18	7-14	8-4	7-17	7-22	7-26	7-24	7-29	7-17	7-23	7-23	7-23	7-28	8-5	7-29	8-1
Barbless	17	30	14	20	22	23	9	21	28	31	25	8-3	19	26	27	29	8-1	8	8-2	5
Kindred	16	30	10	19	20	18	5	19	24	28	23	7-31	7-17	24	24	25	7-30	7	7-31	3
Montcalm	.....	8-1	14	.....	23	.....	5	21	.....	29	.....	30	18	.....	24	.....	31	8	.....	4
Feebar	.....	7-30	12	.....	21	.....	3	19	.....	27	.....	31	17	.....	24	.....	28	5	.....	1
Moore	.....	.....	14	.....	.....	.....	.....	21	.....	.....	.....	.....	19	.....	.....	.....	.....	7	.....	.....

trials has been superior to Minturki and Marmin in quality.

DATE-OF-MATURITY TRIALS

Date-of-maturity trials have been conducted with a number of varieties of wheat, oats, and barley in order to determine which varieties of the three different crops could be grown together as succotash. These tests were made in rod row plots at University Farm, Waseca, Morris, and Crookston during 1946, 1947, and 1948. All crops were planted at the same date at each of the stations.

The annual and average data obtained in these trials are given in table 14.

These results indicate that certain varieties of the various crops can be grown together satisfactorily, even though there may be several days difference in date of maturity. One crop may be harvested slightly prematurely or the other allowed to ripen a day or two longer in order to grow the two crops together.

Date of maturity of the varieties of a crop is rather difficult to determine because of the influence of temperature and rainfall during the period from heading to maturity. There is considerable variation from year to year in the comparative date of maturity of varieties grown at the same station. The data given can be used to select the combination of varieties that can be sown together most advantageously in the various sections of the state.

SOYBEANS

J. W. LAMBERT

Yield Comparisons

Comparative average yield data are given in table 15 for 1946-47 at University Farm; for 1946-48 at Waseca, Morris, and Crookston and in southwestern Minnesota; and for 1947-48 at Grand Rapids. Yields were not taken at University Farm in 1948 because of the very poor stands that resulted from poor germination during the late spring drought.

In 1946-47, Ottawa Mandarin yielded somewhat higher than any of the other varieties at University Farm. Differ-

Table 15. Yield of Soybeans in Bushels per Acre in Field Plot Trials at University Farm in 1946-47; at Waseca, Morris, and Crookston and in Southwestern Minnesota in 1946-48; and at Grand Rapids in 1947-48

Variety	University Farm	Waseca		Morris		Crookston	Grand Rapids	Southwestern Minnesota	
	1946-47	1946-48	1947-48	1946-48	1947-48	1946-48	1947-48	1946-48	1947-48
Minsoy	.....	.....	.....	.....	.....	14.7	11.1	.....	.....
Kabott	15.9	.....	.....	19.4	21.0	12.6	17.8	.....	.....
Flambeau	12.8	25.0*	23.6*	24.0	23.4	15.1	18.4	22.0	22.5
Goldsoy	.....	.....	.....	.....	.....	13.6	18.4	.....	.....
Ottawa Mandarin	18.2	28.9	29.2	23.1	23.3	14.5	12.8	21.6	23.1
Montreal Manchu	13.8	30.1	31.3	.....	23.2	15.6	15.2	22.6	24.3
Wis. Manchu 606	12.9	29.7	28.6	22.0	19.4	.....	.....	22.2	24.6
Habaro	12.9	29.7	30.1	20.2	19.2	.....	.....	21.7	22.9
Overlander Manchu	13.8	.....	.....	22.1	20.7	.....	.....	.....	.....
H5	11.8	27.8	28.2	.....	.....	.....	.....	.....	.....
A3K-884	.....	.....	29.9	.....	19.4	.....	.....	.....	24.7
Earlyana	.....	.....	27.0	.....	.....	.....	.....	.....	21.6
Richland	.....	.....	24.4	.....	.....	.....	.....	.....	22.0

* Flambeau was overripe at Waseca in 1948 before it was harvested—shattered somewhat.

ences were small between the other varieties.

Flambeau ripened about September 7 at Waseca, and in the unseasonably hot weather of late September and early October suffered considerable shattering before harvest. This explains to some extent its low yields at Waseca. Richland averaged only slightly better than Flambeau in 1947-48 at Waseca. The other varieties at Waseca were very similar in yield. It seems noteworthy that Ottawa Mandarin and Montreal Manchu yielded about the same as such varieties as Habaro and Earlyana which were severals days later.

Flambeau, Ottawa Mandarin, and Montreal Manchu yielded about alike at Morris. They yielded somewhat more than the later varieties.

Yield differences were not great at Crookston. Flambeau and Montreal Manchu averaged slightly higher than the others.

In two years of testing at Grand Rapids, Flambeau, Goldsoy, and Kabott excelled in yield. Minsoy averaged lowest.

In southwestern Minnesota during both the three-year and the two-year periods, the varieties showed very little difference in yielding ability. Here again there appears to be no yield advantage from the later-maturing varieties.

Other Agronomic Characters

Comparative data on agronomic characters and oil content are given in table 16. Only University Farm data for maturity are reported. Lodging, plant height, and oil content are reported for University Farm, Waseca, and Morris. Data for oil content are given for 1947 only, since the analyses on the 1948 crop are not available at this time.

At University Farm, Kabott averaged four days earlier than Flambeau which was four to six days earlier than a group of varieties, including Montreal Manchu, Ottawa Mandarin, and Overlander Manchu. Wisconsin Manchu 606, Habaro, A3K-884, and Earlyana fall in the medium maturity group. Over a period of years, it would

Table 16. Averages for Date Mature at University Farm, 1947-48; for Lodging Score at University Farm, Waseca, and Morris, 1947-48; for Plant Height in Inches at University Farm and Waseca, 1947-48, and at Morris, 1948; for Oil Content at University Farm, Waseca, and Morris, 1947

Variety	Date Mature 1947-48	Lodging Score[1] 1947-48			Plant Height 1947-48			Oil Content, 1947		
	University Farm	University Farm	Waseca	Morris	University Farm	Waseca	Morris[2]	University Farm	Waseca	Morris
					Inches	Inches	Inches	Pct.	Pct.	Pct.
Kabott	9-12	.....	.....	1.6	.....	.....	25	19.7	.....	19.8
Flambeau	9-16	1.9	2.7	2.0	26	24	28	19.6	21.2	20.6
Ottawa Mandarin	9-22	1.0	1.1	1.2	28	24	26	20.5	21.5	20.9
Montreal Manchu	9-20	2.5	2.0	2.4	30	28	31	19.5	20.6	20.6
Wis. Manchu 606	9-26	3.0	2.4	2.5	28	30	34	20.2	20.4	20.3
Habaro	9-28	2.8	2.8	2.0	28	26	29	19.0	19.1	19.1
Overlander Manchu	9-21	1.9	.....	2.4	28	.....	32	19.6	.....	20.3
H5	9-24	3.0	2.4	.....	38	35	.....	19.3	20.1	.....
A3K-884	9-28	2.3	2.2	2.1	34	34	36	20.1	20.7	20.2
Earlyana	9-28	3.6	3.2	.....	34	38	.....	19.2	19.8	.....
Richland	10-8	2.2	1.5	.....	32	34	.....	19.8	20.3	.....

[1] Score of 1, all plants erect; 5, all plants completely lodged.
[2] Morris data for 1948 only.

not appear advisable to plant varieties which mature later than this medium group. Richland matured much later than any of the other varieties and cannot be generally recommenedd for seed production anywhere in Minnesota.

Ottawa Mandarin was outstanding in its ability to withstand lodging. Earlyana lodged badly. The rest were intermediate in lodging; A3K-884 and Richland were somewhat superior in standing ability to Habaro, Wisconsin Manchu 606, and H5.

H5 and Earlyana were the tallest varieties. They were only slightly taller than A3K-884 and Richland. Kabott, Flambeau, and Ottawa Mandarin were the shortest varieties. Montreal Manchu, Wisconsin Manchu 606, Overlander Manchu, and Habaro were intermediate in height.

The oil content of all varieties appears satisfactory, with the exception of Habaro which in accordance with previous years had a lower percentage of oil than the other varieties. Ottawa Mandarin was slightly higher in oil than any of the other varieties. The oil percentages averaged slightly higher at Waseca than at University Farm or Morris.

Other Varieties Not So Extensively Tested

Hawkeye is a new variety developed cooperatively by the Iowa Agricultural Experiment Station and the United States Regional Soybean Laboratory. It matures slightly later than Richland and hence is considered too late for general use in Minnesota.

Capital is a variety which was developed at the Central Experiment Farm, Ottawa, Canada. It is a day or two earlier and a few inches taller than Ottawa Mandarin. It also has a slightly higher oil content than Ottawa Mandarin. The two varieties have yielded similarly in the few trials in which they have been compared in Minnesota. Capital lodges considerably more than Ottawa Mandarin and tends to have low, wide-spreading branches.

Several selections recently made at the Minnesota Experiment Station from Lincoln x Richland backcrossed to Lincoln were tested in 1948 for the first time in field plot trials. They appear satisfactory in maturity and in yielding and standing ability, and are outstanding in the oil content of their seeds.