

Miscellaneous Report 15

February 1952

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

Varietal Trials of Farm Crops

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

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, in northern Minnesota at Williams in cooperation with several county organizations and the Grand Rapids Branch Experiment Station, 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, the United States Regional Soybean Laboratory, the Malt Research Institute at Madison, Wisconsin, or in cooperation with the Northwest Crop Improvement Association. Where possible, the trials include promising new varieties developed by other workers.

A list of recommended varieties of farm crops is published 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 sum-

mary of disease reaction taken largely from Folder 22, and a brief history of varieties that were not included in Folder 22 but were grown in the 1951 trials for barley, flax, oats, rye, spring wheat, winter wheat, soybeans, field peas, sunflowers, and safflowers. 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, L. S. Cuendet, and C. G. Norris. Cooperators at the branch experiment stations include R. E. Hodgson and E. L. Pinell at Waseca, A. W. Edson and R. O. Bridgford at Morris, T. M. McCall and O. C. Soine at Crookston, C. L. Cole and C. H. Griffith at Grand Rapids, and M. J. Thompson at Duluth. Varietal trials are conducted also in southwestern Minnesota in cooperation with various counties under the direction of R. G. Robinson and the project leaders at University Farm and in northern Minnesota in cooperation with the Grand Rapids Branch Experiment Station and with county organizations.

Certain phases of varietal improvement are in cooperation with crops research workers of the United States Department of Agriculture.

In 1949, trials of small grains and flax were transferred from University Farm to Rosemount. Summaries in the tables for University Farm and Rosemount are presented under Rosemount and include data obtained at University Farm prior to 1949 and at Rosemount in later years.

Trials of field peas are in cooperation with the branch stations at Morris, Crookston, and Grand Rapids. Tests for seed yields were made in 1951 at Crookston only, while forage yields were obtained at Rosemount and Tracy in 1951. Trials of sunflowers and safflowers are in cooperation with the Morris and Crookston Branch Stations. Tests were made in southwestern Minnesota also.

The 1951 growing season, from April through September, deviated rather widely from normal in both average temperature and total precipitation. These are summarized for the period as follows:

Station	Deviation from normal	
	average monthly temperature degrees F.	total precipitation inches
St. Paul	-1.2	+6.8
Waseca	-3.0	+8.7
Tracy	-3.1	+3.2
Morris	-2.6	-0.8
Crookston	-1.5	-3.1
Grand Rapids	-1.3	+1.2
Duluth	-2.2	+8.9

Because of lower than normal temperatures in March and April and heavier precipitation in both months the seeding date was delayed in 1951 at nearly all locations. May was warmer than in most seasons and although precipitation was heavier than normal by 0.7 inches at St. Paul and Waseca and by 1.9 inches at Tracy, it was 1.9 inches below normal at Crookston and from 0.4 to 0.6 inches below normal at Grand Rapids and Duluth. Lower temperatures and higher precipitation on the average in both August and September made harvesting difficult and in

some cases the harvest date was later than was desirable.

METHODS OF PRESENTING DATA

Data presented in this report consist largely of the results from field-plot trials and represent averages rather than the results of individual years. The years of trial also are given in the tables. In most comparisons a considerable number of the recommended varieties and those grown as checks have been included for the entire period. More recently introduced varieties have been tested for a shorter period of years. Adjustment of yields has been made in such a manner that the differences between varieties are of the same magnitude as in the original data. The method used, first presented by Patterson,¹ is illustrated for rye experimental trials conducted on sandy soils from 1947-50.

In these trials Dakold, Emerald, and Imperial were grown from 1947 to 1950 inclusive, while Pierre, a new variety introduced from South Dakota, was tested only during 1949 and 1950. The original data presented as actual yields and the adjusted yields for all varieties and for Pierre are summarized in table 1.

The averages for Dakold, Emerald, and Imperial are the same both for adjusted and actual yields. The following is an explanation of the method of adjustment.

The mean yield for the three varieties grown for the entire period for each of the years is given under actual yields. The average mean yield for all four years was calculated as 18.1 bushels. In each of the four years the deviation from the mean yield of 18.1 bushels was calculated as +0.5 bushels in 1947 ($18.1 - 17.6 = +0.5$), +5.3 bushels in 1948, -0.8 bushels in 1949, and -5.1 bushels in 1950. These correction factors were then added or subtracted from actual yields and presented in the table under adjusted yields. While these adjustments modify average yields of the

¹ Patterson, R. E. "A Method of Adjustment for Calculating Comparable Yields in Variety Tests." *Agronomy Journal* 42:509-11. 1950.

Table 1. Actual and Adjusted Yields of Rye

Variety	Actual yields (bushels per acre)				
	1947	1948	1949	1950	Average
Dakold	15.5	12.5	16.8	21.7	16.6
Emerald	19.7	14.0	20.5	24.5	19.7
Imperial	17.5	11.9	19.5	23.4	18.1
Total	52.7	38.4	56.8	69.6	.....
Mean	17.6	12.8	18.9	23.2	18.1
Correction factor	+0.5	+5.3	-0.8	-5.1	.....
Pierre .....	.....	.....	18.0	23.3	.....
Adjusted yields (bushels per acre)					
Dakold	16.0	17.8	16.0	16.6	16.6
Emerald	20.2	19.3	19.7	19.4	19.7
Imperial	18.0	17.2	18.7	18.3	18.1
Pierre .....	.....	.....	17.2	18.2	17.7

three standard varieties in any one year, the averages for the four-year periods for these varieties for actual and adjusted yields are exactly the same.

The adjusted yields for the variety Pierre, grown only in 1949 and 1950, were obtained by subtracting the correction factor, -0.8, from the actual yield of 18.0 bushels in 1949, giving 17.2 bushels. The correction factor, -5.1, was then subtracted from the actual yield of 23.3 bushels in 1950, giving a corrected yield of 18.2 bushels. These two yields then were averaged (17.2+18.2 divided by 2=17.7). The adjusted yield of Pierre was entered in the table as 17.7 bushels. Similar corrections have been made for all yields and other agronomic data for all varieties of other crops not grown for the entire period.

That this method of correction does not change the differences in yield for any one year may be illustrated for Pierre and Emerald for 1949. The actual difference between Emerald and Pierre for that year in bushels was 20.5-18.0 or 2.5 bushels. The difference in adjusted yields for that same year between these varieties was 19.7-17.2 or 2.5 bushels.

In this report, calculated least significant differences at the 5 per cent point are included in the yield summaries for each location. The values

given under L.S.D. 5 per cent are in bushels. A difference between two varieties as great as the one given for each location can be expected to occur from chance alone once in 20 trials, on the average. These L.S.D. values apply only to differences between varieties that are grown for the entire period of comparison.

BARLEY

J. W. LAMBERT

Yield Comparisons

Seed for trials was treated with New Improved Ceresan. Average yields in bushels per acre are given in table 2. The years of trial are also given. The data for each station and for the averages of the six stations are comparable even though all varieties were not tested for the entire period. The feed variety Vantage excelled at nearly all stations. Plains and Feebar, two other feed varieties, also yielded well. Trebi was outstanding in yield at stations where it was grown. The malting varieties Barbless, Kindred, and Montcalm were similar in yield but somewhat lower than the highest-yielding feed varieties. Moore yielded relatively well at all locations except Rosemount, Crookston, and northern Minnesota. Kemble in general gave the lowest yields.

Malting Quality

Kindred, Montcalm, and Barbless are rather widely accepted for malting purposes. Moore, which was previously tentatively approved for malting, has not found ready acceptance in the malting industry during the last several months because of a rather prevalent dull gray appearance of its kernels and unfavorable reports on its performance in the brewing process. The rest of the varieties are not considered suitable for malting.

Disease Reaction

All of the varieties are susceptible to leaf rust.

Barbless is moderately resistant to barley stripe, moderately susceptible to spot blotch and net blotch, and susceptible to scab, loose smut, stem rust, and mildew.

Mars is resistant to stem rust, moderately resistant to net blotch, moderately susceptible to mildew, scab, and spot blotch, and susceptible to loose smut and stripe.

Kindred is resistant to stem rust and moderately resistant to spot blotch and net blotch. It is moderately susceptible to mildew and scab and is susceptible to loose smut and stripe.

Montcalm is moderately susceptible to spot blotch and is susceptible to stem rust, net blotch, stripe, loose smut, and mildew.

Moore is resistant to mildew and stem rust but is moderately susceptible to spot blotch and scab and susceptible to barley stripe and loose smut. It has also shown unusual susceptibility to net blotch, particularly at Crookston.

Feebar is resistant to stem rust and moderately resistant to net blotch, stripe, and mildew. It is moderately susceptible to loose smut and susceptible to spot blotch and scab.

Plains is resistant to stem rust and stripe and moderately resistant to net blotch, loose smut, and mildew, but it is susceptible to spot blotch.

Vantage is resistant to stem rust and moderately resistant to net blotch. It is moderately susceptible to stripe and susceptible to spot blotch, mildew, and loose smut.

Kemble, in limited tests, has appeared to be resistant to stem rust and net blotch and susceptible to loose smut.

Other Agronomic Characters

Comparative data on date of heading, height in inches, standing ability, weight per 1,000 kernels in grams, and

Table 2. Average Yields of Barley

Variety	Years of trial	Bushels per acre						Duluth	Northern Minnesota		
		Rosemount	Waseca	Morris	Crookston	Grand Rapids	Southwestern Minnesota		Years of trial	Yields	Years of trial
bushels per acre											
Barbless	1947-51	47.8	47.8	56.6	38.0	49.6	48.2	48.0	1947-51*	45.6	1950-51
Mars	1947-51	43.9	50.3	56.1	45.6	48.1	43.3	47.9	1947-51	41.6	1950-51
Kindred	1947-51	47.7	50.2	52.6	43.5	51.2	46.9	48.7	1947-51	42.0	1950-51
Montcalm	1947-51	43.4	50.7	56.7	43.3	47.9	48.4	48.4	1947-51	44.2	1950-51
Moore	1947-51	43.2	49.6	55.9	35.3	50.9	45.6	46.8	1947-51	45.6	1950-51
Feebar	1947-51	43.7	51.8	59.3	42.8	51.3	48.1	49.5	1947-51	48.5	1950-51
Plains	1947-51	46.2	48.7	57.9	44.0	56.4	47.4	50.1	1947-51	41.2	1950-51
Vantage	1948-51	50.3	55.1	68.5	42.8	56.4	50.2	53.9	1948-51	42.8	1950-51
Kemble	1950-51	41.0	50.3	47.3	40.4	49.8	41.6	45.1		1951	44.7
OAC 21	1947-51	.....	.....	.....	42.7	.....	.....	.....		.....	.....
Peatland	1947-51	.....	.....	.....	.....	48.1	.....	1947-51	44.1	1950-51	42.4
Trebi	1947-51	.....	.....	.....	.....	61.9	.....	1947-51	46.1	1950-51	55.9
Tregal	1947-51	.....	.....	.....	.....	57.2	.....	1947-51	45.0	1950-51	51.5
L.S.D. at 5 per cent point		4.2	4.4	4.6	4.4	4.7	4.3	1.9		5.4	7.6

* No data at Duluth in 1950.

weight per bushel in pounds are given in table 3. These data are averages from six locations: Rosemount, Waseca, Morris, Crookston, Grand Rapids, and southwestern Minnesota.

Plains headed three days earlier than any other variety. Barbless and Moore, the latest varieties, each headed seven days later than Plains. Montcalm also was relatively late in heading.

In height of plant, Montcalm and Barbless were tallest, and Feebar and Plains were shortest.

In standing ability, Mars and Feebar excelled, with Vantage, Plains, and Moore also exhibiting good straw strength. Kindred and Kemble lodged very badly.

For weight of 1,000 kernels, Feebar and Plains were highest and Mars and Kemble lowest. The malting varieties Kindred, Montcalm, and Barbless had medium-sized kernels.

In weight per bushel, Plains, Mars, and Kemble were highest. Feebar and Moore averaged rather low in this respect. The other varieties were intermediate.

FLAX

J. O. CULBERTSON

Yield Comparisons

Table 4 gives the average yields in bushels per acre for the six-year period 1946-51 at Rosemount, Waseca, Morris, Crookston, Grand Rapids, and southwestern Minnesota. The years

each variety was grown at each station are shown in the table. Yields for those varieties grown for less than six years have been adjusted by the method described earlier. Almost all trials were sown at an early date for the particular station and year. Early seeding favors late maturing flax varieties over early maturing varieties, and it is probable that the late varieties such as B5128, Minerva, Royal, and Redwood had an advantage over early varieties such as Redwing, Sheyenne, and Marine.

Rust was much more prevalent in 1951 than for several years because frequent periods of precipitation favored the development and spread of the rust organism. Damage on Dakota was widespread and very heavy in some areas. The relatively new races of rust that attack Dakota are now quite generally found in Minnesota, and damage to this variety may be expected to be severe when seasonal conditions are favorable. Average yield figures for Dakota as shown in table 4 include several years when rust was not a factor and for that reason do not reflect the real damage done in 1951.

No single flax variety has been best at all locations nor in all seasons. Certain varieties, however, have produced better yields, on an average, than others. Redwood, B5128, C.I. 1118, and Royal have yielded somewhat better than the other seven varieties, on an average.

Table 3. Average of Barley Varieties for Date of Heading, Plant Height, Lodging Score, Weight of 1,000 Kernels, and Weight per Bushel

Variety	Date of heading	Plant height	Standing ability*	Weight 1,000 kernels	Weight
		inches		grams	pounds per bushel
Barbless	June 30	34	4	31.0	44.2
Mars	June 26	30	1	28.5	47.1
Kindred	June 26	33	5	31.3	45.9
Montcalm	June 29	35	4	30.3	45.1
Moore	June 30	33	2	29.7	43.5
Feebar	June 27	27	1	35.3	42.3
Plains	June 23	27	2	33.9	47.2
Vantage	June 27	31	2	32.7	44.8
Kemble	June 27	31	5	28.2	47.1

* 1 = very good; 5 = very poor.

Table 4. Average Yields of Flax

Variety	Rosemount		Waseca		Morris		Crookston		Grand Rapids		Southwestern Minnesota	
	Years of trial	Yields	Years of trial	Yields	Years of trial	Yields	Years of trial	Yields	Years of trial	Yields	Years of trial	Yields
	bushels per acre		bushels per acre		bushels per acre		bushels per acre		bushels per acre		bushels per acre	
Bison	1946-51	16.5	1946-51	17.6	1946-51	20.1	1946-51	14.2	1946-51	14.2	1946-51	16.6
Redwing	1946-51	18.3	1946-51	19.5	1946-51	20.6	1946-51	11.1	1946-51	15.9	1946-51	17.5
Koto	1946-51	18.7	1946-61	20.6	1946-51	22.5	1946-51	14.3	1946-51	16.9	1946-51	19.8
Minerva	1946-51	16.9	1946-51	18.8	1946-51	22.4	1946-51	12.8	1946-51	15.4	1946-51	18.0
Dakota	1946-51	18.5	1946-51	20.9	1946-51	23.9	1946-51	13.4	1946-51	18.2	1946-51	19.4
C.I. 1118	1946-51	18.5	1947-51	21.1	1947-51	24.4	1947-51	14.2	1947-51	14.0	1947-51	21.0
Redwood	1946-51	20.5	1947-51	21.6	1947-51	24.8	1947-51	14.9	1947-51	16.0	1947-51	21.4
B5128	1950-51	19.9	1950-51	23.0	1947-51	22.3	1946-51	14.8	1948-51	15.6	1947-51	21.7
Sheyenne	1948-51	18.6	1948-51	20.1	1948-51	22.4	1948-51	12.6	1949-51	15.8	1948-51	18.3
Marine	1949-51	19.4	1949-51	21.4	1949-51	23.5	1949-51	12.5	1950-51	15.9	1949-51	18.9
Royal	1950-51	17.8	1950-51	22.8	1946-51	24.5	1946-51	15.0	1950-51	17.2	1947-51	20.3
L.S.D. at 5 per cent point		1.4		1.3		1.2		1.8		1.5		1.3

Redwood, B5128, and Marine were the highest-yielding varieties at Rosemount; Bison and Minerva have made the poorest average yields. The other varieties were intermediate in average yield.

The highest-yielding varieties at Waseca were B5128, Royal, Redwood, Marine, and C.I. 1118. Bison was lowest in yield.

High-yielding varieties at Morris include Redwood, Royal, C.I. 1118, Dakota, and Marine. Koto, Minerva, B5128, and Sheyenne were intermediate in yield; Bison and Redwing were lowest.

Royal, Redwood, B5128, Koto, and Bison were highest in average yield at Crookston. Dakota, Minerva, Sheyenne, and Marine were intermediate in yield. Redwing was definitely lowest in yield.

Dakota has not rusted seriously at Grand Rapids and has made the highest average yield. Other high-yielding varieties were Royal, Koto, Redwood, Redwing, Marine, Sheyenne, and B5128. Bison and C.I. 1118 were lowest in yield.

B5128, Redwood, and C.I. 1118 were the top-yielding varieties in southwestern Minnesota. Intermediate varieties were Royal, Koto, Dakota, and Marine. Bison, Redwing, Minerva, and Sheyenne were poorest.

Other Agronomic and Quality Characters

Data given in table 5 include date ripe, plant height, weight per 1,000

seeds, oil content, and iodine number for each variety at each station for the years given in the table of yields (table 4) except as follows: No data were obtained on date ripe and plant height in 1946, or on oil content and iodine number in 1950 in southwestern Minnesota, while seed size, oil content, and iodine number were not obtained in 1950 at Grand Rapids.

Date of maturity is an important character in flax. In general, early maturity is preferable, since the crop escapes some of the effects of heat, drought, and possible storms which may occur in late summer. Some of the early maturing varieties do not have the yielding ability of the later varieties, however, and frequently fail to yield as well except when conditions are unfavorable to late maturing varieties. The range in average maturity was nearly two weeks between the earliest varieties, Redwing and Sheyenne, and the latest variety, B5128. Minerva, C.I. 1118, Crystal, Redwood, and Royal are considered as mid-late in maturity while Marine, Dakota, Koto, and Bison are mid-early.

There are no important differences in plant height of the varieties in these trials. Bison is somewhat taller and Sheyenne and Marine slightly shorter than average.

Redwing has small seeds. All the other varieties have medium-sized seeds, although seeds of B5128 and Bison are larger than seeds of Koto, Sheyenne, or Marine.

Table 5. Average of Flax Varieties for Date Ripe, Plant Height, Weight per 1,000 Seeds, Oil Content, and Iodine Number

Variety	Date ripe	Plant height	Weight per 1,000 seeds		Oil content	Iodine number
			inches	grams		
Bison	August 11	23	6.1	38.2	175	
Redwing	August 6	22	4.5	36.7	186	
Koto	August 8	22	5.2	37.5	182	
Minerva	August 14	22	5.9	40.4	184	
Dakota	August 9	22	5.8	36.7	184	
C.I. 1118	August 14	22	5.9	38.2	180	
Redwood	August 13	22	5.8	38.4	181	
B5128	August 19	22	6.7	37.6	179	
Sheyenne	August 6	21	5.2	37.2	181	
Marine	August 8	21	5.1	37.7	187	
Royal	August 13	22	5.5	38.4	174	

Bison has been considered as having good oil content. Minerva is the only variety appreciably higher in oil than Bison, although Redwood and Royal were slightly higher. Redwing and Dakota are definitely deficient in oil content.

Oil from the seed of Redwing, Minerva, Dakota, and Marine has excellent drying quality as indicated by the relatively high iodine number. Koto, Redwood, Sheyenne, and C.I. 1118 have satisfactory oil quality. Bison and Royal have oil of low drying quality.

Disease Reaction

Bison generally has been considered the variety most susceptible to rust. Recently, heavily rusted fields of Dakota have been observed, and when races of rust that are virulent on Dakota are present this variety is as severely injured as Bison. Heavily rusted fields of Koto have also been observed. Redwing is moderately susceptible while Minerva and Royal are moderately resistant to rust. C.I. 1118, Redwood, B5128, Sheyenne, and Marine are immune to races of rust found in Minnesota.

All the flax varieties have some resistance to wilt. Koto is the most highly resistant, followed by C.I. 1118, Redwood, Sheyenne, Marine, Bison, and Dakota; Redwood, Minerva, and Redwing are moderately resistant; B5128 and Royal are moderately susceptible.

None of the varieties are resistant to pasmo, although there are variations in the degree of susceptibility. Marine, Sheyenne, and Minerva are usually less severely injured; Redwing, B5128, C.I. 1118, and Redwood are susceptible. All other varieties listed are intermediate in reaction.

Other Varieties Not So Extensively Tested

Rocket is a variety of flax developed in Canada and recently introduced into the United States. In preliminary trials in Minnesota it has been only fair in yield. It is resistant to rust, but moderately susceptible to wilt and pasmo. It has brown seeds with good oil con-

tent of good drying quality. The flowers are blue.

OATS

H. K. HAYES and K. S. KOO

Yield Comparisons

Seed for the trials was treated with New Improved Ceresan. Average yields of varieties at six experiment stations, southwestern Minnesota, and northern Minnesota are reported in table 6. Years of trial are as designated except for southwestern and northern Minnesota. In southwestern Minnesota trials, the averages for Gopher, Vicland, Bonda, Mindo, Clinton, Andrew, Zephyr, and Ajax are for 1947-51. All northern Minnesota averages, except for Missouri 0-205, are for 1950-51. All yields of James, a hull-less variety, have been multiplied by the factor, 10/7, in order to make them comparable with yields of hulled varieties.

At Rosemount, Missouri 0-205, Zephyr, Branch, Andrew, and Ajax produced the highest yields, and all varieties yielded more than Gopher and Vicland. At Waseca, James, Ajax, Clinton, and Shelby yielded relatively well whereas Branch and Gopher were the highest yielders at Morris. Ajax was outstanding at Crookston, and Branch and Ajax yielded most at Grand Rapids. At Duluth, Branch and Colo were the highest yielders. In southwestern Minnesota, James and Missouri 0-205 were the highest yielders, followed by Shelby, Ajax, Branch, and Zephyr. Vicland, Gopher, and Ajax yielded highest in northern Minnesota.

The new variety, Missouri 0-205, was tested only in 1951. It is a Columbia x (Victoria x Richland) cross and is classed as a red oat while the other varieties are classed as white or yellow oats.

As an average of all locations, Branch and Ajax were outstanding in yield. Shelby, James, and Zephyr yielded slightly more than Gopher, and Andrew, Clinton, Colo, and Missouri 0-205 yielded slightly less. Cherokee, Nema-ha, Bonda, Vicland, and Mindo were significantly below Gopher in yield.

Table 6. Average Yields of Oats

Variety	Years of trial	Rosemount	Waseca	Morris	Crookston	Grand Rapids	Duluth	Southwestern Minnesota	Northern Minnesota	Average
		bushels per acre								
Gopher	1945-51	73.8	72.2	98.8	64.3	75.0	69.0	73.0	71.9	74.7
Vicland	1945-51	74.3	68.3	88.6	61.0	70.8	65.6	65.4	73.6	70.9
Bonda	1945-51	77.9	72.4	82.1	64.2	64.6	68.1	71.2	63.4	70.5
Mindo	1945-51	77.2	74.2	87.5	64.3	68.9	72.6	63.2	60.8	71.1
Clinton	1945-51	78.2	77.1	86.5	65.5	72.3	74.0	72.4	64.0	73.7
Andrew	1945-51	81.4	72.2	90.4	67.7	73.4	72.3	70.0	68.4	74.5
Zephyr	1945-51	82.0	73.8	95.4	64.2	72.8	71.9	75.2	65.1	75.0
Ajax	1945-51	80.2	78.1	95.8	75.3	79.1	78.0	76.9	69.5	79.1
Shelby	1948-51	79.0	76.9	94.4	69.4	72.7	75.8	77.5	62.2	76.0
James	1949-51	77.8	78.8	94.8	68.4	65.1	67.6	82.2	68.5	75.4
Cherokee	1950-51	76.4	61.9	79.4	61.2	73.3	78.4	57.8	64.5	69.1
Nemaha	1950-51	75.2	68.9	80.1	54.5	73.8	73.0	66.4	62.8	69.3
Colo	1950-51	78.8	68.3	91.6	65.0	65.6	80.2	69.4	64.1	72.9
Branch	1950-51	81.5	74.1	103.7	68.8	84.3	80.8	76.4	65.7	79.4
Missouri 0-205	1951	83.0	75.9	82.5	61.4	66.2	65.6	81.7	66.2	72.8
L.S.D. at 5 per cent point		4.6	4.8	5.4	6.1	6.1	5.4	5.9	9.5	2.2

Yields of Ajax and Andrew have been compared at each station after adjusting on the basis of hull percentages. Andrew had an averaged hull percentage at five stations—Rosemount, Waseca, Morris, Crookston, and southwestern Minnesota—of 27.4 per cent, while Ajax averaged 31.9 per cent. The actual yields of Andrew, therefore, were multiplied by the percentage value of 106.6 to make them comparable with Ajax. The results are in the table below.

Station	Actual yields Ajax 31.9 per cent hull	Adjusted yields Andrew on a 31.9 per cent hull basis
Rosemount	80.2	86.8
Waseca	78.1	77.0
Morris	95.8	96.4
Crookston	75.3	72.2
Grand Rapids	79.1	78.2
Duluth	78.0	77.1
Southwestern Minnesota	76.9	74.6
Northern Minnesota	69.5	72.9
Average	79.1	79.4

On this basis Andrew is as high a yielder as Ajax. It is of interest to point out that Branch had a hull percentage of 34.3, on the average. This leads to the conclusion that Andrew produced a higher yield of groats than Branch.

Other Agronomic Characters

Comparative data on agronomic characters are summarized in table 7. Averages for date of heading include data for 1947-51 from Rosemount, Waseca, Morris, and Crookston. Mindo, Andrew, Cherokee, and Nemaha were early; Bonda, Clinton, James, Colo, and Missouri 0-205 were three days later than Mindo; Gopher, Vicland, Zephyr, and Shelby were five to six days later than Mindo; Ajax was seven days later and Branch nine days later than Mindo. Date of heading and date of maturity were not perfectly correlated. For instance, Colo usually matured considerably later than Bonda, Clinton, or James; Zephyr and Shelby usually matured later than Ajax. There was some tendency for late maturing varieties to yield more than the early maturing varieties, although there

were some exceptions to this direct relationship.

Averages for height include data for 1947-51 from Rosemount, Waseca, Morris, Crookston, and southwestern Minnesota. Vicland, Mindo, Nemaha, and Cherokee were relatively short, whereas Branch and Ajax were the tallest varieties. Bonda, Zephyr, Shelby, Colo, and Missouri 0-205 were also relatively tall.

Averages for weight per bushel include data for 1947-51 from Rosemount, Waseca, Morris, Crookston, and southwestern Minnesota. James, Bonda, and Shelby excelled in weight per bushel. Vicland, Gopher, and Ajax were slightly lower in weight per bushel than the other varieties.

Averages for hull percentage include data for 1947-50 from Rosemount, Waseca, Morris, Crookston, and southwestern Minnesota. Colo, Andrew, and Clinton had the lowest hull percentages. Vicland, Bonda, Zephyr, Ajax, Nemaha, and Branch were somewhat higher than Shelby, Gopher, Mindo, and Cherokee in hull percentage.

Averages for weight of 200 kernels include data for 1947-50 from Rosemount, Waseca, Morris, Crookston, and southwestern Minnesota. Zephyr and Bonda exceeded the other varieties in weight of 200 kernels. Andrew, Shelby,

Cherokee, Nemaha, and Colo also developed relatively heavy kernels. If the kernel weight of James is multiplied by 10/7 to compensate for the lack of hull, it can be shown to be comparable to the kernel weight of Mindo, Clinton, and Branch.

Standing ability was averaged on an index basis for 1945-51 at Rosemount, Waseca, and Morris and for 1947-51 in southwestern Minnesota. After obtaining the percentage of the plants which were lodged and the degree of lodging, the comparative standing abilities were arranged in three classes: 1 represented excellent, being distinctly superior to Gopher; 2 good, or about like Gopher; and 3 less desirable or inferior to Gopher. Bonda, Mindo, Clinton, Andrew, James, Cherokee, Nemaha, and Missouri 0-205 excelled the other varieties. Vicland, Zephyr, Shelby, and Colo were equal to Gopher, while Ajax and Branch were inferior to Gopher in standing ability.

Disease Reaction

During the period of trial from 1945-49, as reported in Miscellaneous Report 8 for 1949, stem and crown rust were of no great importance. While Gopher and Ajax had considerable infection with crown rust in 1945 and showed considerable infection in 1947,

Table 7. Averages of Oat Varieties for Date of Heading, Plant Height, Weight per Bushel, Hull Percentage, Weight of 200 Kernels, and Standing Ability

Variety	Date heading	Plant height	Weight	Hull percentage	Weight 200 kernels	Standing ability*
		inches	pounds per bushel		grams	
Gopher	June 29	35	34.1	30.8	4.7	2
Vicland	June 29	32	33.8	32.7	4.8	2
Bonda	June 27	38	37.3	32.0	6.0	1
Mindo	June 24	32	34.8	30.4	5.0	1
Clinton	June 27	35	35.7	28.7	5.0	1
Andrew	June 24	35	35.1	27.4	5.5	1
Zephyr	June 29	38	34.5	32.2	6.3	2
Ajax	July 1	40	34.1	31.9	4.9	3
Shelby	June 30	38	36.7	29.7	5.4	2
James	June 27	35	41.8	0	3.5	1
Cherokee	June 24	33	34.9	29.5	5.7	1
Nemaha	June 25	32	35.0	31.1	5.7	1
Colo	June 27	37	35.0	27.3	5.8	2
Branch	July 3	40	35.2	34.3	5.0	3
Missouri 0-205	June 27	37	34.8	.....	.....	1

* 1 = excellent, 2 = good, 3 = less desirable.

this did not seem to reduce yielding ability greatly in these two years. In 1950 all varieties were injured in some of the trials with stem rust, crown rust, or with both diseases, except Vicland which was resistant to prevalent races of crown rust. In 1951, crown rust was prevalent in most trials but was late in development and did not appreciably decrease yields. Only traces of stem rust were generally present.

Vicland, Andrew, Ajax, Branch, and Missouri 0-205 are resistant to races 1, 2, 3, 5, 7, 12 and susceptible to races 4, 6, 8, 9, 10, 13 of stem rust; the other varieties, except Gopher, are resistant to races 1, 2, 5, 8, 9, and 10 and susceptible to race 7; Gopher is susceptible to races 7 and 8, both of which have been prevalent in Minnesota.

Because of the prevalence of race 45 and other races of crown rust to which Bonda is susceptible, all of the varieties selected from Bond crosses had some infection with crown rust in 1950-51. Vicland, Branch, and Ajax were moderately resistant to race 45. Although susceptible to certain races, Missouri 0-205 was moderately resistant to prevalent races. Vicland in 1950-51 trials was more resistant to crown rust than any other variety.

All varieties in the trials except Vicland have been resistant to *Helminthosporium victoriae*. In some years, yields of Vicland have been seriously reduced by this fungus.

All varieties in the trials were tested for smut reaction and the recommended varieties continued to prove resistant to prevalent races of smut.

Other Varieties Not So Extensively Tested

In Miscellaneous Report 8 for 1949, two Canadian varieties, Beaver and Exeter, were mentioned briefly. They have been tested only in rod-row trials and have not proved superior to recommended varieties. Brief reference was made also to a considerable group of reselected strains of Clinton, Bonham, Berry, and Kent which were grown in rod-row trials in 1949 and 1950. None of these varieties proved particularly desirable. Larain, a selec-

tion from a cross between Gold Rain and Alaska made at the Cereal Division, Central Experimental Farm, Ottawa, Canada, was tested in rod-row trials in 1950. It is susceptible to the rusts and smuts and did not yield especially well in the trials.

Fortune was selected at the University of Saskatchewan, Canada, from the double cross Victory (Victoria x Richland) x (Markton x Victory). It is resistant to race 7 of stem rust but susceptible to race 8. In rod-row trials in 1950 and 1951 it was susceptible to crown rust. It was somewhat later in maturity than most of the other varieties grown and in 1950 and 1951 yielded well.

Marion, selected many years ago, has yielded well in recent trials because it carries moderate resistance to many strains of crown rust.

Mindo reselect has yielded about as well as Mindo and is somewhat more uniform in growth habit.

RYE

H. K. HAYES, R. G. ROBINSON

Average yields of rye over a period of years at seven locations are reported in table 8. Averages for Dakold, Emerald, and Imperial include trials at University Farm and Waseca from 1935-46 except for 1944 at University Farm; at Morris from 1936-51 except for 1937 and 1948; at Crookston from 1947-51; at Grand Rapids from 1935-51 except for 1943; at Duluth from 1938-49 except for 1942; and at southwestern Minnesota from 1949-51. Average adjusted yields for Pierre include trials at Morris, Crookston, Grand Rapids, and southwestern Minnesota from 1949-51 and at Duluth in 1949. Locally grown ryes were included for comparison with the named varieties at Crookston from 1948-51, at Morris and southwestern Minnesota from 1949-51, and at Duluth from 1948-49. Balbo and Prolific Spring were grown only in 1951 in southwestern Minnesota. The grand adjusted average is made by averaging the averages at individual stations.

Table 8. Average Adjusted Yields of Rye

Location	Number of trials	Average adjusted yields						L.S.D. at 5 per cent point
		Dakold	Emerald	Imperial	Pierre	Local ryes	Balbo	
bushels per acre								
University Farm	11	38.1	37.9	40.5	.....	.....	.....	2.3
Waseca	12	36.1	38.6	39.7	.....	.....	.....	2.2
Morris	14	27.2	28.2	29.4	30.7	28.7	.....	1.5
Crookston	5	29.1	30.9	30.9	30.5	28.0	.....	3.8
Grand Rapids	16	36.1	40.6	41.2	41.8	.....	.....	2.2
Duluth	11	17.8	21.2	22.2	23.4	22.8	.....	2.3
Southwestern Minnesota	3	41.2	46.8	42.6	39.3	37.5	29.1	13.7
Grand adjusted average	32.2	34.9	35.2	34.9	32.7	19.7	4.3	1.1

Of the two recommended varieties, Imperial yielded slightly more than Emerald at all locations except Crookston and southwestern Minnesota. At Crookston, both varieties yielded alike and in southwestern Minnesota, Emerald yielded more than any other variety.

Dakold yielded less than Emerald and Imperial at all locations except University Farm where it yielded about like Emerald. Pierre compared favorably with the recommended varieties at Morris, Crookston, Grand Rapids, and Duluth. In southwestern Minnesota, it yielded somewhat less than Imperial and significantly less than Emerald. The local ryes yielded less than Emerald and Imperial at Crookston and southwestern Minnesota, about the same as Emerald and Imperial at Morris, and somewhat more than Emerald at Duluth. Balbo and Prolific Spring yielded significantly lower than the recommended varieties in the 1951 southwestern Minnesota trials.

Trials on sandy soils from 1947-51 have included one trial each in Anoka and Stearns Counties in 1947 and two trials in Anoka County and one each in Stearns, Sherburne, and Wright Counties each year from 1948-51. The adjusted average yields from the 22 trials are reported in table 9. For Dakold, Emerald, and Imperial the 1947 results were given as much weight in the average as the data in later years, even though only two locations were included in 1947 and five were

included in each of the other four years.

Emerald performed relatively well every year in these trials and, on the average, yielded significantly more than

Table 9. Average Adjusted Yields of Rye on Sandy Soil

Variety	Years of trial	Average adjusted yields	
		bushels per acre	5 per cent point
Dakold	1947-51	18.4	
Emerald	1947-51	21.0	
Imperial	1947-51	19.8	
Pierre	1949-51	19.5	
Local ryes	1948-51	18.5	
Balbo	1951	17.8	
Prolific Spring	1951	5.9	
L.S.D. at 5 per cent point		0.9	

any other variety. Imperial and Pierre were superior to Dakold, Balbo, and the local ryes in yielding ability. Prolific Spring yielded much less than the winter rye varieties.

Imperial was slightly taller and later-maturing than the other winter rye varieties. It showed more winter injury than Emerald.

Pierre had the greatest bushel weight and was earlier-maturing than the other varieties. South Dakota² trials indicate that it is more winter hardy than Emerald, but in Minnesota

² South Dakota Agricultural Experiment Station. "Progress Report of Research in Crops and Soils." S. D. Agr. Exp. Sta. Cir. 86. April, 1951.

trials this differential winter injury has not been observed.

Balbo, introduced from Italy and released by the Tennessee Agricultural Experiment Station, is also of interest as a variety for pasturing. In the 1951 trials on sandy soil and at Crookston and southwestern Minnesota, it made more growth in the fall than Emerald but produced less forage in May. It was the earliest-maturing variety tested and also lodged the least. It was less winter hardy than any of the other varieties.

Prolific Spring, introduced from Germany by the University of Saskatchewan, matured nearly two weeks later than the winter rye varieties.

SPRING WHEAT

E. R. AUSEMUS

Yield Comparisons

Comparative yield data are given in table 10 for the varieties grown from 1943-51 at the six experiment stations and southwestern Minnesota during 1946-51. Average yields for varieties grown at Williams for two years are also included, but they are not comparable with the yield data from other locations. Seed for the trials was treated with New Improved Ceresan.

The recommended bread wheat varieties, Lee, Mida, and Rival, outyielded Thatcher. Rival outyielded the other two recommended varieties at Waseca, and is probably the most desirable variety for southern Minnesota. It also yielded well at Morris. Lee was the highest-yielding recommended variety at Rosemount, Morris, Crookston, southwestern Minnesota, and Grand Rapids.

Rushmore, tested for only three years, yielded slightly higher than Lee at Waseca and somewhat higher than Mida and Rival at Crookston and Grand Rapids. In southwestern Minnesota it yielded less than the recommended varieties. Redman, tested at only three locations, was the highest-yielding variety at Williams and next to the highest at Grand Rapids. Henry yielded 1.5

bushels higher than Lee at five stations but has not been recommended because of inferior milling and baking qualities.

Mindum and Stewart were the highest-yielding durums.

Other Agronomic Characters

Adjusted comparative data on agronomic characters are given in table 11. Averages used in these comparisons include data from four stations, Rosemount, Waseca, Morris, and Crookston, for the various periods the varieties were grown during 1943-51. For date of heading, Rushmore and Lee were the earliest. Redman, Mida, and Thatcher were a day later. Rival, which was the latest heading bread wheat, was four days later than Lee. Nugget headed four days earlier than the other durum varieties.

The shortest-strawed bread wheat was Lee. Rushmore and Thatcher were slightly taller. Rival and Mida, the tallest bread wheats, were five inches taller than Lee. Nugget was six or seven inches shorter than the other three durums. Mida had a slightly higher weight per bushel than Lee and Rushmore. Mindum and Stewart had the highest bushel weight of the four durums.

Quality

All of the recommended varieties and Thatcher, Rushmore, and Redman, have acceptable milling and baking characters. Henry has been classified as undesirable in milling and baking quality. All four durums are accepted by the trade for making semolina products.

Disease Reaction

All varieties of bread wheats and two durums, Carleton and Stewart, have been moderately resistant to stem rust prior to 1950. In 1950, both the bread wheats and the durums were susceptible to race 15B of stem rust. Lee is moderately resistant to leaf rust. Other recommended varieties of bread wheats have been susceptible in recent years to prevalent races of leaf rust.

Table 10. Average Yields of Bread Wheats and Durums

Variety	Years used in average	Rose-mount	Waseca	Morris	Crook-ston	Years used in average	South-western Minnesota	Average five locations	Years used in average	Grand Rapids	Duluth	Years used in average	Williams
bushels per acre													
Bread wheats													
Thatcher	1943-51	26.0	20.3	31.5	25.1	1947-51	25.6	25.7	.....	.....	.....	.....	.....
Rival	1943-51	28.3	23.9	34.5	27.2	1946-51	26.7	28.1	1943-51	22.7	23.0	1950-51	22.8
Mida	1943-51	28.8	22.8	33.3	29.0	1946-51	27.9	28.4	1943-51	23.8	21.1	1950-51	26.1
Henry	1943-51	32.9	25.6	36.3	31.4	1946-51	31.4	31.5	1944-51	24.0	23.3	1950-51	29.6
Lee	1946-51	32.2	22.7	35.0	31.3	1947-51	28.8	30.0	1946-51	26.1	21.4	1950-51	28.2
Redman	1946-50	29.6	.....	34.4	26.2	.....	.....	.....	1948-51	26.6	22.0	1950-51	31.3
Rushmore	1949-51	31.4	24.5	34.1	31.0	1949-51	26.3	29.5	1950-51	27.0	23.1	1950-51	26.3
bushels per acre													
Durums													
Mindum	1943-51	30.4	.....	36.4	29.5	.....	.....	32.1*	.....	.....	.....	.....	.....
Carleton	1943-51	26.6	.....	33.7	28.5	.....	.....	29.6	.....	.....	.....	.....	.....
Stewart	1943-51	28.1	.....	36.9	29.9	.....	.....	31.6	.....	.....	.....	.....	.....
Nugget	1950-51	28.1	.....	37.3	27.0	.....	.....	30.8	.....	.....	.....	.....	.....
L.S.D. at 5 per cent point		1.5	1.4	1.4	2.3	.....	1.7	.....	.....	2.0	2.1	.....	4.3

* Averages for Rosemount, Morris, and Crookston.

Table 11. Averages for Spring Wheat Varieties for Date of Heading, Plant Height, and Weight per Bushel

Variety	Years in average	Date headed	Plant height	Weight
Bread wheats			inches	pounds per bushel
Thatcher	1943-51	June 29	35	56.8
Rival	1943-51	July 1	39	58.3
Mida	1943-51	June 29	39	58.4
Henry	1943-51	June 30	38	58.1
Lee	1946-51	June 27	34	58.7
Redman*	1946-50	June 29	36	56.7
Rushmore	1949-51	June 27	35	58.8
Durums†				
Mindum	1943-51	July 3	45	60.5
Carleton	1943-51	July 4	46	59.8
Stewart	1943-51	July 4	46	60.6
Nugget	1950-51	June 29	39	58.0

* Not grown at Waseca. Data for this variety have been adjusted so that they are comparable with other varieties.

† Data from Rosemount, Morris, and Crookston.

Mida and Lee are moderately susceptible to loose smut. Mida, Rival, Lee, Redman, and Rushmore are moderately resistant to bunt. Carleton and Stewart are moderately susceptible to bunt.

All varieties are susceptible to scab, although Rival appears to be somewhat less so than the others. Wheat following corn in rotations in southern Minnesota may be severely injured by scab.

New Varieties Not Extensively Tested

Ten new hybrid bread wheat varieties and one new durum have been tested at one or more of the stations for one or two years. All of these have been resistant to stem rust with the exception of race 15B. Four of the new bread wheats were Timstein or Supresa derivatives; three had Henry as

one of their parents. Most of these new varieties were either resistant or moderately resistant to leaf rust but all were susceptible to stem rust where 15B was found. The new durum was susceptible to stem rust.

WINTER WHEAT

E. R. AUSEMUS

Yield Comparisons

Table 12 gives the comparative average yield data obtained at University Farm, Waseca, Grand Rapids, and southwestern Minnesota for the various periods the varieties were grown during 1942-51. The crops failed at University Farm in 1943, 1944, and 1948, at Waseca in 1948, and at Grand Rapids in 1943, 1944, and 1946 because of winterkilling. Seed for the trials was treated with New Improved Ceresan.

Table 12. Average Yields of Winter Wheat*

Variety	Years used	University	Grand	Average	Years	South-
		Farm				
bushels per acre						
Minturki	1942-51	32.5	24.7	41.3	32.8	1950-51
Minter	1942-51	34.7	26.1	41.6	34.1	1950-51
Blackhawk	1943-51	34.3	24.6	36.5	31.8	1950-51
Ichardi	1949-51	34.3	24.7	40.4	33.1	1950-51
bushels per acre						

* Crops failed at University Farm in 1943, 1944, and 1948, at Waseca in 1948, and at Grand Rapids in 1943, 1944, and 1946.

Table 13. Averages for Winter Wheat Varieties for Date of Heading, Plant Height, and Weight per Bushel*

Variety	Years used	Date heading	Plant height	Winter injury	Weight
			inches	per cent	pounds per bushel
Minturki	1942-51	June 20	40	38	59.0
Minter	1942-51	June 20	39	37	59.8
Blackhawk	1945-51	June 21	41	41	59.2
Iohardi	1949-51	June 18	40	46	61.1

* Crops failed at University Farm in 1943, 1944, and 1948, at Waseca in 1948, and at Grand Rapids in 1943, 1944, and 1946.

Average yields at Waseca were somewhat lower than at the other three stations. Minter gave the highest yield at each of the stations and had the highest average yield.

Other Agronomic Characters

Comparative data on agronomic characters obtained at the three stations, University Farm, Waseca, and Grand Rapids, are given in table 13. Averages for the date of heading, plant height in inches, and weight per bushel are given from data taken in the years during 1942-51, when a crop was harvested. Iohardi was the earliest in heading, being two days ahead of the next two varieties, Minter and Minturki. Blackhawk was three days later than Iohardi. Minter was the shortest variety, with Minturki and Iohardi one inch taller and Blackhawk two inches taller. Minturki and Minter had the least winter injury. Blackhawk had somewhat more injury and Iohardi had the highest. Iohardi excelled in bushel weight, although the test weight of all varieties was excellent.

Disease Reaction

Blackhawk was moderately resistant to leaf rust while the other three varieties were susceptible. Minter was moderately resistant to stem rust prior to 1950, but since race 15B of stem rust has become prevalent, all varieties are susceptible.

Quality

Minter and Blackhawk were superior to Minturki and Iohardi in milling and baking quality. Minter has a whiter

crumb color and lower carotinoid pigment content than Minturki. Its winterhardiness and good agronomic characters make it seem the most desirable available variety.

New Varieties Not Extensively Tested

Nine new hybrid varieties have been tested for two or three years. These are selections from crosses between Hope or H-44 and their derivatives with Minturki or Marmin. Each of these varieties has produced good yields, been moderately resistant to stem rust, except race 15B, and in preliminary milling and baking trials been better than Minturki.

SOYBEANS

J. W. LAMBERT

Yield Comparisons

Average yields in bushels per acre for three locations in southern Minnesota are given in table 14.

Capital averaged slightly higher than any of the other varieties in yield. Hokien, in the two locations where it was tested, yielded almost the same as Capital. These two varieties appear to be identical. Habaro, Korean, and Blackhawk averaged almost as high in yield as Capital. Monroe gave only fair yields at all locations. Hawkeye and Bawender Special yielded well in southwestern Minnesota but gave medium to low yields in the other two locations. Harly and Adams were low in yield in all three locations. Lincoln yielded relatively low at Blue Earth, the only location at which it was tested.

Table 14. Average Soybean Yields at Waseca, Blue Earth, and Southwestern Minnesota

Variety	Waseca		Blue Earth		Southwestern Minnesota		
	Years tested	Yields	Years tested	Yields	Years tested	Yields	Average yields
bushels per acre							
Ottawa Mandarin	1947-51	28.4	1948-51	35.6	1948-51	21.8	28.6
Habaro	1947-51	28.9	1948-51	38.2	1948-51	23.5	30.2
Monroe	1947-51	26.7	1948-51	31.6	1948-51	21.6	26.6
Blackhawk	1947-51	28.8	1948-51	35.8	1948-51	24.9	29.8
Hawkeye	1948-51	24.3	1948-51	34.7	1948-51	25.1	28.0
Capital	1949-51	31.4	1949-51	35.6	1949-51	24.3	30.4
Harly	1949-51	23.7	1949-51	28.2	1949-51	21.2	24.4
Korean	1949-51	28.4	1949-51	37.5	1949-51	24.8	30.2
Bavender Special	1949-51	21.4	1949-51	34.4	1949-51	26.0	27.3
Pridesoy 57	1949-51	29.5	.....	.....	1949-51	20.9	.....
Hokien	1950-51	31.2	.....	.....	1950-51	24.6	.....
Adams	1950-51	21.2	1951	26.6	1950-51	21.3	23.0
Lincoln	.....	.....	1948-51	32.8	.....	.....	.....
L.S.D. at 5 per cent point	.....	1.7	.....	2.5	.....	2.1	1.2

Table 15. Average Soybean Yields at Rosemount and Morris

Variety	Rosemount		Morris		Average yields
	Years tested	Yields	Years tested	Yields	
bushels per acre					
Flambeau	1948-51	25.4	1947-51	25.7	25.6
Ottawa Mandarin	1948-51	27.4	1947-51	25.4	26.4
Habaro	1948-51	22.3	1947-51	22.4	22.4
Monroe	1948-51	24.7	1948-51	21.8	23.2
Blackhawk	1948-51	27.2	1947-51	19.6	23.9
Capital	1948-51	29.6	1948-51	24.8	27.2
Pridesoy 57	1949-51	27.7	1949-51	25.3	26.5
Harly	1949-51	22.5	1949-51	16.7	19.6
Hokien	1950-51	31.2	1950-51	26.4	28.8
L.S.D. at 5 per cent point	.....	1.9	.....	1.5	1.2

Table 16. Averages for Soybean Varieties for Date Mature, Plant Height, Lodging Score, Seed Size, and Oil Content at Three Locations, Waseca, Blue Earth, and Southwestern Minnesota

Variety	Date mature	Plant height	Lodging score*	Seed size	Oil content	
					inches	grams per 100 seeds
Ottawa Mandarin	September 13	28	1.2	17.9	20.5	
Habaro	September 22	31	2.5	17.5	19.3	
Monroe	September 21	39	2.2	14.1	20.2	
Blackhawk	September 25	36	2.0	15.4	20.7	
Hawkeye	October 3	39	1.7	15.8	20.4	
Capital	September 16	32	2.5	12.3	21.1	
Harly	September 23	41	1.9	14.2	19.6	
Korean	September 29	33	2.3	22.8	19.8	
Bavender Special	October 7	40	3.4	15.2	19.0	
Pridesoy 57	September 13	26	1.5	14.9	19.6	
Hokien	September 15	31	2.6	11.8	21.2	
Adams	October 5	41	2.2	11.5	20.1	
Lincoln	October 6	41	2.8	12.0	20.2	

* 1 = erect; 5 = completely lodged.

Table 17. Averages for Soybean Varieties for Date Mature, Plant Height, Lodging Score, Seed Size, and Oil Content at Two Locations, Rosemount and Morris

Variety	Date mature	Plant height	Lodging score*	Seed size	Oil content
Flambeau	September 8	26	2.1	14.6	19.4
Ottawa Mandarin	September 15	26	1.2	16.2	19.8
Habaro	September 26	28	2.1	15.6	18.2
Monroe	September 22	36	2.2	13.2	19.2
Blackhawk	September 28	34	1.9	14.5	20.0
Capital	September 18	30	2.0	11.1	20.2
Pridesoy 57	September 14	25	1.2	13.9	19.4
Harly	September 26	38	2.3	13.3	18.6
Hokien	September 20	30	1.6	11.0	.....

* 1 = erect; 5 = completely lodged.

Average yields at Rosemount and Morris are given in table 15. At these two locations, Capital and Hokien yielded very well. Pridesoy 57, Ottawa Mandarin, and Flambeau also gave good yields. The later varieties, Habaro, Monroe, and Blackhawk, gave only fair yields, and Harly yielded much lower than any other variety in the trials.

Average yields of seed and hay at Crookston are given in table 18. Pridesoy 57 led in seed yield, the other three varieties yielding only slightly less. Ottawa Mandarin and Capital were highest and were equal in hay yields.

Other Agronomic Characters and Oil Content

Averages for agronomic characters and oil content for southern Minnesota are given in table 16.

Averages for date of maturity include data from Blue Earth for 1948-51 and from Waseca and southwestern Minnesota for 1950-51. Averages for oil content do not include data from the 1951 trials. Averages for plant height in inches, lodging score, and seed size in grams per 100 seeds are for the same periods as indicated for yield.

In date of maturity, Pridesoy 57 and Ottawa Mandarin were earliest; Capital and Hokien were slightly later. These varieties are particularly useful in the southern part of Minnesota for later plantings. They have performed very well, however, in plantings made

at normal dates. The varieties Habaro, Monroe, Blackhawk, and Harly were medium in maturity and represent about the optimum in maturity for much of the area of heavy soybean production. Only slightly later than these was the variety Korean. Hawkeye, Bavender Special, Adams, and Lincoln are generally too late for Minnesota conditions. If they are used, they should be seeded as early as possible.

The tallest varieties were Harly, Adams, and Lincoln. Only slightly shorter were Monroe, Hawkeye, and Bavender Special. Shortest among the varieties were Pridesoy 57 and Ottawa Mandarin. These two are perhaps too short in many instances and tend to bear their pods rather close to the ground. Blackhawk appears to be about optimum in height and tends to bear its lowest pods well above the ground. Capital, Hokien, and Habaro are relatively satisfactory in height.

In standing ability Ottawa Mandarin and Pridesoy were outstanding. Blackhawk and Hawkeye stood relatively well. Of the whole group of varieties Bavender Special was the only one that lodged to the extent that it might be troublesome to harvest.

In seed size Korean was very large. Adams, Capital, Hokien, and Lincoln were small. The rest were intermediate. This character seems of minor importance except as it affects seeding rates.

In oil content Capital and Hokien excelled. Blackhawk, Ottawa Mandarin, and Hawkeye had good oil contents.

Table 18. Average Soybean Yields of Seed and Hay and Averages for Plant Height, Seed Size, and Oil at Crookston

Variety	Years tested	Seed	Hay	Plant height	Oil content
		bushels per acre	tons per acre	inches	per cent
Flambeau	1948-51	18.4	2.10	25	19.9
Ottawa Mandarin	1948-51	18.6	2.21	26	20.7
Capital	1948-49, 51	17.3	2.21	29	20.6
Pridesoy 57	1949-51	19.6	2.01	25	20.0
L.S.D. at 5 per cent point		1.5	.16	....	....

Bavender Special and Habaro were lowest in percentage of oil.

Averages for agronomic characters and oil content for Rosemount and Morris are given in table 17.

In maturity Flambeau was about a week earlier than Ottawa Mandarin and Pridesoy 57 and 10 days earlier than Capital. Blackhawk, Habaro, and Harly all matured rather late for the Morris area and should be planted early when used that far north in the state. Monroe was a few days earlier than these three.

In plant height Harly averaged tallest. Slightly shorter were Monroe and Blackhawk. Pridesoy 57, Flambeau, and Ottawa Mandarin were all relatively short.

In standing ability none of the varieties appeared particularly troublesome. Pridesoy 57 and Ottawa Mandarin were outstanding in their ability to withstand lodging.

In seed size Ottawa Mandarin was largest and Capital and Hokien were smallest.

In oil content Capital and Blackhawk were highest, and Habaro and Pridesoy 57 were lowest.

For Crookston, data on plant height and oil content are included in table 18. Capital grew tallest. The other three varieties averaged three or four inches shorter. Ottawa Mandarin and Capital were each somewhat higher in oil than Flambeau or Pridesoy 57.

FIELD PEAS

R. G. ROBINSON, O. C. SOINE,
C. H. GRIFFITH, R. O. BRIDGFORD

Most of the field peas grown in Minnesota in recent years have been sold

to processors for use in soup and pigeon feed. Pea seed can also be fed to sheep, hogs, and cattle. The seed contains more than 20 per cent digestible protein.

Field peas are sometimes used as a forage crop, usually in a mixture with oats for hay or silage. The forage compares favorably with that of other leguminous crops in digestible protein and total digestible nutrients.

Peas are a moderately cool-season crop and should be sown early. Rates of seeding in these trials were based on Chancellor of 90 per cent germination at two bushels per acre and adjusted for seed size and germination to sow equal numbers of viable seeds per plot. Seed for the trials was treated with Spergon for control of seed-borne fungi and inoculated with Nitragin Culture "C" to supply bacteria for nitrogen fixation.

Seed Yield Comparisons

Average yields in bushels per acre are reported in table 19 for 1948-51 at Crookston and for 1948-50 at Morris and Grand Rapids. Averages from Morris and Grand Rapids were given as much weight in calculating the grand average as those from Crookston, even though an additional year's trial is included in the Crookston averages.

At Crookston and Grand Rapids, Multiplier produced more seed than Chancellor or Dashaway which are the other two varieties recommended for Minnesota. Chancellor yielded the most at Morris.

First and Best and Late Scotch yielded somewhat less than the recommended varieties at Crookston and Morris. At Grand Rapids, Late Scotch

Table 19. Average Yields of Peas for 1948-51 at Crookston and for 1948-50 at Morris and Grand Rapids

Variety	Crookston	Morris	Grand Rapids	Grand average
bushels per acre				
Chancellor	20.8	21.6	16.1	19.5
Dashaway	21.2	21.0	16.8	19.7
Multiplier	22.7	20.4	19.0	20.7
First and Best	20.5	19.2	16.3	18.7
Late Scotch	19.6	18.1	18.9	18.9
L.S.D. at 5 per cent point	1.8	2.1	2.4	1.2

yielded more and First and Best about the same as Chancellor and Dashaway.

Hay Yield Comparisons

Hay yields of Multiplier, Chancellor, and Dashaway in mixture with Shelby oats were compared at Rosemount and Tracy in 1951. Peas and oats were mixed in the drill and sown at an acre rate equivalent to 1.5 bushels of Chancellor peas plus 1.5 bushels of Shelby oats. Yields averaged about three tons per acre of hay containing 15 per cent moisture at Rosemount and four tons at Tracy. The crop lodged badly. No appreciable differences in yield between varieties were obtained. In these 1951 trials, Shelby oats was past the best hay stage when the peas were at their best. More trials are needed to determine the best combination of varieties and dates of sowing.

Other Agronomic Characters

Comparative data on other agronomic characters are summarized in table 20. Averages for date first bloom include data for 1948-51 from Crookston, 1949 from Morris, and 1948-50 from Grand Rapids. Date mature averages include data for 1948-51 from Crookston, 1948-50 from Morris, and 1949-50 from Grand Rapids. Vine length averages include data for 1948-49 from Crookston and 1948-50 from Morris and Grand Rapids. Averages for bushel weight and weight of 100 seeds include data for 1948-51 from Crookston and 1948-50 from Morris and Grand Rapids. Averages are calculated

on a location basis, and no allowance is made for differences in the number of trials at each location.

The cream-colored varieties are most satisfactory for sale as dry, edible peas in Minnesota. Bleaching of Late Scotch frequently makes it unsuitable for commercial use.

Dashaway bloomed and matured one day sooner than Chancellor, while Multiplier was somewhat later than the other recommended varieties. First and Best matured much earlier than the other varieties. Late Scotch was the latest-maturing variety.

Multiplier and Late Scotch produced the longest vines. First and Best was the shortest variety.

All varieties were well over the legal weight per bushel of 60 pounds.

In weight of 100 seeds, First and Best weighed considerably more than the other cream-colored varieties. This additional size may be desirable for commercial splitting, and processors generally prefer First and Best for this purpose. First and Best and Late Scotch were generally sown at about three bushels per acre as compared to about two bushels per acre for the smaller-seeded Chancellor and Dashaway.

Other Varieties

Trials of Austrian, White Marrowfat, Superlaska, Delwiche Early Scotch, and Chang were discontinued after three years of testing due to low yield or other undesirable characteristics. Chang performed well but is not desired on the edible pea market because of its black hilum.

Table 20. Seed Color and Averages for Date First Bloom, Date Mature, Vine Length, Weight per Bushel, and Weight of 100 Seeds at Crookston, Morris, and Grand Rapids

Variety	Seed color	Date first bloom	Date mature	Length	Weight	Weight of 100 seeds
				inches	pounds per bushel	grams
Chancellor	cream	June 27	August 15	40	62.9	12.5
Dashaway	cream	June 26	August 14	42	63.1	11.8
Multiplier	cream	July 1	August 16	44	63.1	13.3
First and Best	cream	June 17	August 5	36	61.8	16.9
Late Scotch	green	July 2	August 18	44	62.5	17.1

SUNFLOWERS and SAFFLOWERS

R. G. ROBINSON, O. C. SOINE,
R. O. BRIDGFORD

Trials of short, combine-type sunflower varieties were begun in 1948 to study sunflower performance in western Minnesota, to evaluate the leading varieties, and to compare sunflowers with soybeans and flax as oilseed crops. Safflower varieties were included in the 1950-51 trials for comparison with the other three oilseed crops.

Sunflower oil, like soybean oil, is edible and can be used in many products, such as salad oil, cooking oil, and margarine. The meal remaining after oil extraction is a valuable protein supplement for livestock. The hulls are pressed into fuel "logs" by a Canadian cooperative.

North Dakota, California, and Illinois are the leading states in sunflower production. However, southern Manitoba has much more acreage and production than these states.

Safflower oil, although slower drying than linseed oil, can also be used in the paint, varnish, and linoleum industries.

Safflower is grown commercially on a very small acreage in many of the states west of the Missouri River such as Nebraska, Colorado, California, Montana, Idaho, Oregon, and Washington.

Comparison of Sunflowers, Soybeans, Saffflowers, and Flax

Adapted varieties of soybeans and flax were sown beside the sunflower

plots each year; safflower varieties were added to the comparison in 1950-51. The soybean and flax varieties used were Blackhawk and Redwood in 1948-51 in southwestern Minnesota; Minsoy soybeans in 1948-50, Flambeau in 1951, Minerva flax in 1948-49, Dakota in 1950, and Redwood in 1951 at Crookston; Flambeau soybeans in 1948-50, Dakota flax in 1948 and 1950, and Minerva flax in 1949 at Morris. Comparative average yields and oil content of Advance sunflowers, soybeans, and flax for 1948-51 at Crookston and southwestern Minnesota and for 1948-50 at Morris are reported in table 21; average yields and oil content of N-852 saffflowers are reported for 1950-51 at Crookston and southwestern Minnesota and for 1950 at Morris. The grand average is calculated on a location basis, and no allowance is made for differences in the number of trials at each location. Sunflowers and soybeans were planted in 40- or 42-inch rows and cultivated; saffflowers and flax were sown in 6-inch rows with a grain drill. Oil percentages were calculated on a 10 per cent moisture basis.

The oil content of sunflower seed averaged about 12 per cent higher than that of soybeans. Soybean seed contained a greater percentage of oil than safflower seed at Crookston and Morris, but safflower seed averaged somewhat above soybean seed in southwestern Minnesota. Flaxseed was consistently higher in oil content than seed of the other crops.

In yield of oil per acre, sunflowers were high at Morris but below flax at Crookston and southwestern Minnesota. Soybeans produced much less oil than sunflowers in every trial. Saff-

Table 21. Yield of Seed, Oil Content, and Yield of Oil of Advance Sunflowers, Soybeans, N-852 Safflowers, and Flax Grown on Adjacent Areas in the Same Fields at Crookston, Southwestern Minnesota, and Morris

Crop	Crookston	Southwestern Minnesota	Morris	Grand average
Seed yield (pounds per acre)				
Sunflowers	1,059	1,332	1,252	1,214
Soybeans	924	1,518	878	1,107
Safflowers	508	399	286	398
Flax	974	1,279	873	1,042
Oil content (per cent)				
Sunflowers	29.4	31.2	31.0	30.5
Soybeans	17.9	18.5	18.8	18.4
Safflowers	15.6	19.3	13.5	16.1
Flax	37.7	37.7	37.7	37.7
Oil yield (pounds per acre)				
Sunflowers	311	416	400	376
Soybeans	161	278	164	201
Safflowers	75	89	41	68
Flax	365	483	339	396

flowers produced much less oil than any of the other crops in every trial.

In time of maturity, flax was earliest. Advance sunflowers were generally about as early maturing as Flambeau soybeans. N-852 safflower was earlier than Blackhawk soybeans but later than Flambeau.

Yield and Oil Content of Sunflower Varieties

Advance and Arrowhead were the two best sunflower varieties in Minnesota trials. Advance and both of its parents were developed by the Dominion Experimental Farms in Canada. Advance hybrid seed is produced by planting the variety Sunrise and the inbred S-37-388 in alternate two-row plots and allowing them to open-pollinate. Sunrise should be planted four to seven days before S-37-388 to make certain that it will be shedding pollen when the S-37-388 is receptive. Advance seed is harvested only from S-37-388 plants. Advance seed should be planted for only one generation, as Advance Second Generation yielded considerably less than Advance. Arrowhead originated from a single head which was selected by M. J. Thompson at Duluth from a field of Mammoth Russian, a tall variety that has been used for silage.

Comparative yields and oil content of Advance and Arrowhead are shown in table 22 for 1948-51 at Crookston,

Table 22. Comparative Seed Yields, Oil Content, and Oil Yields of Advance and Arrowhead Sunflowers

Location	Advance	Arrowhead
	Seed yield (pounds per acre)	
Crookston	1,059	1,144
Southwestern Minn.	1,417	1,166
Morris	1,252	1,272
Grand average	1,243	1,195
Oil content (per cent)		
Crookston	29.4	28.0
Southwestern Minn.	32.2	28.1
Morris	31.0	26.8
Grand average	30.9	27.6
Oil yield (pounds per acre)		
Crookston	311	325
Southwestern Minn.	456	328
Morris	400	345
Grand average	389	333

1951 at southwestern Minnesota, and 1948-50 at Morris. The grand average is calculated on a location basis, and no allowance is made for differences in the number of trials at each location. Oil percentages were calculated on a 10 per cent moisture basis.

Advance was clearly superior to Arrowhead in oil content. However, Arrowhead produced slightly more seed than Advance at Morris and Crookston. Advance produced more

pounds of oil per acre than Arrowhead at Morris and southwestern Minnesota and only slightly less oil at Crookston.

Other varieties tested for one or more years at Crookston and Morris and which did not yield as much as Advance or Arrowhead were Advance Second Generation, Sunrise, S-37-388, Girasol Klein, and Saratov.

Other Agronomic Characters

Comparative data on other agronomic characteristics of Advance and Arrowhead are summarized in table 23. Averages for date of flowering include data for 1948-51 from Crookston, 1949-50 from Morris, and 1951 from southwestern Minnesota. Height of plant and weight per bushel averages include data for 1948-51 from Crookston, 1948-50 from Morris, and 1951 from southwestern Minnesota. Averages for diameter of head and weight of 100 seeds include data for 1949-51 from Crookston, 1949-50 from Morris, and 1951 from southwestern Minnesota. Hull percentage averages include 1951 data from Crookston and southwestern Minnesota. Averages are calculated on

Table 23. Comparison of Advance and Arrowhead Sunflowers in Date of Flowering, Height of Plant, Diameter of Head, Weight per Bushel, Percentage of Hull, and Weight of 100 Seeds

	Advance	Arrowhead
Date of flowering	July 31	July 27
Height of plant, inches	62	63
Diameter of head, inches	5.7	5.2
Weight per bushel, pounds	30.1	30.1
Percentage of hull	42.0	42.4
Weight of 100 seeds, grams	6.3	8.3

a location basis, and no allowance is made for differences in the number of trials at each location.

Arrowhead flowered and matured earlier than Advance. That may explain why Arrowhead yielded slightly more oil per acre than Advance at the most northerly location, Crookston, while at Morris and southwestern Minnesota, it yielded considerably less oil per acre than Advance.

Advance was slightly shorter and had a greater head diameter than Arrowhead.

The varieties did not differ in average bushel weight.

Advance seed contained slightly less hull and was considerably smaller than Arrowhead seed.

Safflower Varieties

None of the safflower varieties tested in 1950-51 at Crookston and southwestern Minnesota and at Morris in 1950 performed well enough to be considered an economic crop. The oil content of the seed was only about half that of seed from the same varieties grown in Nebraska.

Safflowers grew very slowly in the spring and weeds were a much more severe problem in the safflowers than in the neighboring flax plots. In 1951, each variety was grown in both 40- or 42-inch cultivated rows like soybeans and in 6-inch noncultivated rows like flax. The 6-inch noncultivated rows, although weedy, tended to yield more seed with a higher oil content than the cultivated rows.

Varieties tested were N-3, N-5, N-6, N-8, and N-852 from the University of Nebraska. N-3 was spineless; the others were spiny like thistles.