Miscellaneous Report 18 June 1953

Varietal Trials of Farm Crops

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Agricultural Experiment Station

CONTENTS

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A LIST of recommended varieties of farm crops for Minnesota is drawn up annually at a meeting of workers at 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 normally be 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 Experiment Station, and on farmers' fields in certain cases.

Reaction to important diseases is tested in specially conducted disease nurseries at the central station in cooperation with the Department of Plant Pathology. Tests for quality are made by the Department 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 Minnesota Extension Folder 22, *Improved Varieties of Farm Crops*. 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 were grown in the 1952 trials for barley, flax, oats, rye, spring wheat, winter wheat, soybeans, corn, alfalfa, bromegrass, red clover, sweetclover, field peas, sunflowers, and safflower. 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 Department of Plant Pathology include E. C. Stakman, J. J. Christensen, M. B. Moore, and M. F. Kernkamp. Cooperators in the Department 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. Pinnell 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 in southwestern Minnesota in cooperation with various counties under the direction of R. G. Robinson and the project leaders at University Farm. In northern Minnesota the trials are conducted in cooperation with the Grand Rapids 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, sunflowers, and safflower are conducted in cooperation with the branch station at Crookston. These crops are also tested in southwestern Minnesota and at Rosemount.

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 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.

For some tests, adjustment of part of the 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, 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 ad-

[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

justed yields. While these adjustments modify average yields of the 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

Table 2. Average Yields of Barley

Name	Years of trial	Rosemount	Waseca	Morris	Crookston	Grand Rapids	Southwestern Minnesota	Average, six locations	Duluth		Northern Minnesota	
									Years of trial	Yields	Years of trial	Yields
		bushels per acre								bushels per acre		bushels per acre
Barbless	1947-52	51.9	45.9	56.1	36.3	49.4	45.8	47.6	1947-52*	47.3	1950-52	38.9
Mars	1947-52	51.9	47.5	56.0	43.2	46.6	41.3	47.8	1947-52	42.4	1950-52	45.9
Kindred	1947-52	51.2	49.3	52.6	41.5	50.5	44.5	48.3	1947-52	43.6	1950-52	48.1
Montcalm	1947-52	50.2	49.2	57.1	42.5	48.5	46.1	48.9	1947-52	47.9	1950-52	54.0
Moore	1947-52	49.3	46.5	56.2	34.4	50.8	43.4	46.8	1947-52	44.4	1950-52	40.2
Feebar	1947-52	53.8	50.0	59.9	43.0	50.4	45.7	50.5	1947-52	50.0	1950-52	49.4
Plains	1947-52	55.6	47.9	57.2	42.9	52.9	45.1	50.3	1947-52	37.4	1950-52	46.4
Vantage	1948-52	55.8	51.6	70.3	43.0	56.6	48.2	54.3	1948-52	43.1	1950-52	48.9
O.A.C. 21	1947-52	.....	.....	.....	40.0	.....	.....	.....	.....	.....	.....	.....
Peatland	1947-52	.....	.....	.....	.....	48.5	.....	.....	1947-52	47.1	1950-52	42.3
Trebi	1947-52	.....	.....	.....	.....	60.3	.....	.....	1947-52	44.9	1950-52	51.5
Tregal	1947-52	.....	.....	.....	.....	56.6	.....	.....	1947-52	45.9	1950-52	50.1
L.S.D. at 5 per cent point		3.6	3.8	3.9	5.2	4.8	3.7	1.7		4.0		7.8

* No yield data at Duluth in 1949.

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 in general gave the lowest yields.

Malting Quality

Kindred, Montcalm, O.A.C. 21, and Barbless are rather widely accepted for malting purposes. Moore has not found ready acceptance in the malting industry because of a rather prevalent dull, gray appearance of its kernels and unfavorable reports on its performance in the brewing process.

The remainder of the varieties are not considered suitable for malting.

Disease Reaction

All of the varieties are susceptible to leaf rust. The varieties classified as resistant to stem rust in the following discussion have shown practical field resistance over a period of years. It is known, however, that they may be attacked by certain races.

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, loose smut, and scab and susceptible to stripe.

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

Moore is resistant to mildew and stem rust but is moderately susceptible to barley stripe and loose smut. It is very susceptible to net blotch.

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, moderately resistant to net blotch, loose smut, and mildew, but 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.

O.A.C. 21 is moderately resistant to net blotch, moderately susceptible to loose smut and spot blotch, and susceptible to stem rust, scab, and mildew.

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

Trebi and Tregal are resistant to a number of races of loose smut, moderately resistant to net blotch, moderately susceptible to spot blotch, and susceptible to stem rust.

Other Agronomic Characters

Comparative data on date of heading, height in inches, standing ability, weight per 1,000 kernels, and weight per bushel are given in table 3. The data for the first eight varieties are averages from six locations: Rosemount, Waseca, Morris, Crookston, Grand Rapids, and southwestern Minnesota. Though O.A.C. 21 was tested only at Crookston, and Peatland, Trebi, and Tregal were tested only at Grand Rapids, the data for these varieties are adjusted to the levels of the data for the first eight varieties.

Plains headed two days earlier than

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	Lodging score*	Weight of 1,000 kernels	Bushel weight
		inches		grams	pounds
Barbless	6–30	33	4	31.2	44.3
Mars	6–25	29	1	28.2	47.5
Kindred	6–25	32	5	31.1	45.9
Montcalm	6–29	34	4	30.3	44.9
Moore	6–29	33	2	30.1	43.7
Feebar	6–26	27	1	35.3	42.2
Plains	6–23	26	2	33.3	46.8
Vantage	6–28	30	2	32.5	44.9
O.A.C. 21	6–28	35	4	29.2	45.4
Peatland	6–30	33	2	27.0	48.0
Trebi	6–26	26	4	39.4	44.5
Tregal	6–27	28	2	32.7	44.8

* 1 = excellent standing ability; 5 = very poor standing ability.

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

In height of plant, O.A.C. 21 and Montcalm were tallest, and Plains, Trebi, and Feebar were shortest.

In standing ability, Mars and Feebar excelled, with Vantage, Plains, Peatland, Tregal, and Moore also exhibiting good straw strength. Kindred lodged very badly, and Barbless, Montcalm, and O.A.C. 21 were poor in standing ability.

For weight of 1,000 kernels Trebi and Feebar were highest and Mars and Peatland lowest. The malting varieties Kindred, Montcalm, and Barbless had kernels of medium size.

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

Flax

J. O. CULBERTSON

Yield Comparisons

Table 4 gives the average yields in bushels per acre for the seven-year period 1946-52 at Rosemount, Waseca, Morris, and Grand Rapids, and in southwestern Minnesota. The yield trial at Crookston was not harvested in 1952, so the data shown are for 1946-51. Yields for varieties grown for less than seven 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 usually favors late maturing flax varieties, and it is probable that the late varieties such as B5128, Minerva, Royal, and Redwood had an advantage over early varieties like Redwing, Sheyenne, and Marine.

Flax diseases did little damage to yields in any of the trials in 1952. Bison, Redwing, and Koto were light to moderately rusted at Rosemount and Waseca and in southwestern Minnesota. Minerva and Royal had from traces to light infection. All other varieties were free from rust.

No single flax variety has been best at all locations or in all seasons. Cer-

Table 4. Average Yields of Flax

Variety	Rosemount		Waseca		Morris		Crookston		Grand Rapids		Williams		Southwestern Minnesota	
	Years of trial	Yield	Years of trial	Yield	Years of trial	Yield	Years of trial	Yield	Years of trial	Yield	Years of trial	Yield	Years of trial	Yield
		bushels per acre		bushels per acre		bushels per acre		bushels per acre		bushels per acre		bushels per acre		bushels per acre
Bison	1946-52	15.6	1946-52	17.2	1946-52	20.8	1946-51	14.2	1946-52	13.2	1950-52	15.5	1946-52	16.8
Redwing	1946-52	17.8	1946-52	18.5	1946-52	20.9	1946-51	11.1	1946-52	15.5	1950-52	19.5	1946-52	17.2
Koto	1946-52	17.5	1946-52	19.8	1946-52	22.6	1946-51	14.3	1946-52	16.0	1950-52	21.6	1946-52	19.6
Minerva	1946-52	16.2	1946-52	18.8	1946-52	22.3	1946-51	12.8	1946-52	14.4	1950-52	21.4	1946-52	19.0
Redwood	1946-52	19.1	1947-52	21.2	1947-52	24.2	1947-51	14.9	1947-52	15.8	1950-52	23.3	1947-52	21.3
B5128	1950-52	17.4	1950-52	21.3	1947-52	22.3	1946-51	14.8	1948-52	14.0	1950-52	21.9	1947-52	21.9
Sheyenne	1948-52	16.4	1948-52	19.7	1948-52	21.7	1948-51	12.6	1949-52	15.5	1950-52	19.3	1948-52	18.0
Marine	1949-52	17.2	1949-52	20.8	1949-52	22.5	1949-51	12.5	1950-52	16.0	1950-52	21.1	1949-52	19.7
Royal	1950-52	15.5	1950-52	20.6	1946-52	23.9	1946-51	15.0	1950-52	15.6	1950-52	21.5	1947-52	20.5
L.S.D. at 5 per cent point		1.3		1.5		1.3		1.8		1.5		3.4		1.2

tain varieties, however, have produced better yields on an average than others. Redwood and B5128 have yielded somewhat better than the other varieties.

Redwood was the highest yielding variety at Rosemount; Redwing, Koto, B5128, and Marine were intermediate in yield. Royal, Minerva, and Sheyenne were lowest in average yield.

At Waseca there was no significant difference in the average yields of B5128, Redwood, Marine, and Royal. Bison was lowest in yield at this station, while the other varieties averaged from 1.5 to 2.8 bushels per acre less than the top variety, B5128.

Redwood and Royal made the best yields in the trials at Morris, with averages significantly above all the other varieties. The poorest varieties were Bison, Redwing, and Sheyenne.

No yields were obtained at Crookston in 1952, and data are shown for the years 1946-51. Royal, Redwood, B5128, Koto, and Bison were highest in average yields. Minerva, Sheyenne, and Marine were intermediate, and Redwing was definitely lowest in yield.

The highest yielding varieties at Grand Rapids were Marine, Koto, Redwood, Royal, Redwing, and Sheyenne. The poorest varieties were Bison and Minerva.

The year 1952 was the third for flax variety trials at Williams, Minnesota, and data for the three years are included in tables 4 and 5. As an average for the three-year period, the highest yielding varieties were Redwood, B5128, Koto, Minerva, and Royal. Bison was much below all others in average yield.

The highest yielding varieties in southwestern Minnesota were B5128, Royal, and Redwood. Bison, Redwing, and Sheyenne were poorest, while the other varieties were intermediate.

Other Agronomic and Quality Characters

Data given in table 5 show the average date ripe, plant height, weight per 1,000 seeds, oil content, and iodine number of the oil. Average seed size, oil content, and iodine number of the oil have not been determined for the 1952 crop, so averages previous to 1952 are reported in the table.

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 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, Redwood, and Royal are considered as mid-

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 of 1,000 seeds	Oil content	Iodine number
		inches	grams	per cent	
Bison	August 10	23	6.1	38.2	175
Redwing	August 5	22	4.5	36.7	186
Koto	August 8	22	5.2	37.5	182
Minerva	August 14	22	5.9	40.4	184
Redwood	August 12	23	5.8	38.4	181
B5128	August 18	23	6.7	37.6	179
Sheyenne	August 6	22	5.2	37.2	181
Marine	August 7	22	5.1	37.7	187
Royal	August 13	23	5.5	38.4	174

late in maturity while Marine, Koto, and Bison are midearly.

There are no important differences in plant height of the varieties in these trials.

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.

The oil content of Bison is considered good. Minerva was the only variety appreciably higher in oil than Bison, although Redwood and Royal were slightly higher. Redwing is definitely deficient in oil content.

Oil from the seed of Redwing, Minerva, and Marine has excellent drying quality—as indicated by the relatively high iodine number. Koto, Redwood, and Sheyenne 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. Since 1951 new races of rust that attack Dakota have been widespread in Minnesota, and Dakota has been fully as susceptible as Bison. Heavily rusted fields of Koto have also been observed. Redwing is moderately susceptible while Minerva and Royal are moderately resistant to rust. Redwood, B5128, Sheyenne, and Marine are immune to races of rust found in Minnesota.

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

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

Varieties Not Extensively Tested

Rocket is a variety of flax developed in Canada and recently introduced in the United States. In preliminary trials in Minnesota it has yielded only 85 per cent as much as Redwood. It is resistant to rust but moderately susceptible to wilt and pasmo. It has brown seeds with good oil content of good drying quality. The flowers are blue.

Oats

W. M. MYERS and K. S. KOO

Yield Comparisons

Average yields of the varieties for six stations and southwestern Minnesota are reported in table 6. Seven varieties, Gopher, Vicland, Bonda, Mindo, Clinton, Andrew, and Ajax, have been tested six years in southwestern Minnesota and eight years at each of the six stations.

Four varieties, Clintafe, Clinton x Marion (C.I. 5440), Clinton x Marion (C.I. 5647), and Sac x Hajira-Joanette (C.I. 5927), were included in the tests in 1952 for the first time. Yields of varieties grown less than eight years have been adjusted to make all variety comparisons valid. Yields of James, a hull-less variety, have been multiplied by the factor 10/7 to make them comparable with yields of hulled varieties. Seed for the trials was treated with New Improved Ceresan.

Two averages are given. The first is

Table 6. Average Yields of Oats

Variety	Years of trial	University Farm and Rosemount	Waseca	Morris	Crookston	Grand Rapids	Duluth	Years of trial	Southwestern Minnesota	Grand average‡ I	Grand average‡ II
		bushels per acre								bushels per acre	
Gopher	1945-52	73.7	73.1	97.2	64.4	75.0	67.5	1947-52	70.6	74.5	75.8
Vicland	1945-52	73.5	68.9	87.4	61.6	70.2	63.4	1947-52	64.5	69.9	71.2
Bonda	1945-52	74.9	72.4	78.5	62.4	64.9	65.9	1947-52	65.8	69.3	70.8
Mindo	1945-52	74.0	74.9	82.5	64.5	67.4	69.6	1947-52	59.2	70.3	71.0
Clinton	1945-52	76.9	77.8	82.2	64.0	71.5	71.1	1947-52	68.0	73.1	73.8
Andrew	1945-52	78.7	73.0	88.1	65.1	71.9	70.2	1947-52	65.2	73.2	74.0
Ajax	1945-52	79.1	79.2	94.4	73.1	79.2	76.6	1947-52	73.4	79.3	79.8
Shelby	1948-52	76.4	76.6	92.9	68.2	74.2	75.3	1948-52	72.7	76.6	77.4
James*	1949-52	77.7	73.4	86.1	64.6	65.8	65.0	1949-52	74.4	72.4	75.2
Branch	1950-52	82.9	70.4	100.7	67.8	83.8	81.1	1950-52	72.4	79.9	78.8
Mo. 0-205	1951-52	83.9	78.9	85.5	53.8	71.9	69.0	1951-52	76.4	74.2	75.7
Clintafe	1952	86.1	83.8	91.1	56.8	72.0	79.8	1952	72.0	77.4	78.0
Clinton x Marion (C.I. 5440)	1952	76.7	79.8	87.7	55.8	.....	.....	1952	68.2	.....	73.6
Clinton x Marion (C.I. 5647)	1952	73.0	83.2	88.0	58.1	.....	.....	1952	63.4	.....	73.1
Sac x Hajira-Joanette (C.I. 5927)	1952	72.0	74.0	76.0	48.1	.....	.....	1952	52.2	.....	64.5
L.S.D. at 5 per cent point†		4.2	4.6	4.9	5.6	5.5	4.9		5.1	1.9	2.2

* Yield adjusted to allow for absence of hull.

† Applies only to comparison between varieties grown for the entire period.

‡ Grand average I is calculated on the basis of the data from all stations. Grand average II is calculated on the basis of the data from five locations—University Farm and Rosemount, Waseca, Morris, Crookston, and southwestern Minnesota. Northern Minnesota is not included in this table because of poor data in 1952.

for data from all locations and the second for data from five locations, excluding that from Grand Rapids and Duluth. The relative yields of the different varieties are generally comparable in the two averages.

The highest yielding varieties in the tests were Ajax, Branch, Clintafe, and Shelby. The difference between Ajax and Shelby was significant but the first three varieties were not significantly different from each other.

Mo. 0-205 and the old standard variety, Gopher, were only slightly lower in yield than Shelby, followed closely in descending order by James, Andrew, Clinton, and the two new varieties—Clinton x Marion (C.I. 5440) and C.I. 5647. Bonda, Mindo, and Vicland were significantly inferior in yield to Clinton, Andrew, and Gopher. Sac x Hajira-Joanette (C.I. 5927) was distinctly inferior to all of the other varieties in the test.

Relative yields of the varieties differed at the various locations. At University Farm and Rosemount, Clintafe was the highest yielding variety and considerably better than all others except second-place Mo. 0-205 and third-place Branch.

These three varieties were followed in descending order by Ajax, Andrew, James, Clinton, Clinton x Marion (C.I. 5440), and Shelby. All varieties except Clinton x Marion (C.I. 5647) and Sac x Hajira-Joanette (C.I. 5927) yielded more than Gopher and Vicland, but Mindo, Bonda, Shelby, Clinton x Marion (C.I. 5440), Clinton, and James were not significantly better.

At Waseca, Clintafe was highest in yield with Clinton x Marion (C.I. 5647) a close second. These were followed in order by Clinton x Marion (C.I. 5440), Ajax, Mo. 0-205, Clinton, and Shelby. All varieties except Vicland, Branch, Andrew, and Bonda were higher in yield than Gopher, but Shelby, Sac x Hajira-Joanette (C.I. 5927), and James were not significantly better.

Branch was the only variety in the test at Morris with higher average yield than Gopher. Ajax, Shelby, and Clintafe followed those varieties in descending order. Andrew, Clinton x Marion (C.I. 5647), Clinton x Marion (C.I. 5440), James, and Mo. 0-205 were intermediate in average yield, while Bonda, Mindo, and Clinton were relatively low.

In the southwestern Minnesota tests, Mo. 0-205 was highest in yield, followed in descending order by James, Ajax, Shelby, Branch, and Clintafe. All other varieties yielded less than Gopher.

The late maturing varieties Ajax, Shelby, and Branch were leading varieties in yield at Crookston. Andrew, James, and Mindo yielded as well or better than Gopher, while Clinton and Bonda yielded only slightly less.

At Grand Rapids, only Branch and Ajax were superior to Gopher in average yield. Following these three varieties in descending order of yield were Shelby, Clintafe, Mo. 0-205, Andrew, and Clinton.

Branch and Clintafe were the highest yielding varieties at Duluth, followed by Ajax and Shelby. Clinton, Andrew, Mindo, and Mo. 0-205 also exceeded Gopher in yield.

Other Agronomic Characters

Comparative data on agronomic characters other than yield are summarized in table 7. These data are for five locations, namely University Farm-Rosemount, Waseca, southwestern Minnesota, Morris, and Crookston. All data are for the years of test indicated for the respective locations in table 6 except that there were no data on lodging for Crookston for 1951 and the date of heading data from southwestern Minnesota were based only on 1950-52 data.

The earliest varieties in date of heading were Mindo, Sac x Hajira-Joanette, and Andrew. Bonda, Clinton, James, and Mo. 0-205 were three days later

Table 7. Average Date of Heading, Plant Height, Weight per Bushel, Hull Percentage, Weight of 200 Kernels, and Standing Ability for Oats at Five Locations

Variety	Date of heading	Plant height	Weight	Hull	Weight of 200 kernels	Standing ability*
		inches	lbs. per bushel	per cent	grams	
Gopher	June 29	35	33.8	30.4	4.7	2
Vicland	June 28	32	33.6	32.3	4.8	2
Bonda	June 26	37	36.8	32.1	6.0	1
Mindo	June 23	32	34.5	30.5	5.0	1
Clinton	June 26	35	35.5	28.6	5.0	1
Andrew	June 24	35	34.7	27.4	5.5	1
Ajax	June 30	40	34.0	32.0	5.0	3
Shelby	June 30	38	36.4	29.8	5.4	2
James	June 26	36	41.8	0	3.6	1
Branch	July 2	39	34.7	33.7	5.0	2
Mo. 0-205	June 26	37	35.2	26.9	4.5	1
Clintafe	June 28	37	34.2	29.0	4.2	1
Clinton x Marion (C.I. 5440)	June 27	37	35.5	30.3	5.5	1
Clinton x Marion (C.I. 5647)	June 27	36	35.5	30.0	5.3	1
Sac x Hajira-Joanette (C.I. 5927)	June 23	34	34.6	29.3	5.3	2

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

than Mindo. Clinton x Marion (C.I. 5440) and Clinton x Marion (C.I. 5647) were four days later than Mindo. Clintafe was five days later than Mindo; it headed at the same time as Vicland; and it was one day earlier than Gopher. Ajax and Shelby were seven days and Branch nine days later than Mindo.

Mindo and Vicland are the shortest varieties while Ajax and Branch are the tallest. Shelby, Bonda, Mo. 0-205, Clintafe, and Clinton x Marion (C.I. 5440) are also relatively tall varieties.

In weight per bushel, James, the hull-less variety, was outstanding. Among the hulled varieties, Bonda and Shelby were superior. Gopher, Vicland, and Ajax were the lowest in weight per bushel. Other varieties were intermediate.

Mo. 0-205 and Andrew were the varieties lowest in per cent of hull, while Branch was highest in this character. Vicland, Bonda, and Ajax were also relatively high in hull percentage.

In weight per 200 kernels, Bonda was highest, followed by Andrew, Clinton x Marion (C.I. 5440), and Shelby. Among the hulled varieties, Clintafe and Mo. 0-205 had the lowest weight of kernels.

Standing ability has been rated in comparison with Gopher. Varieties superior to Gopher are rated as 1, about like Gopher 2, and inferior to Gopher 3. Ajax was rated as 3 or inferior to Gopher. Vicland, Shelby, Branch, and Sac x Hajira-Joanette (C.I. 5927) were rated 2. Other varieties were given the 1 rating.

Disease Reaction

All varieties in the tests are susceptible to stem rust except Sac x Hajira-Joanette, which is resistant at moderate temperatures. Vicland, Andrew, Ajax, Branch, Mo. 0-205, Clinton x Marion (C.I. 5440), and C.I. 5647 are resistant to race 7 but susceptible to race 8. Bonda, Mindo, Clinton, Shelby, James, and Clintafe are resistant to race 8 but susceptible to race 7. Gopher is susceptible to both races 7 and 8. Races 7 and 8 have been prevalent in Minnesota.

All varieties except Clintafe are susceptible to some races of crown rust. Clintafe has resistance to all races of crown rust known in North America. Vicland, Branch, and Ajax have moderate resistance to race 45, which has

been prevalent in recent years. Mo. 0-205 has had moderate resistance in the field to prevalent races.

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 of the recommended varieties except Ajax continued to prove resistant to prevalent races of smut.

Varieties Not Extensively Tested

In Miscellaneous Report 8 for varietal trials in 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 has also been made 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 proved particularly desirable.

Larain, a selection 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 1950-52 it was susceptible to crown rust. It was somewhat later in maturity than most of the other varieties grown and in 1950-52 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.

Cherokee, Nemaha, and Colo were in the trials in 1950 and 1951. They were inferior in yield to most of the recommended varieties and did not prove to be resistant to race 45 of crown rust as was hoped. Therefore, they were not included in the 1952 tests.

Rye

R. G. ROBINSON, K. S. KOO, W. M. MYERS

Yield Comparisons

Average yields of rye at eight locations are reported in table 8. The grand average is obtained by averaging the adjusted averages at the eight locations.

Of the two recommended varieties, Imperial yielded somewhat more than Emerald at University Farm, Waseca, Morris, and Duluth. Emerald has been the highest yielding variety in southwestern Minnesota and in the sandy soil trials in Anoka, Sherburne, Stearns, and Wright Counties. At Crookston and Grand Rapids, the recommended varieties did not differ appreciably in yield.

Pierre compared favorably with the recommended varieties at all locations except in southwestern Minnesota and sandy soil trial counties. At these places it consistently yielded less. Except at University Farm, Dakold did not yield as much as the recommended varieties. Locally grown ryes yielded well at Morris and Duluth but were definitely inferior to Emerald or Imperial at Crookston, in southwestern Minnesota, and on sandy soil. Balbo was a low yielder, and Prolific Spring

Table 8. Average Adjusted Yields of Rye

Variety	University Farm		Waseca		Morris		Crookston		Grand Rapids		Duluth		Southwestern Minnesota		Sandy soil		Grand average yields
	Number of trials	Yields	Number of trials	Yields	Number of trials	Yields	Number of trials	Yields	Number of trials	Yields	Number of trials	Yields	Number of trials	Yields	Number of trials	Yields	
		bu. per acre		bu. per acre		bu. per acre		bu. per acre		bu. per acre		bu. per acre		bu. per acre		bushels per acre	
Emerald	14	36.9	12	38.6	15	27.6	6	27.9	17	40.3	12	20.3	4	41.6	23	20.7	31.7
Imperial	14	39.2	12	39.7	15	28.7	6	28.3	17	40.9	12	21.4	4	38.5	23	19.7	32.1
Pierre	3	38.2	.....	.....	4	29.9	4	26.8	4	41.2	2	22.3	4	35.2	16	19.0	31.4
Dakold	13	37.1	12	36.1	14	26.5	5	26.2	16	35.8	11	17.0	3	36.7	22	18.1	29.2
Local ryes	.....	.....	.....	.....	3	28.9	4	24.9	.....	.....	2	22.8	3	33.0	20	18.4	30.0
Balbo	2	34.6	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	25.3	5	17.9	24.9
Prolific Spring	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	9.9	5	6.0	9.8
L.S.D. at 5 per cent point		2.1		2.2		1.4		3.3		2.3		2.2		3.8		0.9	0.9

yielded much less than the fall sown varieties.

Other Agronomic Characters

Winterhardiness is of major importance for fall sown varieties, and all of these varieties except Balbo are generally sufficiently hardy. In trials where winter injury has occurred, Emerald has shown more resistance than Imperial. South Dakota[2] trials indicate that Pierre is more winter hardy than Emerald, but in Minnesota trials this differential winter injury has not been observed.

Balbo and Pierre matured before the other varieties. Imperial was slightly later than Emerald. Prolific Spring matured two weeks later than the winter rye varieties.

Imperial was slightly taller than the other varieties, but height differences were not important.

In recent years lodging has become a problem—even on the sandy soils—because of abnormal rainfall and the widespread practice on sandy soil of topdressing with nitrogen fertilizer in the spring. None of the rye varieties, except possibly Balbo, has stood up well under these conditions. Emerald has lodged more than Pierre or Imperial.

In weight per bushel Pierre averaged 54 pounds to 53 for Emerald or Imperial.

For pasture Balbo has been reported to be an outstanding variety. In the 1951 trials on sandy soil, at Crookston, and in southwestern Minnesota, Balbo made more growth in the fall than Emerald but produced less forage in May.

Varieties in the 1951 and 1952 trials on sandy soil did not differ in their response to April application of nitrogen fertilizer; all varieties yielded more when fertilized.

Varieties Not Extensively Tested

Many varieties have been tested in rod-row trials at University Farm and on sandy soil. Storm, Bessarabian, and Horton yielded less than Emerald; White Soviet and Russian yielded about the same as Emerald, while Antelope yielded more. Several promising varieties from these rod-row trials were sown in more extensive trials this past fall.

Spring Wheat

E. R. AUSEMUS, D. W. SUNDERMAN, K. J. HSU

Yield Comparisons

Comparative yield data are given in table 9 for the varieties grown at the six experiment stations during 1943-52 and in southwestern Minnesota during 1946-52. Average yields for varieties grown at Williams, Minnesota, during 1950-52 are also included but they are not comparable with the yield data from other locations. Seed was treated with New Improved Ceresan.

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

Rushmore, tested for four years, yielded slightly higher than Lee at Waseca and Duluth and somewhat

[2] *Progress Report of Research in Crops and Soils.* S. D. Agr. Expt. Sta. Cir. 86. April 1951.

Table 9. Average Yields of Bread Wheats and Durums

Variety	Years of trial	Rose-mount	Waseca	Morris	Crookston	Years of trial	South-western Minnesota	Average, five locations	Years of trial	Grand Rapids	Duluth	Years of trial	Williams
Bread wheats			bushels per acre				bushels per acre			bushels per acre			bushels per acre
Thatcher	1943-52	24.3	19.0	31.0	24.5	1947-52	24.3	24.6	.....	.....	.....	.....	.....
Rival	1943-52	26.5	23.0	33.2	26.4	1946-52	25.4	26.9	1943-52	23.8	22.1	1950-52	21.7
Mida	1943-52	27.0	21.6	32.3	27.9	1946-52	26.2	27.0	1943-52	24.4	20.1	1950-52	24.5
Henry	1943-52	31.1	24.6	36.2	30.6	1946-52	30.2	30.5	1944-52	26.3	22.4	1950-52	30.6
Lee	1946-52	30.8	22.0	36.0	29.7	1947-52	28.2	29.3	1946-52	27.2	20.6	1950-52	28.4
Redman	1946-50	29.6	.....	34.4	26.2	.....	.....	.....	1948-52	26.7	21.6	1950-52	28.6
Rushmore	1949-52	29.5	22.8	35.2	29.0	1949-52	25.4	28.4	1950-52	27.3	23.4	1950-52	25.5
Durums													
Mindum	1943-52	28.3	.....	34.2	29.1	.....	.....	30.5*	.....	.....	.....	.....	.....
Carleton	1943-52	24.4	.....	31.0	28.0	.....	.....	27.8*	.....	.....	.....	.....	.....
Stewart	1943-52	26.0	.....	34.7	29.5	.....	.....	30.1*	.....	.....	.....	.....	.....
Nugget	1950-52	25.6	.....	29.6	26.5	.....	.....	27.2*	.....	.....	.....	.....	.....
L.S.D. at 5 per cent point	.....	1.4	1.3	1.4	2.1	.....	1.5	.....	.....	2.0	1.9	.....	3.7

* Average for Rosemount, Morris, and Crookston.

higher than Mida and Rival at the other stations. In southwestern Minnesota it yielded less than the other recommended varieties.

Redman, tested at only three locations, was the highest yielding variety at Williams and also gave good yields at Duluth and Grand Rapids. Henry was the top yielder at five stations, with an average of 1.2 bushels more than Lee, 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 10. Averages used in these comparisons include data from four stations, Rosemount, Waseca, Morris, and Crookston, for the various periods the varieties were grown during 1943-52. For date of heading Rushmore was the earliest, with Lee one day later, Thatcher, Mida, and Redman three days later, and Rival and Henry the latest—four days later. Nugget headed five-six days earlier than the other durum varieties.

The shortest strawed bread wheat was Lee. Thatcher, Rushmore, and Redman were slightly taller. Rival, Mida, and Henry, the tallest bread wheats, were five inches taller than Lee. Nugget was seven-eight inches shorter than the other three durums. Mida had the highest weight per bushel in bread wheats; Stewart and Mindum had the highest weight per bushel in durums.

Quality

All of the recommended varieties and Thatcher 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, were 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.

Mida and Lee are moderately susceptible to loose smut. Mida, Rival, Lee,

Table 10. Averages for Spring Wheat Varieties for Date of Heading, Plant Height, and Weight per Bushel

Variety	Years of trial	Date of heading	Plant height	Bushel weight
			inches	pounds
Bread wheats				
Thatcher	1943-52	June 29	35	57.2
Rival	1943-52	June 30	38	57.8
Mida	1943-52	June 29	38	59.0
Henry	1943-52	June 30	38	57.5
Lee	1946-52	June 27	33	58.6
Redman*	1946-50	June 29	36	56.7
Rushmore	1949-52	June 26	35	58.9
Durums†				
Mindum	1943-52	July 3	45	59.6
Carleton	1943-52	July 3	46	58.6
Stewart	1943-52	July 4	46	59.8
Nugget	1950-52	June 28	38	56.8

* 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.

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.

Varieties Not Extensively Tested

A total of 15 new hybrid bread wheat varieties have been tested at one or more of the stations for one to three years. Most of these have been resistant to stem rust with the exception of race 15B. A few of them have shown resistance to a number of races of stem rust including 15B under field conditions.

Five of the new bread wheats were Frontana x Thatcher selections, four had Henry as one of their parents, and three were Timstein or Surpresa derivatives. Most of these new varieties were either resistant or moderately resistant to leaf rust.

Winter Wheat

E. R. AUSEMUS, D. W. SUNDERMAN, K. J. HSU

Yield Comparisons

Table 11 gives the comparative average yield data obtained at University Farm, Waseca, Grand Rapids, and southwestern Minnesota for the varieties grown in various periods during 1943-52. Seed for the trials was treated with New Improved Ceresan.

Average yields at Waseca were somewhat lower than those 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 University Farm, Waseca, and Grand Rapids are given in table 12. Iohardi was the earliest in heading, followed in order by Minter, Minturki, and Blackhawk, with one day apart between each variety.

Table 11. Average Yields of Winter Wheat*

Variety	Years of trial	University Farm	Waseca	Grand Rapids	Average, three locations	Years of trial	Southwestern Minnesota
			bushels per acre				bushels per acre
Minturki	1943-52	30.3	24.1	40.0	31.5	1950-52	26.6
Minter	1943-52	32.3	25.1	41.0	32.8	1950-52	29.6
Blackhawk	1943-52	31.5	23.7	35.9	30.4	1950-52	25.7
Iohardi	1949-52	29.7	23.3	36.3	29.8	1950-52	26.3

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

Table 12. Average Date of Heading, Plant Height, and Weight per Bushel for Winter Wheat*

Variety	Years of trial	Date of heading	Plant height	Winter injury	Bushel weight
			inches	per cent	pounds
Minturki	1943-52	June 20	39	38	58.7
Minter	1943-52	June 19	37	37	59.7
Blackhawk	1945-52	June 21	39	41	59.0
Iohardi	1949-52	June 18	38	45	60.5

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

Minter was the shortest variety, with Iohardi one inch taller and Minturki and Blackhawk two inches taller. Minter and Minturki had the least winter injury, Blackhawk had somewhat more injury, and Iohardi had the highest. Iohardi excelled in bushel weight, although the test weights of all varieties were good.

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 the varieties are susceptible.

Soybeans

J. W. LAMBERT

Yield Comparisons

Average yields for three locations in southern Minnesota are given in table 13.

Habaro, Blackhawk, Capital, and Korean gave almost identical yields as an average of the three locations. Hokien yielded almost the same as Capital in the two locations where it was tested, lending further support for the belief that they are one and the same. Monroe was lowest in yield at Blue Earth and in southwestern Minnesota and was only slightly better than Hawkeye at Waseca. Hawkeye gave the highest average yield in southwestern Minnesota and a medium yield at Blue Earth.

Average yields at Rosemount and Morris are given in table 14. At these

Table 13. Average Soybean Yields at Waseca and Blue Earth, and in Southwestern Minnesota

Variety	Waseca		Blue Earth		Southwestern Minnesota		Average, three locations
	Years tested	Yields	Years tested	Yields	Years tested	Yields	
		bushels per acre		bushels per acre		bushels per acre	
Ottawa Mandarin	1947-52	30.1	1948-51	35.6	1948-52	20.0	28.6
Habaro	1947-52	30.0	1948-51	38.2	1948-52	22.3	30.2
Monroe	1947-52	28.0	1948-51	31.6	1948-52	20.1	26.6
Blackhawk	1947-52	30.1	1948-51	35.8	1948-52	24.6	30.2
Hawkeye	1948-52	27.0	1948-51	34.7	1948-52	25.2	29.0
Capital	1949-52	32.4	1949-51	35.6	1949-51	23.4	30.5
Korean	1949-52	29.1	1949-51	37.5	1949-52	24.7	30.4
Hokien	1950-52	32.5	.....	.....	1950-52	23.1	.....

Table 14. Average Soybean Yields at Rosemount and Morris

Variety	Rosemount		Morris		Average yields
	Years tested	Yields	Years tested	Yields	
	bushels per acre			bushels per acre	
Flambeau	1948-52	25.7	1948-52	28.4	27.0
Ottawa Mandarin	1948-52	28.5	1948-52	27.0	27.8
Blackhawk	1948-52	29.1	1948-52	24.1	26.6
Monroe	1948-52	25.6	1948-52	22.3	24.0
Capital	1948-52	30.9	1948-52	27.8	29.4
Hokien	1950-52	31.1	1950-52	29.0	30.0
Habaro	1948-52	23.4	1948-52	25.5	24.4

Table 15. Average Yields of Soybean Seed and Hay and Averages for Plant Height, Seed Size, and Oil Content at Crookston

Variety	Years tested	Seed	Hay	Plant height	Oil content
		bushels per acre	tons per acre	inches	per cent
Flambeau	1948-52	19.3	2.03	25	19.9
Ottawa Mandarin	1948-52	19.5	2.11	26	20.7
Capital	1948, 49, 51, 52	18.2	2.10	28	20.6
Pridesoy 57	1949-52	20.3	2.05	25	20.0

two locations Capital and Hokien yielded very well. Ottawa Mandarin and Flambeau also gave good yields. The later varieties, Habaro, Monroe, and Blackhawk, gave only fair yields.

Average yields of seed and hay at Crookston are given in table 15. Pridesoy 57 led in seed yield, the other three varieties yielding only slightly less. Ottawa Mandarin and Capital were highest and were about 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 1950-52. Averages for oil content do not include data from the 1951 or 1952 trials. Averages for plant height, lodging score, and seed size are for the same periods as for yield.

In date of maturity Ottawa Mandarin was earliest; Capital and Hokien were only 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, and Blackhawk were medium in maturity. They 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 is somewhat late for Minnesota conditions; if it is used it should be seeded as early as possible.

The tallest varieties were Monroe and Hawkeye. Shortest among the varieties was Ottawa Mandarin. It is perhaps too short in many instances and tends to bear its 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.

Table 16. Average Date of Maturity, Plant Height, Lodging Score, Seed Size, and Oil Content for Soybeans at Waseca and Blue Earth, and in Southwestern Minnesota

Variety	Date of maturity	Plant height	Lodging score*	Seed size per 100 seeds	Oil content
		inches		grams	per cent
Ottawa Mandarin	September 13	27	1.3	17.9	20.5
Habaro	September 22	30	2.5	17.7	19.3
Monroe	September 21	38	2.3	14.6	20.2
Blackhawk	September 24	36	2.0	15.6	20.7
Hawkeye	October 3	38	1.9	16.2	20.4
Capital	September 15	30	2.5	12.3	21.1
Korean	September 28	32	2.4	23.2	19.8
Hokien	September 14	30	2.4	12.1	21.2

* 1 = erect; 5 = completely lodged.

In standing ability Ottawa Mandarin was outstanding. Blackhawk and Hawkeye also stood relatively well. None of the varieties lodged excessively.

In seed size Korean was very large; Capital and Hokien 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. Habaro and Korean 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 10 days earlier than Capital. Blackhawk and Habaro matured rather late for the Morris area; these varieties should be planted early when used that far north in the state. Monroe matured a few days earlier than Blackhawk.

In plant height Monroe averaged tallest. Slightly shorter was Blackhawk. Flambeau and Ottawa Mandarin were relatively short.

In standing ability none of the varieties appeared particularly troublesome, and Ottawa Mandarin was outstanding in its 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 was lowest.

For Crookston, data on plant height and oil content are included in table 15. 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.

Table 17. Average Date of Maturity, Plant Height, Lodging Score, Seed Size, and Oil Content for Soybeans at Rosemount and Morris

Variety	Date of maturity	Plant height	Lodging score*	Seed size per 100 seeds	Oil content
		inches		grams	per cent
Flambeau	September 7	27	2.5	14.8	19.4
Ottawa Mandarin	September 15	27	1.4	16.6	19.8
Blackhawk	September 27	34	2.1	14.6	20.0
Monroe	September 23	37	2.4	13.4	19.2
Capital	September 17	31	2.4	11.5	20.2
Hokien	September 16	29	2.0	11.6	20.2
Habaro	September 25	30	2.3	16.0	18.2

* 1 = erect; 5 = completely lodged.

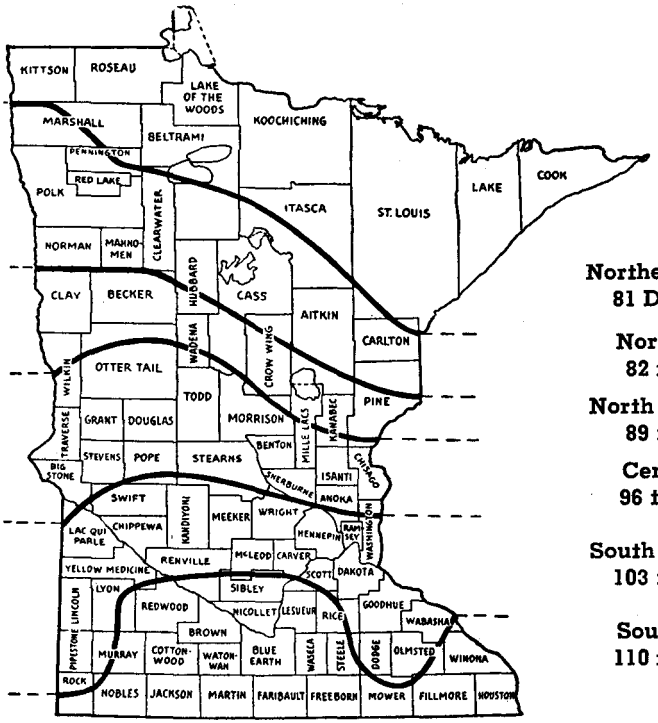
Corn

E. H. RINKE and E. L. PINNELL

About 97 per cent of the corn acreage of Minnesota is planted to hybrid varieties. Over 650 hybrids are registered for sale in Minnesota. These include open-pedigree hybrids developed by state experiment stations and closed-pedigree hybrids developed by commercial seed companies. Only open-pedigree hybrids that have been adequately tested are included on the recommended list. It has not been possible to make extensive trials of closed-pedigree hybrids.

At the present time the recommended list of hybrids includes 18 Minhybrids, four Wisconsin hybrids, one North Da-

Corn Maturity Zones in Minnesota



Northern Minnesota
81 Days or Less

Northern Zone
82 to 88 Days

North Central Zone
89 to 95 Days

Central Zone
96 to 102 Days

South Central Zone
103 to 109 Days

Southern Zone
110 to 116 Days

Zones indicate the approximate number of days growing season that may be expected from emergence after planting to maturity, the stage of being well dented before a killing frost.

kota (Nodak) hybrid, one Manitoba hybrid, and one A.E.S. (Agricultural Experiment Station) hybrid. The latter, A.E.S. 610, was developed through the cooperative efforts of breeders in several states in the North Central Region.

The corn-growing area of Minnesota has been divided into maturity zones (see map). Relative days to maturity for corn refers to the approximate number of days of growing season that may be expected, on the average, from emergence of the seedlings to the stage when the moisture in the ears on standing plants is about 40 per cent. Table 18 gives the maturity ratings for the recommended hybrids.

Tables 19 through 23 present long-time data on the performance of recommended hybrids and a few widely grown open-pedigree hybrids. Several tables are used in some zones because of variation in the number of years in which comparable data are available. Accurate comparisons of hybrids can be made only when the data on the hybrids are presented in the same table.

In some tables data on hybrids recommended for an adjacent zone are

presented for the information of those who prefer to grow hybrids somewhat earlier or later than those recommended for the zone.

Information is given for several characters in addition to ear moisture and yield. The data are largely self-explanatory except for those on corn borer resistance and ear appearance. Corn borer resistance ratings are taken on hand infested plots in classes of 1 to 5, where class 1 indicates resistance (little feeding) and class 5 denotes susceptibility to corn borers (much plant damage).

The ear appearance rating is taken in classes of 1 to 5 on piles of husked ears from each plot. Class 1 ears have a "show type" appearance while those in class 5 have poor eye appeal.

Table 18. Pedigrees and Maturity Ratings of Hybrids Recommended for Minnesota

Hybrid number	Pedigree	Recommendation	Maturity rating in days
Minhybrid 408	(Oh51A x Os420) (A73 x A375)	Southern Zone	113–117
A.E.S. 610	(A73 x M14) (Oh43 x Oh51A)	Southern Zone	112–116*
Minhybrid 412	(Oh5 x Oh51A) (A73 x W22)	Southern Zone	112–116*
Minhybrid 411	(Oh5 x A73) (Oh43 x Oh51A)	Southern Zone	112–116*
Minhybrid 406	(A25 x A334) (A73 x A375)	Southern Zone	111–115
Minhybrid 405	(A311 x A334) (A374 x A375)	Southern Zone	110–114
Minhybrid 404	(A322 x A334) (A374 x A375)	Southern Zone	108–112
Minhybrid 409	(A73 x A334) (Oh5 x Oh51A)	Southern Zone	108–112*
Minhybrid 508	(Oh51A x A334) (A73 x A223)	South Central Zone	107–111*
Minhybrid 504	(A73 x A334) (Oh51A x A395)	South Central Zone	107–111
Minhybrid 503	(A73 x A334) (Oh51A x A375)	South Central Zone	107–111
Minhybrid 505	(A334 x Ill4226) (Oh51A x A375)	South Central Zone	105–109
Minhybrid 507	(W10 x A334) (B9 x Oh51A)	South Central Zone	105–109*
Minhybrid 500	(A71 x A73) (A7 x A12)	South Central Zone	104–108
Minhybrid 608	(A334 x A340) (A357 x A392)	Central Zone	99–103
Minhybrid 602	(A334 x A344) (A357 x A392)	Central Zone	98–102
Minhybrid 607	(A334 x A344) (A357 x A385)	Central Zone	97–101
Minhybrid 706 (white)	(A166 x A188) (A34 x A171)	North Central Zone	90– 94
Wisconsin 275	(W9 x M13) (W49 x WH)	North Central Zone	90– 94
Wisconsin 279	(W9 x M13) (WD x C49)	Northern Zone	86– 90
Minhybrid 802	(A96 x Mt42) (WD x A165)	Northern Zone	84– 88
Nodak 301	(A90 x A111) (ND203 x ND230)	Northern Zone	84– 88
Wisconsin 240	(WD x W9) (W85 x W15)	Northern Zone and Northern Minnesota	82– 86
Wisconsin 255	(WD x W9) (WJ x WH)	Northern Zone and Northern Minnesota	82– 86
Morden 77	(V3 x A116) (WD x ND255)	Northern Minnesota	78– 82

* Tentative ratings on new hybrids.

SOUTHERN ZONE

Table 19. Average Corn Hybrid Performance in 12 Trials, 1948-52

	Plants smutted	Plant height	Ear height	Shank	Roots lodged	Stalks lodged	Ear length	Kernel rows	Ear appear-ance*	Corn borer resistance*	Ear moisture	Yield
	per cent	inches	inches	inches	per cent		inches	number			per cent	bu. per acre
Min. 411	5	92	35	6	10	2	9.4	17	1.9	2.0	28.0	79.0
Min. 412	3	95	39	7	12	2	9.5	18	1.8	1.9	28.9	80.0
A.E.S. 610	4	91	34	6	9	4	9.4	18	2.3	2.5	28.4	77.2
Min. 408	4	92	37	6	8	4	9.4	18	2.1	.....	30.1	75.5
Min. 406	4	90	34	6	8	5	8.8	18	2.5	2.9	27.9†	73.3†

* Class 1 rating is good; 5 is poor.
† Adjusted for missing data in one trial.

Table 20. Average Corn Hybrid Performance in 14 Trials, 1950-52

	Plants smutted	Plant height	Ear height	Shank	Roots lodged	Stalks lodged	Ear length	Kernel rows	Ear appear-ance*	Corn borer resistance*	Ear moisture	Yield
	per cent	inches	inches	inches	per cent		inches	number			per cent	bu. per acre
Min. 404	3	91	38	6	0	5	8.4	18	2.7	2.4†	29.0	65.5
Min. 406	3	92	36	6	0	3	8.4	18	2.5	2.8	29.4	69.1
Min. 408	3	94	38	6	0	3	8.8	18	2.3	3.0	32.2	72.7
Min. 409	4	93	38	6	0	5	8.6	18	2.2	2.9	28.1	71.8
A.E.S. 610	2	92	35	6	0	3	8.8	18	2.3	2.6	30.4	72.6
Min. 503	3	89	37	7	0	4	8.0	18	2.6	2.4	28.2	67.5
Min. 504	4	90	39	7	0	6	8.1	17	2.7	2.7	27.2	69.2
Min. 505	3	94	40	6	0	6	8.6	17	2.6	3.0	28.5	66.4
Min. 507	2	96	40	7	0	6	8.5	17	2.7	2.8	25.8	70.8
Min. 508	6	90	36	6	0	3	8.4	17	2.5	2.8	27.2	69.1
Murdock	8	89	39	6	2	11	7.8	17	2.9	2.9	27.3	58.5

* Class 1 rating is good; 5 is poor.
† Corn borer ratings in this table are for one year only.

Table 21. Average Corn Hybrid Performance in 34 Trials, 1938-52 (11 Years Only)

	Plants smutted	Plant height	Ear height	Shank	Roots lodged	Stalks lodged	Ear length	Kernel rows	Ear appearance*	Ear moisture	Yield
	per cent	inches	inches	inches	per cent		inches	number		per cent	bu. per acre
Min. 404	3	92	40	5	1	3	7.6	18	2.7	26.5	69.0
Min. 405	2	95	41	5	2	3	7.7	18	2.8	26.9	71.0
Murdock	9	93	40	6	17	10	7.5	16	4.6	25.7	53.6

* Class 1 rating is good; 5 is poor.

SOUTH CENTRAL ZONE

Table 22. Average Corn Hybrid Performance in 10 Trials, 1949-52

	Plants smutted	Plant height	Ear height	Shank	Roots lodged	Stalks lodged*	Ear length	Ear rows	Good ears per plant	Ear moisture	Yield	Ear appearance‡
	per cent	inches	inches	inches	per cent		inches	number	per cent	per cent	bu. per acre	
Min. 500	8	89	39	6	1	5	7.5	16	.83	25.8	66.7	3.0
Min. 503	5	91	40	6	1	4	8.0	17	.88	28.5	68.2	2.6
Min. 504	7	91	40	7	1	6	7.9	16	.83	28.6	66.9	3.3
Min. 505	6	93	41	5	1	6	7.7	17	.87	28.1	66.0	2.3
Min. 507	5	96	42	6	1	6	8.1	17	.90	26.4	68.8	2.6
Min. 508	6	89	38	6	0	3	8.0	17	.93	27.9	68.6	2.7
Min. 406†	4	94	40	5	1	6	7.9	18	.84	29.3	69.4	2.7

* 1949 data not included. † Southern Zone hybrid. ‡ Class 1 rating is good; 5 is poor.

CENTRAL ZONE

Table 23. Average Corn Hybrid Performance in 20 Trials, 1942-52

	Plants smutted	Plant height	Ear height	Shank	Roots lodged	Stalks lodged	Ear length	Ear rows	Good ears per plant	Ear moisture*	Yield	Ear appearance†
	per cent	inches	inches	inches	per cent		inches	number	per cent		bu. per acre	
Min. 602	4	83	37	4.6	1	12	7.5	15.7	0.83	27.9	61.6	3.0
Min. 607	3	79	35	5.2	2	13	7.4	15.4	0.86	26.7	62.2	3.3
Min. 608	4	84	39	5.4	0	10	7.4	15.8	0.82	27.8	63.3	2.7

* Data for 1950 and 1951 not included. † Class 1 rating is good; 5 is poor.

NORTH CENTRAL ZONE

Table 24. Average Corn Hybrid Performance in Eight Trials, 1949-52

	Plants smutted	Plant height	Ear height	Shank	Roots lodged	Stalks lodged	Ear length	Ear rows	Good ears per plant	Ear moisture†	Yield	Ear appearance‡
	per cent	inches	inches	inches	per cent		inches	number	per cent	bu. per acre		
Min. 706	2	81	31	6	27	7	7.8	16	.89	27.8	47.4	2.5
Wis. 275	1	76	29	6	6	4	6.8	16	.87	29.2	45.6	2.0
Nodak 301	4	75	29	5	6	8	7.3	16	.87	26.6	44.8	2.5
Wis. 355*	0	81	33	5	20	6	7.2	15	.81	31.1	45.7	2.5

* Not a recommended hybrid. † Data for 1950 and 1951 not included. ‡ Class 1 rating is good; 5 is poor.

NORTHERN ZONE

Table 25. Average Corn Hybrid Performance in 12 Trials, 1946-47, 1949-52

	Plants smutted	Plant height	Ear height	Shank length	Roots lodged	Stalks lodged	Ear length	Ear rows	Ear moisture†	Yield	Ear appearance‡
	per cent	inches	inches	inches	per cent		inches	number	per cent	bu. per acre	
Min. 802	7	68	24	6	8	3	7.0	14	31.5	42.5	1.9
Wis. 240*	3	69	24	5	6	6	8.0	14	33.1	42.2	2.2
Wis. 255	4	70	26	6	2	2	6.8	14	30.5	39.0	3.1
Wis. 279	8	73	27	6	3	2	6.8	16	35.2	43.8	2.3
Nodak 301	3	74	26	5	1	4	7.0	16	33.2	43.5	2.7

* Flint-dent hybrid. † Data for 1950 and 1951 not included. ‡ Class 1 rating is good; 5 is poor.

Table 26. Average Corn Hybrid Performance in Eight Trials, 1946-47, 1949-52

	Plants smutted	Plant height	Ear height	Shank length	Roots lodged	Stalks lodged	Ear length	Ear rows	Ear moisture*	Yield	Ear appearance†
	per cent	inches	inches	inches	per cent		inches	number	per cent	bu. per acre	
Morden 77	12	69	24	5	4	4	6.6	17	29.1	39.7	2.6
Min. 802	11	66	24	7	15	3	7.2	14	32.4	41.0	1.3
Wis. 240	5	70	23	6	12	10	7.8	13	33.2	40.8	1.3
Wis. 255	7	68	26	6	2	2	6.8	14	31.7	38.5	1.0
Wis. 279	11	71	26	6	7	3	6.8	16	37.6	43.0	1.0
Nodak 301	8	75	25	5	3	6	6.9	16	35.4	42.1	2.3
L.S.D. at 5 per cent point	.....	.....	.....	.....	.....	.....	.....	.....	1.90	2.55	.....

* Moisture data for 1950 and 1951 not included. † Class 1 rating is good; 5 is poor.

Alfalfa

L. J. ELLING

Alfalfa trials have been carried out at six locations in Minnesota during the past four years. These locations are Crookston, Grand Rapids, Morris, Rosemount, Waseca, and Winona. Trials before this time were made at Crookston, Grand Rapids, Morris, Waseca, and University Farm.

Because alfalfa is a perennial crop, seedings are made every three to five years rather than annually, as for the cereal crops. Stands are maintained and yields harvested twice annually until stands are uneven or until yields have been harvested for five years. Generally stands are rather uneven after three crop years. New and promising varieties are included in these trials along with standard and commercial varieties.

Yield Comparisons

Table 27 gives forage yields and stand readings of Grimm, Ladak, and Ranger when grown on wilt-infested soil. Other trials have given similar results, but in these the presence of the wilt organism was not definitely established.

In all cases where wilt was a factor, Grimm was more severely thinned than Ladak or Ranger. The yields harvested during the third, fourth, and fifth crop years show that the loss of stand was reflected in the forage yields. Generally there were not significant differences among the three varieties for forage yields during the first and second crop years.

Table 28 gives the forage yields for 13 alfalfa varieties grown at six locations. Some varieties seemed to be superior for forage yield at most locations though the differences were not great. Narragansett and Ladak appeared consistently good with Narragansett yielding slightly better than Ladak.

Grimm and Ranger produced only average yields and were not outstanding at any location. These trials are mainly from two and three crop year stands, and the superiority of Ranger is not generally noted until the third or fourth crop year. The 1952 data from Morris show Ranger as second in forage yield. Ranger was only average for yield in 1950 and 1951 at Morris.

Some varieties are consistently lower for forage yield than the better varieties. Buffalo and Kansas Common yield lower than the better varieties under Minnesota conditions.

Winter Hardiness

The varieties listed in table 28 are, with three exceptions, considered sufficiently winter hardy for Minnesota. These exceptions are Atlantic, Buffalo, and Kansas Common. They do not persist even when bacterial wilt is absent.

Table 27. Forage Yields and Stand Readings for Three Varieties of Alfalfa Grown on Wilt-Infested Soil

Variety	MORRIS Seeded 1940		WASECA Seeded 1943		Seeded 1945	
	Five-year average forage yield	Stand 1946	Two-year average forage yield	Stand 1947	Four-year average forage yield	Stand 1949
	tons per acre	per cent	tons per acre	per cent	tons per acre	per cent
Grimm	3.91	17	2.7	10	2.1	5
Ladak	4.42	80	.....	.....	2.6	77
Ranger	4.32	90	2.8	51	3.0	87

Table 28. Average Yields of Alfalfa

Variety	Crookston (1951-52)	Grand Rapids (1951-52)	Waseca (1951-52)	Morris (1950-52)	Rosemount (1950-52)	Winona (1949-52)
			tons per acre			
Grimm	1.31	3.08	2.69	2.60	3.64	2.29
Ladak	1.62	3.44	2.71	2.92	4.14	2.36
Ranger	1.49	2.90	2.72	2.85	3.69	2.40
Atlantic	1.43	3.11	2.75	2.91	3.99	2.08
Buffalo	1.31	2.63	2.32	2.81	3.64	2.48
Kansas Common	1.39	2.80	2.68	2.65	3.62	2.34
Dakota Common	1.50	3.03	2.69	2.62	3.85	.....
Narragansett	1.59	3.54	3.05	2.96	4.20	.....
Rhizoma	1.44	3.56	2.87	.....	.....	.....
A-224	1.52	3.14	2.76	2.95	4.03	.....
A-225	.....	.....	.....	2.93	4.12	2.30
Turkestan	.....	.....	.....	2.64	3.83	.....
Cossack	1.38	3.24	2.84	.....	.....	2.39

Disease Reaction

Ranger is the most wilt resistant of the Minnesota adapted alfalfa varieties in commercial production. Buffalo is wilt resistant, but because it is susceptible to winter killing it is not adapted in Minnesota. Ladak is somewhat less resistant than Ranger, and A-224 and A-225 are resistant to wilt. The remaining eight varieties that are listed above in table 28 are susceptible to bacterial wilt.

Alfalfa varieties resistant to bacterial wilt do not possess complete resistance as commonly referred to for the cereal crop diseases. For instance, only about 30 per cent of the plants from the Ranger variety are immune to bacterial wilt. However, this is sufficient resistance to give good survival and maintain productive stands on wilt-infested soils.

None of the varieties in commercial production possesses resistance to the leaf spot diseases. Two of these diseases, common leaf spot, *Pseudopeziza medicaginis*, and blackstem, *Ascochyta imperfecta*, are the most common in Minnesota.

Bromegrass

H. L. THOMAS

Recommended varieties of bromegrass are Lincoln, Achenbach, and Fischer, all from the so-called southern group. These varieties have established more quickly, produced more vigorous creeping root stalks, and given approximately .1 to .2 tons per acre more forage yield than Canadian Commercial in tests on the several Minnesota experiment stations over the past eight years. Where grown in an alfalfa mixture the southern types have not shown a tendency to crowd out alfalfa. These plots were kept for three and in some cases four years, and Ladak, a wilt-resistant alfalfa, was the variety used.

Forage yields for 1951 and 1952 are shown in table 29 for the brome varieties which are being tested at the present time.

In dry seasons (and perhaps because of them) the northern types did relatively well at Crookston and Grand Rapids in 1952. However, such a response has not been obtained in any other year since there have been no

Table 29. Bromegrass Forage Yields at 15 Per Cent Moisture

Variety	Rosemount		Waseca	Morris	Crookston		Grand Rapids		Average	
	1951	1952	1952	1952	1951	1952	1951	1952	1951	1952
					tons per acre					
Southern type										
Lincoln	2.29	3.21	1.99	1.97	1.78	3.59	1.43	1.30	1.83	2.41
Achenbach	2.36	3.46	2.19	2.24	1.71	3.55	1.53	1.50	1.86	2.59
Fischer	2.22	2.92	2.08	2.28	1.17	2.29	1.59	1.74	1.66	2.26
Elsberry	2.43	3.16	2.11	1.88	1.59	2.93	1.62	1.79	1.88	2.37
Lyon (Neb. 44)	2.52	3.55	2.36	1.68	1.77	3.28	1.49	1.53	1.92	2.48
Lancaster	2.34	3.60	2.19	2.10	1.58	3.21	1.64	1.77	1.85	2.57
Northern type										
Canadian Commercial	1.76	2.54	1.65	1.60	1.04	2.49	1.49	1.86	1.43	2.02
Martin	2.05	2.81	2.04	.....	1.34	3.40	1.74	1.79	1.71	.....
B. in. 12	2.19	3.00	2.04	2.02	1.32	3.10	1.63	1.69	1.71	2.37
Manchar	2.24	3.34	1.89	1.77	1.60	3.58	1.67	1.69	1.83	2.45
Mandan 404	1.37	2.52	1.87	1.87	1.01	3.09	.....	.....	.....	.....
Homesteader	2.09	3.35	1.96	1.90	1.37	3.15	1.68	1.90	1.71	2.45

other dry years since the brome variety tests were started in 1945.

In general, northern bromes are known to be superior to southern bromes in seed production. Seed yields taken in 1952 by the Minnesota stations are in accord with this, as shown in table 29.

Red Clover

H. L. THOMAS

Tests conducted from 1923-1927 by Prof. A. C. Arny showed that locally grown strains of medium red clover were markedly superior to introductions from foreign countries and southern United States. Average yields of forage collected from 32 experiments conducted from 1945 through 1952 (table 30) show the recommended varieties Wegener and Midland to be practically equal to good commercial seed purchased in Minnesota. With this situation existing it is still considered advisable to have named adapted varieties available so that the origin can be traced and certified seed produced.

Dollard was produced at MacDonald College, Quebec, Canada. Only small quantities of seed are available at present but this variety is being increased.

Less extensive trials of Mammoth red have been conducted. In these trials Graham's Mammoth, a farm strain from southwestern Wisconsin, was significantly higher in forage yield than Altaswede. Altaswede was about equal to Commercial Mammoth in yield and slightly inferior in persistence of stand. Altaswede has a smooth (not hairy) leaf which makes it susceptible to leaf hoppers.

Table 30. Forage Yield at 15 Per Cent Moisture of Medium Red Clover from 32 Experiments, 1945-52*

Variety	Average forage yields
	tons per acre
Wegener	2.60
Midland	2.63
Dollard	2.54
Minnesota Commercial	2.61

* Experiments conducted at Minnesota experiment stations and on farms in cooperation with the Soil Conservation Service.

Biennial Sweet Clover

H. L. THOMAS

The recommended varieties, Evergreen (white blossom) and Madrid (yellow blossom), are considerably better in forage yield in the fall of the seedling year than the commercial varieties. Evergreen has the added advantage of being two weeks later in flowering during the second year and is a very rank-growing, heavy forage producer the second year.

Satisfactory seed yields have been obtained from both recommended varieties. See table 31 for a summary of data collected from experiment stations and other locations, 1945-52.

The picture here is different from the red clover situation. The recommended varieties of sweet clover are distinctly better than the commercial strains which are being grown extensively.

Table 31. Summary of Sweet Clover Data

Variety	Forage yield in per cent of Commercial yellow*	Vigor rating†	Maturity rating
	per cent		
Evergreen	115	1.7	Very late
Madrid	102	2.0	Early
Commercial white	102	3.2	Medium
Commercial yellow	100	3.5	Early

* Taken second year—at 15 per cent moisture.
† Class 1 rating is good; 5 is poor. Rating taken in fall of seedling year.

Field Peas

R. G. ROBINSON and O. C. SOINE

Most of the field peas grown in Minnesota in recent years have been sold to processors for use in soup and pigeon feed, but pea seed can also be fed to sheep, hogs, and cattle. The seed is reported to contain over 20 per cent digestible protein. Field peas are sometimes used as a forage crop, usually in a mixture with oats.

Peas are a moderately cool-season crop and hence should be sown early.

Seed for these trials was treated to control seed-borne fungi and inoculated just before planting to supply bacteria for nitrogen fixation.

Seed Yield Comparisons

Average seed yields and other agronomic characters are reported in table

Table 32. Averages of Pea Varieties for Seed Yield, Date of First Bloom, Date of Maturity, Weight per Bushel, and Weight of 100 Seeds at Crookston

Variety	Years of trial	Yield	Date of first bloom	Date of maturity	Weight	Weight of 100 seeds
		bushels per acre			pounds per bushel	grams
Chancellor	1948-52	21.1	July 2	August 19	62.9	13.1
Dashaway	1948-52	21.3	July 1	August 19	63.1	12.5
Multiplier	1948-52	22.0	July 5	August 20	63.1	13.5
First and Best	1948-52	18.9	June 22	August 8	61.8	15.9
Guinevere	1952	21.1	July 12	August 13	64.1	20.0
Arthur	1952	15.9	July 7	August 10	62.4	22.6
Valley	1952	21.8	June 30	August 10	62.0	20.9
L.S.D. at 5 per cent point		1.8				

32 for 1948-52 at Crookston. Rates of sowing in these trials were based on Chancellor with 90 per cent germination at two bushels per acre and then adjusted for seed size and germination so that equal numbers of viable seeds would be sown per plot. All varieties in these trials have cream-colored seeds.

First and Best and Arthur yielded significantly less than other varieties.

Among the three recommended varieties, Chancellor and Dashaway bloomed and matured earlier than Multiplier. First and Best was the earliest maturing variety. Guinevere and Arthur were later in blooming than the recommended varieties, but they matured sooner.

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

In weight of 100 seeds, First and Best, Guinevere, Arthur, and Valley weighed considerably more than the recommended varieties. This additional size may be desirable for commercial splitting. These larger seeded varieties were generally sown at about 3-3½ bushels per acre, as compared to 2 bushels per acre for the smaller seeded Chancellor.

Other Varieties

Trials of Austrian, White Marrowfat, Superlaska, Delwiche Early Scotch, Late Scotch, and Chang were discontinued after three or four years of trial because of low yield or other undesirable characteristics. Bleaching of the green-seeded varieties frequently made them unsuitable for commercial sale as dry, edible peas. Chang performed well but is not wanted on the edible pea market because of its black hilum (eye).

Forage Yield Comparisons

Average forage yields, protein content, and protein yields of a pea-oat mixture are summarized in table 33 for 1952 for Rosemount and southwestern Minnesota. In these trials peas and Branch 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 Branch oats. Branch oats were also sown alone at two bushels per acre to serve as a check.

Chancellor - Branch or Dashaway-Branch produced more forage than Multiplier-Branch at Rosemount but none of the pea-oat mixtures yielded as much forage as Branch oats alone. In southwestern Minnesota the mixtures did not differ appreciably in forage yield. At time of cutting, the pea-oat mixtures contained about 5 per cent more moisture than oats alone—indicating that they would take somewhat more time to cure for hay.

The pea-oat mixtures were appreciably higher in protein than oats alone and yielded considerably more protein per acre.

Table 33. Average Forage Yields, Protein Content, and Protein Yields of Pea-Oat Mixtures in 1952

Variety	Rosemount			Southwestern Minnesota		
	Forage*	Protein	Protein	Forage*	Protein	Protein
	pounds per acre	per cent	pounds per acre	pounds per acre	per cent	pounds per acre
Chancellor-Branch	4,698	12.1	568	4,108	10.9	448
Dashaway-Branch	4,629	13.4	620	3,966	10.3	408
Multiplier-Branch	4,148	12.6	523	4,070	10.5	427
Branch oats	5,066	9.3	471	3,833	8.1	310
L.S.D. at 5 per cent point	404	.....	.....	495	.....	.....

* Total forage at 15 per cent moisture.

The fact that Multiplier blooms and sets pods somewhat later than Chancellor and Dashaway probably makes it less desirable for mixing with the early and midseason oat varieties now recommended for Minnesota.

Lodging in pea-oat mixtures was severe where the growth was heavy.

Sunflowers and Safflower

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The purpose of trials of short, combine-type sunflower varieties begun in 1948 was 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 1950-52 trials for comparison with the other oilseed crops.

Sunflower oil, like soybean oil, is edible and can be used in margarine, cooking oil, and other products for human consumption. The meal remaining after oil extraction is a valuable protein supplement for livestock. The hulls are pressed into fuel "logs" by a Canadian cooperative. A considerable portion of Minnesota's sunflower seed in 1952 was sold for bird feed.

Sunflowers are grown commercially on a small acreage in North Dakota, California, New Mexico, Illinois, and Minnesota. In recent years, southern Manitoba has generally had much more acreage and production than any of these states. Sunflower rust has in some years been very injurious in Canada.

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

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

Comparison of Sunflowers, Soybeans, Safflower, and Flax

Adapted varieties of soybeans and flax were sown beside the sunflower plots each year; safflower varieties were added to the comparison in 1950-52. Soybean and flax varieties used were Minsoy soybeans in 1948-50, Flambeau soybeans in 1951-52, Minerva flax in 1948-49, Dakota flax in 1950, and Redwood flax in 1951-52 at Crookston; Blackhawk soybeans and Redwood flax in 1948-52 in southwestern Minnesota; Flambeau soybeans in 1948-50, Dakota flax in 1948 and 1950, and Minerva flax in 1949 at Morris. For these crop comparisons, N-852 safflower was used in 1950, N-6 safflower in 1951-52, and Advance sunflowers in all trials.

Comparative average yields and oil content of the four crops for 1948-52 at Crookston and in southwestern Minnesota and for 1948-50 at Morris are reported in table 34. 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; safflower and flax were sown in 6-inch rows with a grain drill. Oil percentages were calculated on a 10 per cent moisture basis.

Because of similarities in culture and in oil uses, the comparisons of sunflowers with soybeans and of safflower with flax are of most practical importance, but it is also interesting to compare the performance of edible oil and drying oil crops.

Sunflowers yielded more seed than any of the other crops at Crookston and Morris but were second to soybeans in southwestern Minnesota. Safflower was the lowest in seed yield and

Table 34. Seed Yields, Oil Content, and Oil Yields of Sunflowers, Soybeans, Safflower, and Flax Grown on Adjacent Areas in the Same Fields at Crookston and Morris and in Southwestern Minnesota

Crop	Crookston	Southwestern Minnesota	Morris	Average
		Seed yield (pounds per acre)		
Sunflowers	1100	1302	1252	1218
Soybeans	912	1485	878	1092
Safflower	544	439	286	423
Flax	900	1252	873	1008
		Oil content (per cent)		
Sunflowers	30.3	31.1	31.0	30.8
Soybeans	17.9	18.6	18.8	18.4
Safflower	18.5	20.1	13.5	17.4
Flax	37.8	37.5	37.7	37.7
		Oil yield (pounds per acre)		
Sunflowers	333	405	400	379
Soybeans	163	276	164	201
Safflower	101	88	41	77
Flax	340	470	339	383

oil yield in every trial and never produced a profitable crop.

The oil content of sunflower seed was over 12 per cent above that of soybeans. Flaxseed was consistently higher in oil content than seed of the other crops. Safflower and soybeans were about the same in oil content.

In yield of oil, sunflowers were much higher than soybeans in every trial. Flax produced more oil per acre than sunflowers at Crookston and in southwestern Minnesota but less than sunflowers at Morris.

Flax was earliest in time of maturity. Sunflowers were generally about as early maturing as Flambeau soybeans; safflower was earlier than Blackhawk soybeans but later than Flambeau.

Yield and Oil Content of Sunflower Varieties

Advance and Arrowhead were the best sunflower varieties in these trials. Advance is a hybrid, so seed for next year's planting should not be saved from the commercial crop. Advance Second Generation has yielded considerably less than Advance. Arrowhead is an open pollinated variety so seed

Table 35. Seed Yields, Oil Content, and Oil Yields of Advance and Arrowhead Sunflowers

Location	Advance	Arrowhead
	Seed yield (pounds per acre)	
Crookston	1100	1153
Southwestern Minnesota	1300	926
Morris	1252	1272
Average	1217	1117
	Oil content (per cent)	
Crookston	30.3	28.7
Southwestern Minnesota	31.6	27.3
Morris	31.0	26.8
Average	31.0	27.6
	Oil yield (pounds per acre)	
Crookston	333	331
Southwestern Minnesota	411	253
Morris	400	345
Average	381	310

for next year's planting can be saved from the commercial crop.

Comparative yields and oil content of Advance and Arrowhead are shown in table 35 for 1948-52 at Crookston, 1951-52 in 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.

Advance was clearly superior to Arrowhead in oil content. However, Arrowhead produced slightly more seed than Advance at Morris and Crookston. Advance produced considerably more oil than Arrowhead in southwestern Minnesota and at Morris and about the same as Arrowhead at Crookston.

Other varieties which were 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 characters of Advance and Arrowhead are summarized in table 36. Averages for date of flowering include data for 1948-52 at Crookston, 1951 at southwestern Minnesota, and 1949-50 at Morris. Plant height and bushel weight averages include data for 1948-52 at Crookston, 1951-52 in southwestern Minnesota, and 1948-50 at Morris. Averages for head diameter, hull percentage, and weight of 100 kernels include data for 1949-52 at Crookston, 1951-52 in southwestern Minnesota, and 1949-50 at Morris.

Averages are calculated on 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 as much oil as Advance at the most northerly location, Crookston, while at Morris and in southwestern Minnesota it yielded considerably less oil per acre than Advance.

Table 36. Comparison of Advance and Arrowhead in Flowering Date, Plant Height, Head Diameter, Bushel Weight, Hull Percentage, and Kernel Weight

	Advance	Arrowhead
Flowering date	July 30	July 26
Plant height, inches	60	62
Head diameter, inches	5.6	5.0
Bushel weight, pounds	30.9	30.3
Hull percentage	40.8	42.4
Weight of 100 kernels, grams	6.4	8.3

Advance was slightly shorter and had a greater head diameter and bushel weight than Arrowhead. Advance kernels contained less hull and were considerably smaller than Arrowhead kernels.

Safflower Varieties

Varieties tested were N-3, N-5, N-6, N-8, and N-852 from the University of Nebraska. N-3 is spineless; the others are spiny like thistles. Varietal trials were conducted in 1950-51 at Crookston and in southwestern Minnesota and at Morris in 1950. N-6, the best variety, was also grown in 1952 at Crookston and in southwestern Minnesota. None of these varieties 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.

Safflower grew very slowly in the spring, and weeds were a much more severe problem in the safflower than in the neighboring flax plots. In 1951-52 safflower 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 slightly more seed with a higher oil content than did the cultivated rows.