

Varietal Trials of Farm Crops



W. M. MYERS	E. L. PINNELL
E. R. AUSEMUS	L. J. ELLING
J. O. CULBERTSON	R. G. ROBINSON
E. H. RINKE	K. S. KOO
J. W. LAMBERT	K. J. HSU
H. L. THOMAS	O. C. SOINE
	D. W. SUNDERMAN

Agricultural Experiment Station

UNIVERSITY OF MINNESOTA

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O. C. Soine, D. W. Sunderman, H. L. Thomas

MANY VARIETIES of farm crops are available from which the farmer can select those he will plant. These varieties differ widely in yielding ability, maturity, standing ability, quality, disease resistance, and other important characteristics. Successful crop production depends to a considerable extent on whether the farmer selects varieties adapted to his farm.

To provide a basis for the selection of the most desirable varieties, the Minnesota Agricultural Experiment Station annually conducts comparative tests of varieties of each of the important farm crops.

Studies of yield, plant height, maturity, lodging resistance, other important agronomic characters, disease resistance, and quality are carried out at the following locations: at the central station at St. Paul; at the six branch experiment stations located at Rosemount, Waseca, Morris, Crookston, Duluth, and Grand Rapids; in southwestern Minnesota, and in northern Minnesota.

The trials in southwestern Minnesota are conducted by R. G. Robinson and the project leaders from St. Paul in cooperation with an organization from the southwestern counties. The trials in northern Minnesota are conducted in cooperation with the North Central Experiment Station at Grand Rapids and the Northwest Experiment Station at Crookston, together with the county organizations.

Recommended varieties, important old varieties, and promising new va-

rieties are grown in replicated field plots at each location. These field plots are of size and shape appropriate for the particular crop. For example, in small grains and flax each plot is a drill strip wide and approximately 1/40 acre in size. These plots are handled so that the factors affecting yield and other characteristics are as nearly the same for all varieties at each location as is possible. In that way the extent of real differences among varieties can be measured with some precision.

New experimental lines in early stages of testing are also grown at some of these same locations in replicated row plots. In the case of small grains and flax, these row plots are each 1 rod long.

Reactions to important diseases are tested in specially conducted disease nurseries at the central station in cooperation with the Department of Plant Pathology and Agricultural Botany. Tests for quality are made by the Department of Agricultural Biochemistry, the United States Regional Soybean Laboratory, the Malt Research Institute at Madison, Wisconsin, the United

States Department of Agriculture, or by commercial firms in cooperation with the Northwest Crop Improvement Association.

Flax quality tests are conducted by V.E. Comstock, USDA research agronomist, in the Department of Agronomy and Plant Genetics. Tests of corn hybrids for resistance to the European corn borer are made at Waseca and St. Paul in cooperation with the Department of Entomology and Economic Zoology.

Included in the trials are improved varieties developed at other experiment stations in the United States and Canada as well as those developed by the Minnesota Agricultural Experiment Station.

On the basis of results from these comparative trials, the list of varieties recommended for use in Minnesota is revised each year at the Experiment Station Crops Conference. Participating in that conference and helping to formulate the list of recommended varieties are staff members from the Departments of Agronomy and Plant Genetics, Plant Pathology and Agricultural Botany, Agricultural Biochemistry, Soils, and Entomology and Economic Zoology, from Agricultural Extension, and from the six branch experiment stations.

Extension Folder 22, *Varieties of Farm Crops*, presents a list of recommended varieties for each crop and also lists of "varieties not adequately tested" and "varieties not recommended."

The present report summarizes yield and other comparative agronomic data on varieties of barley, flax, oats, rye, spring wheat, winter wheat, soybeans, corn, alfalfa, brome grass, red clover, sweetclover, field peas, and sunflowers—all grown in field plots in 1954. Average data rather than the results of individual tests or years are presented. The years during which each variety has been tested are given in the individual tables.

Usually the number of years of trial varies among varieties within the same crop. For some such tests, adjustment of part of the yields has been made so averages of varieties tested for different numbers of years can be compared directly. The method used is illustrated in detail in a previous issue of *Varietal Trials of Farm Crops*,¹ and will not be described here.

Pertinent data on disease reaction of the varieties are taken largely from Folder 22.

Included also in this report are brief descriptions and histories of recommended varieties and of other varieties which have been or may be grown or offered for sale in Minnesota. Descriptions of varieties not included in field plots for 1954—and therefore not summarized in tables in this report—are taken from data from field plot trials, from rod row trials, or in a few cases from tests in adjacent states.

The individual crop summaries and varietal descriptions were prepared by the project leaders in the Department of Agronomy and Plant Genetics who are responsible for the varietal improvement studies with various crops.

Cooperators from the Department of Plant Pathology include 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 in the Department of Entomology and Economic Zoology include F. G. Holdaway and H. C. Chiang. Cooperators at the branch experiment stations include R. E. Hodgson and John Thompson 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 R. S. Grant and W. W. Nelson at Duluth.

In 1949, trials of small grains and

¹ W. M. Myers, et al. *Varietal Trials of Farm Crops*, Minn. Agr. Expt. Sta. Misc. Rpt. 18, 1953.

flax were transferred from St. Paul to Rosemount. Summaries in the tables for St. Paul and Rosemount are pre-

sented under Rosemount and include data obtained at St. Paul prior to 1949 and at Rosemount in later years.

Barley

J. W. Lambert

YIELD COMPARISONS

Average yields of several barley varieties as obtained at various locations in Minnesota during the period 1948-54 are given in table 1. Vantage was the highest yielding variety at Rosemount, Waseca, Morris, Crookston, and in southwestern Minnesota. In the northern and northeastern locations Kindred, Montcalm, Vantage, and Peatland were the highest yielders. Mars and Barbless yielded somewhat less.

OTHER AGRONOMIC CHARACTERS

Comparative data on date of heading, plant height, standing ability, kernel size, and weight per bushel are presented in table 2.

In the southern, central, and western locations Mars was the earliest variety, Kindred was only slightly later, and Barbless, Montcalm, and Vantage averaged several days later. Montcalm was tallest; Mars and Vantage were shortest.

Mars and Vantage had good resistance to lodging, whereas Kindred, Barbless, and Montcalm showed a marked tendency to lodge. Kernel weights were medium for all except Mars, which had a light weight. In bushel weight, Mars excelled and Barbless and Montcalm were lowest.

In the northeastern locations, Mars and Kindred averaged earliest in date of heading; Barbless and Peatland were latest. Peatland and Montcalm were tallest and Mars was shortest. Kindred

and Vantage had the largest kernels, while Peatland and Mars were decidedly small in kernel size. Peatland and Mars were superior in bushel weight and Barbless was lowest.

MALTING QUALITY

Kindred is the variety most widely accepted by American maltsters at the present time. Also regarded with favor by many of the maltsters is the variety Montcalm. These two are now considered definitely superior to Barbless in malting quality. The rest of the varieties listed in tables 1 and 2 are classified strictly as feed barleys.

DISEASE REACTION

All varieties are susceptible to leaf rust. Those 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 net blotch. It is moderately susceptible to mildew, loose smut, and scab and susceptible to

Table 1. Average Yields of Barley, 1948-54*

Variety	Southern, central, and western locations					Northern and northeastern locations				
	Rosemount	Waseca	Morris	Crookston	South-western Minnesota	Average, five locations	Grand Rapids	Duluth	Northern Minnesota	Average, three locations
	bushels per acre									
Barbless	47.6	42.6	58.3	37.8	44.8	46.2	43.4	41.8	39.1	41.4
Mars	47.2	45.1	58.0	40.1	40.0	46.1	40.1	37.2	41.9	39.7
Kindred	48.6	50.9	57.0	39.3	45.3	48.2	44.7	41.3	47.5	44.5
Montcalm	44.5	49.0	58.4	43.1	42.4	47.5	43.5	42.3	47.7	44.5
Vantage	51.5	53.6	70.5	44.8	47.0	53.5	47.8	40.8	46.1	44.9
Peatland							44.3	45.4	41.1	43.6
L.S.D. at 5 per cent point	3.0	3.3	3.7	4.4	3.3	1.6	4.2	3.6	5.4	2.6

* Data for northern Minnesota for 1950-54.

Table 2. Averages of Barley Varieties for Date of Heading, Plant Height, Lodging Score, Weight of 1,000 Kernels, and Weight per Bushel, 1948-54

Variety	Average, southern, central, and western locations					Average, northeastern locations			
	Date of heading*	Plant height	Lodging score†	Weight of 1,000 kernels	Weight per bushel	Date of heading‡	Plant height	Weight of 1,000 kernels	Weight per bushel
		inches		grams	pounds		inches	grams	pounds
Barbless	6-28	34	2.8	29.6	43.6	7-3	32	29.2	42.8
Mars	6-23	29	1.2	26.4	46.2	6-29	28	27.0	46.1
Kindred	6-24	32	3.1	29.7	45.4	6-29	32	31.5	44.2
Montcalm	6-26	35	2.6	27.7	43.4	7-2	34	29.6	43.3
Vantage	6-27	30	1.6	30.7	44.0	7-1	29	31.4	43.7
Peatland						7-3	34	27.5	47.4

* No data for southwestern Minnesota.

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

‡ Data from Grand Rapids only.

stripe. It has until recently been considered moderately resistant to spot blotch. In 1953, however, fields of Kindred were observed which were heavily infected with spot blotch, indicating an increase in a new race or races of spot blotch.

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

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.

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

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Kindred (L) is a six-rowed, rough-awned, white-aleurone variety with good malting quality. It has yielded well and is medium early, but it is highly susceptible to lodging. It is resistant to stem rust and moderately resistant to net blotch and spot blotch. It is moderately susceptible to mildew, loose smut, and scab and is susceptible to stripe. Kindred was selected by a farmer, S. T. Lykken of Kindred, North Dakota. It is recommended as a malting variety in all parts of Minnesota.

Montcalm is a six-rowed, smooth-awned variety with a blue aleurone. It has yielded well in Minnesota and in recent years has been readily accepted by a large part of the American malting industry. It is tall, matures rather late, and has mediocre to poor strength of straw. Montcalm is moderately resistant to net blotch, moderately susceptible to spot blotch, and susceptible to stem rust, stripe, loose smut, and mildew. Montcalm was se-

lected at Macdonald College, Quebec, from the cross (Michigan 31604 x Common Six-Rowed 4307 M. C.) x Mandscheuri 1807 M. C. It is recommended as a malting barley in the northwestern and cutover sections of Minnesota.

Peatland, a six-rowed, rough-awned, stiff-strawed variety with white aleurone, has yielded better on peat soils than most other varieties of barley, as shown by several years' trials. Peatland also has yielded well on mineral soils and thus is recommended as a feed barley in the northeastern section of Minnesota. It is resistant to stem rust and mildew, moderately resistant to spot blotch, net blotch, loose smut, and scab, and susceptible to stripe. Peatland has small seeds and is not generally acceptable for malting purposes. It is a Minnesota selection from the variety Switzerland.

Vantage is a stiff-strawed, six-rowed, smooth-awned feed barley which has a white aleurone. Of the varieties tested in the principal barley growing areas in Minnesota during the last six years Vantage has averaged highest in yield by about five bushels per acre. It is medium in maturity. It is moderately resistant to net blotch and susceptible to mildew, scab, loose smut, and spot blotch. Vantage was developed at Brandon, Manitoba, from a cross (Newal x Peatland) x Plush and is recommended as a feed barley in all sections of Minnesota.

Varieties Not Recommended

Barbless (Wisconsin Ped. 38) is a six-rowed, smooth-awned, white-aleurone variety. It yields well under favorable conditions. Barbless is moderately resistant to barley stripe and net blotch, moderately susceptible to spot blotch, and susceptible to scab, loose smut, stem rust, and mildew. It has weak straw and lodges badly when seeded on heavy or fertile soils. It is late in maturity. Barbless was selected at the

Wisconsin Agricultural Experiment Station from Oderbrucker x Lion.

Bay is a six-rowed, smooth-awned variety which is susceptible to stem rust and gives only fair yields. Its parentage involves Manchuria, Lion, and Spartan. It was selected at the Michigan Agricultural Experiment Station.

Compana is a two-rowed, smooth-awned, white-aleurone variety which was developed for the dry conditions of Montana. It is considered undesirable for Minnesota. It was selected from a composite cross by H. V. Harlan and released first by the Montana Experiment Station.

Feebar is a high-yielding stiff-strawed, six-rowed, stem rust-resistant feed barley developed for the dry conditions of central and western South Dakota. It was selected from the cross Peatland x Vaughn.

Galore is a six-rowed, smooth-awned variety developed in Canada for certain localized conditions. It is unsuitable for malting and is of little value for Minnesota. Its parentage involves O.A.C. 21 and Lion, and the originating station was the Ontario Agricultural College at Guelph, Ontario.

Kemble is a six-rowed, rough-awned variety selected by a farmer. The seed is small, and the plants have a marked tendency to lodge. This variety has also been low in yield in Minnesota trials.

Manchuria is a type rather than a single variety. Several selections have been made within the type, including Minnesota 184, North Dakota 2121, O.A.C. 21, and Oderbrucker. The type is six rowed, rough awned, medium early, and medium tall to tall. The kernels may have either blue or white aleurone.

All the known selections from the type are susceptible to stem rust, but several selections from Manchuria have shown a measure of resistance to spot blotch. Nearly all Manchuria selections are acceptable for malting. Yields of Manchuria selections tested in Minne-

sota have been mediocre. As the name implies the type had its origin in Manchuria but arrived in the United States by several routes.

Mars is a six-rowed, smooth-awned, stiff-strawed, white-aleurone variety that produces plump, well filled kernels. It is early in maturity and has high weight per bushel. 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. The seeds of Mars are small and low in diastatic activity and are therefore considered undesirable for malting purposes. Its parentage includes Lion, Manchuria, and Peatland. Mars was selected at the Minnesota Agricultural Experiment Station.

Moore is a six-rowed, smooth-awned, white-aleurone feed variety that is late in maturity, has moderately stiff straw, and has yielded well in all locations except Crookston. It is resistant to mildew and stem rust, but it is moderately susceptible to scab and spot blotch and to stripe and loose smut. It is very susceptible to net blotch. Moore was developed at the Wisconsin Agricultural Experiment Station from crosses involving Lion, Oderbrucker, Chevron, and Olli.

O.A.C. 21 is a blue-aleurone selection from the Manchuria type. It yields moderately well, has rough awns and weak straw, and is susceptible to stem rust. It has limited acceptance in the American malting trade. As the name implies it was selected at the Ontario Agricultural College.

Plains is a very early, six-rowed, smooth-awned variety developed by the South Dakota Agricultural Experiment Station for the plains country of that state. It has yielded well in Minnesota but is not acceptable for malting. It has short, stiff straw and is resistant to stem rust. Its parentage is Peatland x Dryland.

Trebi is a high-yielding, six-rowed, rough-awned variety with very poor malting quality. It is resistant to certain common races of loose smut but is susceptible to stem rust, covered smut, and a number of other diseases. The kernels have blue aleurone and are very large.

Tregal is a six-rowed, smooth-awned variety which has yielded relatively well in Minnesota, but it is unsuited for malting purposes. Its disease reaction is like that of one of its parents, Trebi. The other parent is Regal. Tregal was selected at the North Dakota Agricultural College.

Oats

W. M. Myers and K. S. Koo

YIELD COMPARISONS

Average yields of the varieties at eight locations are presented in table 3. Because of crop failure, no data are available for northern Minnesota in 1952 or for Waseca in 1953. Trials were initiated in southwestern Minnesota in 1947 and in northern Minnesota in 1950.

Six varieties—Gopher, Bonda, Mindo, Clinton, Andrew, and Ajax—have been continuously under test at five stations for 10 years. New varieties such as Clintland, Sauk, and Waubay have been in the tests for two years, while Rodney was tested for the first time in 1954. Yields of James, a hull-less variety, are multiplied by 10/7 to make them comparable with yields of hulled varieties.

The adjusted grand average of all trials indicates that among the recommended varieties, Ajax and Branch have been highest in yield, followed in declining order by Mo. O-205, Andrew, Clinton, James, Mindo, Clintafe, and Bonda. Of the four varieties in trials for one to two years, Rodney and Sauk were high in yield while Waubay and Clintland were intermediate. Gopher, which was used as a check variety for a long period of years, was intermediate in yielding ability.

In 1954, race 7 of stem rust was again the most prevalent of all races, and the grain production of varieties suscep-

tible to this race was reduced as a result. This was especially true for Shelby, which has been one of the high yielders over a period of years but which was extremely poor in yield in 1953-54. Therefore, this variety was removed from the recommended list.

OTHER AGRONOMIC CHARACTERS

Comparative data on agronomic characters other than yield for five locations are summarized in table 4.

The earliest variety in date of heading was Mindo. Andrew headed one day later and Mo. O-205 and Clintland two days later than Mindo. Bonda, Clinton, and James were three days later than Mindo. Gopher, Clintafe, and Waubay were five days later than Mindo, one day earlier than Sauk, and two days earlier than Ajax and Shelby. Branch and Rodney were the latest, heading out nine and ten days later than Mindo, respectively.

Mindo is the shortest variety while Ajax, Branch, and Rodney are the tallest. Shelby, Bonda, Mo. O-205, Clintafe, Waubay, and Sauk are also relatively tall varieties.

James, the hull-less variety, was outstanding in weight per bushel. Among the hulled varieties, Bonda, Mo. O-205, Waubay, and Clintland were superior. Gopher, Ajax, Clintafe, and Sauk were

Table 3. Average Adjusted Yields of Oats

Variety	Years of trial	Rosemount	Waseca*	Morris	Crockston	bushels per acre				
						Grand Rapids	Duluth	Southwestern Minnesota†	Northern Minnesota‡	Grand average
Gopher	1945-54	67.5	73.5	92.8	64.7	68.4	66.1	67.1	68.5	71.1
Bonda	1945-54	69.4	73.6	75.4	62.3	61.4	63.5	63.0	62.6	66.4
Mindo	1945-54	69.6	76.8	79.8	64.2	62.8	66.7	59.1	61.0	67.5
Clinton	1945-54	71.2	79.0	79.2	64.4	66.5	66.6	63.1	61.2	68.9
Andrew	1945-54	73.8	75.4	84.8	66.3	69.1	69.6	66.2	72.2	72.2
Ajax	1945-54	75.0	80.6	91.5	72.0	77.7	74.7	73.1	72.6	77.2
Shelby	1948-54	67.6	76.4	84.9	69.0	67.1	68.9	65.0	56.1	69.4
James§	1949-54	70.6	73.5	81.2	67.7	58.0	60.5	66.4	63.8	67.7
Branch	1950-54	74.6	75.2	98.0	67.9	79.7	79.9	69.6	68.6	76.7
Mo. O-205	1951-54	77.0	82.4	89.7	69.0	70.3	70.8	74.2	68.8	75.3
Clintafe	1952-54	74.3	75.4	84.4	63.3	64.2	62.7	57.7	57.2	67.4
Waubay|| .....	1952,54	74.2	78.3	90.5	62.7	72.9	70.9	65.0	66.3	72.6
Clintland	1953-54	83.9	76.3	88.3	73.7	60.2	65.1	60.1	62.9	71.3
Sauk	1953-54	76.1	83.1	99.1	79.3	84.7	78.7	72.6	70.9	80.6
Rodney	1954	68.7	82.8	116.7	57.5	88.3	90.0	72.6	77.2	81.7
L.S.D. at 5 per cent point¶		3.5	4.2	4.2	5.1	4.9	4.1	4.1	5.6	1.6

* No data available in 1953.

† No data available in 1945-46.

‡ No data available in 1945-49 and 1952.

§ Yield adjusted to allow for absence of hull.

|| No test conducted for this variety at Grand Rapids, Duluth, and northern Minnesota in 1952.

¶ Only varieties grown for the entire period included.

relatively low in weight per bushel; other varieties were intermediate.

In hull percentage, Mo. O-205, Andrew, and Clintland were the lowest, while Branch and Rodney were the highest. Bonda, Ajax, and Clintafe were also relatively high in this character.

Bonda was highest in weight per 200 kernels, followed by Sauk, Waubay, Rodney, and Andrew. Clintafe had the lowest kernel weight among the hulled varieties.

In standing ability, Gopher, Ajax, Shelby, and Branch were inferior to the other varieties.

DISEASE REACTION

Races 7 and 8 of stem rust have been prevalent in Minnesota, with race 7 the most prevalent in 1953-54. Andrew, Ajax, Branch, Mo. O-205, Waubay, and Sauk are resistant to race 7 but susceptible to race 8. Bonda, Mindo, Clinton, Shelby, James, Clintafe, and Clintland are resistant to race 8 but susceptible to race 7. Rodney is resistant to all known races except 7A which is not prevalent at present. Gopher is susceptible to both races 7 and 8.

All varieties except Clintafe and Clintland are susceptible to certain prevalent races of crown rust. Branch, Mo. O-205, and Rodney have shown some tolerance to this rust in the field because of their resistance to some fraction of the prevalent races.

All varieties except Ajax are resistant to the smuts.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Ajax has white grain and is later in maturity than Bonda, Mindo, Clinton, and Andrew. Ajax has been outstanding in yielding ability on the average and is similar to Shelby in standing ability. It is less desirable than other recommended varieties except Clintafe in weight per bushel. It is susceptible to smut and resistant to race 7 of stem rust. It was developed in Canada from the cross Victory x Hajira.

Andrew is an open-panicked, yellow-grained, very early maturing oat which has excelled in yielding ability in trials arranged by the United States Department of Agriculture throughout the

Table 4. 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 per bushel	Hull	Weight of 200 kernels	Standing ability†
		inches	pounds		per cent		grams
Gopher	June 28	35	32.9	32.2	4.5	2
Bonda	June 26	37	36.0	33.2	5.8	1
Mindo	June 23	32	33.8	31.6	4.9	1
Clinton	June 26	35	33.8	30.3	4.8	1
Andrew	June 24	35	34.4	27.8	5.4	1
Ajax	June 30	40	33.3	33.2	4.9	2
Shelby	June 30	39	34.9	32.6	5.1	2
James	June 26	36	41.1	0	3.5	1
Branch	July 2	41	33.9	34.7	4.8	2
Mo. O-205	June 25	37	35.5	27.0	4.5	1
Clintafe	June 28	37	32.7	33.3	4.0	1
Waubay	June 28	37	35.8	31.3	5.6	1
Clintland	June 25	34	35.7	28.0	5.1	1
Sauk	June 29	37	33.1	30.3	5.7	1
Rodney	July 3	41	34.2	35.0	5.5	1

* Rosemount, Waseca, Morris, Crookston, and southwestern Minnesota.

† 1 = good; 2 = medium.

Corn Belt. It has good weight per bushel, excellent standing ability, and a low hull percentage. It is similar to Clinton in plant height. It is resistant to smut and to race 7 of stem rust. It was selected at the Minnesota Agricultural Experiment Station from a cross of Bond x Rainbow.

Bonda is a good-yielding, open-panicked, early maturing oat with a yellowish-white, large-sized grain of superior bushel weight. It is taller than Andrew or Clinton and is about equal to them in standing ability. It is resistant to smut and to race 8 of stem rust. Bonda was selected at the Minnesota Agricultural Experiment Station from a cross of Bond x Anthony.

Branch is a white oat that excels in height of plant and is late in maturity. It has given excellent yields but has lodged somewhat more than other recommended varieties. It also has a relatively high hull percentage. It is resistant to smut and to race 7 of stem rust. It was developed in Wisconsin from the cross (Forward x Victoria-Richland) x Forward.

Clintafe is about one or two days later in maturity and one to two inches taller than Clinton. It is the only recommended variety resistant to all prevalent races of crown rust. It is also resistant to race 8 of stem rust and to smuts. It has been lower in yield and in bushel weight than Clinton. It was developed at the Iowa Agricultural Experiment Station from a cross of Clinton x Santa Fe, backcrossed three times to Clinton.

Clinton is a good-yielding, open-panicked, yellow-grained, early maturing oat with good weight per bushel. It is intermediate in height between Bonda and Mindo. Clinton has a relatively low hull percentage. It is resistant to smut and to race 8 of stem rust. It was selected at the Iowa Agricultural Experiment Station from a cross of D69 x Bond.

James is a hull-less variety. It has excellent standing ability, is about like Bonda and Clinton in time of maturity, and has good yielding ability. It is resistant to smut and to race 8 of stem rust. It was selected in South Dakota from the cross (Bond-Double Cross B) x Nakota.

Mindo is a good-yielding, very early, open-panicked, yellowish oat with good weight per bushel. The straw is short and the variety has good resistance to lodging. It is resistant to smut and to race 8 of stem rust. Mindo is more susceptible to 2,4-D than other varieties tested. Mindo was selected at the Minnesota Agricultural Experiment Station from a cross of Bond x [(Minota x White Russian) x Black Mesdag].

Mo. O-205 is a grayish-red oat. It is high in yield and has good straw strength, low hull percentage, and good test weight. It is about like Bonda in maturity. It is resistant to smut and to race 7 of stem rust. Mo. O-205 was developed in Missouri from the cross Columbia x (Victoria-Richland).

Varieties Not Adequately Tested

Abegweit is a tall, weak-strawed, and late variety with large white grain of low test weight. It is resistant to race 7 of stem rust but is susceptible to crown rust and to smut. It was selected in Canada from Erban x Vanguard.

Clarion is medium tall and medium maturing, with large, yellow seed of high test weight. It is resistant to race 7 of stem rust, resistant to smuts, and susceptible to crown rust. It was selected in Iowa from the cross Clinton x Marion and was released in several New England states in 1953.

Clintland is similar to Clinton in most characteristics but has resistance to all prevalent North American races of crown rust. It was developed in Indiana from the cross Clinton x Landhafer, backcrossed three times to Clinton.

Garry was developed some years ago in Canada from a cross of Victory x (Victoria x Hajira-Banner). It has been reselected for purity of agronomic characters and disease resistance. It is a tall, late, and good-yielding variety, with large yellow seed of medium test weight. It is resistant to all races of stem rust, including race 7A, and has some tolerance to crown rust. It is also resistant to the smuts.

Rodney is tall and very late, has large, plump seed and a high test weight, and is apparently high in yield. It has resistance at moderate temperatures to all stem rust races except 7A. It was developed in Canada from a cross [(Victoria x Hajira-Banner) x (Victory x Hajira)] x Roxton.

Sauk is tall, late maturing, good yielding, and somewhat susceptible to lodging. It is resistant to race 7 of stem rust. It was developed in Wisconsin from the cross (Forward x Victoria-Richland) x Andrew.

Simcoe is tall, medium maturing, and good yielding. It has large yellowish-white seed of medium test weight. It is resistant to race 7 of stem rust but susceptible to crown rust and the smuts. It was developed in Canada from a cross of Ajax x Erban.

Varieties Not Recommended

Beaver has given medium yields in rod-row trials. It is late maturing, moderately susceptible to lodging, and low in test weight. It is susceptible to crown rust, smuts, and race 8 of stem rust. It is a Canadian variety selected from a cross of Vanguard x Erban.

Benton is tall and medium maturing. It has the same resistance to diseases as Clinton but in three-year trials has yielded less in Minnesota than the recommended varieties. It was produced from a cross of D69 x Bond at the Iowa Station and has been increased in Illinois and Indiana.

Bonham is earlier and slightly taller than Clinton, has good test weight, but has yielded less than the recommended varieties. It is resistant to race 8 of stem rust. It is a mass selection made in Michigan from C.I.3664, a cross of Bond x D69. It has been increased and distributed by the Michigan Station.

Cherokee is slightly earlier and shorter than Clinton and has good test weight. It has been inferior to recommended varieties in yield and, contrary to previous reports, has not been resistant to crown rust. It is resistant to race 8 of stem rust. It is a selection from a cross of D69 x Bond which has been increased in Iowa and Kansas. Cherokee also is grown under the names Ames No. 2, McCarthy, or 3846.

Colo was developed from a cross of Hancock x Morota-Bond. It has been inferior in yield to recommended varieties in tests in Minnesota. It is taller and later than Clinton and Bonda and has been low in test weight. It is susceptible to crown rust but is resistant to race 8 of stem rust.

Craig is medium tall and late. It has large white seed of medium test weight, but in Minnesota trials it has been low in yield. It is susceptible to both races 7 and 8 of stem rust and to crown rust but is resistant to smuts. It was developed in New York from the cross Ithacan x Victoria.

Eaton is a selection from a cross of Bond x Iogold increased in Michigan. It is resistant to the smuts and to race 7 of stem rust. It is susceptible to crown rust.

Exeter is late in maturity. In rod-row trials its yields have been good though not superior to those of recommended varieties. Exeter has weak straw and a low test weight. It is susceptible to crown rust and resistant to race 7 of stem rust. It was selected in Canada from a cross of Victory x Rusota.

Fortune is a tall variety selected at the University of Saskatchewan from the cross Victory x [(Victoria x Rich-

land) x (Markton x Victory)]. It is resistant to race 7 of stem rust but susceptible to race 8; it is also susceptible to crown rust. It is late in maturity, has a tendency to lodge, and is low in test weight.

Gopher is a white-grained, medium maturing variety selected as a pure line from Sixty Day at the Minnesota Agricultural Experiment Station. It is susceptible to stem rust, crown rust, and the smuts.

Larain was selected from a cross between Gold Rain and Alaska made at the Central Experimental Farm, Ottawa. It has weak straw and a low test weight. It is susceptible to the rusts and smuts and inferior in yield to the recommended varieties.

La Salle is early in maturity and medium in height. In preliminary tests in Minnesota it has been inferior in yield. It is resistant to smut and to race 8 of stem rust. It was selected in Illinois from the cross Clinton x Marion.

Marion is a medium-maturing variety selected in Iowa from a cross of Markton x Rainbow. It has been somewhat low in yield in tests in Minnesota but has had slightly greater resistance to prevalent races of crown rust than recommended varieties selected from Bond crosses. It is resistant to race 7 of stem rust.

Nemaha is almost identical to Cherokee and likewise has been inferior in

yield to the recommended varieties. It was developed at Iowa from the cross (Victoria-Richland) x (Morota x Bond).

Shelby has a yellowish-white grain and matures as late or slightly later than Ajax. It does not stand up as well as some other recommended varieties although it has a good straw type. It had yielded somewhat higher on the average than the recommended varieties in the previous years. However, in the past two years its extreme susceptibility to race 7 of stem rust caused a serious reduction in yield. It is resistant to smut and susceptible to crown rust. It was selected in Iowa from a cross of Anthony x Bond.

Waubay is medium in plant height and in maturity. It has large yellow seed of high test weight, and its lodging resistance is good. Waubay, resistant to race 7 of stem rust, has been fair in yield but somewhat lower than recommended varieties with race 7 resistance. It is also resistant to smut but susceptible to crown rust. It was developed in South Dakota from a cross of Clinton x Marion.

Zephyr is medium maturing, has a large grain that is grayish yellow in color, and has medium bushel weight. It is inferior to Bonda, Clinton, Mindo, and Andrew in standing ability. It was selected at the Minnesota Agricultural Experiment Station from the cross Bond x Anthony.

Rye

R. G. Robinson, K. S. Koo, W. M. Myers

Most of Minnesota's rye production consists of winter (fall-sown) varieties. Spring-sown varieties have been tested but have failed to produce even half the yield of winter varieties.

Average yields of rye for several years at five locations are reported in

table 5. Adams and Caribou are the recommended varieties, and they were the highest yielders. Antelope, Dakold 23, and Imperial have also yielded well. Yields of Tetra Petkus are adversely affected by pollen from other varieties and vice versa; therefore Tetra Petkus

must be isolated from other varieties to obtain maximum yields.

Winter hardiness is of major importance for fall-sown varieties, and observations indicate that Caribou, Antelope, Dakold 23, Pierre, Emerald, and perhaps Horton are very hardy. Adams and Imperial are good in winter hardiness, but Bessarabian, Von Rumker, and German are only fair. Tetra Petkus is poor in winter hardiness and has winterkilled slightly more than Minter winter wheat.

Lodging is a serious problem in rye harvesting. Tetra Petkus and Von Rumker are the stiffest strawed varieties. German and Pierre stand slightly better and Emerald slightly worse than the recommended varieties.

Horton and Pierre mature early; Tetra Petkus matures about seven to ten days later. Adams, Caribou, Antelope, Dakold 23, Emerald, and Imperial are about two days later than Horton and two to four days earlier than German, Bessarabian, and Von Rumker.

Height differences among these rye varieties are small and of little importance.

Bushel weight is an important grading factor, and Caribou, Antelope, Dakold 23, and Pierre were generally high in this characteristic. Tetra Petkus was consistently low in bushel weight.

Tetra Petkus has the largest seeds and Bessarabian the second largest. Adams, Imperial, German, and Von Rumker have medium size seeds, and the other varieties have small seeds. On the basis of seed size only—other factors being constant—five pecks of the small-seeded varieties, six pecks of Adams or Imperial, seven to nine pecks of Von Rumker, German, or Bessarabian, and ten to twelve pecks of Tetra Petkus should be sown per acre.

For fall and early spring forage or green manure, Horton was the best variety. Caribou, Antelope, Pierre,

Dakold 23, and German appeared to make less fall growth than the other varieties but these differences were small. Early spring forage growth of Tetra Petkus was noticeably less than that of the other varieties.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Adams is high yielding, winter hardy, and medium in maturity, bushel weight, and seed size. The seed is light brown. It is a combination of lines from Imperial which were selected for high fertility. The University of Wisconsin released it in 1953.

Caribou is high yielding, very winter hardy, medium in maturity, and high in bushel weight. The seed is small and somewhat mixed in color. It was selected from Crown rye by the University of Saskatchewan and increased and released by the University of Minnesota in 1953.

Varieties Not Adequately Tested

German is medium in yield, winter hardy, medium in maturity, and good in lodging resistance. The seed is medium in size and bushel weight. The variety originated in Germany.

Horton is medium in yield, winter hardy, high in bushel weight, and high in fall and early spring forage growth. The seed is small and mixed in color. It resembles Balbo in growth habit and forage production and has the great advantage of winter hardiness, which Balbo lacks. It may have a special place in Minnesota as a pasture rye and as a rye for plowing under before planting corn, potatoes, or soybeans on sandy land. This variety originated at MacDonald College of McGill University in Canada. A single plant selection

Table 5. Average Adjusted Yields of Winter Rye

Variety	Years of trial	St. Paul	Sandy soil ¹	Years of trial	Morris	Grand Rapids	Years of trial	Southwestern Minnesota	
								bushels per acre	Adjusted average
Adams	1951-54	32.6	23.9	1953-54	42.0	45.3	1953-54	bushels per acre	37.0
Caribou	1950-54	34.1	24.2	1953-54	42.9	49.2	1953-54		41.0
Antelope	1950-54	32.6	25.1	1953-54	42.4	45.3	1953-54		40.6
Bessarabian	1950, 1952-54	25.6	23.8				1954		38.6
Dekold 23	1950-54	31.3	21.2	1953-54	41.2	43.1	1953-54		30.5
Emerald	1950-54	30.7	22.2	1953-54	36.6	46.4	1953-54		40.1
German	1953-54	17.9	18.4	1954	36.2		1954		35.0
Horton	1952-54	24.0	23.1	1954	34.0	46.4	1954		34.8
Imperial	1950-54	31.3	23.6	1953-54	35.6	44.6	1953-54		35.0
Pierre	1950-53	29.6	20.2	1953-54	40.7	41.4	1953		32.4
Tetra Petkus	1953-54	8.4	8.4	1953-54	20.6	29.7	1953-54		43.7
Tetra Petkus isolated [†]	1953-54	20.1		1953-54	33.8	44.5	1953-54		30.5
Von Rumker	1954	0.0	24.5				1954		15.8
L.S.D. at 5 per cent point		3.1	2.7		4.5	8.1			31.6
									29.6
									23.5
									7.5

[†] At least 100 feet from any other rye variety.

* Fields in Anoka and Stearns Counties.

from Cochrane rye was selfed for two generations and then allowed to open pollinate for several generations with other selections from Cochrane.

Tetra Petkus is high yielding if there is no winter injury, but in most trials it has been winterkilled or injured so badly that its yield is low or medium. It is late maturing and low in bushel weight. The seed is very large and uniformly greenish-gray in color. Its excellent lodging resistance is its only advantage to the farmer. For maximum yield, this variety must be grown isolated from other rye varieties, because pollen from other rye will reduce the seed set of Tetra Petkus and vice versa. Tetra Petkus originated in Germany as a result of increasing the number of chromosomes in the Petkus variety from fourteen to twenty-eight by using the chemical, colchicine.

Von Rumker is fair in winter hardiness—more hardy than Tetra Petkus but considerably less so than Adams. It is a high yielder if it overwinters without injury. It has excellent lodging resistance and is late maturing, low in bushel weight, and medium in seed size. It originated in northern Germany.

Varieties Not Recommended

Antelope appears identical to Caribou, its sister selection, except it has yielded less in Minnesota. This variety was released by the University of Saskatchewan in 1952.

Balbo is low yielding, early maturing, good in lodging resistance, and poor in winter hardiness. The seed is small and the bushel weight medium. The variety was introduced from Italy and named by the Tennessee Agricultural Experiment Station about 1932.

Bessarabian is fair in winter hardiness and medium late in maturity. It is a medium to high yielder if it overwinters without injury. It has medium large seed and is medium in bushel

weight. The variety originated in Bessarabia, and seed was obtained from the University of Alberta.

Canadian Spring and **Prolific Spring** are spring-sown varieties, very low yielding, late maturing, and low in bushel weight. Prolific Spring was introduced from Germany by the University of Saskatchewan.

Dakold is low yielding but otherwise resembles Dakold 23. It originated at North Dakota Agricultural College.

Dakold 23 is medium to high in yield, very winter hardy, medium in maturity, and high in bushel weight. The seed is small. It was selected for improved winter hardiness from Dakold by the University of Saskatchewan.

Emerald is medium in yield, maturity, and bushel weight. It is very winter hardy. It sometimes lodges badly. The seed is small and green. It was developed at the University of Minnesota by selecting green seed in self-pollinated lines and their combinations.

Florida Black is a spring-sown variety, very low yielding, late maturing, and moderately resistant to leaf rust. The seed is very small and low in bushel weight.

Imperial appears identical to Adams except that it has yielded less in Minnesota and Wisconsin trials. The variety originated at the University of Wisconsin.

Pierre is medium in yield, very winter hardy, early maturing, and fairly good in lodging resistance. The seed is small and of high bushel weight. This variety is a recombination of inbred lines from a population of Dakold and Swedish origin and was released by South Dakota State College in 1950.

White Soviet is low yielding, winter hardy, and medium in maturity. The seed is medium in size and bushel weight. It was developed by a seed company from an introduction from Canada.

Spring Wheat

E. R. Ausemus, D. W. Sunderman, K. J. Hsu

Comparative yield data are given in table 6 for the varieties grown at the six experiment stations during 1946-54 and in southwestern Minnesota during 1947-54. Selkirk was the highest yielding recommended bread wheat at five locations; Lee was second and Rushmore third. Sentry was the highest yielding durum wheat.

Comparative data on agronomic characters are given in table 7. All varieties except Selkirk are susceptible in the field to stem rust. Lee, Selkirk, and the durums are resistant to leaf rust. All recommended varieties have acceptable milling and baking quality.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Bread

For All Sections

Lee is early, bearded, moderately resistant to bunt, resistant to leaf rust, and susceptible to loose smut. It has short, medium-strength straw. It has a good test weight and appears about equal to Thatcher in milling and baking characters. Lee is a selection from a cross of Hope x Timstein made by

Table 6. Average Adjusted Yields of Bread Wheats and Durums

Variety	Years of trial	Rose-mount	Waseca	Morris	Crookston	Years of trial	Average, five loca-tions*		Years of trial	Grand Rapids	Duluth	Years of trial	Northern Minnesota
							South-western Minnesota	locations*					
			bushels per acre				bushels per acre			bushels per acre			bushels per acre
Bread wheats													
Thatcher	1946-54	20.0	19.0	27.5	23.3	1947-54	19.9	21.9	.....	.....	.....	.....	.....
Mida	1946-54	21.9	21.0	27.9	25.2	1947-54	20.9	23.4	1946-54	21.4	19.6	1950-54	20.4
Henry	1946-54	28.2	26.0	33.9	29.6	1947-54	24.8	28.5	1946-54	25.6	23.9	1950-54	27.6
Lee	1946-54	27.3	24.6	33.6	28.2	1947-54	24.2	27.6	1946-54	25.9	22.9	1950-54	26.9
Rushmore	1949-54	25.1	23.9	31.1	26.6	1949-54	22.2	25.8	1950-54	23.1	22.9	1950-54	22.7
Selkirk	1953-54	40.4	36.6	50.9	40.8	1953-54	38.9	41.5	1953-54	21.0	36.6	1953-54	39.9
Kentana	1953-54	28.3	31.6	43.5	35.1	1953-54	34.8	34.7	1954	22.3	.....	1954	32.2
Durums													
Mindum	1946-54	21.5	.....	28.8	24.7	.....	.....	25.0	.....	.....	.....	.....	.....
Carleton	1946-54	17.9	.....	24.8	22.4	.....	.....	21.7	.....	.....	.....	.....	.....
Stewart	1946-54	19.1	.....	27.7	24.5	.....	.....	23.8	.....	.....	.....	.....	.....
Nugget	1950-54	17.6	.....	23.0	21.9	.....	.....	20.8	.....	.....	.....	.....	.....
Sentry	1953-54	21.0	.....	32.9	26.9	.....	.....	26.9	.....	.....	.....	.....	.....
L.S.D. at 5 per cent point		1.4	1.3	1.4	2.4	.....	1.3	0.7	.....	2.1	1.9	.....	2.4

* For durums, averages are of Rosemount, Morris, and Crookston only.

Table 7. Averages of Spring Wheat Varieties for Date of Heading, Plant Height, and Weight per Bushel

Variety	Years of trial	Date heading	Height	Weight per bushel
			inches	pounds
Bread wheats				
Thatcher	1946-54	6/27	35	54.4
Midra	1946-54	6/28	38	56.6
Henry	1946-54	6/28	38	56.0
Lee	1946-54	6/26	33	57.1
Rushmore	1946-54	6/26	35	57.2
Selkirk	1953-54	6/28	35	61.6
Kentana	1953-54	6/28	35	61.5
Durums*				
Mindum	1946-54	7/2	45	56.2†
Carleton	1946-54	7/3	45	54.5†
Stewart	1946-54	7/3	46	55.9†
Nugget	1950-54	6/28	36	52.9†
Sentry	1953-54	6/28	38	57.4

* Grown at Rosemount, Morris, and Waseca.

† Data for 1954 not included.

the Minnesota Agricultural Experiment Station in cooperation with the United States Department of Agriculture.

Rushmore is an early, awnless variety that has yielded less than Lee. It is susceptible to leaf rust but has good test weight and milling and baking qualities. It is a selection from a cross of Rival x Thatcher by the South Dakota Agricultural Experiment Station.

Selkirk is an awnless variety of medium height, maturity, and straw strength. It is moderately resistant to stem rust and leaf rust, is high in yield, and has good bushel weight. Its milling and baking qualities are satisfactory. Selkirk is a selection from a cross of McMurachy-Exchange x Redman⁹ made at the Dominion Laboratory of Cereal Breeding, Winnipeg, Canada.

Durum

West Central and North-western Sections

Carleton is bearded, amber kernalled, and somewhat lower in yield than Mindum. It is moderately resistant to leaf rust and loose smut, moderately sus-

ceptible to bunt, and susceptible to scab. It has strong straw. It is about equal to Mindum in quality for semolina products. Carleton was selected from a Mindum x Vernal Emmer backcross made by the United States Department of Agriculture in cooperation with the North Dakota Agricultural Experiment Station.

Mindum is bearded, amber kernalled, and high in yielding ability. It is moderately susceptible to bunt, susceptible to scab, but resistant to leaf rust. It has weaker straw than Carleton. It has excellent quality for semolina products. Mindum resulted from a durum type selected from a common bread wheat at the Minnesota Agricultural Experiment Station.

Stewart is bearded and amber kernalled, and it yields as well as Mindum. It is moderately resistant to leaf rust and loose smut, moderately susceptible to bunt, and susceptible to scab. It has weaker straw than Carleton. It is equal to Mindum in quality for semolina products. Stewart is a selection from a Mindum x Vernal Emmer backcross made by the United States Department of Agriculture in cooperation with the

North Dakota Agricultural Experiment Station.

Varieties Not Adequately Tested

Bread

Kentana is a bearded semihard wheat produced by the Mexican breeding program. It is moderately resistant to stem rust and leaf rust. It has been tested for two years only and has yielded well with high test weight. This variety was not good in milling and baking quality in 1954 because its mixing time was shorter than the commonly accepted bread wheats.

Durum

Sentry is a selection from Ld 308 x Nugget made at the North Dakota Agricultural Experiment Station. This variety was first tested in 1953 and was the highest yielding durum. It develops considerable rust but appears to have tolerance to stem rust and this tolerance allows it to produce a good yield and quality of grain. Preliminary tests show it to be satisfactory for use in making semolina products.

Varieties Not Recommended

Bread

All varieties are susceptible to stem rust race 15B, but many of them are resistant to other races.

Apex is low in yield and susceptible to leaf rust. It is not as satisfactory in milling and baking characters as Thatcher. It was developed from a cross of (Double Cross x H-44) x Marquis.

Cadet, an awnless variety, has been lower in yield than the best yielding wheats. It is satisfactory in milling and baking characters except that it has a low test weight, similar to Newthatch. It was developed cooperatively by the United States Department of Agriculture and the North Dakota Experiment Station.

Ceres, a bearded variety, has some-

what weaker straw than Thatcher and is equal to it in milling and baking qualities. It is moderately susceptible to fusarial head blight and susceptible to leaf rust, bunt, and loose smut.

Henry, a bearded variety developed by the Wisconsin Station, is good yielding, moderately susceptible to bunt, and susceptible to scab. It is unsatisfactory in milling and baking characters.

Mida is a bearded variety with medium maturity and strength of straw. It is moderately resistant to bunt but susceptible to scab, loose smut, leaf rust, and stem rust. It has satisfactory milling and baking characteristics. It is a selection from a cross of (Ceres-Double Cross) x (Ceres-Hope-Florence) made at the North Dakota Station.

Newthatch has high quality but is not satisfactory in yield or leaf-rust resistance. It is susceptible to scab. It is a combination of a series of selections from a cross of Hope x Thatcher backcrossed to Thatcher. It was developed at the Minnesota Agricultural Experiment Station.

Pilot is a bearded variety that is susceptible to leaf rust and has weak straw. It is lower in yield and bushel weight than the best yielding wheats, but it is satisfactory in milling and baking characters. It is a selection from a cross of Hope x Ceres developed by the United States Department of Agriculture and the North Dakota Station.

Premier is moderately resistant to bunt, but it is susceptible to loose smut, scab, and black chaff. It is unsatisfactory in milling and baking characters. This variety is a selection from a cross of Ceres-Hope-Florence x Double Cross R.L. 625 developed by the North Dakota Station.

Redman is an awnless variety which appears slightly superior to Regent but not equal to the recommended varieties. It was selected from a cross of Canus x Regent made at the Dominion Laboratory of Cereal Breeding at Winnipeg, Canada.

Regent is a beardless variety which has been lower in yield than the recommended varieties and is susceptible to leaf rust and scab. This variety is equal to Thatcher in milling and baking qualities. Regent is a selection from a cross of H-44 x Reward made at the Dominion Laboratory of Cereal Breeding, Winnipeg, Canada.

Rescue is a beardless, low-yielding variety which has been developed for the area where sawfly is present. Rescue shatters easily and is weak strawed, rust susceptible, and of poor quality. It should be grown only in sawfly-infested areas. It is a selection from a cross of Apex x S615 (a solid stem line of common wheat) developed by the Dominion Department of Agriculture at Swift Current, Canada.

Rival, a bearded variety, is susceptible to leaf and stem rust, resistant to bunt and loose smut, moderately susceptible to scab, and susceptible to black chaff. It has somewhat weaker straw than Thatcher and tends to shatter. Rival has a higher test weight than Thatcher and appears about equal to Thatcher in milling and baking qualities. It is a selection from a cross of Ceres x (Hope-Florence) made at the North Dakota Experiment Station.

Spinkota is a bearded variety which is susceptible to leaf rust, stem rust, and bunt and has inferior milling and baking quality. It is a selection of Velvet Chaff or Preston developed by a farmer in South Dakota.

Thatcher is a beardless, strong-strawed wheat. It is very susceptible to leaf rust and scab, but has high milling and baking quality.

Durum

Nugget is a very early maturing variety resistant to leaf rust. It is lower in yield than the recommended varieties but is excellent in quality. This variety is very susceptible to stem rust race 15B. It was developed at the North Dakota Agricultural Experiment Station.

Vernum is a bearded variety resistant to leaf rust. It is lower yielding than are Mindum, Carleton, or Stewart, and its quality for semolina products is not equal to Carleton and Stewart. It is a selection from Mindum x Vernal Emmer backcrossed to Mindum that was developed cooperatively by the United States Department of Agriculture and the North Dakota Agricultural Experiment Station.

Winter Wheat

E. R. Ausemus, K. J. Hsu, D. W. Sunderman

The comparative data on yield and agronomic characters for winter wheat grown at four stations during 1943-1954 are given in tables 8 and 9. Over the period of test Minter was the best yielder, Minturki and Minter the most winter hardy, Iohardi the earliest in heading, and Blackhawk the tallest and most resistant to leaf rust. The bushel weights of all varieties were good and the qualities satisfactory. None of these

varieties, however, is resistant to stem rust race 15B.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Winter wheat, where it can be grown successfully (as in southern Minnesota, in an area near Grand Rapids, and in

Table 8. Average Yield of Winter Wheat*

Variety	Minnesota number	Years used	St. Paul	Waseca	Grand Rapids	Average, three locations	Years used	Southwest Minnesota
						bushels per acre		bushels per acre
Minturki	1507	1943-54	30.7	24.6	34.1	29.8	1950-54	17.9
Minter	2713	1943-54	32.6	26.2	36.0	31.6	1950-54	22.1
Blackhawk	2725	1943-54	31.6	25.0	31.9	29.5	1950-54	19.1
Iohardi	2800	1949-54	30.4	23.8	30.3	28.2	1950-54	17.4

* Crops failed at St. Paul in 1943, 1944, 1948, and 1954; at Waseca in 1948 and 1954; and at Grand Rapids in 1943, 1944, and 1946.

extreme north central Minnesota), is more profitable than spring wheat. The two recommended varieties have been developed at the Minnesota Agricultural Experiment Station. Both are susceptible to stem rust race 15B.

Minter is a bearded, white-chaffed winter wheat which is equal to Minturki in winter hardiness and slightly better in yielding ability. Minter has had a somewhat higher weight per bushel, whiter crumb color, and a lower pigment content than Minturki. It is a selection from a backcross of (Hope x Minturki) x Minturki.

Minturki is a bearded, white-chaffed, stiff-strawed variety of the Turkey type. It is early maturing and yields well. It is moderately resistant to bunt, loose smut, and fusarial head blight but moderately susceptible to leaf rust. It is very winter hardy but not as reliable on sandy lands as winter rye. Minturki was selected from a cross of Turkey x Odessa.

Varieties Not Recommended

Blackhawk is a bearded variety of good quality. It is less winter hardy than Minturki, Marmin, or Minter, so it yields less than these varieties when winter injury is severe. It is a selection of a Fultz x Minturki cross developed by the Wisconsin Agricultural Experiment Station.

Iobred produces a high quality grain, but it is less winter hardy than Minturki and also yields less.

Iohardi is an awned variety which was released to Iowa farmers in the fall of 1948. It is a selection from an Iobred x Minhardi cross developed at the Iowa Agricultural Experiment Station.

Iowin, developed by the Iowa Station, is not as winter hardy as Minturki.

Kanred is not as winter hardy as Minturki and has weaker straw.

Marmin is a bearded winter wheat similar to Minturki except that this variety has been poorer in milling and

Table 9. Average Date of Heading, Plant Height, Winter Injury, and Weight per Bushel for Winter Wheat*

Variety	Years used	Date headed	Height	Winter injury	Bushel weight
			inches	per cent	pounds
Minturki	1943-54	June 20	38	37	58.4
Minter	1943-54	June 19	37	36	59.7
Blackhawk	1943-54	June 20	40	39	58.8
Iohardi	1949-53	June 18	38	42	59.7

* Crops failed at St. Paul in 1943, 1944, 1948, and 1954; at Waseca in 1948 and 1954; and at Grand Rapids in 1943, 1944, and 1946.

baking characters. It was selected from a cross of Minturki x Marquis.

Minhardi is a beardless variety more winter hardy and stiffer strawed than

Minturki but more susceptible to stem rust and bunt. It is less widely adapted than Minturki, and the grain quality is somewhat less desirable than Minturki.

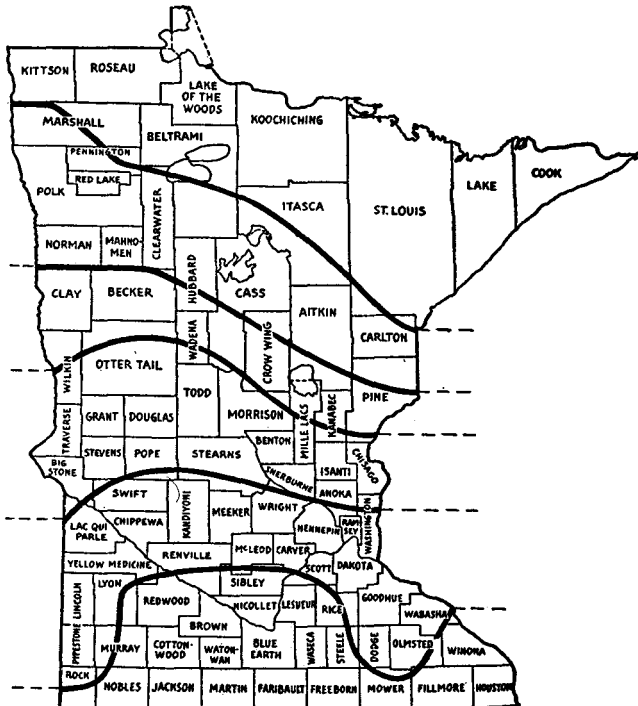
Corn

E. H. Rinke and E. L. Pinnell

About 98 per cent of the corn acreage of Minnesota is planted to hybrid varieties. Over 650 hybrids are registered for sale in Minnesota. These in-

clude open-pedigree hybrids developed by state experiment stations and closed-pedigree hybrids developed by commercial seed companies.

Corn Maturity Zones in Minnesota



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

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 17 Minhybrids, four Wisconsin hybrids, one North Dakota (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 refers to the average number of days that may be expected from emergence of the seedlings to the stage when moisture in the ears on standing plants is about 40 per cent. Table 10 gives the

pedigrees and maturity ratings for the recommended hybrids.

Tables 11 through 17 present long-time data on the performance of recommended hybrids and also of a few widely grown open-pedigree hybrids. 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.

Data are obtained from test plantings on experiment station and farmers' fields. Varieties are planted at population levels of approximately 12,000 plants per acre. Fertilization is determined by each farmer on whose farm the test plot is grown.

Table 10. Pedigrees and Maturity Ratings of Hybrids Recommended for Minnesota

Hybrid	Pedigree	Maturity zone	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 414	(A286 x A295) (A73 x A375)	Southern Zone	110-114*
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 511	(A73 x A401) (Oh51A x A286)	South Central Zone	107-111*
Minhybrid 509	(A286 x A295) (Oh51A x A375)	South Central Zone	107-111*
Minhybrid 507	(W10 x A334) (B9 x Oh51A)	South Central Zone	105-109*
Wisconsin 464A	(WM13R x R3) (W153R x W374)	South Central Zone	103-107
Minhybrid 608	(A334 x A340) (A357 x A392)	Central Zone	99-103
Minhybrid 609	(A203 x A218) (A344 x A385)	Central Zone	96-100*
Minhybrid 711	(A116 x A208) (W9 x A296)	North Central Zone	93- 97*
Minhybrid 706 (white)	(A166 x A188) (A34 x A171)	North Central Zone	90- 94
Minhybrid 707	(A116 x A204) (W9 x A96)	North Central Zone	89- 93*
Wisconsin 279	(W9 x M13) (WD x C49)	Northern Zone	86- 90
Minhybrid 802	(A96 x M42) (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 11. Average Corn Hybrid Performance in 17 Trials, 1951-54

Variety	Maturity		Smut	Height			Lodging		Ear		Good ears per 100 plants	Appear-ance*		Corn borer resist-ance*	Ear moist-ure	Yield
	Days	Zone		Plant	Ear	Shank	Root	Stalk	Length	Rows		Plant	Ear			
			per cent	inches	inches	per cent	inches	number							per cent	bushels per acre
Minhybrid 408	113-117	S	2	94	39	7	5	3	9.0	17	93	2.2	2.3	3.6	30.1	84.1
Minhybrid 412	112-116	S	2	96	41	7	10	1	9.4	17	94	1.8	2.0	2.2	30.0	88.8
A.E.S. 610	112-116	S	2	92	36	5	7	3	9.2	17	93	2.8	2.4	2.8	29.5	83.8
Minhybrid 411	112-116	S	2	94	37	5	4	2	9.1	17	93	2.4	2.2	1.9	29.0	86.4
Minhybrid 406†	111-115	S	2	92	38	6	4	2	8.6	19	90	2.3	2.5	3.3	28.5	82.6
Minhybrid 409	108-112	S	4	92	38	5	10	3	8.8	17	92	2.5	2.2	2.8	27.6	82.4
L.S.D. at 5 per cent point															0.8	2.7

* 1 = excellent; 5 = poor.

† Not recommended.

SOUTHERN ZONE

Table 12. Average Corn Hybrid Performance in 13 Trials, 1952-54

Variety	Maturity		Smut	Height			Lodging		Ear		Good ears per 100 plants	Appear-ance*		Corn borer resist-ance†	Ear moist-ure	Yield
	Days	Zone		Plant	Ear	Shank	Root	Stalk	Length	Rows		Plant	Ear			
			per cent	inches	inches	per cent	inches	number							per cent	bushels per acre
Minhybrid 408	113-117	S	1	95	40	8	7	3	8.8	16	93	2.2	2.4	4.3	29.1	88.2
Minhybrid 412	112-116	S	2	97	42	8	13	1	9.2	16	94	1.9	2.1	2.8	29.5	93.6
A.E.S. 610	112-116	S	2	93	36	5	10	3	9.0	16	93	2.8	2.4	3.2	28.7	89.1
Minhybrid 411	112-116	S	2	95	40	5	6	1	8.8	16	93	2.4	2.5	1.8	28.6	91.2
Minhybrid 406‡	111-115	S	2	94	40	6	5	2	8.5	19	90	2.3	2.5	4.0	27.4	88.4
Minhybrid 414	110-114	S	2	95	39	6	7	1	8.8	17	89	2.6	2.1	1.7	27.4	92.4
Minhybrid 409	108-112	S	4	94	40	5	13	3	8.8	16	91	2.5	2.1	3.0	27.0	87.7
Minhybrid 503	107-111	SC	3	95	40	5	10	2	8.0	16	89	2.9	2.5	4.6	27.0	83.4
Minhybrid 508	107-111	SC	5	91	37	6	10	2	8.8	16	92	2.5	2.4	3.6	26.5	86.3
Minhybrid 511	107-111	SC	2	93	40	8	14	3	8.5	15	88	2.6	2.4	2.4	26.0	90.9
Minhybrid 509	107-111	SC	3	96	41	6	16	2	8.8	16	92	3.1	2.5	2.4	25.9	87.9
Minhybrid 507	105-109	SC	2	99	42	6	11	5	9.2	16	93	2.7	2.6	4.2	24.0	89.5
L.S.D. at 5 per cent point															1.0	3.2

* 1 = excellent; 5 = poor.

† Ratings for 1954 only.

‡ Not recommended.

SOUTH CENTRAL ZONE

Table 13. Average Corn Hybrid Performance in 14 Trials, 1950-54

Variety	Maturity		Smut	Height		Shank	Lodging		Ear		Good ears per 100 plants	Appearance*		Ear moisture	Yield
	Days	Zone		Plant	Ear		Root	Stalk	Length	Rows		Plant	Ear		
			per cent	inches		inches	per cent		inches	number				per cent	bushels per acre
Minhybrid 503	107-111	SC	5	93	39	6	3	3	7.7	16	85	2.6	2.8	27.7	75.2
Minhybrid 504	107-111	SC	9	94	40	7	6	5	7.1	16	83	2.4	3.1	27.6	73.0
Minhybrid 508	107-111	SC	7	91	38	6	3	3	7.6	17	90	2.4	2.8	26.9	74.6
Minhybrid 507	105-109	SC	6	98	42	6	6	6	7.8	16	89	2.7	2.4	24.9	73.9
Wis. 464A	103-107	SC	6	95	42	5	19	5	7.3	16	85	3.0	2.8	25.4	71.6

* 1 = excellent; 5 = poor.

SOUTH CENTRAL ZONE

Table 14. Average Corn Hybrid Performance in Six Trials, 1952, 1954

Variety	Maturity		Smut	Height		Shank	Lodging		Ear		Good ears per 100 plants	Appearance*		Ear moisture†	Yield
	Days	Zone		Plant	Ear		Root	Stalk	Length	Rows		Plant	Ear		
			per cent	inches		inches	per cent		inches	number				per cent	bushels per acre
Minhybrid 503	107-111	SC	8	96	38	6	2	4	7.7	16	85	2.4	2.8	30.7	82.2
Minhybrid 508	107-111	SC	12	92	35	7	2	4	7.5	17	91	2.8	3.0	30.9	79.0
Minhybrid 509	107-111	SC	7	101	43	5	6	2	7.8	16	91	2.0	2.9	30.1	85.0
Minhybrid 511	107-111	SC	6	101	40	7	4	3	7.8	16	90	2.4	2.8	31.0	84.4
Minhybrid 507	105-109	SC	10	102	39	6	4	5	7.9	17	95	2.3	2.4	29.1	80.8
Wis. 464A	103-107	SC	12	96	40	5	10	5	7.3	16	94	3.0	2.7	29.9	79.2

* 1 = excellent; 5 = poor.

† Ratings for 1954 only.

CENTRAL ZONE

Table 15. Average Corn Hybrid Performance in 10 Trials, 1952-54

Variety	Maturity		Height			Lodging			Ear		Good ears per 100 plants	Appearance*		Ear moisture†	Yield
	Days	Zone	Smut	Plant	Ear	Shank	Root	Stalk	Length	Rows		Plant	Ear		
Minhybrid 608	99-103	C	per cent	inches		inches	per cent		inches	number				per cent	bushels per acre
Minhybrid 608	99-103	C	5	90	41	6.8	6	8	7.7	16	91	1.8	3.1	28.6	65.8
Minhybrid 609	96-100	C	3	83	36	7.0	0	4	8.2	15	95	1.7	2.7	28.3	64.0
Minhybrid 711	93- 97	NC	3	86	35	6.8	12	9	8.1	15	88	2.6	2.5	27.7	60.7

* 1 = excellent; 5 = poor.

† Ratings for 1954 only.

NORTH CENTRAL ZONE

Table 16. Average Corn Hybrid Performance in 10 Trials, 1951-54

Variety	Maturity		Height			Lodging			Ear		Good ears per 100 plants	Appearance*		Ear moisture	Yield
	Days	Zone	Smut	Plant	Ear	Shank	Root	Stalk	Length	Rows		Plant	Ear		
Minhybrid 711	93-97	NC	per cent	inches		inches	per cent		inches	number				per cent	bushels per acre
Minhybrid 711	93-97	NC	1	85	34	6	5	4	6.9	15	89	2.1	1.8	34.4	50.7
Minhybrid 708†	90-94	NC	1	86	32	7	34	4	7.7	16	87	2.5	1.8	34.5	51.6
Minhybrid 707	89-93	NC	2	84	34	7	12	4	6.5	15	88	2.3	2.4	32.8	53.1
Wis. 275‡	90-94	NC	2	80	32	6	5	3	6.7	15	83	2.4	2.6	34.0	47.9
Wis. 355‡	93-97	NC	1	89	35	6	25	2	7.1	15	81	2.1	2.7	36.3	42.5

* 1 = excellent; 5 = poor.

† White hybrid.

‡ Not recommended.

NORTHERN ZONE

Table 17. Average Corn Hybrid Performance in 14 Trials, 1951-54

Variety	Maturity		Smut		Height		Ear		Lodging		Ear		Good ears		Ear moisture	Yield bushels per acre
	Days	Zone	per cent	inches	Plant	Ear	Shank	Root	Stalk	Length	Rows	per 100 plants	Plant	Ear		
Wis. 279	86-90	N	16	76	27	5	14	3	7.0	16	77	2.0	2.8	31.7	46.1	
N.D. 301	84-88	N	10	76	27	5	10	4	7.5	15	81	2.7	2.7	30.3	46.1	
Minhybrid 802	82-86	N	9	72	26	7	39	6	7.5	15	84	3.7	2.1	29.4	46.0	
Wis. 255	82-86	N	5	75	28	6	19	3	7.0	14	80	3.1	3.0	29.2	43.4	
Wis. 240†	82-86	N	6	73	24	5	26	8	7.9	14	77	2.9	2.5	31.6	42.7	
Mor. 77	78-82	NM	13	74	25	5	20	5	6.7	16	72	3.0	2.8	26.4	42.2	

* 1 = excellent; 5 = poor.

† Flint dent hybrid.

Ratings of 1 (excellent) to 5 (poor) are used for corn borer reaction, plant appearance, and ear appearance. Corn borer ratings are taken on hand-infested plots. Percentages of smut, root lodging, and stalk breakage are averages of those trials which exhibited considerable damage for the specific character and consequently these figures are higher than they would be if data from all locations were averaged.

Flax

J. O. Culbertson

Table 18 gives the average yields in bushels per acre for the flax varieties grown at Rosemount, Waseca, Morris, Crookston, and Grand Rapids and in northern and southwestern Minnesota. Data were taken over the period 1949-54 at Morris and in southwestern Minnesota; 1949-53 at Rosemount; 1949-52 and 1954 at Waseca; 1949-51 and 1953-54 at Crookston; 1950-54 at Grand Rapids; and 1950-53 in northern Minnesota.

Redwing, Koto, and Minerva were dropped from the list of varieties recommended for sowing in 1954 and were not included in the trials. Sheyenne was also dropped from the trials, because it had been shown to be less desirable than Marine.

An attempt is made to sow all flax yield trials at an early date at each station. This early sowing usually favors the late maturing varieties, so such varieties as Redwood and B5128 probably had an advantage over Marine, an early maturing variety.

Most of the flax varieties being grown by farmers are immune to local races of rust, and little damage resulted from this disease in 1954. All the varieties are more or less susceptible to pasmo; heavy infections were reported from Waseca and Morris and a light infection from Redwood Falls. Losses

Table 18. Average Yields of Flax

Variety	Rosemount		Waseca		Morris		Crookston		Grand Rapids		Northern Minnesota		Southwestern Minnesota	
	Number of trials	Yields bushels per acre	Number of trials	Yields bushels per acre	Number of trials	Yields bushels per acre	Number of trials	Yields bushels per acre	Number of trials	Yields bushels per acre	Number of trials	Yields bushels per acre	Number of trials	Yields bushels per acre
Bison	5	14.7	5	15.2	6	21.6	5	14.4	5	10.8	4	16.0	6	15.8
Redwood	5	17.8	5	20.0	6	24.0	5	15.6	5	11.9	4	21.1	6	18.4
B5128	4	15.6	4	19.9	6	22.6	5	15.8	5	11.4	4	20.4	6	19.4
Marine	5	16.3	5	17.7	6	22.0	5	13.0	5	12.0	4	19.6	6	17.4
L.S.D. at 5 per cent point		1.5		1.7		1.4		1.6		1.4		2.5		1.3

from pasmo are difficult to estimate, but the more susceptible varieties such as B5128 and Redwood were undoubtedly injured more than the less susceptible Marine.

No single variety has been best for all locations or in all seasons. During the years of these trials, seasons generally have been favorable for late maturing varieties and these frequently have shown up best in the trials. It is likely that in very hot, dry years, a variety such as Marine would yield fully as well as Redwood or B5128.

YIELD COMPARISONS

Redwood has made the highest average yield at Rosemount, Waseca, and Morris and in Northern Minnesota, although in some instances other varieties were nearly as high in yield. B5128 was highest in yield at Crookston and in southwestern Minnesota, and Marine yielded highest at Grand Rapids.

Bison has yielded less than the other three varieties at all stations except Crookston.

OTHER AGRONOMIC AND QUALITY CHARACTERS

Data given in table 19 show the average date of ripening, plant height, weight per 1,000 seeds, oil content, and iodine number of the oil.

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, drouth, 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 one week between the earliest variety, Marine, and the latest variety, B5128.

Bison and Redwood were intermediate in maturity.

There were no important differences in plant height.

All the varieties have medium-sized seeds, although seeds of B5128 are larger than those of Marine.

The oil contents of Bison and Redwood are considered good, while B5128 was only slightly lower. Marine does not have quite as high oil content as the other three varieties.

Oil from the seed of Marine has a high iodine number, indicating excellent drying quality. Redwood ranks good, while B5128 is fair and Bison low in oil quality.

DISEASE REACTION

Bison is very susceptible to local races of rust, while Redwood, B5128, and Marine are immune.

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

None of the varieties is resistant to pasmo, although there are variations in the degrees of susceptibility. Marine is usually less severely injured; B5128 and Redwood are susceptible.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

All Sections

B5128 is a brown-seeded, blue-flowered variety resulting from a cross of Golden x Rio made at the North Dakota Agricultural Experiment Station. It is late maturing, immune to races of rust found in Minnesota, and moderately susceptible to both wilt and pasmo. For best results it should be sown early. The variety has good oil content of only fair quality. B5128 con-

tains a mixture of types, including a small percentage of yellow-seeded plants and a small percentage of rust-susceptible plants.

Marine is a brown-seeded, blue-flowered, early maturing flax selected from a cross of C.I. 975 x Sheyenne made at the North Dakota Agricultural Experiment Station. It is immune to races of rust found in Minnesota, resistant to wilt, and moderately resistant to pasmo. Marine has not yielded as well as Redwood or B5128 when sown early, but in late sowings it seems superior in yield to both these varieties. It has fairly good oil content and the oil is of high quality. This variety is recommended for sowing wherever an early maturing, disease-resistant variety is desirable.

Redwood is a brown-seeded, blue-flowered variety originating from a cross of B5128 x Redson made at the Minnesota Agricultural Experiment Station in 1941. It is midlate in maturity, immune to races of rust found in Minnesota, moderately wilt resistant, and moderately susceptible to pasmo. It has made excellent yields in field trials and has good oil content of good quality. The straw is of excellent fiber quality.

Varieties Not Adequately Tested

Raja is a new Canadian variety which has been tested only one year in Minnesota. It is an early maturing variety with brown seeds and blue flowers. The plant is medium tall and seeds are medium in size. Preliminary trials indicate it is low in both oil content and quality when grown in Minnesota. Raja is resistant to rust and wilt but susceptible to pasmo.

Varieties Not Recommended

B. Golden is a yellow-seeded variety with pink flowers that fade to white on exposure to light. It is moderately sus-

Table 19. 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 12	23	6.1	38.2	176
Redwood	August 13	23	5.8	38.2	181
B5128	August 17	23	6.7	38.0	178
Marine	August 10	22	5.1	37.6	188

ceptible to wilt. It is immune from races of rust common to the United States but is very susceptible to pasmo. The oil content of the seed is high and the oil is of good drying quality. It is not recommended because of its susceptibility to pasmo and because its short straw limits its ability to compete with weeds and causes some difficulty in harvesting. It was developed at the North Dakota Agricultural Experiment Station.

Bison is susceptible to rust but has yielded well in the Red River Valley in years when rust was not severe. It is resistant to wilt and moderately susceptible to pasmo. It is high in oil content but low in oil quality. It was developed at the North Dakota Station by plant selection. Bison has brown seeds and blue flowers.

Biwing is resistant to wilt but is moderately susceptible to rust and pasmo. It has fair oil content and quality and only fair yielding ability. The flowers are blue, the seeds brown. It was developed by the Minnesota Station.

Buda is resistant to wilt, moderately resistant to rust, and moderately susceptible to pasmo. It has fair yielding ability. The seeds are brown, the flowers blue. Buda was developed by the North Dakota Agricultural Station.

Crystal was developed by the Minnesota Agricultural Experiment Station. It has been difficult at times to obtain good stands of Crystal. The variety is immune to races of rust found in Minnesota, moderately resistant to pasmo,

and susceptible to late wilt. The seeds are yellow, with high oil content of good quality. The flowers are white.

Dakota is not recommended for Minnesota because it is susceptible to races of rust now prevalent in the state. Dakota is a selection from a cross of Renew x Bison that was first introduced in North Dakota. It has brown seeds and blue flowers.

Koto is brown seeded, high yielding, midlate in maturity, resistant to wilt, moderately susceptible to pasmo, but susceptible to races of rust common in Minnesota. It can be distinguished from Redwing by its characteristic dark blue flowers. It has medium-sized seed and satisfactory oil content and quality. It is a selection from a cross of (Russian x Argentine) x Bison made at the Northern Great Plains Field Station, Mandan, North Dakota.

Minerva is yellow seeded; the flowers are very dark blue. Yields have been moderately good. While this variety has been moderately susceptible to late wilt at St. Paul, it has been much more resistant at Fargo. It is moderately resistant to rust but moderately susceptible to pasmo. It has exceeded all varieties in percentage of oil content, and the oil quality is similar to that of Redwing. The straw is slightly less valuable for fiber for paper production than that of other varieties. It is a selection made in Minnesota from a backcross of C.I. 649 x Bison.

Redwing is well adapted for southern and central Minnesota but not for northwestern Minnesota. However, it

has been satisfactory in Koochiching and Lake of the Woods Counties and parts of Roseau County. It is early in maturity, moderately resistant to wilt, and susceptible to pasmo and rust. The seed is of small size and produces an oil of high drying quality. It was selected at Minnesota from Acc. No. 91. Where an early variety is required, Marine has been superior to Redwing.

Rocket was developed in Canada. In trials in Minnesota it has yielded slightly less than Redwood. It is resistant to rust but moderately susceptible to wilt and pasmo. It has brown seeds with good oil content of good quality. The flowers are blue.

Royal is a midlate maturing variety that is moderately susceptible to rust and wilt and susceptible to pasmo. The oil content and quality are similar to Bison. This variety has weak straw. It was developed at Saskatoon, Saskatchewan, Canada as C.A.N. 1727. The seeds are brown and the flowers blue.

Sheyenne is early, immune to races

of rust found in Minnesota, resistant to wilt, but moderately susceptible to pasmo. In trials in the state it has yielded less than have the recommended varieties when both were planted at an early date. It was developed at the North Dakota Agricultural Experiment Station. The seeds are brown, the flowers blue.

Victory is high yielding, moderately susceptible to rust and wilt, and very susceptible to pasmo. The variety lacks uniformity of type. It is easily distinguished by the characteristic large white flowers and large brown seeds. It was developed at the North Dakota Station.

Viking is very similar to B. Golden.

Walsh is a blue-flowered variety with extra-large brown seeds. It has yielded less than the recommended varieties. It is moderately resistant to wilt, immune to races of rust common in the United States, and very susceptible to pasmo. It was developed at the North Dakota Station.

Soybeans

J. W. Lambert

YIELD COMPARISONS

Average yields of soybeans for seven locations in Minnesota are given in table 20. Chippewa was outstanding in yield at all southern locations. Renville yielded well at Blue Earth and Dodge Center. Harosoy gave the highest yields in southwestern Minnesota. Hardome, an early variety tested in the southern trials for the first time, gave the lowest yields.

Of the varieties tested more than one year at Morris and Rosemount, Capital averaged highest in yield. Chippewa, Hardome, Norchief, and Ottawa Mandarin yielded similarly and only slightly less than Capital. Harosoy, a late

variety tested only one year in these trials, was lowest in yield.

Norchief and Ottawa Mandarin were the highest yielders at Crookston.

OTHER AGRONOMIC CHARACTERS

Agronomic data other than yield are given in table 21.

In the three southern locations, Hardome was the earliest variety tested, maturing three days earlier than Ottawa Mandarin. The latest variety was Hawkeye, which matured five days later than Harosoy. Blackhawk was about medium in maturity and about

Table 20. Average Yields of Soybeans

Variety	Southern locations						Central locations			Northern (Crookston)		
	Years of trial	Blue Earth	South-western Minnesota	Waseca	Average, three locations	Dodge Center 1953-54	Years of trial	Morris	Rose-mount	Average, two locations	Years of trial	Yield
												bushels per acre
Blackhawk	1950-54	37.3	27.3	34.2	32.9	27.6	1950-54	27.6	33.7	30.7		
Capital	1950-54	36.4	27.9	34.4	32.9	30.0	1950-54	31.7	36.5	34.1		
Chippewa	1952-54	41.9	29.2	37.7	36.3	33.0	1952-54	30.2	36.0	33.1		
Flambeau						24.0	1950-54	31.1	32.4	31.8	1951-54	22.1
Habaro	1950-54	39.0	26.4	34.5	33.3		1950-54	27.8				
Hardome	1954	34.7	25.2	29.2	29.7	27.3	1953-54	28.4	37.6	33.0	1954	19.3
Harosoy	1953-54	38.1	30.5	33.0	33.9	30.1	1954	26.2	29.2	27.7		
Hawkeye	1950-54	34.4	27.2	31.8	31.1							
Norchief						26.9	1953-54	30.8	35.3	33.1	1951-54	23.8
Ottawa Mandarin	1950-54	36.0	24.0	33.9	31.3	28.9	1950-54	29.5	35.7	32.6	1951-54	23.4
Pagoda							1953-54	25.8			1953-54	21.0
Renville	1950-54	39.1	26.2	34.8	33.4	31.5	1950-54	30.7	30.3	30.5		
L.S.D. at 5 per cent point		2.5	1.7	1.9	1.2	2.9		1.7	2.1	1.4		1.7

Table 21. Averages of Soybean Varieties for Date of Maturity, Plant Height, Lodging Score, and Weight per 100 Seeds in Southern and Central Locations and at Crookston*

Variety	Blue Earth, southwestern Minnesota, and Waseca				Morris and Rosemount				Crookston		
	Date mature	Plant height	Lodging score†	Weight per 100 seeds	Date mature	Plant height	Lodging score†	Weight per 100 seeds	Date mature	Plant height	Weight per 100 seeds
		inches		grams		inches		grams		inches	grams
Blackhawk	9-25	36	2.2	16.5	9-30	37	2.7	16.4			
Capital	9-16	32	2.6	13.3	9-20	33	2.7	13.0			
Chippewa	9-19	34	1.5	15.8	9-23	33	2.0	14.7			
Flambeau					9-11	29	2.8	15.8	9-6	26	14.8
Habaro	9-24	31	2.5	20.0							
Hardome	9-11	33	3.1	15.8	9-17	35	2.7	16.5	9-21	34	15.6
Harosoy	9-29	40	2.7	18.8	10-4	39		17.5			
Hawkeye	10-4	40	2.1	17.4							
Norchief					9-13	27	2.0	15.2	9-17	25	15.6
Ottawa Mandarin	9-14	28	1.3	19.4	9-18	28	1.6	19.5	9-21	29	16.9
Pagoda									9-1	22	15.9
Renville	9-19	30	1.4	18.3	9-23	30	1.5	17.5			

* For same years of trial as shown in table 20 except that maturity dates at Crookston are for 1954 only.
 † 1 = erect; 5 = completely lodged.

six days later than Chippewa and Renville.

At Morris and Rosemount, Flambeau was the earliest variety but matured only two days sooner than Norchief, six before Hardome, and seven before Ottawa Mandarin. Harosoy was the latest variety in these trials, maturing four days later than Blackhawk and 11 days later than Chippewa and Renville.

In view of their relatively poorer yield performance and their lateness, it would seem that varieties such as Blackhawk and Harosoy are poor choices for central Minnesota. Capital, Chippewa, Renville, and Ottawa Mandarin promise as great or greater yields with much less risk of frost injury.

Tallest among the varieties grown in the southern Minnesota trials were Harosoy and Hawkeye. The shortest were Ottawa Mandarin and Renville. In the central locations Harosoy and Blackhawk were tallest, while Norchief, Ottawa Mandarin, and Flambeau were shortest.

Ottawa Mandarin and Renville were outstanding in resistance to lodging. Chippewa was very good in this respect, considering its medium tall plant height. Hardome, Capital, Harosoy, and Flambeau averaged somewhat poorer in standing ability than the rest of the varieties.

Seed size averaged larger in the southern than in the central locations or Crookston. Ottawa Mandarin, Habaro, and Harosoy had the largest seeds and Capital the smallest. The only apparent commercial consideration of seed size is in relation to the amount of seed required for planting.

OIL CONTENT

Because of high costs of chemical analyses, the varieties in the regular yield trials have not been routinely analyzed for oil content in recent years, and comparative data for the periods and locations indicated in table 20 are

not available. However, from determinations made in former years on the older varieties and in recent years on the newer ones, the following general comments seem appropriate.

Of the varieties shown in the table, Renville has the highest oil content. Blackhawk, Capital, Chippewa, Hardome, and Norchief are very good in this respect. Fair to good in oil content are Flambeau, Harosoy, Hawkeye, and Ottawa Mandarin. Habaro has a low oil content.

ORIGIN AND DESCRIPTION OF VARIETIES

Maturity before frost is an important consideration in soybean varieties used for seed production. Varieties must be earlier as the average growing season becomes shorter. For this reason the regions of adaptation for seed production are included in the description of varieties.

Varieties used for hay can be somewhat later maturing than those used for seed. In general, a variety can be used about one maturity zone (see map, page 23) farther north for hay than for seed.

Recommended Varieties

Blackhawk gives high yields, grows 34 to 38 inches tall, and has considerable resistance to lodging. It tends to bear its lowest pods fairly well above the ground. The seeds are medium in size and yellow except for the light brown seed scars. The oil content of the seed is relatively high. This variety is a selection made at the Iowa Agricultural Experiment Station from a cross of Mukden x Richland. It is recommended for the Southern and South Central Corn Maturity Zones.

Capital is a high-yielding variety that averages 30 to 32 inches in height and has a distinct tendency to lodge. The

seeds are small and a dull yellow with light brown seed scars; they have a relatively high oil content. Capital was selected at the Central Experimental Farm, Ottawa, Canada, from a cross of 171 x A.K. (Harrow). It is recommended for areas of the state south of the Northern Corn Maturity Zone.

Chippewa is superior in yielding ability, grows 32 to 34 inches tall, and has very good resistance to lodging. The seeds are of medium size and are yellow with black seed scars. The oil content of the seeds is relatively high. It was selected at the U. S. Regional Soybean Laboratory, Urbana, Illinois from the cross of Lincoln x (Lincoln x Richland). It averages six or seven days earlier than Blackhawk in maturity. Chippewa is recommended for the South Central and Southern Corn Maturity Zones and for about the southern one-third of the Central Zone.

Flambeau grows 26 to 29 inches tall and has a considerable tendency to lodge. It has been a high yielder among the early varieties. The seeds are yellow with black seed scars and have a medium oil content. The variety is a selection made at the Wisconsin Agricultural Experiment Station from an introduction from Russia. It is recommended for planting in the Central, North Central, and Northern Corn Maturity Zones.

Norchief has been outstanding in yield and oil content among the early varieties. It grows 25 to 28 inches tall and has good resistance to lodging. The seeds are medium in size and are yellow with black seed scars. It is a selection made at the Wisconsin Agricultural Experiment Station from a cross of Hawkeye x Flambeau. It matures a few days later than Flambeau but several days earlier than Ottawa Mandarin; hence it is recommended for the Central and North Central Corn Maturity Zones and about the southern one-half of the Northern Zone.

Ottawa Mandarin grows to height of 24 to 28 inches and is highly resistant to lodging. The seeds are fairly large and are yellow with light buff seed scars. Oil content is medium. This variety is a selection made at the Central Experimental Farm, Ottawa, Canada from the variety Mandarin. It is recommended in areas of the state south of the Northern Corn Maturity Zone.

Renville grows from 26 to 31 inches tall and is highly resistant to lodging. The seeds are medium in size and are yellow with light brown seed scars. This variety has the highest oil content of any of the varieties tested in Minnesota in recent years. It was selected at the Minnesota Agricultural Experiment Station from a cross of Lincoln x (Lincoln x Richland) made at the United States Regional Soybean Laboratory at Urbana, Illinois. It averages a week earlier in maturity than Blackhawk and is recommended for the South Central and Southern Corn Maturity Zones and for the southern one-third of the Central Zone.

Varieties Not Adequately Tested

Hardome is an early selection from a cross of Mandarin x (Mandarin x A.K.). This variety was developed at the Dominion Experimental Farm at Harrow, Ontario. In two years of testing it has given fair yields, is slightly earlier than Ottawa Mandarin, and is of good height considering its maturity. It has a distinct tendency to lodge and is fair to good in oil content.

Harosoy is a medium late selection made at the same station and from the same cross as Hardome. In two years of testing in Minnesota it has given satisfactory yields, particularly in southwestern Minnesota. It matures about four to six days later than Blackhawk and grows relatively taller. It has a marked tendency to lodge and is medium in oil content.

Pagoda is an old variety in which very early selections recently have been made in Canada. The selection included in tables 20 and 21 has been tested only two years but appears to have promise as a variety for the northernmost areas of Minnesota. It is rather short and stands well.

Varieties Not Recommended

Adams was developed cooperatively by the Iowa Agricultural Experiment Station and the United States Regional Soybean Laboratory from the cross Illini x Dunfield. It is too late for Minnesota.

Bavender Special was selected by an Iowa farmer. It is very late in maturity, lodges excessively, and is rather low in oil content.

Earlyana was selected from a natural hybrid at the Purdue Agricultural Experiment Station. It has given only fair yields in Minnesota and has lodged excessively. It matures two or three days later than Blackhawk.

Habaro has been tested and used in Minnesota longer than any other variety. It has yielded well and is well adapted to southern Minnesota. However, it is low in oil content, tends to lodge, and often shatters in dry autumns. It is a selection made at the Minnesota Agricultural Experiment Station from an early introduction.

Harly was selected at the Central Experimental Farm, Ottawa, Canada from a cross of Mandarin x A.K. (Harrow). It is medium early and grows rather tall. In three years of testing in Minnesota it has given relatively low yields.

Hawkeye was developed cooperatively by the Iowa Agricultural Experiment Station and the United States Department of Agriculture from a cross of Mukden x Richland. It matures a week to 10 days later than Blackhawk and has not outyielded Blackhawk in Minnesota.

Hokien, in three years of testing in Minnesota, appeared to be identical with the variety Capital.

Korean was selected in Canada from an importation from the Orient; a Mr. Rickard of Champaign, Illinois brought it to the United States. It gives relatively good yields in southern Minnesota, but oil content of this variety is only fair. It matures about four days later than Blackhawk, grows to medium height, and lodges rather badly. The seeds are very large.

Lincoln was selected at the United States Regional Soybean Laboratory from a cross of Mandarin x Manchu. It is too late in maturity for Minnesota.

Manchu, Wis. 606, a selection made at the Wisconsin Agricultural Experiment Station from the older Manchu variety, has been grown rather extensively in Minnesota. It is similar to Habaro in yielding ability, maturity, and height. It lodges somewhat more than Habaro but has an appreciably higher oil content.

Mandarin, Wis. 507, a selection made at Wisconsin from the original Mandarin type, was for several years on the list of varieties recommended for Minnesota. However, it yields less, lodges more, and has a lower oil content than Ottawa Mandarin. When seed of the latter became available, Wis. 507 was removed from the list.

Monroe is a tall-growing variety that is about midway in maturity between Capital and Blackhawk. In several years of testing it has given lower yields than either of these varieties and has a marked tendency to lodge. Monroe was selected at the Ohio Agricultural Experiment Station from a cross of Mukden x Mandarin.

Pridesoy 57 is an early variety with good standing ability. The plants are slightly shorter and the oil content lower than those of Ottawa Mandarin. It is a selection from the older variety, Pridesoy.

Sunflowers

R. G. Robinson and O. C. Soine

Short, combine-harvested sunflower varieties have been tested for seven years on heavy soil in western Minnesota and have proved to be an adapted crop. At Crookston and Morris and in southwestern Minnesota, sunflowers produced much more oil per acre than did soybeans. Trials for two years on sandy soil in Anoka County also resulted in more oil production per acre from sunflowers than from soybeans.

In 1954, combine-harvested sunflowers occupied about 3,000 acres in northwestern Minnesota. Most of the crop was sold to bird feed dealers and to a Canadian cooperative which processes sunflower seed as an oilseed crop like soybeans.

Sunflower oil, like soybean oil, is edible and can be used in margarine, cooking oil, salad oil, and other food products. The meal or flour remaining after oil extraction is a valuable protein supplement for livestock, or it can be added to wheat flour to improve the quality and nutritional value of cakes and other bakery products.

SEED YIELD AND OIL CONTENT COMPARISONS

Average adjusted yields and oil content of sunflower varieties at Crookston, Anoka, Rosemount, and in southwestern Minnesota are shown in table 22.

Advance is recommended for either feed or oil in all parts of Minnesota. Arrowhead is recommended in central and northern Minnesota for feed only. Although Arrowhead yields more seed than does Advance in central and northern Minnesota, its seed contains

less oil and will probably bring a lower price on the oilseed market. Mennonite seed contains less oil than does Arrowhead seed, and Mennonite is slightly later in maturity.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Advance is medium in maturity and stands well for combining. The seed is small, low in hull, high in oil content, and high in bushel weight. It grows about 5 feet tall and matures about the same time as the earliest soybean varieties. Advance is a topcross hybrid released about 1945 by the Dominion Experimental Farms in Canada and is produced by crossing the inbred, S-37-388, with the variety, Sunrise. Only seed harvested from the S-37-388 in the crossing field should be used for seed. Therefore, it is desirable for farmers to buy new, certified seed every year just as they do with hybrid corn.

Arrowhead is about five days earlier than Advance, is slightly taller, and is not quite as strong stalked. The seed is medium in size, low in hull, medium in oil content, and high in bushel weight. It has more seedling vigor and shows slightly less bird damage than Advance. It is an open-pollinated variety, so seed for next year's planting can be saved from the commercial crop. Arrowhead was selected from Mammoth Russian by M. J. Thompson at the Northeast Experiment Station about 1920. It is recommended in central and northern Minnesota for feed only.

Table 22. Average Adjusted Yields and Oil Content of Sunflower Seed

Variety	Crookston			Southwestern Minnesota			Anoka (two farms)			Rosemount		
	Years of trial	Yields pounds per acre	Oil* per cent	Years of trial	Yields pounds per acre	Oil* per cent	Years of trial	Yields pounds per acre	Oil* per cent	Years of trial	Yields pounds per acre	Oil* per cent
Advance	1948-54	1,064	33.5	1951-54	1,235	31.5	1953	847	34.1	1953-54	981	31.6
Arrowhead	1948-54	1,210	31.9	1951-54	1,105	30.7	1953-54	1,067	34.7	1953-54	1,468	29.8
Mennonite	1953-54	1,201	28.7	1953-54	1,068	28.2	1953-54	820	31.1	1954	1,210	24.3
Beacon	1954	618	29.1	1954	1,124	29.7	.....	.....	.....	1954	1,199	30.8
Manchurian	.....	.....	.....	1953-54	541	27.4	1953	397	25.6	.....	.....	.....
Greystripe	.....	.....	.....	1953-54	379	30.2	1953	611	25.1	.....	.....	.....

* Dry matter basis.

Varieties Not Adequately Tested

Mennonite is slightly later maturing and taller than Arrowhead. The seed is large, high in hull, low in oil content, and medium in bushel weight. It originated in Russia many years ago.

Beacon is late maturing and slightly taller than Arrowhead. The seed is small, medium in hull, medium in oil content, and high in bushel weight. The variety lacks uniformity in height, maturity, and seed color. This variety, the most rust-resistant tested, was developed by the Dominion Experimental Farm at Morden, Manitoba by combining 27 rust resistant lines.

Varieties Not Recommended

Commercial Advance or "Advance, second generation" yields considerably less than Advance and therefore should not be used for planting.

Greystripe is the latest maturing and tallest variety tested in Minnesota trials. The seed is large, high in hull, low in oil content, and low in bushel weight.

Manchurian is late maturing and is probably too tall for combine harvesting. The seed is large, high in hull, low in oil content, and low in bushel weight.

Sunrise is used as the pollen parent of Advance hybrid. It is medium in maturity and low in yield. The seed is small, low in hull, high in oil content, and high in bushel weight. It originated from a selection made by the Dominion Forage Crops Laboratory in Saskatchewan and was released in 1942 after four generations of inbreeding.

S-37-388 is used as the female parent of Advance hybrid. It is early maturing and low yielding. It is an inbred line from Mennonite developed by the Dominion Experimental Farms.

Alfalfa

L. J. Elling and W. M. Myers

Alfalfa varietal trials were carried out at Crookston, Grand Rapids, Morris, Rosemount, Waseca, and Winona from 1948 to 1953. Prior to 1949, trials were made at Crookston, Grand Rapids, Morris, Waseca, and St. Paul. New seedings were established at Crookston, Grand Rapids, Morris, Rosemount, and Waseca in 1953 and at Duluth in 1954.

Because alfalfa is a perennial crop, seedings are made every three to five years rather than annually, as the cereal crops. Stands are maintained and yields harvested twice annually until stands become 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. Readings for stand, winterkilling, and diseases are recorded as the opportunity is presented.

YIELD COMPARISONS

Table 23 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 24 gives the forage yields for 16 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. In these trials bacterial wilt and winter injury have not been important factors, so such varieties as Atlantic and Buffalo appear much better than usual in Minnesota. The yields obtained in 1953 show that Buffalo performed very well following the 1952-53 winter when there was no winter injury.

Because data obtained the first crop year are often unreliable, the actual data secured in 1954 from 1953 seedings are not reported. When additional data

Table 23. Forage Yields and Stand Readings for Three Varieties of Alfalfa Grown on Wilt-Infested Soil

Variety	Waseca					
	Morris, seeded 1940		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

have been obtained they will be combined with the 1954 results and reported.

Generally the varieties tested earlier performed much the same as they had in other trials. Ladak and Narragansett gave good yields at most locations, although Ladak was quite low at Morris. At all locations Ranger and Grimm performed about the same as in previous tests, yielding somewhat less than Ladak and Narragansett. Vernal, a new synthetic variety from Wisconsin, was among the highest yielding varieties at all locations. Buffalo was the lowest yielding variety in the tests.

WINTER HARDINESS

The varieties listed in table 24 are, with the exceptions of Atlantic, Buffalo, and Kansas Common, considered sufficiently winter hardy for Minnesota. Atlantic, Buffalo, and Kansas Common are not reliable even when bacterial wilt is absent. Vernal has shown good winter hardiness in Wisconsin trials but has not received sufficient testing in Minnesota trials for a satisfactory evaluation of this character.

DISEASE REACTION

Bacterial wilt is the only alfalfa disease for which there is satisfactory resistance in adapted varieties. Ranger and Ladak have performed satisfactorily in trials on wilt-infested soil where susceptible varieties gave poorer performance (see table 23). Ladak is somewhat less resistant than Ranger.

In field studies of artificially inoculated plants, Vernal has shown higher resistance than either Ranger or Ladak. Buffalo is resistant to bacterial wilt, but because it is susceptible to winter-killing it is not adapted in Minnesota. Of the remaining varieties listed in table 24, A-224, A-225, and Turkestan are resistant and the others are susceptible.

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

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

For All Rotations

Ladak is a winter-hardy variety introduced by the United States Department of Agriculture from northern India. It has averaged slightly higher than Ranger in forage yield. It recovers slowly after cutting, but the yield of the second cutting of Ladak has not been much lower than that of other varieties. It is recommended for seeding in both long and short rotations.

Ranger is a winter-hardy variety developed by the United States Department of Agriculture and the Nebraska Agricultural Experiment Station. Slightly superior to Ladak in wilt resistance, Ranger is recommended for seeding in both long and short rotations.

For Short Rotations Only (Two Crop Years or Less)

Narragansett was developed by the Rhode Island Agricultural Experiment Station. In Minnesota trials it has produced definitely higher forage yields than Ranger and slightly higher yields than Ladak. Narragansett is winter hardy, it recovers rapidly after cutting, and its seedlings are vigorous. This variety is susceptible to bacterial wilt and should be seeded only in short rotations (one or two years of hay production). Narragansett appears to be low in seed production and for this reason may never become a widely grown variety.

Varieties Not Adequately Tested

Du Puits is a variety of alfalfa introduced from France. It is susceptible to bacterial wilt and may not be sufficiently winter hardy for Minnesota. This variety has given satisfactory forage yields in limited trials.

Vernal was developed at the Wisconsin Agricultural Experiment Station and released in 1953. It has not been tested long enough in Minnesota for a complete evaluation; however, it is wilt resistant, appears winter hardy, and has given satisfactory forage yields in limited trials.

Varieties Not Recommended

Uncertified southwestern-grown seed should never be seeded for forage production, for such seed lacks winter hardiness. This is in contrast to certified seed of adapted varieties produced in southwestern United States, which is perfectly satisfactory in Minnesota.

Common alfalfas are named for the state or region in which they are grown. Seed of these strains is not designated as a variety, and performance is not consistent from one lot to another. Generally, the common alfal-

fas are susceptible to bacterial wilt and yield somewhat less than improved varieties.

Alfalfa blends sold under trade brands are being offered for sale in Minnesota. These should not be considered as varieties because the varietal identification is lost when seed from different lots is blended. Blending seed of different lots does not increase winter hardiness, disease resistance, or insect resistance over that expected in the original lots.

Atlantic is a synthetic variety developed by the New Jersey Agricultural Experiment Station. It yields about the same as Ranger, but it is susceptible to bacterial wilt and is not sufficiently winter hardy for Minnesota.

Buffalo is a wilt-resistant variety developed by selection from Kansas Common, which it resembles in most other characteristics. It is not sufficiently winter hardy for use in Minnesota.

Grimm is a winter-hardy variety developed in Carver County by Wendelin Grimm. Where bacterial wilt is prevalent, the persistence of Grimm is decidedly less than that of Ranger or Ladak. Grimm is equal to Ranger and lower than Narragansett for forage yield where wilt is not a factor.

Table 24. Average Alfalfa Forage Yields

Variety	Crookston, 1951-53	Grand Rapids, 1951-52	Morris, 1950-53	Rose- mount, 1950-53	Waseca, 1951-52	Winona, 1949-52
Ladak	1.41	3.44	2.85	4.07	2.71	2.36
Narragansett	1.36	3.54	2.95	4.14	3.05	.....
Ranger	1.29	2.90	2.85	3.70	2.72	2.40
Atlantic	1.25	3.11	2.84	3.96	2.75	2.08
A-224	1.28	3.14	2.93	3.85	.....	.....
A-225	.....	.....	2.98	4.14	.....	2.30
Buffalo	1.14	2.63	2.84	3.73	2.32	2.48
Canadian Variegated	.....	.....	.....	.....	.....	2.27
Cossack	1.22	3.24	.....	.....	2.84	2.39
Dakota Common	1.29	3.03	2.61	3.88	2.69	.....
Grimm	1.14	3.08	2.64	3.64	2.69	2.29
Kansas Common	1.23	2.80	2.70	3.76	2.68	2.34
Meeker Baltic	.....	.....	.....	.....	.....	2.01
Montana Common	.....	.....	.....	.....	.....	2.26
Rhizoma	1.22	3.56	.....	.....	2.75	.....
Turkestan	.....	.....	2.60	3.84	.....	.....

Nomad was developed in Oregon from plants of an old stand that spread by underground stems. Under conditions where adapted, **Nomad** is a spreading or creeping variety. It is not adapted to Minnesota.

Rhizoma was developed by the University of British Columbia. Under favorable conditions the plants spread by underground stems but the variety has not shown this characteristic in Min-

nesota. In trials in Minnesota, it has been about equal to **Ranger** in yield but is very susceptible to bacterial wilt.

Talent was selected from the French variety, **Provence**. **Talent** is susceptible to bacterial wilt and is not sufficiently winter hardy for Minnesota.

Williamsburg was selected from **Kansas Common** for stem rot resistance. It, like **Kansas Common**, is not sufficiently winter hardy for Minnesota.

Bromegrass

H. L. Thomas

YIELD COMPARISONS

Because bromegrass is a perennial crop, data are collected from the same plots over a period of years. A series of plots was planted at all stations in 1950 and these plots are still in existence. All of the data presented in table 25 are from this series. All of the varieties were included in each test so that the averages reported are actual and not adjusted.

The recommended brome varieties, with the exception of **Fischer**, are superior to all others in these tests. **Manchar** looks desirable—especially when both forage and seed production are considered. If it continues to perform in this fashion it will be considered for increase. **Manchar** was introduced from **Manchuria** by the **USDA** and has been mass selected at **Pullman, Washington**. It is classified as intermediate between the southern and northern types.

None of the varieties has ever suffered from winterkilling under **Minnesota** conditions. The diseases of importance in this crop are leaf spot and possibly seedling damping-off. Disease resistance comparisons have not been made in the variety tests.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

The list of recommended varieties has been compiled from data collected during the period 1944 to 1950.

Lincoln, **Achenbach**, and **Fischer** are recommended varieties. These southern strains start growth earlier in the spring than **Canadian brome** and are somewhat more productive. **Lincoln** was selected in **Nebraska**, **Achenbach** in **Kansas**, and **Fischer** in **Iowa**. All of these are so-called farm strains. That is, they have been grown by one or two farmers, in the areas designated, for a long period of time and seem to have acquired a natural adaptation.

Varieties Not Recommended

B. in.-12 is a mass selection chiefly of nonspreading or restricted-spreading plants increased at the **Utah Agricultural Experiment Station, Logan, Utah**.

Elsberry is a southern, early maturing type of bromegrass, the best of several accessions tested in the **Soil Conservation Service Nursery at Elsberry, Missouri**. It is believed to be derived

from an old field of brome grass located in northwestern Missouri or southeastern Iowa.

Homesteader is a composite of five strains originating from fields established in South Dakota 40 or 50 years ago. It has been increased at the South Dakota Agricultural Experiment Station, Brookings, South Dakota.

Lancaster (Nebr. 44) is a new strain developed at the Nebraska Agricultural Experiment Station, Lincoln, Nebraska. It is a synthetic variety produced by the hybridization of several unrelated outstanding plants. The variety has been superior in forage yield, quality, and seed yield in tests at the Nebraska Station.

Lyon (Nebr. 36), a selection similar to Lincoln, shows considerable refinement of plant characters over Lincoln brome grass. It is outstanding in its production of high-quality, relatively heavy seed. Preliminary testing shows

it to be equal or superior to Lincoln in forage and seed yields. Lyon was increased at the Nebraska Agricultural Experiment Station, Lincoln, Nebraska.

Manchar, a tall, leafy, semibunch type of brome grass introduced from Manchuria under P.E.I. 109812 by the U. S. Department of Agriculture, was subjected to mass selection at Pullman, Washington. Its outstanding characteristics are seedling vigor and high seed production. It is intermediate in growth habit between the southern type, as exemplified by Achenbach, and the northern type of smooth brome grass. It was increased at the Washington Agricultural Experiment Station, Pullman, Washington.

Martin is a mass selection developed from plants obtained from seed produced on an old brome grass field in Martin County, Minnesota. It was increased at the Minnesota Agricultural Experiment Station, St. Paul.

Table 25. Average Forage and Seed Yields of Brome grass Varieties from Rosemount, Waseca, Morris, Crookston, and Grand Rapids—1951-1954*

	Forage yield (15 per cent moisture)		Seed yield
	First cutting	Second cutting	
	tons per acre		pounds per acre
Southern type			
Lincoln	1.86	1.35	140
Achenbach	1.86	1.41	118
Fischer	1.76	1.19	155
Elsberry	1.75	1.23	91
Lyon	1.84	1.40	107
Lancaster	1.84	1.37	156
Minnesota Synthetic A	2.10	2.18	.....
Oklahoma No. 1	1.46	.90	.....
Oklahoma Synthetic	1.46	1.01	.....
Northern type			
Canadian Commercial	1.49	1.07	150
Martin	1.85	1.40	.....
B. in-12	1.71	1.18	180
Manchar	1.80	1.45	208
Mandan 404	1.60	1.53	.....
Homesteader	1.77	1.31	130
Alta Fescue	1.15	1.25	.....
L.S.D. at 5 per cent point .....	.14	.21	.....

* Three replications were made at each station during the period. Not all stations were represented every year, but each of them were for at least two of the four years.

Red Clover

H. L. Thomas

YIELD COMPARISONS

Tests conducted from 1923-27 by Professor A. C. Arny showed that locally grown strains of medium red clover were markedly superior to introductions from foreign countries and the southern United States. Average yields of forage collected from experiments conducted from 1945 through 1954 show the recommended varieties Wegener and Midland to be equal in yield to good commercial seed purchased in Minnesota. With this situation existing, it is considered advisable to use named adapted varieties so that the seed is of known origin and performance.

There are no significant differences in forage yield among the four principal varieties shown in table 26.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Midland is a blend of strains from Ohio, Indiana, Illinois, and Iowa that is produced through the cooperation of several midwest experiment stations and the United States Department of

Agriculture. Under Minnesota conditions, it is equal to Wegener in forage yield for both first and second cuttings and is a good seed producer.

Wegener is a strain grown for a number of years by E. C. Wegener, Bertha, Minnesota. It is adapted to Minnesota conditions, is a good forage and seed yielder, and provides a good second cutting.

Varieties Not Recommended

Dollard is a selection made several years ago at MacDonald College, Quebec, Canada. Dollard is superior in seed yield and has been shown to be resistant to some forms of anthracnose and black stem in regional tests. Seed of Dollard is being increased for possible recommendation on a regional basis.

Kenland is the only variety of which large amounts of seed are commercially available. It is resistant to southern anthracnose and is adapted to approximately the southern half of the red clover belt. It is susceptible to northern anthracnose and is probably not sufficiently winter hardy for Minnesota. It was developed by the Kentucky

Table 26. Average Forage and Seed Yields of Red Clover Varieties at All Minnesota Experiment Stations—1945-1952*

	Forage yield (15 per cent moisture)		Seed yield
	First cutting	Second cutting	
	tons per acre		pounds per acre
Wegener	1.70	1.32	113
Midland	1.61	1.25	101
Dollard	1.65	1.44	131
Minnesota Commercial	1.73	1.38	105
L.S.D. at 5 per cent point	N.S.	N.S.	19

* The number of years at each station varied. There were 17 experiments in all.

Agricultural Experiment Station and the United States Department of Agriculture.

Altaswede is a late, single-cut type developed by the Alberta, Canada, Agricultural Experiment Station. Despite claims that have been made for

it, Altaswede has not proved to be perennial in tests in Minnesota, and it has yielded significantly less than commercial Mammoth. It has smooth (not hairy) leaves, which are reputed to make it susceptible to leafhopper attacks.

Biennial Sweetclover

H. L. Thomas

YIELD COMPARISONS

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 and of being a very rank-growing, heavy forage producer the second year.

Satisfactory seed yields have been obtained from both recommended varieties. See table 27 for a summary of data collected from experiment stations and other locations, 1945-52.

The recommended varieties of sweetclover are distinctly better than the commercial strains which are being grown extensively.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Evergreen is a white-blossomed sweetclover introduction from Ohio. It produces a larger growth than common types the fall of the first year, is a heavy forage producer the second year, and comes to full bloom two or three weeks later than common types. Therefore, it has a longer grazing season.

Madrid is a yellow-blossomed, biennial type introduced into the United States from Madrid, Spain in 1910. The

first-year growth of Madrid is superior to common types and the forage and seed production the second year are satisfactory.

Varieties Not Recommended

Alpha is a dwarf variety developed at the University of Saskatchewan.

Brandon Dwarf, a dwarf white, was developed at Brandon, Manitoba.

Erector is a white-blossomed variety which was mass selected at Brandon, Manitoba. Its lower branches ascend at an acute angle.

Nebraska Fine Stem is a selection made at the Nebraska Experiment Station.

No. 1 Arctic is derived from a Siberian importation. It has white blossoms.

Spanish, Reg. No. 1. is white blossomed. It was introduced from Madrid, Spain in 1910 and was formerly called Madrid white.

Table 27. Summary of Sweetclover Data

Variety	Forage yield of Commer- cial 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 seeding year.

Willamette is white blossomed. It was developed at Corvallis, Oregon by growing successive generations in the same soil, allowing disease organisms to eliminate the susceptible sweetclover plants.

Birdsfoot Trefoil

H. L. Thomas

YIELD COMPARISONS

Among trefoil varieties tested to date, only Empire and Viking (both New York selections) appear winter hardy enough for Minnesota conditions.

Empire is recommended because it is slightly superior to Viking in winter hardiness and because Viking has been tested less extensively. Empire grows along the ground and Viking is upright.

Table 28. Yields and Stands of Birdsfoot Trefoil at the Rosemount Station, 1953 and 1954

Variety	Total yield, 1953*	Stand, 6/16/53	Total yield, 1954*	Stand, 5/5/54
	tons per acre	per cent	tons per acre	per cent
Empire	2.71	93	.83	88
Viking	2.92	93	.87	83
Cascade†	2.98	95	.50	47
Granger†	2.96	95	.40	42
Italian broadleaf	2.69	87	.80	42
Oregon narrowleaf	1.22	85	zero	3

* Yields tested at 15 per cent moisture.

† Cascade and Granger are Oregon selections.

Dry, Edible Peas and Field Peas

R. G. Robinson and O. C. Soine

Most of Minnesota's dry, edible peas are produced in the Red River Valley. The peas are sold to a processor 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. In other parts of the state, field peas are occasionally sown in a mixture with oats and harvested as a forage crop.

YIELD TRIAL DATA

Chancellor, Dashaway, and Multiplier are the recommended varieties, and their performance in comparison with that of other recently tested varieties at Crookston is shown in table 29. Rates of sowing of all varieties were adjusted for differences in seed size and germination so that equal numbers

of viable seeds were sown on each plot. These adjustments were based on Chancellor of 90 per cent germination at two bushels per acre.

Forage trials of field pea-oat mixtures were conducted at Rosemount and in southwestern Minnesota. In these trials 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 oats. For forage purposes, the variety of peas did not seem to make much difference; however, observations indicate that Dashaway or Chancellor are the preferable varieties for pea-oat mixtures, because they are small seeded, medium in maturity, and productive. Medium- to large-seeded pea varieties are not economical for forage since seed cost per acre would be excessive. A medium- to late-maturing, rust- and lodging-resistant oat variety should be used in the pea-oat mixture.

These trials have also indicated that rape, alfalfa, or vetch sown with the pea-oat mixtures made satisfactory stands, provided the pea-oat forage was not cut too low. The rape made sufficient growth to provide some pasture in the fall.

ORIGIN AND DESCRIPTION OF VARIETIES

Recommended Varieties

Chancellor is high yielding, medium in maturity, and long vined. The seed is small, cream colored, and high in bushel weight. The Dominion Experimental Farm at Ottawa, Canada selected it in 1906 from an English variety also called Chancellor.

Dashaway is like Chancellor except it is one day earlier and has slightly smaller seeds. It was selected in 1914 from Golden Vine by F. J. Dash, a Saskatchewan farmer, and distributed by the University of Saskatchewan in

1922. It is generally grown on more acres in Minnesota than any other variety of dry, edible peas.

Multiplier is like Chancellor except it is somewhat later in flowering and maturing and has slightly larger seeds. It is thought to be of Canadian origin.

Varieties Not Adequately Tested

O.A.C. 181 is high yielding, early maturing, and long vined. The seed is medium in size, high in bushel weight, and cream colored. It originated in 1918 at the Ontario Agricultural College from a cross of Prussian Blue x White Wonder.

Varieties Not Recommended

Alaska is low yielding, very early maturing, and short vined. The seed is medium in size, green in color, and medium in bushel weight. Alaska is also used as a canning variety. It was introduced as an American variety about 1884 but was probably the same as the English variety, Earliest of All. Many strains of this variety are available.

Arthur is medium in yield, early maturing, and long vined. The seed is large, cream colored, and high in bushel weight. It has many extremely enlarged, flattened stems and bears its pods in a cluster at the top of the plant, so it is a good variety for combining. It is reported to be a good variety for splitting. It originated at the Dominion Experimental Farm at Ottawa, Canada in 1892 from a cross of Mummy x Multiplier.

Austrian is low yielding, late maturing, and medium in vine length. The seed is small, dark speckled in color, and high in bushel weight. It has pink flowers and is very fine stemmed. Large acreages are sown in the fall in the southern states and used for pasture, winter cover, and green manure. It originated in Austria.

Table 29. 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	Bushel weight	Weight of 100 seeds	
						bushels per acre	pounds	grams
Chancellor	1948-54	24.2	July 2	August 20	63.5	13.2	
Dashaway	1948-54	24.7	July 1	August 20	63.6	12.8	
Multiplier	1948-54	24.3	July 5	August 21	63.5	13.6	
Guinevere	1952-54	18.7	July 10	August 15	64.0	19.7	
Arthur	1952-54	20.6	July 5	August 11	62.9	22.5	
Valley	1952-54	23.9	July 1	August 11	62.6	20.9	
O.A.C. 181	1953-54	23.0	June 23	August 10	62.4	16.9	
L.S.D. at 5 per cent point		4.9					

Chang is high yielding, medium in maturity, and long vined. The seed is medium in size, high in bushel weight, and cream colored with a black hilum. Processors do not like it because the black hilum spoils the appearance of whole pea soup. It has more seedling vigor than most other pea varieties. It is a University of Minnesota selection from seed introduced from China by the USDA.

Delwiche Early Scotch is low yielding, early maturing, and short vined. The seed is medium in size, mottled green in color, and medium in bushel weight. It originated from a cross of Alaska x Late Scotch and was released by the University of Wisconsin in 1949.

First and Best is medium in yield, short vined, and the earliest maturing of the cream-colored varieties. The seed is medium in size and bushel weight and seems to be desirable for splitting. It is of American origin and has sometimes been called Extra Early. It is grown on more acres in the United

States than any other cream-colored pea.

Guinevere is like Arthur except it is somewhat later in maturity. It may be of lower quality than Arthur for edible purposes. A Canadian farmer selected it from Arthur in 1918, and it was increased in Saskatchewan.

Late Scotch is medium in yield, late in maturity, and long vined. The seed is medium in size, mottled green in color, and medium in bushel weight. It was selected from Scotch peas by the University of Wisconsin about 1910.

Valley is high yielding, early maturing, and long vined. The seed is large, cream colored, and high in bushel weight. It originated in 1924 at the Dominion Experimental Farm at Ottawa, Canada from a cross of Chancellor x Early Raymond.

White Marrowfat is medium in yield, late maturing, and long vined. The seed is large, cream colored, and medium in bushel weight. It originated at the Dominion Experimental Farm at Ottawa, Canada in 1891.