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SMALL GRAIN VARIETIES IN MINNESOTA

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DIVISION OF AGRONOMY AND PLANT GENETICS

INCREASE PLOT OF MARQUILLO WHEAT, UNIVERSITY FARM, 1929

UNIVERSITY FARM, ST. PAUL

CONTENTS

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SMALL GRAIN VARIETIES IN MINNESOTA[1]

H. K. WILSON and A. C. ARNY

INTRODUCTION

Ideally situated in a region providing favorable environmental conditions, Minnesota ranks high in the production of spring and winter wheat, oats, barley, and rye.

Variety testing is a necessary link in the improvement of crop varieties. It is important that the results of these tests be summarized from time to time for analysis. Rather complete summary tables at the end of each crop discussion afford opportunity for technical workers to use the material as they may desire.

TABLE I

TEMPERATURE AND PRECIPITATION RECORDS FOR THE MINNESOTA AGRICULTURAL EXPERIMENT STATIONS

	Mean temperature in degrees F.*					
	April	May	June	July	August	Annual mean
St. Paul	46.2	57.6	67.2	72.0	69.5	44.3
Waseca	44.5	57.1	66.5	71.8	69.4	44.0
Morris	44.2	56.0	66.1	70.4	67.8	41.5
Crookston	41.4	54.0	64.2	67.4	65.7	37.8
Grand Rapids	38.9	52.5	62.5	68.1	64.4	38.5
Duluth	38.0	48.1	58.4	65.4	63.8	38.9
	Mean rainfall in inches					
St. Paul	2.33	3.41	4.07	3.46	3.38	27.40
Waseca	2.91	4.60	4.65	4.39	3.14	30.39
Morris	2.44	3.22	4.24	3.84	3.04	23.98
Crookston	1.79	2.74	3.55	3.44	3.01	21.88
Grand Rapids	1.84	2.08	4.27	3.00	3.30	22.72
Duluth	2.03	3.41	4.16	3.78	3.78	28.93

* Temperature and rainfall records were obtained by the United States Weather Bureau and cover the longest period of years for which records were available, and represent normal conditions.

The state of Minnesota comprises an area of 84,682 square miles, and widely differing environmental conditions prevail in the different sections. The relatively light rainfall of the Red River Valley, together with the heavy lacustrine soils, results in a region ideally suited to the production of spring wheat and other small grain crops. In the southern part of the state conditions are such that the coarse grain crops are grown and winter wheat replaces spring wheat to a large extent. The higher yields of winter wheat in this section make it a more profitable crop than spring wheat. These differences have led to the establishment of not one but several experiment stations located

[1] The manuscript for this bulletin was submitted in December, 1929, at which time the 1929 yield data were not available.

as follows: (1) Central Station, University Farm, St. Paul; (2) Southeast Branch Station, Waseca; (3) West Central Branch Station, Morris; (4) Northwest Branch Station, Crookston; (5) North Central Branch Station, Grand Rapids, and (6) Northeast Branch Station, Duluth.

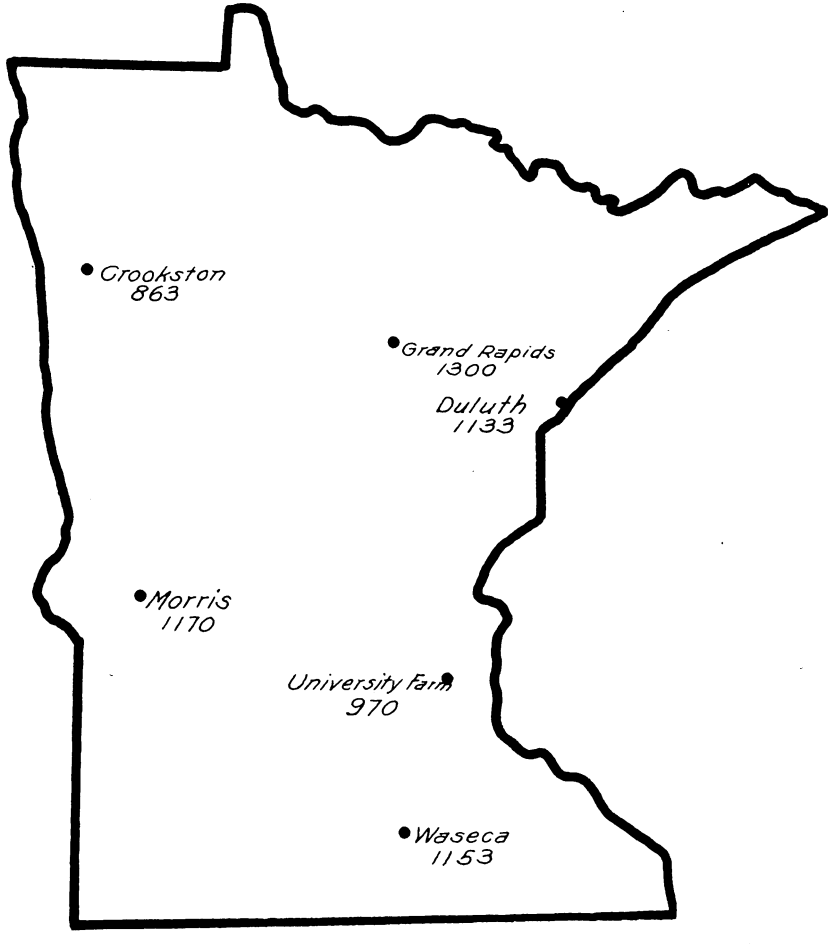

Fig. 1. Map of Minnesota Showing the Location of Central and Branch Experiment Stations Together with Elevation Above Sea Level

Each of the grain crops is treated under the separate divisions of spring wheat, winter wheat, oats, barley, and rye.

Experimental Technique

Yield tests reported in this bulletin were made in plots 8 feet by 132 feet with an 18-inch alley between plots. Two drill rows were removed from the sides of each plot to prevent possible border effect.

Each variety was grown in 3 systematically replicated plots. Following border removal the area harvested for yield was 1/55 of an acre.

At the Waseca Station six square yards were harvested from each plot for yield records. These samples were shipped to University Farm for threshing.

All data have been checked at the Central Station. Yields were analyzed by the probable error method using the following formula:[1]

$$P.E. = \pm .6745 \sqrt{\frac{\Sigma d^2}{N(n-1)}}$$

SPRING WHEAT

Varieties have been grouped as (1) standard varieties recommended for Minnesota and (2) varieties that have been tested but are not recommended for use in Minnesota.

Recommended Spring Wheat Varieties for Minnesota

The recommended varieties are included in Table II.

TABLE II

YIELDS PER ACRE OF STANDARD RECOMMENDED MINNESOTA SPRING AND DURUM WHEAT VARIETIES FOR THE FOUR-YEAR PERIOD, 1925-28

Variety	Minn. No.	Univ. Farm	Waseca	Morris	Crookston
		Bu.	Bu.	Bu.	Bu.
Marquis	Acc. 1239	23.5	23.1	19.2	25.0
Marquillo	2202	27.0	22.2	23.8	33.5
Ceres	Acc. 2223	29.9	25.1	20.8	28.4
Mindum	470	30.6	29.1	28.5	33.8

Marquis has long been the standard spring wheat variety and is used as a basis for judging the qualities of new productions (1, 17).[2] The high quality of the flour produced from Marquis has made it a favored variety of the milling trade. In Minnesota, it has failed to yield on a par with recent improved varieties of spring wheat chiefly because of its susceptibility to black stem rust. In years when black stem rust is not serious, as is often the case at University Farm (Table XI), Marquis produces high yields of superior grain. Conditions at University Farm are unusual, however, and do not represent the rust epidemics which occur frequently in the spring wheat-producing sections of the state. The reduced yield from stem rust is greater at the Morris and Crookston branch stations. In addition to rust susceptibility, Marquis is subject to scab and root rot.

[1] Hayes, H. K., and Garber, R. J., Breeding Crop Plants, page 84. (Second edition.) New York: McGraw-Hill Book Co. 1927.

[2] Reference by numbers is to "Literature Cited," page 83.

Marquillo, produced from a cross between a spring and a durum variety, is a notable example of the successful hybridization of wheat species. Since the first tests in rod rows, Marquillo has shown its superior yielding ability over existing spring wheat varieties. Its superiority over Marquis may be attributed to the high degree of resistance to black stem rust (9, 10, 11, 14). This variety resembles Marquis in many plant characteristics, being an awnless variety with a very stiff straw (Tables VI, VII, VIII, IX).

Ceres, a production of the North Dakota Agricultural Experiment Station, has been superior to Marquis in yield largely because of its resistance to stem rust (9, 10, 21). In the Red River Valley section of Minnesota, Ceres has not been equal to Marquillo, but as Marquillo has not been available in sufficient quantities to supply the demand, Ceres is recommended for use in Minnesota. The somewhat weak straw and susceptibility to loose smut are undesirable characteristics of the variety.

Mindum is a durum wheat belonging to the Arnautka group. It is the highest yielding variety of durum wheat tested in Minnesota (Table IV). While not so rust resistant as Pentad, it has excelled in yield and in quality of macaroni and other durum wheat products. It is by far the most desirable durum variety for Minnesota.

Varieties Tested But Not Recommended for Minnesota

TABLE III

COMPARATIVE AVERAGE YIELDS OF SPRING WHEAT VARIETIES DISCARDED FROM THE VARIETY TRIALS, 1925-27

Variety	Minn. No.	Univ. Farm	Waseca	Morris	Crookston
		Bu.	Bu.	Bu.	Bu.
Kota	Acc. 2151	25.3	18.3	17.0	18.2
Red Sask	Acc. 2193	19.3	16.8	16.2	20.0
Quality	Acc. 2207	20.4	19.4	17.5	19.9
Reliance	Acc. 2221	22.9	17.0	14.4	19.3
Garnet	Acc. 2203	19.8	17.7	16.1	20.0
Reward	Acc. 2204	21.3	19.4	18.1	27.2
Kota x Marquis, N. D. No. 1656	Acc. 2224	28.9	25.1	22.4	...
Progress	Acc. 2225	27.8	...	...	...
Haynes Bluestem	169	22.9	...	...	...
Parker's Selection	Acc. 2222	22.1	...	...	...
Ruby	Acc. 2155	...	...	...	18.5
Marquis*	Acc. 1239	21.8	19.7	18.3	24.3

* Included as a standard.

Kota has proved highly resistant to stem rust (22) but millers object to it because of its poor milling qualities. Also, it has a weak straw and is susceptible to smuts.

Red Sask has yielded low principally because of rust susceptibility.

Quality, a white kerneled variety, is undesirable in Minnesota because of its rust susceptibility and variable milling and baking qualities.

Reliance has proved susceptible to stem rust in Minnesota and has yielded low as a result.

Garnet has failed to yield on a par with Marquis and in milling, yields a yellow flour.

Reward is an early variety yielding well in years when rust is not present. Its rust susceptibility renders it of little value in Minnesota.

Kota x Marquis, North Dakota No. 1656, is weak strawed.

Progress, a rather high yielding variety, is not recommended because of its very inferior qualities as a bread wheat. In the northeastern sections of the state it shows promise when grown for feeding purposes only.

Haynes Bluestem is grown at University Farm to gauge new varieties. It is susceptible to rust and is of little value.

Parker's Selection closely resembles Marquis from which it was selected. Rust susceptibility led to the discarding of this variety.

Ruby has proved susceptible to rust and has failed to yield as well as Marquis.

TABLE IV

COMPARATIVE AVERAGE YIELDS OF DURUM WHEAT VARIETIES FOR THE THREE-YEAR PERIOD, 1919-21

Variety	Minn. No.	Univ. Farm	Waseca	Morris	Crookston
		Bu.	Bu.	Bu.	Bu.
Mindum	470	23.3	29.5	15.5	26.0
Arnautka	Acc. 2103	20.8	23.8	...	19.2
Acme	Acc. 1967	18.3	...	...	18.1
Kubanka	Acc. 2102	...	...	...	20.8
Pentad	Acc. 1968	...	...	...	21.8

The yield data in Table IV clearly indicate the superiority of Mindum over the other durum varieties. The yields for the Crookston Station are especially significant as it is in this section that most of Minnesota's durum wheat is produced. Pentad, a red durum wheat, has no place in Minnesota because of its extremely low quality. Detailed data for individual years are given in Tables XI-XVI.

Milling and Baking Trials

All milling and baking trials were made under the supervision of the Division of Agricultural Biochemistry. In every case baking results represent an average of not less than four bakes.

Marquis is outstanding as a bread wheat and serves as a desirable standard for other varieties. Marquis and Marquillo averages for all four stations are as follows:

	Protein Per cent	Loaf texture Score	Loaf volume cc.	Color score
Marquis	14.9	98.9	1809	98.9
Marquillo	15.8	98.0	1809	97.6

TABLE V

SUMMARY OF MILLING AND BAKING TESTS FOR SPRING WHEAT VARIETIES GROWN AT UNIVERSITY FARM, 1925-26, WASECA, 1924-25, MORRIS AND CROOKSTON, 1926-27

Variety	Crude protein (N. x 5.7)				Loaf texture score				Loaf volume in cc.				Loaf color score			
	U. Farm	Waseca	Morris	Crookston	U. Farm	Waseca	Morris	Crookston	U. Farm	Waseca	Morris	Crookston	U. Farm	Waseca	Morris	Crookston
	Per cent	Per cent	Per cent	Per cent	Score	Score	Score	Score	cc.	cc.	cc.	cc.	Score	Score	Score	Score
Marquis	16.5	15.6	14.0	13.7	98.5	99.5	98.8	99.0	1930	1933	1688	1685	101.0	98.0	98.5	98.0
Marquillo	15.8	17.0	15.0	15.2	96.5	99.0	98.6	98.1	1933	2025	1526	1750	97.5	98.0	97.0	97.0
Ceres	16.0	...	13.8	14.1	97.0	...	97.5	99.6	1983	....	1902	1877	100.0	...	98.0	99.0
Quality	14.8	...	14.3	13.9	99.5	...	99.8	97.8	1898	....	1921	2098	99.0	...	100.0	99.0
Reward	...	...	15.7	15.6	...	...	99.3	97.6	....	....	2022	1657	....	...	99.3	99.0
Kota	15.6	...	...	...	99.5	...	...	...	1888	....	....	....	97.5	...	...	...
Progress	17.3	...	...	...	97.5	...	...	...	1738	....	....	....	97.5	...	...	...
Bluestem	16.5	...	...	...	99.0	...	...	...	1883	....	....	....	97.0	...	...	...
Red Sask	14.4	...	...	...	99.0	...	...	...	1798	....	....	....	100.5	...	...	...
Reliance	15.3	...	...	...	100.0	...	...	...	1743	....	....	....	98.0	...	...	...
Parker's Selection...	16.3	...	...	...	96.5	...	...	...	2048	....	....	....	97.0	...	...	...
Kota x Marquis, N. D. No. 1656...	15.0	...	15.5	...	98.5	...	99.1	...	1788	....	1923	....	100.0	...	98.5	...

These data show Marquillo to be equal or superior to Marquis except in texture and loaf color. The difference in texture is small. The natural color of the Marquillo loaf is slightly yellow. Since the standard practice in this country is to bleach flour, the yellow color of Marquillo flour should respond to treatment.

Ceres compares favorably with Marquis and is considered as a high quality milling wheat.

Preston, Kota, Progress, and Reliance are low in volume and color of loaf.

Parker's Selection produced a large loaf with an inferior color.

Agronomic Data at Individual Stations

Since the response of varieties is affected to a large extent by the environment under which they are grown, these data are presented in summary form for each of the four stations in the most nearly representative of the spring wheat producing areas.

University Farm

TABLE VI

SUMMARY OF AGRONOMIC DATA FOR SPRING WHEAT VARIETIES TESTED AT UNIVERSITY FARM

Variety	Yield per acre, 1925-27	Stem rust, 1927-28	Weight per bu, 1925-27	Weight per 1000 kernels, 1925-27	Straw per acre, 1925-27	Lodging		Date* of heading, 1925-27	Date* of maturity, 1925-27	Height, 1925-27
						Per cent 1927-28	Degrees from ⊥ 1927-28			
	Bu.	Per cent	Lbs.	Grams	Tons					Inches
Marquis	21.8	48	57.2	25.8	1.4	5	15	6/26	7/26	35
Preston	24.6	..	55.9	26.1	1.5	..	..	6/26	7/27	..
Bluestem	22.9	42	53.4	24.7	1.6	58	27	7/2	8/1	41
Kota	25.3	..	58.7	26.0	1.6	..	..	6/25	7/26	38
Red Sask	19.3	..	56.4	25.5	1.4	..	..	6/22	7/26	33
Marquillo	25.1	3	56.6	28.8	1.3	0	..	6/22	7/25	31
Quality	20.4	..	57.6	34.6	1.2	..	..	6/19	7/22	31
Ceres	28.5	12	58.3	27.2	1.5	47	22	6/23	7/25	36
Progress	27.8	12	59.5	30.4	1.6	47	34	6/22	7/24	34
Reliance	22.9	..	54.9	24.5	1.5	..	..	6/28	7/29	35
Parker's Selection	22.1	..	57.2	27.1	1.4	..	..	6/25	7/24	36
Garnet	19.8	..	56.6	25.3	1.3	..	..	6/22	7/21	33
Kota x Marquis, N. D. No. 1656	28.9	5	58.2	29.1	1.4	100	29	6/23	7/25	36
Mindum	29.9	30	59.4	33.9	1.5	100	29	6/26	7/30	41

*Marquis, days to heading 64; to maturity 94.

In analyzing the data in Table VI, it must be kept in mind that the trials at University Farm do not necessarily represent varietal behavior in the important spring wheat producing sections of the state. The highest yielding variety at University Farm may prove of little value in the Red River Valley. This is true principally because stem rust epidemics rarely occur in the variety plots at the Central Station. Prior

to 1927 no stem rust occurred in the variety plots and the reasons for discarding some of the varieties must be sought in the following tables, summarizing the data from branch stations in the spring wheat section.

Yields given in Table VI are negatively correlated with black stem rust infection altho, as previously indicated, the averages are not directly comparable.

Weight per bushel and weight per thousand kernels may or may not be correlated. Quality, ranking sixth in weight per bushel, shows a much greater kernel weight than any other hard spring variety. Marquillo produced a large kernel, excelling Marquis and Ceres in this respect.

Yield of straw corresponds closely with height of plant. Marquillo and Marquis are short and produced lower yields of straw. Marquillo possesses a very stiff straw, leading Marquis by a slight margin. The other varieties for the two-year period exhibited weak straw tendencies.

Dates of heading and of maturity merely corroborate the classification of the varieties into early and late groupings as indicated in the brief descriptions given on pages 15-18.

Waseca

The production of spring wheat in this section is in direct competition with corn belt crops. For this reason spring wheat is not as important as in the Red River Valley district where corn is more or less a marginal crop. The farmer who wishes to grow spring wheat is advised to use the same varieties as those recommended for other parts of the state. Stem rust resistant varieties, as Marquillo and Ceres, are of great importance here where the higher temperatures and rainfall

TABLE VII

SUMMARY OF AGRONOMIC DATA FOR SPING WHEAT VARIETIES TESTED AT WASECA, 1925-27

Variety	Yield per acre	Stem rust	Weight per bushel	Weight per 1000 kernels	Lodging		Date of heading	Date of maturity	Height
					Per cent	Degrees from ⊥			
	Bu.	Per cent	Lbs.	Grams					Inches
Marquis	19.7	53	55.1	22.7	3	30	6/30	7/31	38
Preston	20.2	34	53.2	21.3	14	35	7/1	8/1	38
Kota	18.3	2	56.5	20.8	78	69	7/1	7/30	37
Marquillo	19.6	T	55.5	25.2	0	..	6/27	8/1	35
Reward	19.4	49	57.4	23.3	0	..	6/24	7/27	33
Ceres ..,.....	22.2	3	57.2	23.6	9	33	6/29	7/30	37
Quality	19.4	57	54.6	27.1	11	5	6/24	7/28	34
Red Sask.....	16.8	49	52.1	20.2	6	26	6/27	7/30	36
Reliance	17.0	60	51.9	20.1	15	40	7/2	7/30	38
Garnet	17.7	53	...	18.1	..	..	7/1	7/29	34
Kota x Marquis, N. D. No. 1656	24.8	2	56.7	25.5	51	40	6/29	7/30	37
Mindum	27.7	4	60.0	35.6	68	54	6/30	8/3	47

(Table I) are conducive to the development of rust epidemics. Winter wheat is likely to be a better crop than the spring types.

Marquis and Marquillo show about the same yielding ability at Waseca, while Ceres excels both. It is quite probable that Ceres is a better variety for this section of the state.

Marquillo, closely followed by Kota, Kota x Marquis, North Dakota No. 1656, and Ceres, leads in resistance to stem rust. All others with the exception of the durum variety, Mindum, were susceptible to varying degrees.

In other characters the varieties exhibit similar relationships as at University Farm, St. Paul.

Morris

The Morris Station is located in the west central part of the state, directly south of the Red River Valley district. Here we have a region more suitable for the growing of spring wheat than is represented by either the University Farm or Waseca stations.

TABLE VIII

SUMMARY OF AGRONOMIC DATA FOR SPRING WHEAT VARIETIES TESTED AT MORRIS, 1925-27

Variety	Yield per acre	Stem rust	Weight per bushel	Weight per 1000 kernels	Date* of heading	Date* of maturity	Height
	Bu.	Per cent	Lbs.	Grams			Inches
Marquis	18.3	66	54.3	21.5	7/1	8/1	35
Kota	17.0	17	59.8	22.5	7/3	8/2	35
Red Sask	16.2	66	52.2	20.7	6/29	7/29	33
Marquillo	22.9	10	56.8	29.4	6/30	8/1	32
Ceres	19.2	22	57.1	24.5	7/2	8/2	35
Reward	18.1	62	55.9	24.4	6/26	7/26	29
Quality	17.5	64	53.3	27.4	6/26	7/28	31
Garnet	16.1	66	52.3	17.5	6/27	7/25	31
Reliance	14.4	66	53.3	21.4	7/2	7/31	35
Kota x Marquis, N. D. No. 1656	21.9	17	57.3	27.2	7/1	8/2	35
Mindum	27.2	18	61.9	37.4	7/2	8/6	41

* Marquis, days to heading 79; to maturity 111.

Marquillo, the superior variety at Morris, excelled all other hard spring varieties. The yields show a high negative correlation with stem rust except in the case of Kota. This variety gave a low yield even tho semi-resistant to rust. Other varieties failed to yield as well as Marquillo and could be eliminated on the basis of yield alone, to say nothing of their rust susceptibility and other undesirable characteristics.

Crookston

In many ways Crookston is the most representative station of the spring and durum wheat-producing sections of Minnesota. For this reason considerable emphasis has been placed on spring and durum

varietal tests at Crookston. A variety which responds to the environment of this station can be accepted with reasonable certainty as being adapted to Minnesota's spring and durum wheat belt.

TABLE IX

SUMMARY OF AGRONOMIC DATA FOR SPRING WHEAT VARIETIES TESTED AT CROOKSTON, 1925-27

Variety	Yield per acre	Stem rust	Weight per bushel	Weight per 1000 kernels	Lodging*		Date† of heading	Date† of maturity	Height
					Per cent	Degrees from ⊥			
	Bu.	Per cent	Lbs.	Grams					Inches
Marquis	24.3	58	54.1	19.1	0.0	..	7/9	8/10	40
Ruby	18.5	31	53.7	16.4	4	90	7/2	8/2	37
Kota	18.2	14	56.7	19.9	46	30	7/9	8/8	41
Marquillo	33.2	11	57.6	27.8	0.0	..	7/5	8/8	38
Ceres	29.6	22	58.5	23.2	0.0	..	7/5	8/6	40
Quality	19.9	52	54.7	25.0	20	90	7/2	8/4	36
Reward	27.2	50	58.9	23.3	0.0	..	6/30	8/4	37
Garnet	20.0	50	52.0	...	20	90	7/3	8/3	36
Red Sask	20.0	62	51.0	18.2	0.0	..	7/4	8/7	39
Reliance	19.3	78	50.9	17.5	0.0	..	7/8	8/8	39
Mindum	33.9	11	62.2	34.2	34	45	7/8	8/12	51

* No lodging in 1926.

† Marquis, days to heading 86; to maturity 119.

At Crookston, Marquillo is outstanding in yielding ability, being far superior to all hard red spring varieties and equal to the one durum, Mindum. It is rather significant for a spring wheat to yield on a par with a durum variety. Likewise Marquillo has escaped any serious rust damage, while Marquis and other susceptible varieties have suffered greatly as reflected in lower yields. Ceres ranks second to Marquillo, justifying its place in the list of varieties recommended for Minnesota. There can be no question as to the superiority of the two varieties for the Minnesota farmer who wishes to grow common spring wheat.

Other agronomic characters exhibit similar varietal relationships as previously discussed.

Grand Rapids

TABLE X

SUMMARY OF AGRONOMIC DATA FOR SPRING WHEAT VARIETIES TESTED AT GRAND RAPIDS, 1925-27

Variety	Yield per acre	Stem rust	Weight per bushel	Weight per 1000 kernels	Date* of heading	Date* of maturity	Height
	Bu.	Per cent	Lbs.	Grams			Inches
Marquis	21.0	51	53.1	24.2	7/8	8/16	43
Kota	19.2	31	56.4	24.5	7/9	8/13	44
Java	23.7	36	57.7	31.0	7/8	8/14	44
Marquillo	26.1	18	53.8	31.3	7/8	8/15	37
Ceres	24.0	44	55.0	25.2	7/9	8/13	43
Mindum	23.3	9	57.6	36.9	7/0	8/18	48

* Marquis, days to heading 79; to maturity 118.

Grand Rapids, in the northern part of the state, represents an area of little importance in the production of spring wheat. A large part of the wheat produced in this section is utilized in the feeding of livestock. For this reason the spring wheat variety tests have been less extensive than at the other stations.

As in the spring wheat belt, Marquillo ranks first. Other agronomic characters are similar to those given for other stations.

Duluth

Located in the northeastern section of the state, the Duluth district is decidedly unsuited to more than minor production of spring wheat. Progress, a variety unsuited for milling, is especially suited to this region (Table XVI) and is recommended if the wheat is grown for feeding poultry or livestock. If the crop is grown for milling purposes, Marquillo or Ceres should replace Progress.

Agronomic data are not presented for this station since they are not complete and would be of little value coming from an area which is marginal in spring and durum wheat production.

History and Description of Tested Hard Spring Varieties[3]

Haynes Bluestem, Minn. No. 169, C. I. No. 1505, is the result of a pure line selection in 1892 from the original variety developed by L. H. Haynes of Fargo, North Dakota.

Awnless; white, pubescent glumes; weak straw; red kernels; very susceptible to stem rust; late maturing; fair milling and baking qualities.

Preston, Minn. No. 924, C. I. No. 2958. A selection from Preston (Velvet Chaff), Minn. Acc. No. 188, by the Minnesota Agricultural Experiment Station in 1903. The original Preston resulted from a cross between Ladoga, a Siberian wheat, and Red Fife. The hybrid was made by Dr. William Saunders at the Dominion Experimental Farms, Ottawa, Canada, in 1888.

Spike awned; white, glabrous glumes; weak straw; susceptible to stem rust; midlate; yields less than Marquis; produces flour of variable baking qualities.

Marquis, Minn. Acc. No. 1239. A selection by Dr. C. E. Saunders of Ottawa, Canada, from a cross between Hard Red Calcutta and Red Fife made by Dr. A. P. Saunders in 1892.

Awnless; white to yellowish, glabrous glumes; strong straw; susceptible to stem rust; midlate; desirable milling and baking qualities.

Ruby, Minn. Acc. No. 2155. Result of a cross between Red Fife and a hybrid wheat known as Downy Riga in 1905. Developed by the Dominion Experimental Farms, Ottawa, Canada.

[3] Free use has been made of U. S. Dept. Agr. Bull. 1074, "Classification of American Wheat Varieties." Individual references are not made for each variety (4).

Awnless; yellowish white, glabrous glumes; strong purple straw; susceptible to stem rust; early maturing; yields less than Marquis.

Kota, Minn. Acc. No. 2151, C. I. No. 5378. Distributed by the North Dakota Agricultural Experiment Station from wheat introduced from Russia in 1903 (22).

Awned; white, glabrous glumes; weak straw; resistant to stem rust, susceptible to smuts; yields less than Marquis; not a good milling wheat.

Red Sask, Minn. Acc. No. 2193. Originated as a natural cross in the Australian variety Bobs about 1916 by the Department of Field Husbandry, University of Saskatchewan.

Awnless; white, glabrous glumes; stiff straw; susceptible to stem rust; matures with Marquis; yields less than Marquis.

Marquillo, Minn. No. 2202, C. I. No. 6887. Produced by the Minnesota Agricultural Experiment Station from a cross between Marquis and Iumillo, a rust resistant durum variety (1).

Resembles Marquis; awnless; strong straw; resistant to stem rust; matures slightly earlier than Marquis; excels Marquis in yield when stem rust is a factor; milling and baking tests have shown the variety equal to Marquis in size and texture of loaf produced, altho yellow in color.

Garnet, Minn. Acc. No. 2203, C. I. No. 8181. Developed by the Dominion Experimental Farms, Ottawa, Canada, from a cross between Preston and Riga.

Awnless; glabrous, yellow glumes; weak straw; susceptible to stem rust; early maturing; yields less than Marquis; when milled and baked, produces a loaf with a yellow color.

Reward, Minn. Acc. No. 2204, C. I. No. 8182. Developed in 1912 at the Dominion Experimental Farms, Ottawa, Canada. Progeny of a cross between Marquis and Prelude.

Awnless; pubescent, white glumes; stiff straw; susceptible to stem rust; early maturing; yields less than Marquis.

Quality, Minn. Acc. No. 2207. Produced by Luther Burbank and first distributed by him in 1918. Sometimes referred to as "Burbank."

Awnless; glabrous, white plumes; white kernels; stiff straw; susceptible to stem rust; slightly earlier than Marquis; variable milling and baking qualities.

Reliance, Minn. Acc. No. 2221, C. I. No. 7370. Developed by the Office of Cereal Crops and Diseases, Bureau of Plant Industry, United States Department of Agriculture, in co-operation with the Oregon, California, Montana, North Dakota, and Minnesota experiment stations. J. A. Clark selected the variety from the progeny of a cross between Kanred and Marquis.

Awned; glabrous, white glumes; midstrong to weak straw; susceptible to stem rust; yields less than Marquis.

Parker's Selection, Minn. Acc. No. 2222. A selection from Marquis by J. L. Parker at Gilbert Plains, Manitoba.

Resembles Marquis; awnless; glabrous, white glumes; strong straw; susceptible to stem rust; does not outyield Marquis.

Ceres, Minn. Acc. No. 2223. Developed in 1918 from a cross between Kota and Marquis by the North Dakota Agricultural Experiment Station (21).

Awned; glabrous, white glumes; medium weak straw; resistant to stem rust; as early maturing and about equal in milling and baking qualities as Marquis; outyields Marquis; susceptible to scab, bunt, and loose smut.

Kota x Marquis, Minn. Acc. No. 2224, North Dakota No. 1656. Progeny of a cross between Kota and Marquis by the North Dakota Agricultural Experiment Station (21).

Awned; glabrous, white glumes; weak straw; highly resistant to stem rust; matures with Marquis; outyields Marquis.

Progress, Minn. Acc. No. 2225, C. I. No. 6902. Developed by the Wisconsin Agricultural Experiment Station from a selection from a field of the Java variety.

Resembles Java; awned; glabrous, white glumes; midstrong straw; semi-resistant to stem rust; high yielding variety; very inferior milling and baking qualities.

Kota x Marquis, Minn. Acc. No. 2242, North Dakota No. 1656.81. Developed by the North Dakota Agricultural Experiment Station from the progeny of a Kota-Marquis cross.

Resembles Ceres; awned; glabrous, white glumes; midstrong to weak straw; resistant to stem rust; shows promise in preliminary milling and baking tests.

Kota x Marquis, Minn. Acc. No. 2244, North Dakota No. 1656.84. A North Dakota selection from a cross of Kota with Marquis.

Resembles Ceres; awned; glabrous, white glumes; midstrong to weak straw; resistant to stem rust; outyields Marquis; matures with Marquis; milling and baking qualities good with limited number of tests.

Kota x Marquis, Minn. Acc. No. 2298, North Dakota No. 1656.97. Also a production of the North Dakota Station.

Resembles Ceres; awned; glabrous, white glumes; midstrong to weak straw; resistant to stem rust; insufficient test to warrant definite conclusions.

Mindum, Minn. No. 470. The result of the selection of a durum type from a common bread wheat by the Minnesota Agricultural Experiment Station in 1896 (1). Named Mindum, a contraction of Minnesota and durum, in 1918.

Yellowish, glabrous glumes; amber colored kernels; midweak straw; fairly resistant to stem rust; high yielding ability.

Acme, Minn. Acc. No. 1967. A pure line selection from Kubanka (C. I. No. 1516) by Manley Champlin, formerly of South Dakota.

Yellowish, glabrous glumes; amber colored kernels; weak straw; resistant to stem rust; yields less than Mindum and not so desirable for the manufacture of macaroni products.

Pentad, Minn. Acc. No. 1968. Introduced as D-V from Russia in 1903 by Dr. H. L. Bolley of the North Dakota Agricultural Experiment Station.

White, glabrous glumes; red colored kernels; midstrong straw; very resistant to stem rust; yields less than Mindum; very undesirable for the manufacture of macaroni products.

Kubanka, Minn. Acc. No. 2102, C. I. No. 4063. Introduced from Russia in 1900 by M. A. Carleton of the United States Department of Agriculture.

Yellowish, glabrous glumes; amber colored kernels; midstrong straw; resistant to stem rust; yields less than Mindum; fair milling variety.

Arnautka, Minn. Acc. No. 2103. Believed to have been introduced by Russian immigrants to North Dakota. Distributed by the United States Department of Agriculture.

Yellowish, glabrous glumes; amber colored kernels; midstrong straw; fairly resistant to stem rust; not as high yielding as Mindum.

Monad, Minn. Acc. No. 2156. Original introduction as D-I from Russia in 1902 by the North Dakota Agricultural Experiment Station. Similar to Acme; yields less than Mindum.

Akrona, Minn. Acc. No. 2226, C. I. No. 6881. Result of a selection from Arnautka, C. I. No. 1493, in 1912 by Clyde McKee of the Montana Agricultural Experiment Station. Developed by the Office of Cereal Crops and Diseases, United States Department of Agriculture, at the Akron Field Station, Akron, Colorado.

Yellowish, glabrous glumes; amber colored kernels; midstrong straw; resistant to stem rust; yields less than Mindum.

Emmer, Vernal, Minn. Acc. No. 1165. A species of wheat often erroneously referred to as speltz. Glumes are retained in threshing. Of little value as a crop but offers great possibilities as breeding material since it is highly resistant to black stem rust and certain other important diseases menacing spring wheat in Minnesota.

Varietal Yields at Individual Stations

Tables XI to XVI present the yearly yields of the spring and durum wheat varieties for each station for a period of years, together with averages in comparison with Marquis on a percentage basis for the same period of years.

TABLE XI

YIELDS PER ACRE OF SPRING AND DURUM WHEAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, UNIVERSITY FARM, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Marquis	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Common spring wheats														
Marquis	Acc. 1239	38.2	19.2	22.4	24.8	29.3	19.5	33.3	29.2	16.3	19.8	28.8	100.0	..
Preston	924	39.0	21.8	24.7	22.9	30.9	15.3	32.0	32.6	16.6	24.6	...	103.3	10
Haynes Bluestem	169	32.8	17.1	20.6	19.2	32.7	15.9	23.6	28.1	14.7	23.9	20.5	88.7	11
Kota	Acc. 2151	...	...	17.9	23.0	27.8	20.1	31.4	30.7	18.7	26.6	...	100.8	8
Red Sask	Acc. 2193	...	...	...	25.4	32.0	20.2	37.7	30.1	16.6	22.0	...	106.9	7
Marquillo	2202	...	...	...	...	...	...	32.0	31.4	12.1	31.7	32.8	109.9	5
Quality	Acc. 2207	...	...	...	...	...	...	28.2	28.5	7.1	25.7	...	90.8	4
Kota x Marquis	Acc. 2224	...	...	...	...	...	...	...	33.9	19.9	36.3	25.4	122.7	4
Ceres	Acc. 2223	...	...	...	...	...	...	...	34.1	19.5	31.8	34.4	127.3	4
Progress	Acc. 2225	...	...	...	...	...	...	...	30.2	16.2	37.0	28.8	119.2	4
Reliance	Acc. 2221	...	...	...	...	...	...	...	31.5	16.8	20.5	...	105.4	3
Parker's Selection	Acc. 2222	...	...	...	...	...	...	...	28.1	13.4	24.8	...	101.5	3
Garnet	Acc. 2203	...	...	...	...	...	...	...	27.5	9.9	21.9	...	90.8	3
Reward	Acc. 2204	...	...	...	...	...	...	...	29.6	7.4	26.8	31.0	100.7	4
Kota x Marquis	Acc. 2244	...	...	...	...	...	...	...	...	...	36.5	26.3	129.2	2
Kota x Marquis	Acc. 2242	...	...	...	...	...	...	...	...	...	36.4	25.5	127.4	2
Durum wheats														
Mindum	470	40.3	16.3	24.4	29.1	35.7	16.6	24.9	36.2	15.9	37.6	32.6	110.3	11
Acme	Acc. 1967	32.2	13.9	18.2	22.7	...	...	...	...	...	...	...	83.2	4
Arnautka	Acc. 2103	...	18.2	19.6	24.7	33.6	...	...	...	...	...	...	100.4	4
Kubanka	Acc. 2102	...	16.8	20.0	...	...	...	...	...	...	...	...	88.5	2
Monad	Acc. 2156	...	...	20.2	23.2	31.5	...	...	...	...	...	...	97.9	3
Pentad	Acc. 1968	...	...	23.2	35.8	17.4	28.0	...	...	...	...	...	108.8	4
Akrona	Acc. 2226	...	...	...	...	...	...	...	...	18.0	37.3	25.4	124.3	3
Miscellaneous														
Emmer	Acc. 1165	...	18.7	23.7	21.4	...	20.8	33.6	...	...	...	...	99.2	5
P.E. of experiments in per cent		3.1	3.0	3.8	1.7	4.9	0.9	4.3	3.4	4.7	3.8	2.3		

TABLE XII

YIELDS PER ACRE OF SPRING AND DURUM WHEAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, WASECA, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Marquis	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Common spring wheats														
Marquis	Acc. 1239	47.8	18.6	20.0	20.0	17.1	21.6	37.2	24.6	16.5	17.9	33.4	100.0	..
Preston	924	45.7	17.6	18.4	17.4	19.6	...	...	29.8	16.1	14.6	25.8	94.9	9
Ruby	Acc. 2155	...	...	19.3	14.6	14.6	...	...	...	...	...	...	84.9	3
Kota	Acc. 2151	...	...	...	13.6	21.3	15.7	39.3	16.7	16.9	21.2	...	93.4	7
Marquillo	2202	...	...	...	...	...	...	42.1	23.3	13.0	22.4	30.0	100.9	5
Reward	Acc. 2204	...	...	...	...	...	...	...	27.1	14.1	17.0	25.3	90.4	4
Kota x Marquis	Acc. 2224	...	...	...	...	...	...	...	23.3	20.8	30.4	25.8	108.5	4
Ceres	Acc. 2223	...	...	...	...	...	...	...	24.9	18.6	23.2	33.5	108.4	4
Quality	Acc. 2207	...	...	...	...	...	...	...	25.4	13.2	19.6	...	98.6	3
Red Sask	Acc. 2193	...	...	...	...	...	...	...	18.9	17.4	14.0	...	85.3	3
Reliance	Acc. 2221	...	...	...	...	...	...	...	18.6	19.0	13.3	...	86.3	3
Garnet	Acc. 2203	...	...	...	...	...	...	...	18.2	16.4	18.6	...	90.2	3
Kota x Marquis	Acc. 2244	...	...	...	...	...	...	...	...	...	32.9	28.6	119.9	2
Kota x Marquis	Acc. 2242	...	...	...	...	...	...	...	...	...	31.5	23.4	107.0	2
Durum wheats														
Mindum	470	54.5	23.0	36.8	28.6	29.1	25.2	35.1	24.8	30.5	27.8	33.2	126.9	11
Arnautka	Acc. 2103	...	19.6	26.8	24.9	...	...	...	...	...	...	...	121.7	3
Miscellaneous														
Emmer	1165	...	...	32.7	18.4	29.0	18.9	36.9	...	...	...	...	117.3	5
P.E. of experiments in per cent		...	3.4	4.5	7.4	6.0	2.5	5.7	5.5	6.5	4.2	3.4		

TABLE XIII

YIELDS PER ACRE OF SPRING AND DURUM WHEAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, MORRIS, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Marquis	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Common spring wheats														
Marquis	Acc. 1239	21.6	17.9	12.7	12.5	30.4	23.6	28.9	17.6	19.6	17.7	21.7	100.0	..
Preston	924	18.0	14.5	12.0	8.9	28.0	26.4	32.2	14.4	...	...	...	93.5	8
Ruby	Acc. 2155	...	...	8.7	12.1	22.2	20.3	28.2	...	...	...	...	84.6	5
Kota	Acc. 2151	...	...	...	9.6	24.0	26.4	30.4	15.9	17.0	18.2	...	94.1	7
Red Sask	Acc. 2193	...	...	...	...	30.5	24.5	33.2	14.7	15.4	18.4	...	99.2	6
Marquillo	2202	...	...	...	...	...	...	27.9	20.6	17.2	30.9	26.6	116.8	5
Kota x Marquis	Acc. 2224	...	...	...	...	...	...	...	17.0	16.1	32.6	24.4	117.6	4
Ceres	Acc. 2223	...	...	...	...	...	...	...	16.4	17.4	23.9	25.4	108.5	4
Reward	Acc. 2204	...	...	...	...	...	...	...	16.4	15.2	22.6	19.4	96.1	4
Quality	Acc. 2207	...	...	...	...	...	...	...	17.7	15.0	19.9	...	95.8	3
Garnet	Acc. 2203	...	...	...	...	...	...	...	13.2	15.3	19.7	...	87.8	3
Reliance	Acc. 2221	...	...	...	...	...	...	...	9.4	18.1	15.8	...	78.9	3
Kota x Marquis	Acc. 2244	...	...	...	...	...	...	...	...	16.5	33.8	24.4	126.6	3
Kota x Marquis	Acc. 2242	...	...	...	...	...	...	...	...	16.9	32.2	23.7	123.4	3
Durum wheats														
Mindum	470	23.3	20.9	11.9	13.8	32.3	31.3	28.3	31.6	18.1	31.8	32.6	123.1	11
Miscellaneous														
Emmer	1165	...	...	...	10.1	22.1	26.5	29.9	...	...	...	...	92.9	4
P.E. of experiments in per cent		6.2	4.8	5.9	4.5	4.1	6.1	4.5	2.7	10.4	9.9	3.7		

TABLE XIV

YIELDS PER ACRE OF SPRING AND DURUM WHEAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, CROOKSTON, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Marquis	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Common spring wheats														
Marquis	Acc. 1239	26.8	12.7	17.4	15.1	17.4	13.5	20.5	27.9	25.4	19.5	27.1	100.0	..
Preston	924	23.7	10.5	21.2	11.1	18.0	...	...	...	...	...	...	94.5	5
Ruby	Acc. 2155	...	...	12.2	9.9	13.9	...	27.0	23.1	20.5	11.8	...	82.7	7
Kota	Acc. 2151	...	...	16.0	10.1	20.2	15.6	22.7	23.1	20.7	10.7	...	88.8	8
Marquillo	2202	...	...	...	...	...	...	30.0	37.7	35.0	26.8	34.5	136.2	5
Kota x Marquis	Acc. 2224	...	...	...	...	...	...	32.6	36.9	31.2	...	26.2	125.8	4
Ceres	Acc. 2223	...	...	...	...	...	...	30.0	33.7	31.6	23.6	24.6	119.1	5
Quality	Acc. 2207	...	...	...	...	...	...	29.3	22.4	23.9	13.3	...	95.3	4
Reward	Acc. 2204	...	...	...	...	...	...	...	33.0	24.7	23.8	25.3	106.9	4
Garnet	Acc. 2203	...	...	...	...	...	...	...	16.1	24.4	19.5	...	82.4	3
Red Sask	Acc. 2193	...	...	...	...	...	...	...	22.1	22.6	15.4	...	82.6	3
Reliance	Acc. 2221	...	...	...	...	...	...	...	18.3	24.1	15.6	...	79.7	3
Kota x Marquis	Acc. 2244	...	...	...	...	...	...	...	...	...	24.3	25.9	107.7	2
Axminster	Acc. 2296	...	...	...	...	...	...	...	...	...	21.1	25.3	99.6	2
Kota x Marquis	Acc. 2298	...	...	...	...	...	...	...	...	...	...	30.7	....	..
Durum wheats														
Mindum	470	41.8	26.1	25.4	10.8	21.2	17.2	35.6	40.2	35.4	26.2	33.3	140.3	11
Pentad	Acc. 1968	32.2	14.4	21.9	18.6	24.2	...	...	...	...	...	...	124.5	5
Acme	Acc. 1967	32.6	16.6	11.0	12.2	...	...	...	...	...	...	...	100.6	4
Kubanka	Acc. 2102	32.3	17.2	21.2	12.6	19.2	12.2	31.9	36.4	...	...	...	120.9	8
Arnautka	Acc. 2103	32.9	15.7	15.9	12.4	...	...	...	...	...	...	...	106.8	4
Akrona	Acc. 2226	...	...	...	...	...	...	...	...	...	25.9	34.5	129.6	2
Black Chaff Durum	Acc. 2295	...	...	...	...	...	...	...	...	...	19.7	29.1	104.7	2
Miscellaneous														
Emmer	1165	38.9	38.0	22.7	9.5	21.1	17.6	25.2	...	...	...	...	140.2	7
P.E. of experiments in per cent		6.0	6.7	7.2	10.4	4.5	4.2	8.8	6.0	4.0	6.8	5.2		

TABLE XV

YIELDS PER ACRE OF SPRING AND DURUM WHEAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, GRAND RAPIDS, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Marquis	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Common spring wheats														
Marquis	Acc. 1239	35.4	1.3	5.0	6.5	18.4	10.6	15.0	19.2	25.3	18.6	15.1	100.0	..
Preston	924	40.0	0.8	7.1	2.4	19.9	...	...	...	...	...	...	105.4	5
Ruby	Acc. 2155	...	...	5.4	6.1	12.8	...	...	...	...	...	...	81.3	3
Kota	Acc. 2151	...	...	...	4.1	13.0	15.1	20.5	19.9	16.0	21.7	...	97.1	7
Java	Acc. 2206	...	...	...	...	...	16.2	19.7	23.0	21.3	26.9	...	120.7	5
Marquillo	2202	...	...	...	...	...	...	15.4	21.3	35.8	21.2	13.6	115.1	5
Ceres	Acc. 2223	...	...	...	...	...	...	...	24.3	28.8	19.0	19.4	117.0	4
Progress	Acc. 2225	...	...	...	...	...	...	...	...	26.5	29.3	19.8	128.1	3
Kota x Marquis	Acc. 2244	...	...	...	...	...	...	...	...	...	26.2	21.2	140.7	2
Durum wheats														
Mindum	470	46.3	5.5	8.9	6.1	13.1	11.2	13.9	18.4	25.8	25.8	20.1	114.5	11
Pentad	Acc. 1968	...	...	...	6.0	15.6	...	...	...	...	...	...	86.7	2
Monad	Acc. 2156	...	...	...	5.1	12.8	...	...	...	...	...	...	71.9	2
Miscellaneous														
Emmer	1165	54.4	21.5	11.9	7.6	21.9	13.9	18.3	...	...	...	...	162.1	7
P.E. of experiments in per cent		4.0	6.5	7.8	6.7	8.4	9.2	11.3	3.5	8.4	3.9	4.5		

TABLE XVI

YIELDS PER ACRE OF SPRING AND DURUM WHEAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, DULUTH, 1919-28

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Marquis	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Common spring wheats													
Marquis	Acc. 1239	18.8	15.3	16.7	19.2	15.7	20.9	8.8	16.4	...	24.9	100.0	..
Preston	924	13.8	17.1	15.1	24.7	...	...	...	...	...	...	101.0	4
Kota	Acc. 2151	...	...	10.4	18.5	16.3	17.0	12.2	18.0	13.1	...	94.6	6
Java	Acc. 2206	...	...	...	...	24.7	27.7	11.5	16.7	19.4	...	130.4	4
Marquillo	2202	...	...	...	...	...	20.3	11.8	17.5	24.1	23.9	103.5	4
Progress	Acc. 2225	...	...	...	...	...	...	13.9	25.1	24.1	28.9	135.5	3
Ceres	Acc. 2223	...	...	...	...	...	...	12.2	18.0	18.8	26.5	113.2	3
Kota x Marquis	Acc. 2244	...	...	...	...	...	...	...	...	22.6	25.8	103.6	2
Durum wheats													
Mindum	470	26.7	8.5	20.4	20.7	21.1	16.7	9.0	18.8	...	25.7	106.9	9
Arnautka	Acc. 2103	18.2	12.9	22.4	...	...	...	...	...	...	...	105.3	3
Pentad	Acc. 1968	...	...	21.2	26.7	...	...	...	...	...	...	133.4	2
Miscellaneous													
Emmer	1165	...	10.0	15.6	17.1	14.0	18.8	...	...	...	...	86.0	5
P.E. of experiments in per cent		4.2	12.4	12.1	9.0	5.8	7.6	9.2	9.5	4.7	11.5		

WINTER WHEAT

Winter wheat has increased steadily in importance since the development of Minturki by the Minnesota Agricultural Experiment Station. Its distribution in 1919 furnished an impetus to winter wheat production in southern Minnesota and made it possible for farmers to produce highly profitable crops with reasonable certainty.

A number of winter wheat varieties have been tested at the Central and branch stations in search for a variety suited to conditions prevailing in the state.

Performance of Winter Wheat Varieties in Minnesota

Only one winter wheat variety, Minturki, is recommended for use in Minnesota. A number of the most promising varieties have been tested at the Central and branch stations. The Crookston and Duluth stations do not conduct winter wheat variety tests since the crop is unadapted to those sections of the state. Limited tests are made at Grand Rapids but the St. Paul, Waseca, and Morris stations provide data most useful in evaluating varieties for Minnesota farmers.

Averages in Table XVII do not include 1928 since crop failures resulted at University Farm and Grand Rapids. The 1928 yields for the other stations are given in Tables XXIV, XXV, XXVII. Crop failure at University Farm was owing to water and ice forming on the fields which caused the plants to smother. Obviously, these conditions should not be confused with winter-killing as the term is ordinarily employed. Unfavorable seeding conditions occasioned the abandonment of the plots at Grand Rapids in 1928.

TABLE XVII

YIELDS PER ACRE OF WINTER WHEAT VARIETIES FOR THE FOUR-YEAR PERIOD, 1924-27

Variety	Minn. No.	Univ. Farm	Waseca	Morris	Grand Rapids
		Bu.	Bu.	Bu.	Bu.
Minturki	1507	33.2	34.6	24.0	21.8
Crimean	Acc. 845	32.7	25.8	21.5	21.6
Minard	2199	34.0	32.2	20.6	22.3
Turkey Selection	1488	32.3	29.9	22.3	16.5
Kanred	Acc. 2191	30.8	34.2	23.2	...

Minturki is accepted as the standard winter wheat variety in Minnesota (1, 7). This variety has replaced nearly all others and its increased utilization has paralleled increased winter wheat acreages in Minnesota. Minturki has yielded high in tests at all stations, showing marked resistance to winter-killing and black stem rust. In addition, the variety mills an acceptable grade of flour (Table XVIII).

Crimean does not yield as well on an average as Minturki. Greater susceptibility to black stem rust makes this variety less desirable.

Minard, while yielding nearly as well as Minturki, is not recommended because it is more susceptible to rust and lacks milling and baking qualities.

Turkey Selection is much superior to the ordinary Turkey wheats in winter hardiness. Its lower yield is sufficient reason for the variety not being recommended for general use in Minnesota.

Kanred yields well providing the winters are favorable. Under Minnesota conditions, winter-killing is sufficient hazard to rate this variety under Minturki.

Milling and Baking Trials

As with spring wheat, all milling and baking trials were made under the supervision of the Division of Agricultural Biochemistry.

TABLE XVIII

SUMMARY OF MILLING AND BAKING TESTS FOR WINTER WHEAT VARIETIES GROWN AT UNIVERSITY FARM, 1923-27, WASECA, 1926-28, MORRIS, 1921-23, AND GRAND RAPIDS, 1926-27

Variety	Crude protein (N. x 5.7) in per cent				Loaf texture score			
	Univ. Farm	Waseca	Morris	Grand Rapids	Univ. Farm	Waseca	Morris	Grand Rapids
Minturki	13.1	16.6	14 7	13.1	97.3	97.7	97.7	99.3
Crimean	12.7	...	14.4	15.0	98.6	...	97.7	99.5
Minard	12.9	14.8	13.7	14.9	99.1	97.1	98.0	98.7
Kanred	...	15.2	...	...	...	95.9	...	...

Variety	Loaf volume in cc.				Loaf color score			
	Univ. Farm	Waseca	Morris	Grand Rapids	Univ. Farm	Waseca	Morris	Grand Rapids
Minturki	1849	2045	1890	1827	95.6	97.7	96.3	97.5
Crimean	1823	....	1943	1745	97.8	...	97.7	97.5
Minard	1753	1942	1777	1647	98.2	97.0	96.0	96.5
Kanred	....	2027	....	....	...	96.7	...	...

Winter wheat can be milled into satisfactory flour suitable for bread-making as shown in Table XVIII. Considerable prejudice against winter wheat from the standpoint of milling qualities is unwarranted.

Minturki produces high grade flour more consistently than the other varieties tested except Crimean. On an average the variety ranks high in protein, loaf texture, loaf volume, and loaf color. On the basis of trials made with grain from the Waseca Station, Kanred fails to reach the standard set by Minturki as a milling wheat.

Agronomic Data at Individual Stations

Summary tables giving the agronomic data in some detail are presented for the four principal stations engaged in the testing of winter wheat varieties.

University Farm

In Table XIX no data are given for 1928 because of crop failure, as previously indicated.

The average yielding ability for 1925-27, inclusive, indicates the superiority of Minturki at University Farm. Minard, Minhardi, and Crimean are not far behind.

Minhardi has been recognized as the most winter hardy of the varieties. On the basis of the averages in Table XIX, it shows no significant superiority over Minard, Minturki, Turkey Selection, or Crimean. Kanred, Iowa 1946, and Red Rock are non-winter hardy under University Farm conditions. Red Rock, a soft, red winter wheat, is so susceptible to winter injury that it serves as a good check for this character.

Since stem rust rarely occurs at University Farm, data are available for one year only, 1927. The results indicate the greater resistance of Minturki. Red Rock was very susceptible with other varieties intermediate in degree of infection.

The better varieties are on a par in weight per measured bushel. Kanred, Turkey, and Red Rock produced lightweight grain. In thousand-kernel weight, Red Rock, Minturki, and Kanred are superior. This character appears to have no relationship to yielding ability or weight per bushel of the varieties tested. Straw yields are similar; the varieties suffering greatest winter-killing and subsequent reduced stand produced the lowest straw yields. As no lodging occurred prior to 1927, it is difficult to draw conclusions from the results for one year. The weakness of the Kanred straw is evident. Heading and maturity dates cover a very small range indicating but little difference between the varieties. Crimean produced the tallest and Kanred the shortest straw of the varieties tested. Other varieties were about equal in plant height.

Waseca

The Waseca Station is located in an area ideally suited to winter wheat production. This renders data from this station of especial significance to the farmer interested in this crop. It is in this section of the state that winter wheat has been a highly profitable crop and to a large extent has replaced spring wheat. Winter wheat production is recommended to farmers in this area. (See Table XX.)

Kanred yielded on a par with Minturki during the four years, 1924-27. A winter with conditions favorable for killing would be likely to alter the relationship between the two varieties since Kanred is more susceptible to winter injury. Minturki and Kanred were the most rust resistant varieties at Waseca for a three-year period. Except for weaker straw, other agronomic characters are similar to those given for University Farm (Table XIX).

TABLE XIX

SUMMARY OF AGRONOMIC DATA FOR WINTER WHEAT VARIETIES TESTED AT UNIVERSITY FARM

Variety	Yield per acre, 1925-27	Winter killing, 1925-27	Stem rust, 1927*	Weight per bushel, 1925-27	Weight per 1000 kernels, 1925-27	Straw per acre, 1925-27	Lodging		Date of heading, 1924-27	Date of maturity, 1924-27	Height, 1925-27
							Per cent, 1927	Degrees from ⊥ 1927			
	Bu.	Per cent	Per cent	Lbs.	Grams	Tons					Inches
Minturki	30.4	9	T	58.5	29.8	1.5	2	5	6/16	7/22	34
Minhardi	28.6	7	27	59.0	24.6	1.4	0	..	....	....	34
Crimean	28.6	10	15	58.7	27.1	1.4	12	5	6/17	7/22	38
Minard	29.1	8	23	59.5	26.6	1.5	0	..	6/17	7/22	34
Turkey Sel.	26.9	9	24	57.1	28.8	1.5	2	5	6/16	7/23	35
Kanred	25.6	16	20	57.2	29.6	1.4	82	23	6/15	7/23	31
Iowa No. 1946	23.2	22	23	58.0	...	1.3	1	5	6/17	7/24	35
Red Rock	15.3	49	73	55.8	30.1	1.1	0	..	6/16	7/24	35

* No stem rust or lodging in 1925 or 1926.

TABLE XX

SUMMARY OF AGRONOMIC DATA FOR WINTER WHEAT VARIETIES TESTED AT WASECA

Variety	Yield per acre, 1924-27	Winter killing, 1922-28	Stem rust, 1924-25, 1927	Weight per bushel, 1924-27	Weight per 1000 kernels, 1924-27	Straw per acre, 1924-27	Lodging		Date of heading, 1925-27	Date of maturity, 1924-27	Height, 1924-27
							Per cent, 1924-25, 1927	Degrees from ⊥ 1924-25, 1927			
	Bu.	Per cent	Per cent	Lbs.	Grams	Tons					Inches
Minturki	34.6	4	2	58.4	26.7	2.9	33	32	6/20	7/22	41
Crimean	25.8	..	16	56.7	23.6	2.7	26	35	6/20	7/23	42
Minard	32.2	5	19	57.1	23.8	3.2	13	57	6/20	7/24	41
Turkey Sel.	29.9	..	27	56.9	26.4	2.9	66	39	6/20	7/23	41
Kanred	34.2	18	5	56.8	27.3	2.7	96	42	6/18	7/22	41

TABLE XXI

SUMMARY OF AGRONOMIC DATA FOR WINTER WHEAT VARIETIES TESTED AT MORRIS

Variety	Yield per acre, 1924-28	Winter killing, 1924-28	Stem rust, 1927-28	Weight per bushel, 1926-28	Weight per 1000 kernels, 1926-27	Straw per acre, 1926-28	Lodging		Date of heading, 1926-28	Date of maturity, 1926-28	Height, 1926-28
							Per cent, 1927-28	Degrees from ⊥ 1927-28			
	Bu.	Per cent	Per cent	Lbs.	Grams	Tons					Inches
Minturki	23.9	23	9	55.5	26.8	1.6	27	40	6/22	7/24	38
Crimean	21.7	27	32	55.4	20.8	1.9	19	39	6/22	7/25	38
Minard	21.3	26	25	54.9	22.1	1.9	23	22	6/22	7/25	36
Turkey Sel.	22.5	27	38	56.8	22.2	1.9	39	41	6/22	7/25	36
Kanred	22.2	32	43	56.9	24.6	1.8	27	43	6/22	7/23	36

Morris

Since the Morris Station is located in the section just south of the Red River Valley district, it is strategically situated for both spring and winter wheat variety testing. Morris does not, however, represent an area as well suited to winter wheat as the Waseca Station since there is greater probability of winter-killing. (See Table XXI, p. 29.)

All varieties are grouped rather closely in yield for the five-year period. The same is true for winter-killing with Minturki having the advantage in both cases. It is evident that winter-killing is much more likely to occur in the Morris section. As a result winter hardiness is a most important character. The reaction of the different varieties to stem rust infection is similar to that reported for other stations except Kanred proved highly susceptible. As a rule, rust infection does not lower yields to the same degree in winter as in spring wheat. This is partly due to the earlier maturity of the fall-sown varieties.

Grand Rapids

The Grand Rapids Station is located in a section of the state that may be considered as marginal for winter wheat production. During years of abundant snowfall little winter injury may result. In exceptionally favorable years yields of more than 60 bushels per acre have been reported. In other years the entire crop may be lost due to winter injury. Under suitable soil conditions it is probable that Minturki will produce a satisfactory yield in a normal year.

TABLE XXII

SUMMARY OF AGRONOMIC DATA FOR THE WINTER WHEAT VARIETIES TESTED AT GRAND RAPIDS*

Variety	Yield per acre, 1924-27	Winter-killing, 1924-27	Stem rust	Weight per bushel	Weight per 1000 kernels	Date of heading, 1924, 1927	Date of maturity	Height
	Bu.	Per cent	Per cent	Lbs.	Grams			Inches
Minturki	21.8	38	34	53.6	25.2	7/5	8/15	40
Crimean	21.6	36	75	53.5	24.4	7/13	8/16	41
Minard	22.3	37	73	51.6	19.5	7/6	8/18	38
Turkey Sel.	16.5	38	83	54.1	21.2	7/6	8/11	41

* The data are for 1926-27 unless otherwise stated.

All varieties are on a par with the exception of Turkey Selection. This variety yielded lower altho it was no more subject to winter injury. The Minturki variety was most resistant to stem rust. Other agronomic data add little to the previous discussion. Considering all points, Minturki is the most suitable variety for this region.

Duluth

The winter wheat variety trials conducted at Duluth have been conclusive in showing that winter wheat is not suited to this section of

the state. Winter injury is frequent. The results of the tests made at Duluth are given in Table XXVII.

History and Description of Tested Winter Wheat Varieties[4]

Crimean, Minn. Acc. No. 845. Introduced originally from Russia.

Awned; white, glabrous glumes; weak straw; red kernels; susceptible to stem rust; good milling and baking qualities; early maturing; winter hardy (1).

Malakoff, Minn. Acc. No. 918. An introduction from a region near the Black Sea, Russia. Seed lot was obtained from the Ratekin Seed Co., Shenandoah, Iowa. This company is credited with the first distribution.

Awned; white, glabrous glumes; similar to Crimean in all respects, moderately winter hardy.

Odessa, Minn. Acc. No. 943. Introduced from Russia.

Awnless; brown, glabrous glumes; midstrong straw; red kernels; susceptible to stem rust; good milling wheat; late maturing; winter hardy; low yielding ability.

Turkey Selection, Minn. No. 1488. A selection by the Minnesota Agricultural Experiment Station from the Turkey variety.

Awned; white, glabrous glumes; midstrong straw; dark red kernels; susceptible to stem rust; midlate; one of the most winter hardy selections of the turkey variety but less hardy than Minturki; yields less than Minturki.

Minhardi, Minn. No. 1505. Developed by the Minnesota Agricultural Experiment Station from a cross between Turkey and Odessa. Named Minhardi because of its great winter hardiness (1).

Awnless; white, glabrous glumes; stiff straw; red kernels; very susceptible to stem rust; matures at same time as Minturki; generally yields less than Minturki.

Minturki, Minn. No. 1507. Developed by the Minnesota Agricultural Experiment Station from a cross between Turkey and Odessa in 1902. The variety was named and distributed in 1919.

Awned; white, glabrous glumes; strong straw; red kernels; resistant to stem rust and covered smut; good milling and baking qualities; early maturing; winter hardy; high yielding variety.

Wisconsin Pedigree No. 2, Minn. Acc. No. 1583. A pure line selection of Turkey developed by the Wisconsin Agricultural Experiment Station.

Practically identical with Turkey altho not as winter hardy as Minn. No. 1488.

[4] As with spring wheat, free use has been made of U. S. Dept. Agri. Bull. 1074, "Classification of American Wheat Varieties" (4).

Buffum, Minn. Acc. No. 1651. From a single plant selection in a field of Turkey wheat by B. C. Buffum of Worland, Wyoming.

Awnless; white to yellowish, glabrous glumes; midstrong to weak straw; red kernels; susceptible to stem rust; late maturing; winter hardy; yields less than Minturki.

Bacska, Minn. Acc. No. 2152. Result of a pure line selection by the Wisconsin Agricultural Experiment Station from Bacska, a wheat introduced from Austria-Hungary by the United States Department of Agriculture. Synonymous with Wisconsin Pedigree No. 408.

Awned; white, glabrous glumes; weak straw; red kernels; susceptible to stem rust; late maturing; not as winter hardy nor as high yielding as Minturki.

Red Rock, Minn. Acc. No. 2154. Developed by the Michigan Agricultural Experiment Station from an individual kernel selected from a white wheat known as Plymouth Rock (19).

Awned; brown, glabrous glumes; midstrong straw; soft red kernels; susceptible to stem rust; late maturing; lacks winter hardiness; lower yield than Minturki.

Iowa No. 1946, Minn. Acc. No. 2190. Pure line selection from the Turkey variety by the Iowa Agricultural Experiment Station.

Similar to Turkey; not as winter hardy as Minturki and yields less.

Kanred, Minn. Acc. No. 2191. Developed from the selection of a single head from Crimean by the Kansas Agricultural Experiment Station.

Awned; white, glabrous glumes; weak straw; dark red kernels; resistant to some forms of stem rust but frequently susceptible in Minnesota; early maturing; lacks winter hardiness and yielding ability of Minturki.

Minard, Minn. No. 2199. Progeny of a cross between a wheat of unknown origin and Turkey (1).

Resembles Turkey except for producing a kernel with corneous endosperm. Yields no better than Minturki, is less winter hardy, and is susceptible to stem rust.

Iobred, Minn. Acc. No. 2201. Pure line selection from the Turkey variety by the Iowa Agricultural Experiment Station.

Resembles Turkey; less winter hardy than Minturki and yields less.

Varietal Yields at Individual Stations

To present complete data on yields of winter wheat varieties for individual years, data have been assembled for each of the stations conducting varietal trials. These data are given in Tables XXIII to XXVII, inclusive. The average yield of each variety for the period it was grown is given in per cent of the yield of Minturki for the same years.

TABLE XXIII

YIELDS OF WINTER WHEAT VARIETIES PER ACRE, UNIVERSITY FARM, 1917-27

Variety	Minn. No.	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	Averages 1921-27	Averages 1924-27	Percentage of Minturki	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minturki	1507	48.7	28.7	31.8	32.7	14.0	13.3	28.7	41.5	30.8	20.2	40.2	27.0	33.2	100.0	..
Minhardi	1505	40.6	38.1	30.0	31.5	12.2	26.0	26.2	...	33.3	19.4	33.2	...	...	100.5	10
Crimean	Acc. 845	35.3	28.3	27.2	27.9	13.9	12.7	20.7	45.3	32.5	16.2	37.0	25.5	32.7	89.8	11
Malakoff	Acc. 918	40.7	24.5	29.8	...	...	...	...	...	...	...	...	...	...	87.0	3
Minard	2199	...	28.7	26.9	30.1	13.8	10.2	25.7	48.6	31.3	18.0	38.0	26.5	34.0	96.2	10
Odessa	Acc. 943	...	35.2	24.7	30.1	11.8	22.1	26.0	...	...	...	...	...	...	100.5	6
Wis. Ped. No. 2	Acc. 1583	...	32.8	25.3	28.6	13.1	7.0	22.9	43.0	30.3	...	...	...	...	91.6	8
Buffum	Acc. 1651	...	...	29.7	23.6	9.8	18.2	24.0	...	...	...	...	...	...	87.4	5
Red Rock	Acc. 2154	...	...	27.9	28.2	3.8	2.1	0.0	37.7	14.4	8.8	22.8	12.8	20.9	57.5	9
Bacska	Acc. 2152	...	...	...	26.8	10.3	8.0	19.6	39.3	31.0	...	...	...	...	83.9	6
Turkey Sel.	1488	...	...	...	...	14.1	17.5	24.0	48.5	31.1	15.5	34.1	26.4	32.3	97.9	7
Kanred	Acc. 2191	...	...	...	...	11.8	2.2	19.4	46.6	29.6	10.5	35.6	22.4	30.8	82.5	7
Iowa No. 1946	Acc. 2190	...	...	...	...	11.3	4.4	17.1	45.6	29.1	7.4	33.1	21.1	28.8	78.4	7
Iobred	Acc. 2201	...	...	...	...	...	...	17.1	41.9	27.1	...	...	...	...	85.2	3
Marquis*	Acc. 1239	...	...	...	21.2	9.8	17.2	13.8	29.9	29.9	18.8	11.0	18.6	22.4	68.5	8
P.E. of experiments in per cent		4.8	14.4	4.4	4.1	3.8	16.6	0.8	5.4	6.2	9.8	2.9				

* Marquis, spring wheat variety, included as a basis for comparison.

TABLE XXIV

YIELDS OF WINTER WHEAT VARIETIES PER ACRE, WASECA, 1919-28

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Average, 1924-27	Percentage of Minturki	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minturki	1507	23.2	40.0	14.3	32.0	23.9	51.3	30.8	20.7	35.6	29.8	34.6	100.0	..
Crimean	Acc. 845	20.8	31.6	9.4	40.9	21.9	33.5	19.8	17.6	32.4	...	25.8	83.8	9
Minhardi	1505	17.6	34.3	9.0	41.8	19.8	...	...	...	...	...	...	91.8	5
Odessa	Acc. 943	16.7	...	5.2	26.8	15.2	...	...	...	...	...	...	68.4	4
Minard	2199	...	...	12.1	41.8	26.5	47.2	25.6	17.7	38.5	33.9	32.2	102.1	8
Turkey Sel.	1488	...	...	9.4	...	...	44.1	31.9	15.0	28.6	...	29.9	84.5	5
Kanred	Acc. 2191	...	...	...	50.4	20.7	54.1	28.3	17.3	37.1	27.7	34.2	105.1	7
P.E. of experiments in per cent		3.3	1.5	8.7	3.7	21.5	6.6	10.1	5.2	5.6	17.9			

TABLE XXV

YIELDS OF WINTER WHEAT VARIETIES PER ACRE, MORRIS, 1919, 1921-28

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Average, 1924-28	Percentage of Minturki	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.			
Minturki	1507	11.4		17.7	28.0	17.2	45.7	0.0	24.5	25.9	23.5	23.9	100.0	..
Crimean	Acc. 845	9.5		16.6	22.3	13.6	36.8	0.0	30.9	18.3	22.7	21.7	88.0	9
Minhardi	1505	9.1		17.5	28.7	16.4	...	...	...	...	...	...	96.5	4
Minard	2199	...	No	18.9	27.3	14.8	35.0	0.0	27.7	19.8	23.9	21.3	91.7	8
Turkey Sel.	1488	...	data	17.2	...	...	37.7	0.0	31.4	20.1	23.4	22.5	94.5	6
Kanred	Acc. 2191	...		...	23.7	17.6	42.6	0.0	28.3	21.7	18.6	22.2	92.5	7
Odessa	Acc. 943	...		9.8	24.7	11.9	...	...	...	...	...	...	73.8	3
P.E. of experiments in per cent		...		2.7	4.4	7.0	5.9	...	3.1	3.8	4.6			

TABLE XXVI

YIELDS OF WINTER WHEAT VARIETIES PER ACRE, GRAND RAPIDS, 1920, 1924-27*

Variety	Minn. No.	1920	1924	1925	1926	1927	Average, 1924-27	Percentage of Minturki	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minturki	1507	38.8	56.9	0.0	5.2	25.0	21.8	100.0	..
Crimean	Acc. 845	26.9	56.7	0.0	9.0	20.8	21.6	90.1	5
Minard	2199	...	68.6	0.0	2.6	18.0	22.3	102.4	4
Turkey Sel.	1488	...	52.9	0.0	3.3	9.8	16.5	75.8	4
P.E. of experiments in per cent		3.9	2.2	...	34.1	4.4			

* No crop in 1928.

TABLE XXVII

YIELDS OF WINTER WHEAT VARIETIES PER ACRE, DULUTH, 1922-28

Variety	Minn. No.	1922	1923	1924	1925	1926	1927	1928	Average, 1922-28	Percentage of Minturki	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minturki	1507	18.3	21.0	27.0	2.4	0.0	0.0	0.0	9.8	100.0	..
Minard	2199	20.0	22.7	34.1	2.3	0.0	0.0	0.0	11.3	115.1	7
Crimean	Acc. 845	14.4	16.4	...	...	...	...	...	...	78.4	2
Kanred	Acc. 2191	12.3	15.6	...	...	...	...	...	...	71.0	2
Minhardi	1505	16.2	15.7	...	...	...	...	...	...	81.2	2
Odessa	Acc. 943	13.8	15.1	...	...	...	...	...	...	73.5	2
P.E. of experiments in per cent		10.2	10.2	7.4	13.8	...	...	...			

OATS

Performance of Oat Varieties in Minnesota

Oat varieties have been grouped as follows: (1) standard varieties recommended for Minnesota and (2) varieties which have been tested but not recommended for use in Minnesota.

TABLE XXVIII

YIELDS PER ACRE OF STANDARD MINNESOTA OAT VARIETIES FOR THE FOUR-YEAR PERIOD, 1925-28

Variety	Minn. No.	Univ. Farm	Waseca	Morris	Crookston	Grand Rapids	Duluth
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Minota	512	62.6	73.0	57.3	65.7	50.9	55.7
Victory	Acc. 514	63.9	63.7	59.3	58.1	36.7	47.8
Anthony	686	62.4	75.5	70.1	74.8	51.3	60.7
Gopher	674	62.2	81.1	64.3	64.9	57.7	45.4

Minota has yielded well for a number of years in Minnesota, and serves as a desirable standard for other varieties. It is a midseason variety, best suited to the central and northern sections of Minnesota. When stem and crown rust are not present in epidemic form, this variety gives highly satisfactory yields. Rust epidemics result in greatly

reduced yields of Minota and has led to a search for rust resistant varieties. As with spring wheat, little stem rust occurs at University Farm. Stem rust data for the Morris and Crookston stations (Tables XXXII and XXXIII) indicate the true reaction of the varieties tested.

Victory, similar to Minota in many respects, has been on the recommended list for a number of years. On an average, this variety yielded slightly more at Morris, Grand Rapids, and Duluth but less at the other stations (Table XXIX). Victory is susceptible to rust epidemics but has been grown because resistant varieties were not sufficient to supply the demand. With the development of new superior varieties, it is reasonable to expect that both Victory and Minota will be replaced by more desirable types.

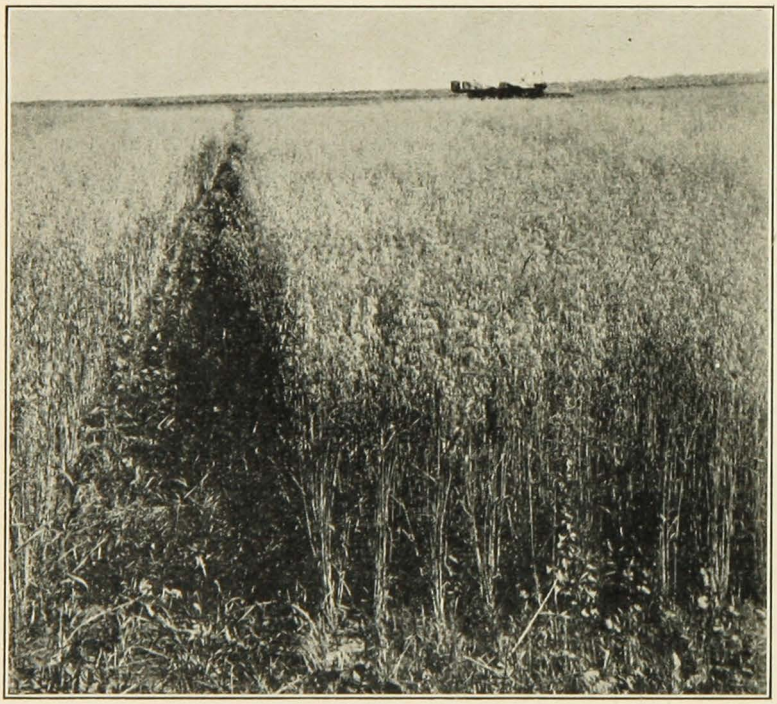

Fig. 2. Gopher Oats at Right
This stiff-strawed, early-maturing variety has a wide adaptation in Minnesota.

Anthony has outyielded Minota and Victory in most trials. In years of stem rust epidemics it is much superior. While not immune to stem rust, Anthony is highly resistant (Tables XXXII and XXXIII) and this is reflected in increased yield (9, 10, 12). Since Anthony is a midseason variety, it is best adapted to the northern two thirds of the state. It is not so well suited to southern Minnesota as Gopher

(Table XXXI). Anthony is susceptible to covered smut, as are practically all standard varieties, and the seed should be thoroly treated annually. With this precaution the variety has an important place in Minnesota agriculture.

Gopher is easily the outstanding oat variety for southern Minnesota (1). As it is one of the earliest of the varieties tested at the Minnesota stations, Gopher generally matures before stem and crown rust do much damage. This is important in southern Minnesota where rust damage is likely to be great. Without exception it is the stiffest strawed variety of commercial importance and yields well on a wide variety of soils. Gopher is not limited to southern Minnesota as in many years it is outstanding in the central and northern sections as indicated in Tables XXXV to XL. As a rule, however, the later maturing oat, Anthony, should be grown in the northern two thirds of the state and Gopher in the southern third. The early maturity and stiff straw make Gopher a very satisfactory variety as a companion crop with clovers and grasses.

TABLE XXIX

COMPARATIVE AVERAGE YIELDS OF OAT VARIETIES DISCARDED FROM THE VARIETY TRIALS, 1920-22

Variety	Minn. No.	Univ. Farm	Waseca	Morris	Crookston	Grand Rapids	Duluth
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Minota*	512	68.1	59.5	32.6	54.9	50.1	57.0
Victory	Acc. 514	67.1	56.3	39.4	49.4	51.8	59.6
Silvermine	Acc. 506	64.5	54.2	37.6	52.0	46.7	...
White Russian..	Acc. 339	59.0	48.4	35.0	45.2	47.4	...
Irish Victor....	Acc. 533	66.3	61.1	36.2	47.8	48.7	...
Swedish Sel. ...	513	65.2	53.6	32.9	43.8	48.0	...
Garton No. 784.	Acc. 576	59.5	50.8	28.4	45.3	42.0	50.2
Gopher*	674	61.7	76.6	49.2	...	...	...
Kherson Sel. ...	Acc. 358	60.7	53.7	36.5	56.1	...	...
Albion	Acc. 531	59.4	63.4	40.1	44.0	43.1	46.4
Iowar	Acc. 670	55.7	63.2	43.7	39.5	45.8	60.9

* Included as standards.

Silvermine, Minn. Acc. No. 506, was discarded after a thoro test because it was lower in yield than Minota.

White Russian or White Tartar has yielded consistently less than Minota. The chief value of this variety is its use as breeding material since it is highly resistant to black stem rust.

Irish Victor, while yielding well at Waseca and Morris, has not been as suitable under varying conditions as Minota.

Swedish Select is not equal to Minota in yielding ability or strength of straw.

Garton No. 784 has yielded consistently less than Minota.

Kherson Selection, Minn. Acc. No. 358, yielded less than Gopher at University Farm, Waseca, and Morris. Weak straw and susceptibility to rust are undesirable characteristics of the variety.

Albion (Iowa 103) ranks below Gopher in the averages included in Table XXIX. Grand Rapids is the only station where it has been equal to Gopher (Table XXXIX). Since early varieties are not recommended for the section represented by Grand Rapids, this exception is of little significance.

Iowar has not yielded as well as Gopher.

Agronomic Data at Individual Stations

Agronomic data are presented for the Central and the branch experiment stations. Varietal behavior is of most significance when considered in the light of the individual station. Entirely different oat varieties are recommended for the northern and southern sections of the state.

University Farm

The Central Station located at University Farm, St. Paul, may be considered as near the line dividing the state into two sections, the northern suited to the midseason oat varieties and the southern section where early varieties are best adapted. On an average the midseason varieties perform best at this station.

White Russian x Victory No. 694 and Minota x White Russian No. 693, two varieties highly resistant to stem rust, rank high in yield for the three-year period, 1926-28 (Table XXX). Minn. No. 693 is several days earlier than Minn. No. 694 and gives promise as a new variety. Both varieties have yielded more than Minota and Victory, the standard recommended varieties. Green Russian has been tested for a number of years and fails to equal Minota in yielding ability (Table XXXV). Anthony, a variety resistant to stem rust, produced by hybridization, has outyielded the standard varieties and is recommended for use in the area represented by University Farm. Improved Ligowa and Green Russian are not recommended. Green Russian is undesirable because of its weak straw. Miami and Swenson, the latter a side oat, failed to yield on a par with Minota and Victory. Gopher has not yielded as well as Anthony. The low yields of Liberty Hull-less indicate that the hull-less oats now available are not the equal of the hulled varieties.

Other agronomic data are of less importance than yield but are important in the final acceptance or rejection of varieties. All varieties have given nearly equal straw yields. All of the old standard varieties are susceptible to stem rust. Anthony and the newly developed hybrids, Minn. Nos. 693 and 694, were highly resistant to stem rust. Gopher appears intermediate not as a result of resistance but because of early maturity. In weight per measured bushel, Anthony ranks high. This character shows little or no relationship to yielding

TABLE XXX

SUMMARY OF AGRONOMIC DATA FOR OAT VARIETIES TESTED AT UNIVERSITY FARM, 1926-28

Variety	Yield per acre	Straw per acre	Stem rust†	Weight per bushel	Primary and secondary kernels, 1924-27		Lodging†		Date‡ of heading	Date‡ of maturity	Height
					Weight per 1000	Percentage of hull	Per cent	Degrees from ⊥			
	Bu.	Tons	Per cent	Lbs.	Grams						Inches
Minota	60.4	1.5	28	30.0	20.1	27.6	18	42	7/3	7/29	33
Victory	60.5	1.5	43	32.3	23.4	30.9	26	36	7/4	7/30	37
Improved Ligowa	58.3	1.5	44	31.1	22.9	33.3	38	15	7/4	7/30	37
Green Russian	62.5	1.5	34	31.7	23.0	28.5	74	23	7/1	7/29	36
Anthony	61.1	1.4	5	33.1	24.4	29.3	1	8	7/3	7/30	36
Wh. Russian x Victory No. 694	69.6	1.5	4	32.8	...	...	30	43	7/3	7/31	36
Miami	58.4	1.5	25	33.5	...	...	19	36	6/29	7/29	35
Swenson	55.6	1.4	28	31.8	...	...	56	44	7/1	7/26	37
Gopher	58.4	1.4	18	30.5	20.7	27.4	0	..	6/24	7/22	30
Minota x Wh. Russian No. 693	65.7	1.5	3	30.1	...	...	15	16	6/27	7/27	31
Liberty Hull-less*	51.8	1.5	39	40.0	...	...	32	10	6/25	7/24	35

* Actual yield x 10/7.

† Stem rust and lodging averages, 1927-28. No rust or lodging in 1926.

‡ Minota, days to heading 67; to maturity 94.

ability. Anthony produced the heaviest kernels during the 1924-27 period. Minota and Gopher developed the smallest kernels and were lowest in the percentage of hull. Improved Ligowa, with a very high percentage of hull, has been dropped from the list of varieties recommended for Minnesota. Since the weight of grain and percentage of hull are factors of great importance in oat quality, detailed data on these characters are given in Tables XLI to XLV. In strength of straw, Gopher and Anthony rank first, with Minota x White Russian, Minn. No. 693, nearly as strong. Other varieties were intermediate, Green Russian producing the weakest straw. Gopher, Minn. No. 693, Liberty Hull-less, and Swenson were earliest in maturity. Other varieties are classed as midseason. The short strawed varieties were Gopher, Minn. No. 693, and Minota.

Waseca

The Waseca Station represents an area best served by an early oat variety. Here, early maturity is a more important factor than at University Farm.

The early varieties, Minota x White Russian, Minn. No. 693, and Gopher were superior in yielding ability at Waseca during the three-year period covered by Table XXXI. The midseason varieties should not be grown in southern Minnesota.

Straw yields show greater differences between early and midseason varieties and are related to the length of straw. Figures on stem rust corroborate data for the varieties tested at University Farm; Anthony and the two new hybrids 693 and 694 being highly resistant to stem rust. Weight per bushel is not related to yield as the two highest yielding varieties tested less than 32 pounds. Anthony, as at University Farm, produced the largest kernels. In addition the hull percentage of these kernels was the lowest of all varieties. Gopher with a small kernel also was low in percentage of hull. Stiffness of straw, data on heading, and maturity are similar to the results obtained at University Farm.

Morris

As was true for University Farm, the Morris Station is near the division line for early and midseason varieties. Altho the data in Table XXXII favor the midseason varieties, in some years the early varieties have given highest yields (Table XXXVII).

The yields given in Table XXXII indicate the superiority of Anthony closely followed by the earlier maturing hybrid, Minota x White Russian, Minn. No. 693. The other varieties are grouped rather closely with the exception of the low yielding Liberty Hull-less. Gopher has usually yielded less than Anthony during the five-year period both varieties have been in comparative tests (Table XXXVII).

TABLE XXXI

SUMMARY OF AGRONOMIC DATA FOR OAT VARIETIES TESTED AT WASECA, 1926-28

Variety	Yield per acre	Straw per acre	Stem rust	Weight per bushel	Primary and secondary kernels, 1925-27		Lodging†		Date of heading	Date of maturity	Height
					Weight per 1000	Percentage of hull	Per cent	Degrees from ⊥			
	Bu.	Tons	Per cent	Lbs.	Grams						Inches
Minota	66.1	1.7	38	29.6	18.0	28.0	0	..	7/8	8/3	39
Victory	56.1	1.6	52	31.0	21.8	33.9	30	82	7/7	8/2	42
Anthony	67.2	1.7	1	33.3	23.4	27.6	0	..	7/9	8/5	41
Wh. Russian x Victory No. 694	67.4	1.8	T	31.3	...	...	14	45	7/8	8/7	42
Green Russian	56.0	1.7	32	28.8	...	...	65	78	7/7	8/2	42
Gopher	73.5	1.5	33	31.0	19.2	28.4	7	90	6/30	7/27	35
Minota x Wh. Russian No. 693	77.2	1.5	T	30.9	...	...	0	..	7/4	8/2	39
Liberty Hu'l-less*	54.3	1.5	66	39.2	...	...	50	90	7/3	7/31	41

* Actual yield x 10/7. † No lodging in 1928, averages for 1926-27.

TABLE XXXII

SUMMARY OF AGRONOMIC DATA FOR OAT VARIETIES TESTED AT MORRIS, 1926-28

Variety	Yield per acre	Straw per acre	Stem rust	Weight per bushel	Primary and secondary kernels, 1925-27		Lodging†		Date‡ of heading	Date‡ of maturity	Height
					Weight per 1000	Percentage of hull	Per cent	Degrees from ⊥			
	Bu.	Tons	Per cent	Lbs.	Grams						Inches
Minota	47.8	1.5	41	30.4	21.9	23.0	5	24	7/2	8/4	36
Victory	48.9	1.5	45	32.6	27.0	26.1	14	27	7/6	8/4	44
Anthony	61.4	1.4	17	35.0	26.9	25.2	11	22	7/5	8/6	36
Green Russian	48.1	1.5	47	31.9	...	...	..	..	7/6	8/4	39
Wh. Russian x Victory No. 694	56.2	1.5	26	33.8	...	...	..	..	7/6	8/7	38
Gopher	55.9	1.2	36	33.7	22.7	23.1	4	15	6/30	7/28	32
Minota x Wh. Russian No. 693	60.9	1.4	21	32.0	...	...	..	..	7/3	8/1	36
Liberty Hull-less*	34.7	1.3	43	39.9	...	...	..	..	7/2	8/2	37

* Actual yield x 10/7. † Lodging for 1924-25 and 1927. ‡ Minota, days to heading 74; to maturity 107.

Other agronomic data are similar to those previously given for the Central and Waseca stations. More severe stem rust infection has been in evidence at Morris, with the two highest yielding varieties most resistant. Anthony produced grain of distinctly greater bushel weight than other varieties. Victory and Anthony produced the largest kernels but Anthony excelled Victory in producing a lower percentage of hull. Gopher and Minota results were similar to those for the other stations. Lodging data are meager as no lodging occurred in 1926 and storms in 1928 prevented the securing of representative notes. Maturity data show the varieties to be slightly later at Morris than at Waseca.

Crookston

The Crookston Station in the heart of the Red River Valley represents an area well suited to the production of the midseason oat varieties.

Minota x White Russian, Minn. No. 693, Anthony, and White Russian x Victory, Minn. No. 694, form a high yielding group at the Crookston Station. Other varieties were decidedly inferior in yielding ability. Anthony is recommended in this part of the state as the other two hybrids are not available.

Other agronomic data are of interest. Severe epidemics of stem rust often occur at Crookston and all varieties are attacked. The three highest yielding varieties have been most resistant to infection. As at Morris, Anthony has produced the heaviest weight grain. Anthony produced the heaviest kernels and ranked second to Minota in low hull percentage. Lodging notes do not cover 1928 because of severe storms flattening all varieties. Lodging differences are small. Approximately one more week is required for the maturity of Minota at Crookston as compared with Morris. The longer period of plant growth is accompanied with greater plant height.

Grand Rapids

The cool growing season of the Grand Rapids section favors oat production. Here, as at Crookston, midseason varieties are best adapted.

White Russian x Victory No. 694 and Minota x White Russian No. 693 were high yielding during the three-year period covered in Table XXXIV. It is rather surprising that Gopher has excelled Anthony since the initial comparative trials. Minota and Victory appear to have little place in the Grand Rapids area.

Stem rust is usually present at Grand Rapids. The high yielding varieties as at other stations were the most resistant. Notwithstanding a reduced yield, Anthony produced the heaviest grain, closely followed by the new hybrid varieties. Anthony ranked first in kernel weight

TABLE XXXIII

SUMMARY OF AGRONOMIC DATA FOR OAT VARIETIES TESTED AT CROOKSTON, 1926-28

Variety	Yield per acre	Stem rust	Weight per bushel	Primary and secondary kernels, 1925-27		Lodging†		Date‡ of heading	Date‡ of maturity	Height
				Weight per 1000	Percentage of hull	Per cent	Degrees from ⊥			
	Bu.	Per cent	Lbs.	Grams						Inches
Minota	56.9	62	31.3	19.1	25.8	2	90	7/11	8/10	..
Victory	51.0	73	31.5	21.0	33.2	13	52	7/12	8/11	47
Anthony	67.2	24	35.5	24.4	27.0	7	53	7/10	8/12	46
White Russian x Victory No. 694	66.9	32	34.5	...	...	..	..	7/10	8/13	45
Green Russian	54.1	64	31.8	19.6	28.0	13	20	7/8	8/8	46
Gopher	52.9	55	31.5	19.4	27.6	6	90	7/2	8/2	38
Minota x White Russian No. 693	69.2	22	32.3	...	...	..	..	7/5	8/8	43
Liberty Hull-less*	40.1	64	38.9	...	...	14	90	6/30	8/1	42

* Actual yield x 10/7.

† Lodging average, 1925-27.

‡ Minota, days to heading 84; to maturity 114.

TABLE XXXIV

SUMMARY OF AGRONOMIC DATA FOR OAT VARIETIES TESTED AT GRAND RAPIDS, 1926-28

Variety	Yield per acre	Stem rust	Weight per bushel	Primary and secondary kernels, 1925-27		Date† of heading	Date† of maturity	Height
				Weight per 1000	Percentage of hull			
	Bu.	Per cent	Lbs.	Grams				Inches
Minota	46.6	70	31.2	23.3	20.8	7/20	8/17	43
Victory	30.3	88	32.9	26.0	25.5	7/20	8/19	48
Anthony	50.5	27	36.4	28.9	21.1	7/20	8/19	47
Wh. Russian x Victory No. 694	61.5	46	36.0	...	...	....	....	47
Gopher	54.9	60	34.2	...	...	7/20	8/6	38
Minota x Wh. Russian No. 693	58.1	27	33.7	...	...	....	....	42
Liberty Hull-less*	35.8	90	40.6	...	...	7/11	8/7	45

* Actual yield x 10/7.

† Minota, days to heading 70; to maturity 111.

and second in hull percentage. The period required for plant maturity was similar to that for the Crookston Station.

Duluth

Agronomic notes for the Duluth Station are omitted since the data indicate that conditions are similar to Grand Rapids. Anthony and some of the recently developed hybrids are most promising for the northeastern section of the state (Table XL).

History and Description of Tested Oat Varieties

Minota, Minn. No. 512. Selected by the Minnesota Agricultural Experiment Station from an unnamed commercial variety in 1906. Named Minota in 1919.

Common type; open panicle; awnless, yellowish-white grain; mid-tall, stiff straw; susceptible to stem rust; midlate; good yielding variety.

Victory, Minn. Acc. No. 514. Originated at Svalöf, Sweden. First introduced into the nursery at University Farm in 1908. A later introduction via the Department of Field Husbandry, University of Saskatchewan, was made in 1915. The latter introduction is the basis for results in this bulletin.

Common type; open panicle; awnless or few weak awns; large, white grain; tall, niidstrong straw; susceptible to stem rust; midlate to late; yields well.

Improved Ligowa, Minn. No. 281. Originated through a head selection made at University Farm in 1895 from the Swedish Select group.

Common type; open panicle, heavy to light awned; white grain;

midtall, midstrong straw; susceptible to stem rust; midlate; not as high yielding as Victory or Minota.

Silvermine, Minn. Acc. No. 506. Introduced from the Cornell Agricultural Experiment Station in New York in 1914.

Common type; open panicle; awnless, white grain; midtall to tall; midstrong straw; susceptible to stem rust; midseason; inferior to Minota.

Lincoln, Minn. Acc. No. 505. Introduced from the Cornell Agricultural Experiment Station in New York in 1914.

Common type; open panicle; awnless; white grain; tall; strong straw; susceptible to stem rust; midlate to late; yields less than Minota.

Banner, Minn. Acc. No. 507. Introduced from the Department of Field Husbandry, University of Saskatchewan in 1914.

Common type; open panicle; awned; white grain; tall; weak straw; susceptible to stem rust; late season; lower in yield than Minota.

O. A. C. No. 72, Minn. Acc. No. 500. Introduced from the Agricultural Experimental Union, Guelph, Ontario in 1914.

Common type; open panicle; awned; white grain; tall; strong straw; susceptible to stem rust; midlate to late; yields less than Minota.

White Russian (White Tartar), Minn. Acc. No. 339. Seed was secured from a local seed company in 1905.

Orientalis type; side panicle; awnless; white to yellowish white grain; midtall; strong straw; highly resistant to stem rust; late; yields less than Minota.

Kherson Selection, Minn. Acc. No. 358. A Kherson oat selected by the Nebraska Experiment Station in 1906.

Common type; open panicle; awnless; white grain; midtall; weak straw; susceptible to stem rust; late; yields less than Gopher.

Silvermine, Minn. No. 337. Selected in 1914 by the Minnesota Agricultural Experiment Station from seed obtained from a local seed company.

Common type; open panicle; awnless; white to yellowish white grain; midtall to tall; midstrong straw; susceptible to stem rust; late; yields less than Minota.

Irish Victor, Minn. Acc. No. 533. An Irish Victor pure line obtained from the Maine Agricultural Experiment Station in 1916 as Maine No. 340.

Common type; open panicle; awnless; white grain; tall, stiff straw; susceptible to stem rust; late; yields less than Minota except at Waseca and Morris.

Swedish Select, Minn. No. 513. A pure line selection by the Minnesota Agricultural Experiment Station in 1908.

Common type; open panicle; awned; white grain; midtall; weak straw; susceptible to stem rust; midlate; yields less than Minota.

Gold Rain, Minn. Acc. No. 669. Introduced from Svalöf, Sweden in 1915.

Common type; open panicle; awnless; yellow grain; midtall; midstrong straw; susceptible to stem rust; midseason; yields less than Minota.

Fulghum, Minn. Acc. No. 537. An introduction from the Alabama Agricultural Experiment Station in 1916.

Byzantina type; open panicle; awned, red grain; midtall, stiff straw; resistant to stem rust; early to midseason; yields less than Minota.

Lincoln, Minn. Acc. No. 575. Introduced to Minnesota in 1915.

Common type; open panicle; awnless, white grain; midtall; midstrong straw; susceptible to stem rust; midseason to late; yields less than Minota.

Garton No. 784, Minn. Acc. No. 576. Introduced in Minnesota in 1915.

Orientalis type; side panicle, awned, brown to black grain; short. stiff straw; susceptible to stem rust; midlate; yields less than Minota.

Scottish Chief, Minn. Acc. No. 577. Introduced to Minnesota in 1915.

Common type; open panicle; white grain; tall, weak straw; susceptible to stem rust; midseason to late; not as high yielding as Minota.

Garton No. 473, Minn. Acc. No. 578. Introduced in 1915.

Common type; open panicle; white grain; midtall; midstrong straw; susceptible to stem rust; midseason; ranks below Minota in yield.

Wolverine, Minn. Acc. No. 672, C. I. No. 1591. Developed by the Michigan Agricultural Experiment Station from a plant selection from an unnamed variety (5).

Common type; open panicle; awnless, white grain; midtall to tall, stiff straw; susceptible to stem rust; midseason; yields less than Minota.

College Wonder, Minn. Acc. No. 673. Introduced from the Michigan Agricultural Experiment Station in 1920 (5).

Common type; open panicle; awned, white grain; midtall; stiff straw; susceptible to stem rust; midseason; lower yield than Minota.

Iogren, Minn. Acc. No. 675, C. I. No. 2024. A pure line selection from Green Russian developed by the Iowa Agricultural Experiment Station (3).

Common type; open panicle; awned, yellow to yellowish white grain; midtall to tall; midstrong straw; susceptible to stem rust; midseason; yields less than Minota.

Green Russian, Minn. Acc. No. 677. Introduced from the New York Agricultural Experiment Station as Russian Green, Line 52.

Common type; open panicle; awned, yellow grain; midtall to tall; weak straw; susceptible to stem rust; midlate to late; yields on a par with Minota.

Anthony, Minn. No. 686. Progeny of a cross between White Russian and Victory. Developed by the Minnesota Agricultural Experiment Station. First seed was distributed to growers in 1929.

Common type; open panicle; awnless to weakly awned, white grain; midtall, midstrong straw; highly resistant to stem rust; midseason; excels standard varieties in yield.

White Russian x Victory, Minn. No. 694. Developed through hybridization by the Minnesota Agricultural Experiment Station.

Resembles Anthony; offers promise as a high yielding, stem rust resistant variety; test not complete.

Miami, Minn. Acc. No. 702. A pure line selection from the Siberian variety by the Ohio Agricultural Experiment Station.

Common type; open panicle; strongly awned, white grain; tall, midstrong straw; susceptible to stem rust; yields less than Minota.

Swenson, Minn. Acc. No. 701. Introduced by Enoch Swenson of North Branch, Minnesota.

Orientalis type; side panicle; white, awned grain; tall, weak straw; susceptible to stem rust; late season; yields less than standard varieties.

Markton, Minn. Acc. No. 691, C. I. No. 2053. A pure line selection made by the Bureau of Plant Industry, United States Department of Agriculture, in co-operation with the Oregon Agricultural Experiment Station to develop an oat immune to smuts (20).

Common type; open panicle; yellowish-white, awned grain; short to midtall; very susceptible to stem rust; immune to covered smut; early season; yields less than Gopher.

Minota x White Russian, Minn. No. 693. Developed by the Minnesota Agricultural Experiment Station.

Common type; open panicle; white, weakly awned grain; short, stiff straw; resistant to stem rust; midseason; high yielding variety requiring further testing.

White Russian x Victory, Minn. No. 696. Produced by the Minnesota Agricultural Experiment Station.

Resembles Anthony; a promising stem rust resistant variety requiring further testing.

White Russian x Victory, Minn. No. 697. Developed by the Minnesota Agricultural Experiment Station.

Plant characters similar to Anthony; requires further testing.

White Russian x Victory, Minn. No. 698. Produced by the Minnesota Agricultural Experiment Station.

Similar to Anthony; being continued in varietal tests.

White Russian x Victory, Minn. No. 699. Hybridized by the Minnesota Agricultural Experiment Station.

Resembles Anthony; requires further testing.

O. A. C. No. 144, Minn. Acc. No. 703. Selection in 1912 from O. A. C. No. 72 by the Department of Field Husbandry, Guelph, Ontario.

Common type; open panicle; practically awnless, brownish-white grain; tall, stiff straw; susceptible to stem rust; late; yields less than Minota.

North Dakota No. 20014, Minn. Acc. No. 708. A pure line selection from Green Russian by the North Dakota Agricultural Experiment Station.

Common type; open panicle; awned, white grain; midtall, midstrong straw; highly resistant to stem rust; midseason; yield tests incomplete.

North Dakota No. 22005, Minn. Acc. No. 709. A pure line selection from Green Russian by the North Dakota Agricultural Experiment Station.

Common type; open panicle; nearly awnless, yellowish-white grain; short to midtall; midstrong straw; resistant to stem rust; early to midseason; yield tests incomplete.

Rainbow, Minn. Acc. No. 710, North Dakota No. 22006. Pure line selection from Green Russian by the North Dakota Agricultural Experiment Station. Distributed in North Dakota in 1929.

Common type; open panicle; nearly awnless, yellowish-white grain; midtall; midstrong straw; highly resistant to stem rust; early to midseason; yield tests incomplete.

Albion (Iowa 103), Minn. Acc. No. 531. Developed from a single white-kerneled plant selected from Kherson in 1906 by the Iowa Agricultural Experiment Station (3).

Common type; open panicle; awned, white grain; short, strong straw; susceptible to stem rust; very early; yields less than Gopher.

Gopher, Minn. No. 674. A pure line selection from Sixty Day by the Minnesota Agricultural Experiment Station (1).

Common type; open panicle; awned, white grain; short, stiff straw; susceptible to stem rust, but earliness often enables it to escape damage; very early; yields well in southern Minnesota.

Iowar, Minn. Acc. No. 670. Selected from Kherson by the Iowa Agricultural Experiment Station (3).

Common type; open panicle; awnless, white grain; midtall; strong straw; susceptible to stem rust; early; not as high yielding as Gopher.

Nebraska No. 21, Minn. Acc. No. 563. Introduced from the Nebraska Agricultural Experiment Station in 1919.

Common type; open panicle; yellow grain; short, midstrong straw; susceptible to stem rust; outyielded by Gopher.

White Cross, Minn. Acc. No. 681. Developed by the Wisconsin Agricultural Experiment Station from a cross between Big Four (Wisconsin Pedigree No. 2) and Sixty Day.

Common type; open panicle; white grain; tall, weak straw; susceptible to stem rust; early season; yields less than Gopher.

Kanota, Minn. Acc. No. 682. Selection from Fulghum by the Kansas Agricultural Experiment Station.

Avena byzantina; open panicle; yellowish brown to red, awned grain; short, stiff straw; resistant to stem rust; early season; yields less than Gopher.

Sixty Day (Cole), Minn. Acc. No. 683. Introduced from the South Dakota Agricultural Experiment Station as South Dakota No. 316.

Similar to Gopher except not as stiff strawed and lower in yield.

Sixty Day, Minn. Acc. No. 684. Introduced from the North Dakota Agricultural Experiment Station as North Dakota No. 666.

Similar to Minn. Acc. No. 683. Not as high yielding as Gopher.

Iogold, Minn. Acc. No. 711. A pure line selection from Kherson by L. C. Burnett of the Iowa Agricultural Experiment Station in co-operation with the Office of Cereal Crops and Diseases, United States Department of Agriculture (2).

Common type; open panicle; weakly awned, yellow grain; midtall, stiff straw; semiresistant to stem rust; early maturing; requires further testing in Minnesota.

Liberty Hull-less, Minn. Acc. No. 676. Seed was secured from the Ontario Agricultural College.

Avena nuda; open panicle; white, naked grain; tall, weak straw; susceptible to stem rust; early; highest yielding hull-less oat tested but yields much less than standard hulled varieties.

Varietal Yields at Individual Stations

Annual yields for the oat varieties tested are given for the individual stations in Tables XXXV to XL, inclusive. Yields are compared on a percentage basis using Minota as a check variety.

Summaries of Kernel Weights and Hull Percentages

These data are presented for the primary and secondary kernels determined separately and for the groups combined. The column for primaries and secondaries is not an average of the primary and secondary column but a separate determination made with another sample of seed. (See Tables XLI-XLV, pages 57-59.)

TABLE XXXV

YIELDS PER ACRE OF OAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, UNIVERSITY FARM, 1917-28

Variety	Minn. No.	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Minota	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minota	512	77.1	78.3	41.6	63.0	47.3	94.0	55.1	52.5	69.1	29.9	66.6	84.6	100.0	..
Victory	Acc. 514	85.9	79.0	43.5	64.0	44.1	93.3	51.6	45.3	73.9	39.2	61.2	81.1	100.4	12
Imp. Ligowa	281	73.5	78.8	48.7	56.0	41.6	93.8	37.7	54.0	73.4	31.3	58.3	85.4	96.5	12
Silvermine	Acc. 506	75.6	79.8	48.5	60.6	44.3	88.7	...	...	...	...	...	...	99.1	6
Lincoln	Acc. 505	70.0	81.9	40.4	62.0	37.6	...	...	...	...	...	...	...	95.0	5
Banner	Acc. 507	72.8	76.9	41.7	55.5	37.4	...	...	...	...	...	...	...	92.5	5
O. A. C. No. 72	Acc. 500	72.0	77.3	41.5	52.3	...	...	...	...	...	...	...	...	93.5	4
White Russian	Acc. 339	62.0	69.2	46.8	47.4	34.1	95.6	44.9	...	...	...	...	...	87.6	7
Kherson Selection	Acc. 358	...	79.8	47.4	61.5	37.7	83.0	48.5	...	...	...	...	...	94.4	6
Silvermine	337	...	78.1	46.9	59.1	43.5	88.6	...	...	...	...	...	...	97.5	5
Irish Victor	Acc. 533	...	...	49.7	63.0	43.6	92.2	47.1	...	...	...	...	...	98.2	5
Swedish Select	513	66.6	74.9	42.1	63.4	39.1	93.2	...	...	...	...	...	...	94.5	6
Gold Rain	Acc. 669	...	...	50.2	64.6	38.0	89.9	...	...	...	...	...	...	98.7	4
Fulghum	Acc. 537	...	...	35.3	51.2	15.5	75.3	...	...	...	...	...	...	72.1	4
Lincoln	Acc. 575	...	...	43.6	64.5	39.5	92.6	...	...	...	...	...	...	97.7	4
Garton No. 784	Acc. 576	...	...	48.5	60.8	41.8	75.8	...	...	...	...	...	...	92.3	4
Scottish Chief	Acc. 577	...	...	44.3	52.9	36.6	...	...	...	...	...	...	...	88.1	3
Garton No. 473	Acc. 578	...	...	46.8	53.5	37.1	...	...	...	...	...	...	...	90.5	3
Wolverine	Acc. 672	...	...	...	58.0	42.2	87.3	45.6	...	...	...	...	...	89.9	4
College Wonder	Acc. 673	...	...	...	60.4	39.3	97.0	52.8	...	...	...	...	...	96.2	4
Iogren	Acc. 675	...	...	...	...	...	78.8	46.8	...	...	...	...	...	84.2	2
Green Russian	Acc. 677	...	...	...	...	43.3	85.6	44.4	57.2	74.9	33.5	...	84.1	97.8	7
Anthony	686	...	...	...	...	...	...	...	54.9	66.4	31.0	72.2	80.0	100.6	5
Wh. Russian x Victory	694	...	...	...	...	...	...	...	...	...	40.7	78.7	89.4	115.3	3
Miami	Acc. 702	...	...	...	...	...	...	...	...	...	37.1	66.0	72.1	96.7	3
Swenson	Acc. 701	...	...	...	...	...	...	...	...	...	31.8	47.8	87.3	92.1	3
Markton	Acc. 691	...	...	...	...	...	...	46.3	51.5	66.7	34.4	53.6	...	92.4	5
Minota x Wh. Russian	693	...	...	...	...	...	...	...	...	...	28.8	80.4	87.9	108.8	3
Wh. Russian x Victory	696	...	...	...	...	...	...	...	...	...	...	83.8	92.2	116.4	2

TABLE XXXV—*Continued*

YIELDS PER ACRE OF OAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, UNIVERSITY FARM, 1917-28

Variety	Minn. No.	1917	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Minota	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Wh. Russian x Victory	697	...	...	...	...	...	...	...	...	...	...	77.6	84.2	107.0	2
Wh. Russian x Victory	698	...	...	...	...	...	...	...	...	...	...	76.8	82.6	105.4	2
Wh. Russian x Victory	699	...	...	...	...	...	...	...	...	...	...	81.0	87.2	111.2	2
O. A. C. No. 144	Acc. 703	...	...	...	...	...	...	...	...	...	...	61.6	75.7	90.8	2
N. D. No. 20014	Acc. 708	...	...	...	...	...	...	...	...	...	...	...	61.5	....	..
N. D. No. 22005	Acc. 709	...	...	...	...	...	...	...	...	...	...	...	85.3	....	..
Rainbow	Acc. 710	...	...	...	...	...	...	...	...	...	...	...	58.7	....	..
Albion	Acc. 531	73.2	67.5	46.4	52.6	43.1	82.6	54.6	...	...	...	...	...	92.0	7
Gopher	674	...	...	...	57.6	50.7	76.8	60.5	58.3	73.4	34.1	55.6	85.6	98.3	9
Iowar	Acc. 670	...	...	...	60.5	34.3	72.2	53.1	...	...	...	...	...	84.8	4
Nebraska No. 21	Acc. 563	...	...	...	...	38.7	74.4	54.8	...	...	...	...	...	85.5	3
White Cross	Acc. 681	...	...	...	...	...	74.6	50.9	...	...	...	...	...	84.1	2
Kanota	Acc. 682	...	...	...	...	...	86.4	43.9	60.2	60.2	30.7	...	...	93.6	5
Sixty Day (Cole)	Acc. 683	...	...	...	...	...	69.3	47.4	56.3	...	...	...	...	85.8	3
Sixty Day	Acc. 684	...	...	...	...	...	78.7	53.2	57.0	...	...	...	...	93.7	3
Iogold	Acc. 711	...	...	...	...	...	...	...	...	...	...	...	72.0	....	..
Liberty Hull-less*	Acc. 676	...	...	...	...	35.3	33.1	30.2	51.3	67.9	33.3	35.0	87.2	74.8	8
P.E. of experiments in per cent..		2.1	2.7	3.6	4.6	3.6	2.8	4.6	5.0	3.0	7.3	4.1	3.2		

* Corrected for hull; actual yield x 10/7.

TABLE XXXVI

YIELDS PER ACRE OF OAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, WASECA, 1920-28

Variety	Minn. No.	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Minota	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minota	512	81.4	45.8	51.3	85.4	79.2	93.7	55.9	40.5	102.0	100.0	..
Victory	Acc. 514	74.2	37.9	56.8	79.5	74.5	86.5	47.1	29.9	91.2	90.9	9
Silvermine	Acc. 506	72.5	42.7	47.4	...	...	...	...	...	...	91.1	3
Lincoln	Acc. 505	67.0	40.2	34.9	...	...	...	...	...	...	79.6	3
White Russian	Acc. 339	58.5	36.9	49.7	...	...	...	...	...	...	81.3	3
Kherson Selection	Acc. 358	75.7	36.7	48.8	...	...	...	...	...	...	90.3	3
Irish Victor	Acc. 533	72.6	49.9	60.9	...	...	...	...	...	...	102.7	3
Swedish Select	513	68.4	35.3	57.1	...	...	...	...	...	...	90.1	3
Garton No. 784	Acc. 576	65.6	41.9	54.8	...	...	...	...	...	...	90.9	3
Garton No. 473	Acc. 578	54.1	43.4	56.6	...	...	...	...	...	...	86.3	3
Iogren	Acc. 675	...	...	...	71.5	82.1	83.9	...	...	...	91.9	3
Anthony	686	...	...	...	...	91.1	100.4	48.8	50.0	102.8	105.9	5
White Russian x Victory	694	...	...	...	...	...	...	63.2	52.2	86.8	101.9	3
Green Russian	Acc. 677	...	...	...	...	...	...	49.0	35.9	87.7	87.0	3
White Russian x Victory	699	...	...	...	...	...	...	...	70.0	100.2	119.4	2
White Russian x Victory	696	...	...	...	...	...	...	...	69.8	99.1	118.5	2
White Russian x Victory	697	...	...	...	...	...	...	...	59.8	87.7	103.5	2
White Russian x Victory	698	...	...	...	...	...	...	...	51.7	93.1	101.6	2
Markton	Acc. 691	...	...	...	...	...	...	...	24.7	...	....	..
N. D. No. 22005	Acc. 709	...	...	...	...	...	...	...	...	106.2	....	..
Rainbow	Acc. 710	...	...	...	...	...	...	...	...	103.6	....	..
N. D. No. 20014	Acc. 708	...	...	...	...	...	...	...	...	107.4	....	..
Swenson	Acc. 701	...	...	...	...	...	...	...	25.0	82.4	75.4	2
Gopher	674	71.6	66.5	91.8	81.8	83.1	104.0	72.8	46.3	101.4	113.2	9
Albion	Acc. 531	63.0	54.4	72.7	66.7	...	...	...	...	...	97.3	4
Iowar	Acc. 670	72.7	63.3	53.5	82.8	...	...	...	...	...	103.2	4
Nebraska No. 21	Acc. 563	...	58.5	67.7	81.0	...	...	...	...	...	113.5	3
Kanota	Acc. 682	...	...	...	...	...	87.2	43.0	...	...	87.0	2
Iogold	Acc. 711	...	...	...	...	...	...	...	...	105.4	....	..
Minota x White Russian	693	...	...	...	...	...	...	62.4	66.5	102.6	116.7	3
Liberty Hull-less*	Acc. 676	...	...	...	...	...	95.3	54.1	19.6	89.2	88.4	4
P.E. of experiments in per cent		4.3	3.3	6.0	2.7	4.1	3.1	6.5	4.6	4.2		

* Corrected for hull; actual yield x 10/7.

TABLE XXXVII

YIELDS PER ACRE OF OAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, MORRIS, 1919-28

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Minota	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minota	512	30.4	20.7	30.7	46.4	53.2	73.0	85.7	46.9	47.6	49.1	100.0	..
Victory	Acc. 514	...	31.5	32.8	54.0	59.0	69.5	90.2	55.2	47.4	44.4	106.8	9
Silvermine	Acc. 506	28.0	24.6	35.4	51.8	58.7	...	...	...	...	...	109.4	5
Lincoln	Acc. 505	24.5	23.7	26.7	52.9	...	...	...	...	...	...	99.7	4
Swedish Select	513	24.3	19.2	29.3	50.3	...	...	...	...	...	...	96.0	4
Kherson Selection	Acc. 358	23.8	26.5	31.0	51.9	53.9	...	...	...	...	...	103.1	5
White Russian	Acc. 339	13.2	18.6	38.0	48.3	52.1	54.8	...	...	...	...	88.4	6
Irish Victor	Acc. 533	...	22.7	37.1	48.9	59.5	...	...	...	...	...	111.4	4
Garton No. 784	Acc. 576	...	16.9	26.0	42.2	...	...	...	...	...	...	87.0	3
Garton No. 473	Acc. 578	...	25.7	36.6	49.9	...	...	...	...	...	...	114.7	3
Scottish Chief	Acc. 577	...	...	30.0	46.0	...	...	...	...	...	...	98.6	2
Gold Rain	Acc. 669	...	...	36.4	44.9	...	...	...	...	...	...	105.4	2
Iogren	Acc. 675	...	...	...	...	43.2	60.5	89.8	...	...	...	91.3	3
Anthony	686	...	...	...	...	...	74.2	96.1	54.3	67.2	62.7	117.3	5
Green Russian	Acc. 677	...	...	...	...	...	...	...	52.5	50.2	41.6	100.5	3
White Russian x Victory	694	...	...	...	...	...	...	...	51.3	62.5	54.9	117.5	3
White Russian x Victory	697	...	...	...	...	...	...	...	...	72.7	54.6	131.6	2
White Russian x Vitcory	696	...	...	...	...	...	...	...	...	70.2	55.2	129.7	2
White Russian x Victory	698	...	...	...	...	...	...	...	...	66.2	55.1	125.4	2
White Russian x Victory	699	...	...	...	...	...	...	...	...	62.8	57.6	124.5	2
Minota x White Russian	693	...	...	...	...	...	...	...	49.7	74.2	58.8	127.2	3
Markton	Acc. 691	...	...	...	...	...	...	...	...	42.9	...	....	..
N. D. No. 22005	Acc. 709	...	...	...	...	...	...	...	...	...	60.2	....	..
Rainbow	Acc. 710	...	...	...	...	...	...	...	...	...	58.0	....	..
N. D. No. 20014	Acc. 708	...	...	...	...	...	...	...	...	...	57.4	....	..
Swenson	Acc. 701	...	...	...	...	...	...	...	...	25.6	30.7	58.2	2
Albion	Acc. 531	38.9	37.4	33.1	49.7	32.1	...	...	...	...	...	105.4	5
Gopher	674	...	39.1	48.7	59.9	45.7	83.6	89.5	49.1	68.8	49.9	117.9	9
Iowar	Acc. 670	...	33.6	45.0	52.5	42.3	...	...	...	...	...	114.8	4
Nebraska No. 21	Acc. 563	...	...	39.9	47.1	38.4	...	...	...	...	...	96.2	3
Kanota	Acc. 682	...	...	...	...	...	...	80.5	51.5	...	...	99.5	2
Liberty Hull-less*	Acc. 676	...	...	...	...	...	...	...	42.1	44.9	30.7	82.0	3
P.E. of experiments in per cent...		4.2	7.5	5.9	3.5	13.2	4.8	2.9	3.7	2.8	4.9		

* Corrected for hull; actual yield x 10/7.

TABLE XXXVIII

YIELDS PER ACRE OF OAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, CROOKSTON, 1920-28

Variety	Minn. No.	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Minota	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minota	512	56.4	46.9	61.4	48.4	61.7	91.9	61.9	39.7	69.2	100.0	..
Victory	Acc. 514	63.6	27.8	56.8	48.5	66.3	79.2	55.6	28.2	69.2	92.1	9
Improved Ligowa	281	56.1	...	49.9	47.8	63.3	78.9	...	...	...	92.6	5
Silvermine	Acc. 506	62.3	36.5	57.3	53.6	...	...	...	...	...	98.4	4
Lincoln	Acc. 505	60.6	33.5	64.2	...	...	...	...	...	...	96.1	3
O. A. C. No. 72	Acc. 500	59.2	37.8	...	...	...	...	...	...	...	93.9	2
White Russian	Acc. 339	48.2	22.7	64.8	35.9	58.8	64.3	...	...	...	80.4	6
Kherson Selection	Acc. 358	58.0	32.5	77.7	52.3	63.1	91.0	...	...	...	102.2	6
Irish Victor	Acc. 533	44.3	41.0	58.1	55.9	...	...	...	...	...	93.5	4
Swedish Select	513	48.9	28.3	54.1	...	...	...	...	...	...	79.7	3
Gold Rain	Acc. 669	46.3	25.0	54.0	...	...	...	...	...	...	76.1	3
Garton No. 784	Acc. 576	64.9	22.6	48.5	...	...	...	...	...	...	82.6	3
Scottish Chief	Acc. 577	54.1	26.2	65.3	...	...	...	...	...	...	88.4	3
Garton No. 473	Acc. 578	48.4	17.7	52.0	...	...	...	...	...	...	71.7	3
Anthony	686	...	...	...	...	63.0	97.7	65.3	61.1	75.0	111.6	5
White Russian x Victory	694	...	...	...	...	...	...	70.2	56.0	74.4	117.4	3
Green Russian	Acc. 677	...	...	...	...	61.2	...	54.7	34.4	73.1	96.1	4
N. D. No. 22005	Acc. 709	...	...	...	...	...	...	...	68.9	75.4	132.5	2
N. D. No. 20014	Acc. 708	...	...	...	...	...	...	...	67.0	80.6	135.5	2
White Russian x Victory	699	...	...	...	...	...	...	...	66.9	77.0	132.1	2
White Russian x Victory	696	...	...	...	...	...	...	...	66.2	82.8	136.8	2
White Russian x Victory	697	...	...	...	...	...	...	...	63.3	72.8	125.0	2
Rainbow	Acc. 710	...	...	...	...	...	...	...	55.0	71.9	116.5	2
White Russian x Victory	698	...	...	...	...	...	...	...	52.1	67.1	109.4	2
Minota x White Russian	693	...	...	...	...	...	...	69.9	60.9	76.7	121.5	3
Markton	Acc. 691	...	...	...	...	...	...	...	21.0	...	....	..
Swenson	Acc. 701	...	...	...	...	...	...	...	17.5	49.0	61.1	2
Albion	Acc. 531	35.2	38.3	58.6	50.2	...	...	...	...	...	85.5	4
Richland	Acc. 532	56.7	29.6	63.2	...	...	...	...	...	...	90.8	3
Iowar	Acc. 670	40.3	31.8	46.4	48.1	...	...	...	...	...	78.2	4
Gopher	674	...	...	65.5	58.7	58.6	100.7	45.4	35.5	77.8	125.3	7
Nebraska No. 21	Acc. 563	...	28.5	61.9	52.1	...	...	...	...	...	90.9	3
Kanota	Acc. 682	...	...	...	...	...	79.8	34.1	...	...	74.1	2
Liberty Hull-less*	Acc. 676	...	...	...	...	...	50.5	41.8	22.9	55.5	65.0	4
P.E. of experiments in per cent		10.9	4.7	6.7	5.3	4.8	5.2	4.2	3.2	4.7		

* Corrected for hull; actual yield x 10/7.

TABLE XXXIX

YIELDS PER ACRE OF OAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, GRAND RAPIDS, 1919-28

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Minota	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minota	512	...	56.7	34.9	58.8	71.0	45.9	63.9	45.5	25.2	69.1	100.0	..
Victory	Acc. 514	34.3	58.8	33.4	63.3	51.2	44.6	55.8	19.7	26.6	44.7	84.5	9
Improved Ligowa	281	31.4	48.2	19.8	64.2	58.5	37.0	61.7	80.6	25.2	63.1	97.3	9
Silvermine	Acc. 506	26.2	54.4	29.2	56.6	61.2	...	...	...	...	...	91.0	4
Lincoln	Acc. 505	30.9	58.8	29.4	60.1	...	...	...	...	...	...	98.6	3
Swedish Select	513	27.8	55.3	26.7	62.1	...	...	...	...	...	...	95.8	3
O. A. C. No. 72	Acc. 500	32.4	53.0	19.5	...	...	...	...	...	...	...	79.1	2
White Russian	Acc. 339	23.3	61.6	24.8	55.8	73.2	26.8	45.9	...	...	...	87.0	6
Kherson Selection	Acc. 358	32.7	...	29.2	60.1	56.4	...	...	...	...	...	88.5	3
Irish Victor	Acc. 533	...	59.2	27.0	60.0	47.0	...	...	...	...	...	87.3	4
Garton No. 784	Acc. 576	...	49.2	20.9	55.9	...	...	...	...	...	...	83.8	3
Garton No. 473	Acc. 578	...	52.1	20.9	63.5	...	...	...	...	...	...	90.8	3
Scottish Chief	Acc. 577	...	...	24.4	59.3	...	...	...	...	...	...	89.3	2
Gold Rain	Acc. 669	...	...	27.5	65.0	...	...	...	...	...	...	98.7	2
Anthony	686	...	...	...	...	...	51.9	53.6	35.1	46.4	69.9	102.9	5
White Russian x Victory	694	...	...	...	...	...	...	...	64.7	63.0	56.7	131.9	3
White Russian x Victory	699	...	...	...	...	...	...	...	...	60.2	72.4	140.6	2
White Russian x Victory	698	...	...	...	...	...	...	...	...	59.0	49.3	114.8	2
White Russian x Vitcory	696	...	...	...	...	...	...	...	...	55.0	67.6	130.0	2
White Russian x Victory	697	...	...	...	...	...	...	...	...	...	61.4	....	..
Minota x White Russian	693	...	...	...	...	...	...	...	52.5	49.8	71.9	124.6	3
N. D. No. 22005	Acc. 709	...	...	...	...	...	...	...	...	...	70.0	....	..
Rainbow	Acc. 710	...	...	...	...	...	...	...	...	...	73.7	....	..
N. D. No. 20014	Acc. 708	...	...	...	...	...	...	...	...	...	64.0	....	..
Swenson	Acc. 701	...	...	...	...	...	...	...	...	28.4	44.2	77.0	2
Albion	Acc. 531	45.7	46.4	31.1	51.9	70.4	...	...	...	...	...	90.2	4
Gopher	674	...	...	30.9	61.0	54.3	29.4	65.8	55.8	35.7	73.3	98.0	8
Iowar	Acc. 670	...	52.5	28.1	56.9	67.3	...	...	...	...	...	92.5	4
Nebraska No. 21	Acc. 563	...	...	30.8	53.9	57.7	...	...	...	...	...	86.5	3
Kanota	Acc. 682	...	...	...	...	...	...	64.8	50.0	...	...	104.9	2
Liberty Hull-less*	Acc. 676	...	...	...	...	...	...	53.3	38.6	18.3	50.5	78.9	4
P.E. of experiments in per cent		5.7	7.9	1.7	6.8	3.2	14.6	9.2	12.7	5.9	3.3		

* Corrected for hull; actual yield x 10/7.

TABLE XL

YIELDS PER ACRE OF OAT VARIETIES TESTED IN FORTIETH ACRE PLOTS, DULUTH, 1919-28

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Minota	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Minota	512	48.3	70.5	47.0	53.4	57.3	63.7	53.7	57.9	51.4	59.8	100.0	..
Victory	Acc. 514	53.5	75.3	41.8	61.7	54.4	68.9	48.4	54.2	35.4	53.3	97.1	10
Improved Ligowa	281	46.2	77.7	40.5	52.5	60.4	110.2	42.1	...	...	65.9	109.2	8
Silvermine	Acc. 506	45.7	68.1	45.8	...	58.8	...	...	...	...	...	97.9	4
Lincoln	Acc. 505	47.7	73.5	44.4	44.9	...	...	...	...	...	...	96.0	4
Kherson Selection	Acc. 358	40.9	76.1	42.2	...	49.0	...	...	...	...	...	93.3	4
Garton No. 784	Acc. 576	...	66.3	38.4	46.0	...	...	...	...	...	...	88.2	3
White Russian	Acc. 339	...	...	38.7	50.0	60.2	75.8	54.9	...	...	...	101.6	5
Irish Victor	Acc. 533	...	...	41.8	47.3	52.7	...	...	...	...	...	89.9	3
Swedish Select	513	48.8	...	38.1	58.9	...	...	...	...	...	...	98.0	3
Gold Rain	Acc. 669	...	...	39.3	49.5	...	...	...	...	...	...	88.4	2
Scottish Chief	Acc. 577	...	...	35.5	50.4	...	...	...	...	...	...	85.6	2
Garton No. 473	Acc. 578	...	...	25.8	45.1	...	...	...	...	...	...	70.6	2
Anthony	686	...	...	...	...	...	87.3	58.3	45.3	74.3	64.7	115.1	5
White Russian x Victory	694	...	...	...	...	...	...	...	62.7	74.2	53.6	112.7	3
Minota x White Russian	693	...	...	...	...	...	...	68.2	60.7	59.6	54.1	108.9	4
White Russian x Victory	696	...	...	...	...	...	...	...	...	...	65.9	....	..
White Russian x Victory	697	...	...	...	...	...	...	...	...	...	62.2	....	..
White Russian x Victory	698	...	...	...	...	...	...	...	...	...	67.0	....	..
White Russian x Victory	699	...	...	...	...	...	...	...	...	...	62.1	....	..
N. D. No. 20014	Acc. 708	...	...	...	...	...	...	...	...	...	60.2	....	..
N. D. No. 22005	Acc. 709	...	...	...	...	...	...	...	...	...	53.9	....	..
Rainbow	Acc. 710	...	...	...	...	...	...	...	...	...	53.8	....	..
Swenson	Acc. 701	...	...	...	...	...	...	...	...	35.5	51.7	78.4	2
Albion	Acc. 531	54.3	51.0	41.6	46.7	53.3	...	...	...	...	...	89.3	5
Gopher	674	...	57.0	49.7	...	65.0	72.6	46.7	61.7	42.6	30.7	92.3	8
Iowar	Acc. 670	...	58.9	56.2	67.6	55.7	70.3	...	...	...	...	105.8	5
Nebraska No. 21	Acc. 563	...	...	50.2	...	47.2	...	...	...	...	...	93.4	2
Kanota	Acc. 682	...	...	...	...	...	...	34.6	54.0	...	...	79.4	2
Liberty Hull-less*	Acc. 676	...	...	...	...	...	...	38.1	63.0	34.7	30.1	74.5	4
P.E. of experiments in per cent		4.5	4.5	9.0	6.1	6.3	15.1	9.0	9.4	7.5	6.5		

* Corrected for hull; actual yield x 10/7.

TABLE XLI

WEIGHT PER THOUSAND KERNELS AND HULL PERCENTAGE OF OAT VARIETIES TESTED AT UNIVERSITY FARM

Variety	Weight per 1000 kernels						Percentage of hull					
	Primaries		Secondaries		Primaries and secondaries		Primaries		Secondaries		Primaries and secondaries	
	1924-27	1926-27	1924-27	1926-27	1924-27	1926-27	1924-27	1926-27	1924-27	1926-27	1924-27	1926-27
Minota	26.4	26.2	14.6	14.4	20.1	20.3	29.5	28.7	24.3	23.1	27.6	26.7
Victory	28.6	27.2	18.1	17.1	23.4	22.1	33.3	33.5	26.6	27.9	30.9	30.9
Improved Ligowa	28.8	28.1	17.2	16.6	22.9	22.5	34.7	34.0	32.6	26.2	33.3	30.7
Green Russian	28.6	27.6	17.4	16.8	23.0	22.2	30.7	30.1	25.1	25.1	28.5	28.2
Anthony	30.2	29.4	18.6	17.8	24.4	23.6	32.0	31.0	25.0	24.2	29.3	28.3
Wh. Russ. x Vict. No. 694	...	30.1	18.3	...	...	25.7	...	28.1	...	21.8	...	25.7
Miami	...	31.7	...	19.3	...	26.0	...	30.0	...	22.8	...	27.0
Swenson	...	28.1	...	12.7	...	20.4	...	34.0	...	25.6	...	31.5
Gopher	25.2	24.5	16.1	15.4	20.7	20.0	30.0	29.1	23.3	23.5	27.4	27.0
Markton	29.3	28.2	15.5	13.7	24.9	25.9	30.4	31.6	26.7	29.6	29.0	30.8
Min. x Wh. Russ. No. 693	...	26.3	...	15.7	...	21.0	...	26.5	...	22.6	...	25.0

TABLE XLII

WEIGHT PER THOUSAND KERNELS AND HULL PERCENTAGE OF OAT VARIETIES TESTED AT WASECA

Variety	Weight per 1000 kernels						Percentage of hull					
	Primaries		Secondaries		Primaries and secondaries		Primaries		Secondaries		Primaries and secondaries	
	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27
Minota	22.7	21.4	13.4	12.1	18.0	16.6	29.5	33.7	25.0	29.3	28.0	32.3
Victory	26.8	24.7	16.9	15.3	21.8	19.9	36.9	43.5	29.1	34.6	33.9	40.1
Anthony	29.5	29.5	17.3	16.7	23.4	23.1	30.1	32.3	23.1	25.0	27.6	29.7
Wh. Russ. x Vict. No. 694	...	28.5	...	17.5	...	23.0	...	28.7	...	21.9	...	26.1
Green Russian	...	23.0	...	13.9	...	18.4	...	34.9	...	32.2	...	35.4
Gopher	24.1	28.3	14.4	13.7	19.2	18.7	29.1	31.9	24.7	28.2	28.4	31.8
Min. x. Wh. Russ. No. 693	...	26.9	...	15.4	...	21.3	...	26.5	...	22.6	...	25.2

TABLE XLIII

WEIGHT PER THOUSAND KERNELS AND HULL PERCENTAGE OF OAT VARIETIES TESTED AT MORRIS

Variety	Weight per 1000 kernels						Percentage of hull					
	Primaries		Secondaries		Primaries and secondaries		Primaries		Secondaries		Primaries and secondaries	
	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27
Minota	27.7	27.4	16.1	15.2	21.9	21.3	24.2	25.8	21.0	22.7	23.0	24.6
Victory	33.6	32.3	20.4	19.1	27.0	25.7	28.3	30.0	22.0	23.7	26.1	27.6
Anthony	33.8	32.5	17.3	18.9	26.9	25.7	27.7	28.6	21.1	22.1	25.2	26.2
Green Russian	...	29.9	...	20.5	...	23.9	...	28.5	...	22.1	...	30.6
Wh. Russ. x Vict. No. 694	...	34.0	...	18.2	...	27.3	...	25.2	...	19.9	...	23.2
Gopher	28.3	27.1	17.1	16.2	22.7	21.7	25.0	25.7	19.4	20.5	23.1	24.1
Min. x Wh. Russ. No. 693	...	28.0	...	17.3	...	22.7	...	24.8	...	20.0	...	23.0

TABLE XLIV

WEIGHT PER THOUSAND KERNELS AND HULL PERCENTAGE OF OAT VARIETIES TESTED AT CROOKSTON

Variety	Weight per 1000 kernels						Percentage of hull					
	Primaries		Secondaries		Primaries and secondaries		Primaries		Secondaries		Primaries and secondaries	
	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27
Minota	24.0	23.7	13.6	12.5	19.1	18.1	27.3	29.9	22.9	26.8	25.8	28.9
Victory	27.7	24.9	16.1	13.5	21.0	19.7	35.1	39.9	28.3	33.1	33.2	37.8
Anthony	31.2	30.2	17.7	17.1	24.4	23.7	29.6	31.9	22.1	24.8	27.0	29.6
Wh. Russ. x Vict. No. 694	...	29.9	...	17.4	...	23.6	...	30.2	...	22.4	...	27.0
Green Russian	24.5	24.3	14.7	14.4	19.6	19.4	30.0	34.8	24.8	29.9	28.0	32.9
Gopher	24.2	21.9	14.7	12.9	19.4	17.4	30.0	34.1	23.7	27.3	27.6	31.5
Min. x Wh. Russ. No. 693	...	26.6	...	16.6	...	21.6	...	27.5	...	22.8	...	25.7

TABLE XLV

WEIGHT PER THOUSAND KERNELS AND HULL PERCENTAGE OF OAT VARIETIES TESTED AT GRAND RAPIDS

Variety	Weight per 1000 kernels						Percentage of hull					
	Primaries		Secondaries		Primaries and secondaries		Primaries		Secondaries		Primaries and secondaries	
	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27	1925-27	1926-27
Minota	27.7	27.0	18.8	17.9	23.3	25.0	27.4	29.2	20.8	22.5	24.7	26.5
Victory	30.5	29.2	21.4	19.6	26.0	24.5	33.8	35.2	25.5	28.5	30.3	32.3
Improved Ligowa	28.3	26.2	19.7	18.3	24.0	22.3	31.0	38.2	29.3	33.2	32.6	36.2
Anthony	35.0	35.6	22.7	22.3	28.9	29.0	27.5	28.6	21.1	22.6	25.0	26.3
Wh. Russ. x Vict. No. 694	...	35.0	...	22.6	...	28.8	...	26.8	...	20.0	...	24.1
Gopher	...	29.3	...	20.8	...	25.1	...	27.6	...	23.4	...	25.9
Min. x Wh. Russ. No. 693	...	31.7	...	20.2	...	25.9	...	25.3	...	19.9	...	23.2

BARLEY

The Minnesota Agricultural Experiment Station in co-operation with the Bureau of Plant Industry, United States Department of Agriculture, has been successful in developing new and valuable barley varieties. All of the varieties recommended to the farmers of the state were produced at the Central Station. A summary of yield performance at the different Minnesota stations is given in Table XLVI.

TABLE XLVI

YIELDS PER ACRE OF BARLEY VARIETIES RECOMMENDED FOR MINNESOTA*

Variety	Minn. No.	Univ. Farm	Waseca	Morris	Crookston	Grand Rapids	Duluth
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Improved Manchuria ...	184	46.0	51.3	37.1	31.6	...	43.7
Minsturdi	439	39.6	...	...	...	...	...
Velvet	447	46.4	50.3	36.0	36.8	28.0	47.9
Glabron	445	51.0	47.6	37.6	33.7	32.7	46.0
Svansota	440	43.4	48.1	39.2	35.5	39.7	35.0

* Averages for 1926-28 except Crookston, which are for 1925-27.

As a worthy representative of the Manchurian group of barleys, Minn. No. 184 has been an outstanding variety in Minnesota. This variety is resistant to the spot blotch disease (13) and has been the best all around rough-awned variety for Minnesota farmers. However, the development of the new smooth-awned varieties is resulting in its replacement by Velvet and Glabron.

Minsturdi was developed for use on fertile soils where lodging

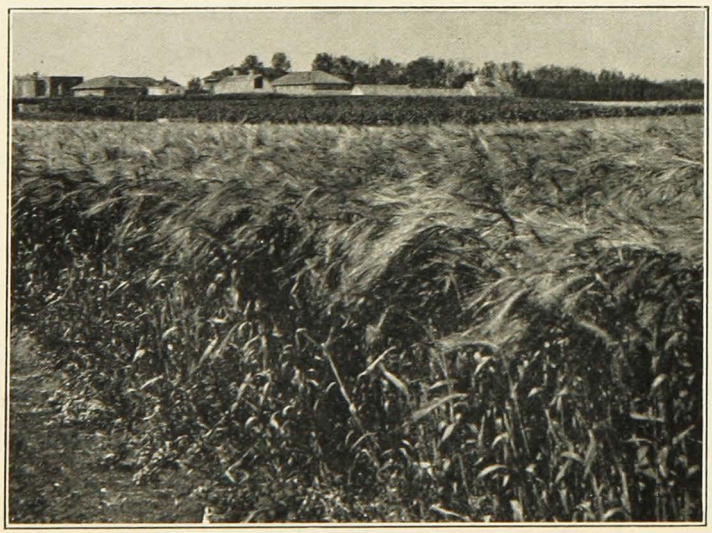

Fig. 3. Increase Plot of Velvet Barley, Morris Branch Station

frequently occurred. Under these conditions it is a suitable rough-awned variety as it produces a short, stiff straw that will stand up where improved Manchuria would lodge. On general soil types it is not so desirable as Manchuria. The susceptibility of Minsturdi to the barley stripe disease *Helminthosporium gramineum* is its most undesirable character.

Velvet was developed at the Central Station to meet the demand for a high yielding barley, free from the objectionable rough awns or beards (8, 9). The variety has awns but they are smooth and do not present the problems of rough-awned varieties. Velvet has been equal to Improved Manchuria in yielding ability since its introduction to farmers in 1926. This variety has done much to spread the barley-growing industry.

Glabron, another smooth-awned variety, was distributed in 1929 (8, 9). This variety appears to be somewhat superior to Velvet in yielding ability and in strength of straw.

Svansota, another Minnesota production, is the best two-row barley available. Extensive tests indicate that the variety is especially adapted to the northeastern section of Minnesota. Svansota is rough-awned and is susceptible to the barley stripe disease.

A number of other barley varieties have been tested at the Central and branch stations. None of these except Trebi rank as high as the varieties recommended. Trebi was the highest yielding variety. The yields by years are given in the summaries for the individual stations, Tables LIII to LVIII.

Trebi barley has yielded well in many tests. However, this variety has not been recommended because of its extreme susceptibility to disease, particularly the spot blotch disease caused by *Helminthosporium sativum*. Further, Trebi often meets objections from the commercial trade. This results in lower priced sales.

Hull-less barley varieties are undesirable in Minnesota because yields are much lower than for the hulled types. The hooded or awnless barleys have not been successful under Minnesota conditions.

Agronomic Data at Individual Stations

To simplify the analysis of the data, summaries of the more important agronomic notes are presented for the individual stations.

University Farm

During the three-year period, 1926-28, Glabron produced the highest average yield with Trebi a close second. Velvet and Improved Manchuria yielded on a par. Minsturdi ranked lowest. The variety plots are not on soils which would permit Minsturdi to show to the

best advantage since it is recommended only for heavy soils where lodging is likely to occur.

TABLE XLVII

SUMMARY OF AGRONOMIC DATA FOR BARLEY VARIETIES TESTED AT UNIVERSITY FARM, 1926-27*

Variety	Yield per acre	Weight per bushel	Weight per 1000 kernels	Lodging†		Date‡ of heading	Date‡ of maturity	Height
				Per cent	Degrees from ⊥			
	Bu.	Lbs.	Grams					Inches
Improved Manchuria...	46.0	44.5	30.2	66	24	6/27	7/25	33
Minsturdi	39.6	41.5	38.2	4	14	6/24	7/22	26
Glabron	51.0	45.4	31.2	7	20	6/28	7/26	33
Velvet	46.4	44.5	31.1	32	50	6/28	7/26	33
Trebi	49.6	41.5	35.9	33	51	6/27	7/26	27
Svansota	43.4	45.2	41.3	36	45	7/2	7/28	32

* Weight per 1000 kernels and lodging averages are for 1925-27.
† No lodging occurred in 1928.
‡ Manchuria, days from planting to heading 59; to maturity 87.

Data for other agronomic characters present interesting differences. Glabron has given greater bushel weight than Svansota, a two-row variety. Trebi and Minsturdi were low in weight per bushel. As might be expected, Svansota produced the largest kernels followed by Minsturdi and Trebi. The latter two characters appear uncorrelated. Glabron was a close second to Minsturdi in strength of straw. Minsturdi and Trebi are short strawed as compared with the other varieties included in Table XLVII.

Waseca

The Waseca Station serves an area more representative of the corn belt than is true for the other stations.

TABLE XLVIII

SUMMARY OF AGRONOMIC DATA FOR BARLEY VARIETIES TESTED AT WASECA, 1926-28*

Variety	Yield per acre	Weight per bushel	Weight per 1000 kernels	Lodging		Date of heading	Date of maturity	Height
				Per cent	Degrees from ⊥			
	Bu.	Lbs.	Grams					Inches
Improved Manchuria ...	51.3	46.8	30.6	100	45	6/27	7/26	34
Velvet	50.3	47.0	31.0	11	45	6/28	7/26	34
Glabron	47.6	46.2	32.5	7	41	6/28	7/26	34
Trebi	60.6	45.2	40.1	12	62	6/27	7/26	27
Svansota	48.1	48.0	43.6	55	45	7/2	7/29	34

*Weight per 1000 kernels, 1923-27.

At Waseca during the three-year period covered in Table XLVIII, Trebi has been outstanding in yield. However, its undesirable characteristics previously mentioned have not warranted the recommendation

of the variety. The other varieties are grouped in yield with Glabron ranking last.

Other agronomic data are somewhat different than those given for University Farm (Table XLVII). Trebi was lowest in weight per bushel of the six-rowed varieties. Lodging relationships of the varieties were similar to those for University Farm; Glabron and Velvet were the strongest varieties, while Trebi also stood up well. Svansota required a longer growing season than the other varieties. Trebi produced the shortest plants during the three-year period.

Morris

The Morris Station, located in the west central section of Minnesota, represents an area where barley is an important feed crop.

TABLE XLIX

SUMMARY OF AGRONOMIC DATA FOR BARLEY VARIETIES TESTED AT MORRIS, 1926-28*

Variety	Yield per acre	Weight per bushel	Weight per 1000 kernels	Lodging†		Date‡ of heading	Date‡ of maturity	Height
				Per cent	Degrees from ⊥			
	Bu.	Lbs.	Grams					Inches
Improved Manchuria ...	45.8	45.8	29.1	26	48	7/2	7/24	31
Velvet	46.5	46.5	30.3	22	45	7/3	7/26	32
Glabron	45.7	45.7	32.0	22	45	7/3	7/26	32
Trebi	45.5	46.5	37.6	34	52	6/30	7/26	32
Svansota	47.6	47.6	42.9	27	40	7/4	7/30	30

* Weight per 1000 kernels, 1923-27; lodging, 1927-28.

† No lodging occurred in 1926.

‡ Manchuria, days from planting to heading 69; to maturity 91.

All varieties were on about the same yield level during the three years covered in Table XLIX. Probably no significant differences occurred. The smooth-awned varieties, Velvet and Glabron, are preferred because of the absence of the rough awn or beard.

Other agronomic characters are similar to those given previously. In weight per bushel all varieties were nearly equal. Of the six-rowed varieties, Trebi produced the largest kernel while Glabron ranked second. Lodging data cover but two years. The growing season requirements correspond to the results at Waseca. Trebi developed taller straw at Morris than at the other stations while Svansota was somewhat shorter than usual.

Crookston

In the Crookston area, barley may be of especial value to the farmer as a substitute for corn. The short growing season prevents large yields of corn but is ideally suited to barley production.

Trebi led in yield during the five-year period. Svansota and Glabron ranked second and third. Trebi does especially well in this area. The

two-rowed Svansota is well suited to the northwestern part of the state but most farmers will prefer Glabron or Velvet which are nearly equal in yielding ability.

TABLE L

SUMMARY OF AGRONOMIC DATA FOR BARLEY VARIETIES TESTED AT CROOKSTON, 1923-27*

Variety	Yield per acre	Weight per bushel	Weight per 1000 kernels	Lodging†		Date‡ of heading	Date‡ of maturity	Height
				Per cent	Degrees from ⊥			
	Bu.	Lbs.	Grams					Inches
Improved Manchuria ...	34.8	44.3	29.5	88	15	7/10	8/6	39
Velvet	35.9	43.6	29.7	28	5	7/11	8/7	42
Glabron	36.2	43.6	31.7	0	..	7/9	8/6	41
Trebi	42.7	42.5	40.6	12	30	7/9	8/9	32
Svansota	37.3	45.0	41.7	0	..	....	8/12	37

* Height in inches, 1924-27; lodging, 1927 only.
† No lodging occurred 1923-26; crop failure in 1928.
‡ Manchuria, days from planting to heading 69; to maturity 96.

Other agronomic data are interesting. Trebi ranked lowest in weight per bushel and highest in thousand-kernel weight of the six-rowed varieties. Glabron produced a larger kernel than Velvet. The lodging data for the one year are indicative only but show the greater strength of Glabron straw over Velvet. Data of maturity is later than for the more southern stations. Height relationships are similar to those given for University Farm.

Grand Rapids

As at Crookston, this section of the state is not as well suited to corn production and the barley crop has an important part in the cropping scheme.

TABLE LI

SUMMARY OF AGRONOMIC DATA FOR BARLEY VARIETIES TESTED AT GRAND RAPIDS, 1926-28*

Variety	Yield per acre	Weight per bushel	Weight per 1000 kernels	Lodging	Date of heading	Date of maturity	Height
	Bu.	Lbs.	Grams	Per cent			Inches
Velvet	28.0	46.0	33.0	25	7/11	8/11	42
Glabron	32.7	47.0	37.2	17	7/9	8/10	41
Trebi	36.8	45.0	44.0	32	7/9	8/11	33
Svansota	39.6	50.0	50.2	74	7/13	8/14	42
Colsess	33.5	43 0	34.1	19	7/6	8/7	32

* Weight per 1000 kernels, 1926-27.

Svansota, as has been indicated previously, is particularly well suited to the section represented by the Grand Rapids Station. This variety has outyielded all others, being followed by Trebi. The heavy bushel weight and very large kernels of Svansota corroborate the yield evidence. The weak straw is evident in the comparisons with the other

varieties. In seasonal requirements, Colsess was earliest and Svansota latest. Velvet and Glabron produced tall plants while Colsess and Trebi were short. This is in line with the usual plant response in other trials in the state.

Duluth

Located in the northeastern part of the state, the Duluth Station serves an area which is on the frontier of Minnesota agriculture. Barley as a substitute for corn probably fulfills a greater need than in any other part of the state.

TABLE LII

SUMMARY OF AGRONOMIC DATA FOR BARLEY VARIETIES TESTED AT DULUTH

Variety	Yield per acre, 1926-28	Weight per bushel, 1927-28	Date of heading, 1925-26	Date of maturity, 1925-26
	Bu.	Lbs.		
Improved Manchuria	43.7	44.4	7/14	8/15
Velvet	47.9	45.5	7/14	8/13
Glabron	46.0	46.7	7/13	8/13
Trebi	52.3	44.1	7/13	8/14
Svansota	35.0	...	7/17	8/15

Agronomic data for the Duluth station are incomplete. In yield, Trebi followed by Velvet and Glabron has led during the three years covered in Table LII. Over a longer period of years Svansota has ranked much higher than the above data would indicate. (Table LVIII).

History and Description of Tested Barley Varieties[5]

Improved Manchuria, Minn. No. 184, C. I. No. 2330.[6] Developed from an individual plant selection from the Manchurian group (1).

Six-rowed; hulled; white lemma; rough-awned; weak straw; high yielding in Minnesota.

Chevalier (French Chevalier), Minn. Acc. No. 230, C. I. No. 175. According to Harlan this variety probably originated in England.

Two-rowed; hulled; white lemma; rough-awned; weak straw; yields less than Svansota.

Svanhals, Minn. Acc. No. 381. Introduced from Svalöf, Sweden.

Two-rowed; hulled; white lemma; rough-awned; weak straw; yields less than Svansota.

Servian, Minn. No. 426.[6] Originated as a plant selection.

Six-rowed; hulled; white lemma; rough-awned; weak straw; ranks below Improved Manchuria in yield.

[5] Whenever possible, free use has been made of U. S. Dept. Agr. Bull. 1334, "Tests of Barley Varieties in America" (6).

[6] These varieties were developed at the Minnesota Agricultural Experiment Station in co-operation with the Bureau of Plant Industry, United States Department of Agriculture.

Minsturdi, Minn. No. 439.[6] Produced from a cross between South African and Manchuria (1).

Six-rowed; hulled; white lemma; rough-owned; very stiff straw; susceptible to barley stripe disease; yields well on heavier soils where most varieties lodge.

Svansota, Minn. No. 440.[6] This variety resulted from a cross between U. S. Dept. No. 456 and Svanhals.

Two-rowed; hulled; white lemma; rough-awned; weak straw; highest yielding two-row barley tested in Minnesota.

Glabron, Minn. No. 445.[6] Developed from a cross between a smooth-awned selection and Manchuria. Distributed to Minnesota farmers in 1929.

Six-rowed; hulled; white lemma; smooth-awned; strong straw; yields somewhat superior to Improved Manchuria.

Velvet, Minn. No. 447.[6] Developed from a cross between a smooth-awned selection and Luth (1).

Six-rowed; hulled; white lemma; smooth-awned; midstrong straw; yields equal to Improved Manchuria.

Trebi, Minn. No. 448.[6] Developed from a plant selection.

Six-rowed; hulled; white lemma; rough-awned; weak straw; high yielding but susceptible to disease.

Comfort, Minn. No. 451.[6] Developed from a cross between a smooth-awned selection and Luth.

Six-rowed; hulled; white lemma; smooth-awned; midstrong straw; yields equal to Improved Manchuria.

Peatland, Minn. No. 452.[6] A plant selection from a variety called "Switzerland."

Six-rowed; hulled; white lemma; very rough-awned; strong straw; yields equal to Improved Manchuria.

Smooth Awn x Manchuria, Minn. No. 457.[6] Developed by hybridization.

Six-rowed; hulled; white lemma; smooth-awned; requires further testing.

Colsess, Minn. Acc. No. 461. Developed by the Colorado Experiment Station from a cross between Coast and Success.

Six-rowed; hulled; white lemma; hooded; strong straw; not as high yielding in Minnesota as awned types.

Smooth Awn x Manchuria, Minn. No. 462.[6] Produced by hybridization.

[6] These varieties were developed at the Minnesota Agricultural Experiment Station in cooperation with the Bureau of Plant Industry, United States Department of Agriculture.

Six-rowed; hulled; white lemma; smooth-awned; requires further testing.

Princess, Minn. Acc. No. 467. Developed by plant selection at Svalöf, Sweden.

Two-rowed; hulled; white lemma; rough-awned; weak straw; yields less than Svansota.

Ace, Minn. Acc. No. 468. Plant selection from the Smyrna group by the Bureau of Plant Industry, United States Department of Agriculture co-operating with the South Dakota Agricultural Experiment Station.

Two-rowed; hulled; white lemma; rough-awned; weak straw; yields less than Svansota.

Samofa, Minn. No. 469.[6] Developed from a cross between South African and Manchuria.

Six-rowed; hulled; white lemma; rough-awned; strong straw; yields less than Improved Manchuria.

Bohman, Minn. No. 470.[6] Developed from a cross between Bohemian and Manchuria.

Two-rowed; hulled; white lemma; rough-awned; midstrong to weak straw; yields less than Svansota.

Himalaya, Minn. Acc. No. 473. The probable origin of this variety is in Central Asia.

Six-rowed; hull-less; white lemma; blue caryopsis; hooded; weak straw; low yielding.

Varietal Yields at Individual Stations

Annual yields of the varieties tested for each individual station are given in Tables LIII to LVIII. These data offer opportunity for extended analysis of the results for each station. Varieties tested and discarded during the past several years are included in data given. Yields are compared on a percentage basis using Improved Manchuria, Minn. No. 184, as a standard.

TABLE LIII

YIELDS PER ACRE OF BARLEY VARIETIES TESTED IN FORTIETH ACRE PLOTS, UNIVERSITY FARM, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Imp. Manch.	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Six-row common														
Improved Manchuria....	184	52.2	35.6	27.9	26.9	48.3	35.4	25.4	46.3	43.2	47.5	47.4	100.0	..
Minsturdi	439	...	24.1	29.1	43.3	54.1	24.1	41.2	53.5	40.9	48.9	29.1	101.1	9
Servian	426	...	23.2	24.8	29.5	...	...	...	...	...	...	...	85.7	3
Samofa	469	...	25.7	26.9	28.0	...	...	...	...	...	...	...	89.2	3
Glabron	445	...	...	...	...	67.2	33.9	40.4	52.5	59.5	45.4	48.0	118.2	7
Velvet	447	...	...	...	...	67.2	28.2	25.4	46.3	48.5	43.4	47.3	104.4	7
Comfort	451	...	...	...	...	...	28.9	34.8	43.9	47.1	...	...	102.9	4
Trebi	448	...	...	...	...	...	23.9	43.4	55.2	43.2	60.2	45.3	110.6	6
Smooth Awn x Manchuria	457	...	...	...	...	...	...	...	...	55.4	45.2	46.7	106.7	3
Smooth Awn x Manchuria	462	...	...	...	...	...	...	...	...	...	50.3	46.8	102.3	2
Peatland	452	...	...	...	...	...	...	...	...	...	49.0	49.4	103.7	2
Two-row common														
Chevalier	Acc. 230	41.5	29.8	37.4	34.3	63.2	...	...	...	...	...	...	108.0	5
Svansota	440	...	24.0	29.3	32.5	74.8	35.2	37.2	48.1	36.4	45.0	48.7	107.1	10
Bohman	470	...	26.9	27.7	23.0	...	...	...	...	...	...	...	85.8	3
Princess	Acc. 467	...	...	29.2	22.2	54.9	...	...	...	...	...	...	103.1	3
Ace	Acc. 468	...	...	...	...	26.3	30.7	34.7	...	...	...	...	84.1	3
Miscellaneous														
White Hull-less	Acc. 428	...	...	14.7	16.0	35.6	19.4	21.1	...	...	...	...	65.2	5
Himalaya	Acc. 473	...	...	...	14.2	33.9	22.7	29.8	...	...	...	...	74.0	4
Colsess	Acc. 461	...	...	...	...	...	...	...	...	...	45.9	39.2	89.7	2
P.E. of experiments in per cent		2.8	2.8	6.7	4.8	5.0	1.1	4.7	3.2	9.1	4.8	2.8		

TABLE LIV

YIELDS PER ACRE OF BARLEY VARIETIES TESTED IN FORTIETH ACRE PLOTS, WASECA, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Imp. Manch.	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Six-row common														
Improved Manchuria....	184	66.0	34.8	33.5	47.8	70.4	49.5	70.3	58.2	55.1	41.3	57.4	100.0	..
Minsturdi	439	...	37.2	33.2	42.6	65.6	39.1	53.6	51.9	...	...	...	88.7	7
Samofa	469	...	...	33.4	38.3	71.3	...	...	...	...	...	...	94.3	3
Glabron	445	...	...	...	...	70.4	47.0	74.2	58.3	46.8	39.4	56.7	97.7	7
Velvet	447	...	...	...	...	65.0	50.9	68.5	60.6	56.1	39.8	54.9	98.4	7
Trebi	448	...	...	...	...	...	62.2	82.5	64.5	60.6	53.8	67.5	117.9	6
Comfort	451	...	...	...	...	...	50.9	66.8	58.1	47.9	...	...	96.0	4
Smooth Awn x Manchuria	457	...	...	...	...	...	...	...	...	54.2	42.9	58.8	101.4	3
Smooth Awn x Manchuria	462	...	...	...	...	...	...	...	...	...	42.7	65.5	109.6	2
Peatland	452	...	...	...	...	...	...	...	...	...	45.4	53.0	99.7	2
Two-row common														
Chevalier	Acc. 230	56.1	29.8	37.4	34.3	57.7	...	...	...	...	...	...	85.3	5
Svansota	440	...	33.0	35.1	29.0	72.1	53.6	72.5	56.9	52.6	36.3	55.3	95.8	10
Bohman	470	...	...	...	22.8	54.7	...	...	...	...	...	...	65.6	2
Miscellaneous														
Colsess	Acc. 461	...	...	...	...	...	...	...	...	...	35.6	53.0	89.8	2
P.E. of experiments in per cent		3.5	8.9	4.5	8.7	4.0	2.2	2.8	4.6	3.4	4.5	3.5		

TABLE LV

YIELDS PER ACRE OF BARLEY VARIETIES TESTED IN FORTIETH ACRE PLOTS, MORRIS, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Imp. Manch.	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Six-row common														
Improved Manchuria....	184	35.8	29.4	32.1	28.8	31.0	37.5	40.8	43.1	24.1	43.6	35.1	100.0	..
Minsturdi	439	...	34.3	19.4	21.3	22.9	34.7	43.8	32.9	...	...	...	86.2	7
Samofa	469	...	...	16.4	23.7	26.5	...	...	...	...	...	...	72.5	3
Glabron	445	...	...	...	...	29.0	36.8	46.6	42.0	30.3	50.0	32.4	104.7	7
Velvet	447	...	...	...	...	30.4	39.3	37.4	42.2	25.5	45.6	36.8	100.8	7
Trebi	448	...	...	...	...	...	38.6	46.8	41.4	32.9	54.6	27.4	107.8	6
Comfort	451	...	...	...	...	...	37.6	36.1	44.7	...	...	...	97.5	3
Smooth Awn x Manchuria	457	...	...	...	...	...	...	...	...	28.8	52.3	41.8	119.6	3
Smooth Awn x Manchuria	462	...	...	...	...	...	...	...	...	...	...	38.3	....	..
Peatland	452	...	...	...	...	...	...	...	...	...	45.4	26.8	91.7	2
Two-row common														
Chevalier	Acc. 230	30.1	32.7	...	21.0	23.4	...	...	...	...	...	...	85.8	4
Svansota	440	...	31.5	28.7	21.5	26.6	43.3	46.5	43.5	26.2	49.1	42.3	104.0	10
Bohman	470	...	...	...	22.0	25.5	...	...	...	...	...	...	79.4	2
Miscellaneous														
Colsess	Acc. 461	...	...	...	...	...	...	...	...	...	41.9	29.6	90.9	2
P.E. of experiments in per cent		5.0	6.1	5.8	6.2	4.5	1.7	2.6	3.5	5.6	2.4	4.6		

TABLE LVI

YIELDS PER ACRE OF BARLEY VARIETIES TESTED IN FORTIETH ACRE PLOTS, CROOKSTON, 1918-27

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927*	Percentage of Imp. Manch.	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Six-row common													
Improved Manchuria	184	33.2	25.8	29.7	24.4	53.6	34.8	44.1	30.3	38.6	26.0	100.0	..
Minsturdi	439	...	25.2	34.3	25.2	44.4	37.4	39.0	45.4	...	...	103.4	7
Samofa	469	...	...	36.7	...	46.3	...	...	...	...	...	99.6	2
Glabron	445	...	...	...	...	58.2	34.1	45.9	32.3	41.2	27.6	105.2	6
Velvet	447	...	...	...	...	53.0	37.8	31.3	32.2	45.4	32.8	102.2	6
Trebi	448	...	...	...	...	...	38.4	47.0	48.6	42.5	36.8	122.7	5
Comfort	451	...	...	...	...	...	42.8	33.0	42.5	36.7	...	104.9	4
Smooth Awn x Manchuria	457	...	...	...	...	...	...	...	...	39.0	25.9	100.5	2
Smooth Awn x Manchuria	462	...	...	...	...	...	...	...	...	...	31.9	....	..
Peatland	452	...	...	...	...	...	...	...	...	...	39.8	....	..
Two-row common													
Chevalier	Acc. 230	50.5	16.6	30.8	17.0	54.7	32.6	...	...	...	...	100.3	6
Svansota	440	...	15.5	28.2	23.1	56.8	38.7	41.6	39.8	32.4	34.2	101.0	9
Svanhals	Acc. 381	55.5	12.8	31.6	14.9	46.6	...	...	...	...	...	96.8	5
Bohman	470	...	...	25.5	19.9	41.1	...	...	...	...	...	80.3	3
Miscellaneous													
Colsess	Acc. 461	...	...	...	...	...	...	...	...	...	28.1	....	..
P.E. of experiments in per cent		10.6	11.9	7.8	8.8	8.9	4.5	6.0	8.6	9.5	7.0		

* Crop failure in 1928, no yields.

TABLE LVII

YIELDS PER ACRE OF BARLEY VARIETIES TESTED IN FORTIETH ACRE PLOTS, GRAND RAPIDS, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Imp. Manch.	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Six-row common														
Improved Manchuria	184	42.8	37.5	34.1	14.5	41.5	30.5	24.5	17.4	43.5	...	33.5	100.0	..
Minsturdi	439	...	40.3	33.1	14.9	41.4	20.8	19.6	...	...	...	...	93.2	6
Samofa	469	...	...	...	16.5	33.1	...	...	...	...	...	...	88.6	2
Glabron	445	...	...	...	...	44.2	34.3	27.1	26.7	39.0	30.4	28.6	104.7	6
Velvet	447	...	...	...	...	34.2	23.3	24.9	14.6	29.0	20.1	34.8	84.2	6
Trebi	448	...	...	...	...	...	31.2	29.7	...	54.0	17.2	39.2	116.7	4
Comfort	451	...	...	...	...	...	37.5	27.6	11.2	32.7	...	...	94.0	4
Smooth Awn x Manchuria	457	...	...	...	...	...	...	...	...	51.0	32.7	33.8	110.1	2
Peatland	452	...	...	...	...	...	...	...	...	...	...	44.4	....	..
Smooth Awn x Manchuria	462	...	...	...	...	...	...	...	...	...	...	40.3	....	..
Two-row common														
Chevalier	Acc. 230	41.6	34.8	30.5	9.9	36.2	...	...	...	...	...	...	89.8	5
Svansota	440	...	32.0	31.6	9.4	41.0	35.3	22.4	...	47.0	32.1	39.7	99.5	8
Bohman	470	...	...	...	15.1	38.8	...	...	...	...	...	...	96.3	2
Miscellaneous														
White Hull-less	Acc. 428	20.5	18.3	18.8	4.6	...	16.4	...	...	...	...	...	49.3	5
Colsess	Acc. 461	...	...	...	...	...	...	...	...	45.4	26.9	28.2	95.6	2
P.E. of experiments in per cent		11.4	5.3	7.5	4.5	5.7	6.4	4.2	14.1	5.1	6.6	4.3		

TABLE LVIII

YIELDS PER ACRE OF BARLEY VARIETIES TESTED IN FORTIETH ACRE PLOTS, DULUTH, 1919-28

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Imp. Manch.	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Six-row common													
Improved Manchuria	184	47.1	45.1	27.5	31.3	44.0	34.8	11.4	43.2	51.8	36.3	100.0	..
Minsturdi	439	42.5	40.1	29.0	21.2	25.8	26.6	30.5	...	...	...	89.4	7
Glabron	445	...	...	...	36.2	41.1	30.5	26.2	45.1	56.0	37.0	107.6	7
Velvet	447	...	...	...	42.6	35.3	37.4	26.3	45.6	60.0	38.0	112.8	7
Trebi	448	...	...	...	...	38.8	28.9	46.4	50.6	65.1	41.3	122.4	6
Comfort	451	...	...	...	...	41.9	36.0	...	...	...	...	98.9	2
Smooth Awn x Manchuria	457	...	...	...	...	...	...	...	46.0	53.2	35.1	102.3	3
Smooth Awn x Manchuria	462	...	...	...	...	...	...	...	...	62.9	39.6	116.3	2
Peatland	452	...	...	...	...	...	...	...	...	56.4	35.5	104.3	2
Two-row common													
Chevalier	Acc. 230	41.3	33.5	24.1	22.4	...	...	...	...	...	...	80.3	4
Svansota	440	53.8	50.1	33.5	25.8	37.3	37.9	30.7	40.5	41.9	22.5	100.4	10
Miscellaneous													
Colsess	Acc. 461	...	...	...	...	...	...	...	...	62.5	34.4	110.0	2
P.E. of experiments in per cent		2.3	6.7	9.0	9.4	6.2	11.1	21.4	4.2	7.5	6.8		

RYE

As a crop well suited to growth under widely varying conditions unsuitable for the other small grains, rye has an important place in Minnesota agriculture. In general, rye will produce higher yields on sandy soil than any other grain crop. For this reason it is usually grown on the poorer soil types. The ability to grow on soils low in organic matter together with winter hardiness is responsible for the importance of rye in the Northwest. The crop does not compete extensively with the other cereals but is grown, as a rule, under more or less adverse conditions.

Since rye is cross pollinated, varieties are not nearly so numerous as with other small grains. It is highly advantageous to have as few varieties as possible to prevent mixtures which are bound to occur when different varieties are grown on neighboring farms.

Varietal Performance

Swedish, Minn. No. 2, has been the standard rye variety in Minnesota since its development at the University Farm through selection for winter hardiness (1). A short summary for the more important varieties tested at the Central and branch stations during the four-year period, 1925-28, is given in Table LIX.

TABLE LIX

SUMMARY OF YIELDS PER ACRE FOR RYE VARIETIES TESTED IN FORTIETH ACRE PLOTS, 1925-28

Variety	Minn. No.	Univ. Farm	Waseca	Morris	Crookston	Grand Rapids
		Bu.	Bu.	Bu.	Bu.	Bu.
Swedish No. 2.....	2	25.8	32.9	35.7	16.1	28.4
Rosen	Acc. 82	20.5	33.6	...	...	17.1
Emerald	92	22.4	...	36.2	...	...
Dakold	Acc. 93	30.1	...	...	20.6	...
Prolific Spring.....	Acc. 89	31.5	...	...	...	...

At University Farm, Prolific Spring, a variety which is planted in the spring, has outyielded all other varieties. Dakold (16), a variety developed by the North Dakota Station, ranked second with a yield nearly as high. Rosen, developed by the Michigan Agricultural Experiment Station, gave the lowest yield principally because of winter injury. Emerald, a variety with a uniformly green colored seed, developed through selection by the Minnesota Station, ranked fourth in yield, being excelled by Swedish.

Tests at the branch stations are not as complete as at University Farm. At Waseca, where winter-killing is not so important, Rosen ranked high in yield. This variety is recommended for southern Minnesota. Emerald has outyielded Swedish during the four-year period in tests at the Morris Station. Dakold has been superior to Swedish

in the Crookston varietal trials. The importance of the winter hardiness of Swedish is evident in the results at Grand Rapids where it outyielded Rosen by 11.3 bushels per acre.

Agronomic Data at Individual Stations

The demands of different sections make it difficult to discuss the varieties for the state as a whole. Accordingly, summaries are presented for the more important results at the individual stations. For the most part, 1928 data are omitted from the summaries. These data make it possible to make more comparisons among varieties. The 1928 yields are presented for each station in Tables LXV to LXX.

University Farm

The trials at University Farm are usually more complete than at the branch stations as preliminary studies are made to learn if the variety warrants wider trials in other sections of the state.

TABLE LX

SUMMARY OF AGRONOMIC DATA FOR RYE VARIETIES TESTED AT UNIVERSITY FARM, 1924-27*

Variety	Yield per acre	Weight per bushel	Weight per 1000 kernels	Straw per acre	Lodging†		Date of heading	Date of maturity	Height
					Per cent	Degrees from ⊥			
	Bu.	Lbs.	Grams	Tons					Inches
Swedish No. 2.....	23.9	53.9	23.4	1.3	72	5	5/30	7/17	51
Rosen	27.9	51.8	26.1	1.1	47	16	6/3	7/19	49
Petkus	29.2	51.4	25.5	1.0	..	..	6/5	7/19	46
Midsommerog	24.6	52.3	17.7	1.2	..	..	6/4	7/20	49
Emerald	24.2	53.3	22.3	1.2	69	32	6/1	7/18	49
Dakold	27.0	54.9	21.2	1.2	47	17	5/29	7/17	..
Prolific Spring.....	31.8	...	...	1.2	33	63	6/15	7/28	43

* Results for 1928 are omitted because of unusual conditions as the result of an ice sheet during the winter of 1927-28.

† Lodging data for 1926-28.

Swedish No. 2 ranks lowest in the yields given in Table LX. However, this variety ranks high in winter hardiness and in yield performance at the branch stations as will be shown in later tables.

Rosen has yielded well during the four years covered in Table LX. However, during the winter of 1928 when conditions were favorable for winter-killing and were made more severe by an ice sheet, Rosen was a total failure and Swedish showed 58 per cent injury.

Petkus is a variety developed in Germany by selection (16). The Minnesota seed was obtained from Svalöf, Sweden. This variety is not recommended because of susceptibility to winter injury.

Midsommerog, a Swedish variety, is nearly as susceptible to winter injury as Rosen and was dropped from the varietal trials.

Emerald, produced by the Minnesota Station through selection for a uniformly green colored kernel, has yielded on a par with Midsom-

merog. This variety has performed well at Waseca (Table LXVI).

Dakold, a product of the North Dakota Agricultural Experiment Station, has yielded on a par with the fall-sown varieties. This variety appears to be as winter hardy as Swedish and to have somewhat higher yielding ability at University Farm. Unfortunately it has not been tested at the branch stations, except Crookston, until recently.

Prolific Spring outyielded all other varieties during the four-year period, 1924-27. This variety has shown real promise but has not been recommended for use in the state as it has been grown only at University Farm.

Other agronomic data for varieties tested at University Farm are of value. Dakold, Swedish, and Emerald produced grain with the greatest bushel weight. The low bushel weights of Midsommerog, Petkus, and Rosen, three varieties not recommended for this area, are significant. Rosen and Petkus with low bushel weight produced the largest kernels as determined by the weight per thousand. Midsommerog produced an extremely small kernel. All varieties were nearly equal in production of straw, this character showing some relationship to height of plant. In strength of straw, all varieties have lodged to some extent. Swedish produced the strongest straw while Prolific Spring lodged severely. Little differences in time of maturity are apparent for the winter varieties. Prolific Spring matures several days later than the other varieties.

Waseca

TABLE LXI

SUMMARY OF AGRONOMIC DATA FOR RYE VARIETIES TESTED AT WASECA, 1925-27

Variety	Yield per acre	Weight per bushel	Weight per 1000 kernels	Straw per acre	Lodging		Winter-killing	Date of maturity	Height
					Per cent	Degrees from ⊥			
	Bu.	Lbs.	Grams	Tons			Per cent		Inches
Swedish No. 2.....	31.4	51.4	20.7	2.6	0	..	0	7/17	47
Rosen	37.5	49.4	23.4	2.1	0	..	3	7/18	45
Midsommerog	32.5	49.7	16.6	2.4	67	45	1	7/19	47

The yields of Rosen at Waseca justify its recommendation for southern Minnesota where mild winters prevail. Midsommerog and Swedish were nearly on a par in yield, both falling below Rosen. Swedish excelled in weight per bushel while Rosen with the lowest bushel weight produced grain with the largest thousand-kernel weight. Straw yields were much higher at Waseca than at University Farm and were correlated with plant height. The weak straw of Midsommerog is shown by the data in Table LXI. Winter-killing during this period was of little importance at Waseca. All three varieties matured at about the same time.

Morris

TABLE LXII

SUMMARY OF AGRONOMIC DATA FOR RYE VARIETIES TESTED AT MORRIS, 1925-27*

Variety	Yield per acre	Weight per bushel	Weight per 1000 kernels	Lodging†		Date of heading	Date of maturity	Height
				Per cent	Degrees from ⊥			
	Bu.	Lbs.	Grams					Inches
Swedish No. 2	37.5	52.8	19.2	62	33	6/7	7/22	49
Emerald	38.2	53.7	20.0	65	31	6/9	7/22	48
Midsommerog	39.3	52.1	19.2	66	46	6/8	7/22	48

* Lodging data for 1924, 1925, and 1927.

† No lodging in 1926.

Each of the three varieties, Swedish, Emerald, and Midsommerog, gave high yields during the three-year period. There were no winters with conditions favorable for killing during this period to lower the yield of Midsommerog. Weight per bushel and thousand-kernel weight show but small differences. Varieties were nearly equal in strength of straw. All matured on the same date and produced plants of nearly the same height.

Crookston

TABLE LXIII

SUMMARY OF AGRONOMIC DATA FOR RYE VARIETIES TESTED AT CROOKSTON, 1925-27*

Variety	Yield per acre	Weight per bushel	Winter-killing	Date of heading	Date of maturity
	Bu.	Lbs.	Per cent		
Swedish No. 2	14.7	52.0	13	6/8	7/28
Dakold	17.6	52.2	8	6/7	7/26
Midsommerog	15.7	52.2	33	6/12	8/1

* Yield and winter-killing data 1924-27.

Winter injury is important at Crookston and rye yields are usually lower than for the more southern stations. Dakold produced the highest yield. Midsommerog and Swedish with nearly equal yields ranked second and third. Midsommerog is much more susceptible to winter injury than Swedish or Dakold and is not safe to use as total crop failure may result when the conditions favor killing. The varieties were equal in bushel weight.

Grand Rapids

TABLE LXIV

SUMMARY OF AGRONOMIC DATA FOR RYE VARIETIES TESTED AT GRAND RAPIDS, 1925-27*

Variety	Yield per acre, 1924-27	Winter-killing	Date of heading	Date of maturity	Height
	Bu.	Per cent			Inches
Swedish No. 2	35.5	3	6/14	7/30	45
Rosen	30.2	33	6/18	8/2	46
Midsommerog	27.6	15	6/22	8/3	50

* Yields for 1924-27.

Swedish No. 2 has outyielded the less winter hardy varieties, Midsommerog and Rosen, by a good margin. The data on winter-killing indicate why Rosen and Midsommerog have not been recommended for central and northern Minnesota. With Swedish earliest, the varieties exhibited maturity relationships similar to those for other stations. In plant height Midsommerog was somewhat taller than Swedish and Rosen.

Duluth

No agronomic data are presented for the Duluth Station. Conditions are similar to those for Grand Rapids. Swedish No. 2 has performed best at this station for a number of years. Complete yield data are given in Table LXX.

Varietal Yields at Individual Stations

Yield data for each individual station by years are presented in Tables LXV to LXX. These include 1928 data which were omitted from the agronomic summaries. The yield of each variety is compared on a percentage basis with the yields of Swedish for the same period of years.

TABLE LXV

YIELDS PER ACRE FOR RYE VARIETIES TESTED IN FORTIETH ACRE PLOTS, UNIVERSITY FARM, 1918-28

Variety	Minn. No.	1918	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Swedish	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Winter varieties														
Swedish No. 2	2	31.1	26.6	39.7	19.5	29.6	21.7	25.1	28.3	13.5	28.8	32.7	100.0	..
Rosen	Acc. 82	...	25.1	45.3	18.1	23.6	20.9	29.6	35.8	16.7	29.5	0.0	92.1	10
Petkus	Acc. 86	...	...	...	17.3	...	19.2	29.9	32.1	14.1	40.8	...	112.1	6
Midsommerog	Acc. 87	...	...	...	16.8	...	18.7	25.9	29.7	11.8	30.8	...	97.7	6
Emerald	92	...	...	...	...	...	22.1	27.8	30.2	12.6	26.2	20.7	93.0	6
Dakold	Acc. 93	...	...	...	...	...	...	29.9	31.2	13.4	33.4	42.2	116.9	5
Minnesota Selection	102	...	...	...	...	...	...	...	...	...	34.0	33.2	109.3	2
Minnesota Selection	103	...	...	...	...	...	...	...	...	...	32.1	24.9	92.7	2
Minnesota Selection	104	...	...	...	...	...	...	...	...	...	25.3	32.2	93.5	2
Recombination	105	...	...	...	...	...	...	...	...	11.7	29.1	26.6	89.9	3
Spring varieties														
Common Spring	Acc. 61	34.6	6.1	27.0	14.1	43.7	...	...	35.9	...	...	...	92.3	6
Abruzzes	Acc. 83	...	...	23.0	4.1	19.4	...	...	...	...	...	...	52.4	3
Prolific	Acc. 89	...	...	...	...	39.6	20.6	30.9	36.5	18.1	41.6	29.9	120.9	7
P.E. of experiments in per cent		2.9	4.2	2.7	6.3	3.8	1.1	2.9	5.6	7.0	10.9	4.5		

TABLE LXVI

YIELDS PER ACRE FOR RYE VARIETIES TESTED IN FORTIETH ACRE PLOTS, WASECA, 1920-23, 1925-28

Variety	Minn. No.	1920	1921	1922	1923	1925	1926	1927	1928	Percentage of Swedish	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Winter varieties											
Swedish No. 2	2	36.5	24.7	39.2	24.7	22.6	37.9	33.6	37.5	100.0	..
Rosen	Acc. 82	46.7	28.6	44.1	23.8	30.3	38.9	43.3	21.7	108.1	8
Emerald	92	...	...	...	...	30.8	41.1	...	31.6	105.6	3
Midsommerog	Acc. 87	...	...	...	...	24.2	38.2	35.1	...	103.6	3
Recombination	105	...	...	...	...	...	...	41.4	38.1	111.8	2
Spring varieties											
Common Spring	Acc. 61	29.5	18.1	18.9	23.4	...	...	...	...	71.9	4
P.E. of experiments in per cent		3.8	2.9	3.5	6.6	5.9	3.4	8.1	6.7		

TABLE LXVII

YIELDS PER ACRE FOR RYE VARIETIES TESTED IN FORTIETH ACRE PLOTS, MORRIS, 1919-28

Variety	Minn. No.	1919	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Swedish	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Winter varieties													
Swedish No. 2	2	23.4	6.3	17.6	35.3	17.1	33.2	31.6	34.8	46.1	30.3	100.0	..
Rosen	Acc. 82	20.1	...	16.3	32.6	15.9	...	...	...	...	...	90.9	4
Emerald	92	...	...	...	...	...	28.5	36.5	35.8	42.3	30.1	98.4	5
Midsommerog	Acc. 87	...	...	...	...	...	32.9	36.7	36.4	44.9	...	103.6	4
Recombination	105	...	...	...	...	...	...	...	...	...	27.8	....	..
Spring varieties													
Common Spring	Acc. 61	17.3	3.5	8.7	22.8	18.0	...	...	...	...	...	70.5	5
P.E. of experiments in per cent		7.3	4.0	6.7	11.1	7.1	3.4	3.6	4.8	2.8	2.4		

TABLE LXVIII

YIELDS PER ACRE FOR RYE VARIETIES TESTED IN FORTIETH ACRE PLOTS, CROOKSTON, 1921-28

Variety	Minn. No.	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Swedish	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Winter varieties											
Swedish No. 2	2	8.8	15.9	16.3	12.4	22.1	14.5	9.7	18.1	100.0	..
Rosen	Acc. 82	9.2	10.5	3.5	...	...	...	...	...	56.6	3
Emerald	92	...	...	12.5	10.3	23.0	20.1	...	12.2	93.6	5
Dakold	Acc. 93	...	...	...	10.8	28.8	20.0	10.6	23.0	121.4	5
Midsommerog	Acc. 87	...	...	...	9.8	31.1	12.8	9.0	...	106.8	4
Recombination	105	...	...	...	...	...	...	12.3	...	....	..
Spring varieties											
Common Spring	Acc. 61	8.2	8.8	15.4	...	31.8	...	...	...	101.7	4
P.E. of experiments in per cent		10.4	9.0	6.0	12.8	8.2	14.3	11.7	3.8		

TABLE LXIX

YIELDS PER ACRE FOR RYE VARIETIES TESTED IN FORTIETH ACRE PLOTS, GRAND RAPIDS, 1919-20, 1924-28

Variety	Minn. No.	1919	1920	1924	1925	1926	1927	1928	Percentage of Swedish	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Winter varieties										
Swedish No. 2	2	29.2	44.7	59.8	33.0	24.9	24.1	31.5	100.0	..
Wisconsin Ped.	Acc. 84	28.7	47.1	...	...	...	...	...	102.6	2
Rosen	Acc. 82	31.8	57.9	77.9	6.7	10.8	25.5	25.2	95.4	7
Colorless Sel.	90	...	...	51.4	31.5	21.3	25.7	27.9	91.1	5
Med. Green Sel.	91	...	...	61.6	23.0	22.5	27.0	...	94.6	4
Emerald	92	...	...	59.1	20.4	22.3	...	...	86.5	3
Midsommerog	Acc. 87	...	...	55.0	10.1	14.6	30.8	...	77.9	4
Recombination	105	...	...	...	...	...	26.0	...	....	..
Dakold	Acc. 93	...	...	...	...	...	...	28.4	....	..
P.E. of experiments in per cent		2.9	2.4	1.9	17.3	15.2	3.2	6.2		

TABLE LXX

YIELDS PER ACRE FOR RYE VARIETIES TESTED IN FORTIETH ACRE PLOTS, DULUTH, 1920-28

Variety	Minn. No.	1920	1921	1922	1923	1924	1925	1926	1927	1928	Percentage of Swedish	Years
		Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		
Winter varieties												
Swedish No. 2	2	13.9	22.7	28.0	19.6	16.7	14.7	20.0	17.7	15.9	100.0	..
Rosen	Acc. 82	10.5	23.3	22.0	17.7	...	...	...	...	...	87.2	4
Emerald	92	...	...	...	...	15.8	11.4	14.4	...	13.3	81.6	4
Midsommerog	Acc. 87	...	...	...	...	10.0	3.5	18.7	20.6	16.6	81.6	5
Recombination	105	...	...	...	...	...	...	...	20.6	15.9	108.6	2
Spring varieties												
Common Spring	Acc. 61	22.0	12.9	9.5	...	...	...	...	...	...	68.7	3
P.E. of experiments in per cent		9.5	6.1	9.6	10.4	4.9	15.1	17.5	5.1	9.9		

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