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# RECOMMENDED VARIETIES OF FARM CROPS FOR MINNESOTA

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INCREASE PLOT OF VELVET BARLEY, MORRIS BRANCH STATION, 1925

UNIVERSITY FARM ST. PAUL

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# RECOMMENDED VARIETIES OF FARM CROPS FOR MINNESOTA

By A. C. ARNY and H. K. HAYES

In Minnesota each year approximately seventeen million acres are devoted to the growing of farm crops. These crops have an average annual farm value either for sale or as feeds for farm animals, of approximately four hundred million dollars.

With practically his entire income derived from crops either through direct sale or through the sale of livestock or livestock products, it appears very clear that the Minnesota farmer can not afford to experiment with varieties of these crops which have not been thoroly tried and found to be the best available.

In Minnesota, the plant breeders of the experiment station, working under co-operative relations with plant breeders from the United States Department of Agriculture and with the plant pathologists at University Farm, have already developed, under a systematic plan of procedure, several varieties of grain that are higher yielders than varieties commonly grown because they are more disease resistant or have other desirable plant characters, or both. All new varieties are given preliminary trials at University Farm and the branch stations and on the basis of their performance records they are carried on into the final variety trials or are discontinued.

Experiment station workers in other states, in Canada, and in foreign countries are also developing new varieties. Private individuals and seed firms frequently bring out new varieties, and it is not an uncommon practice, especially for seed firms, to introduce old varieties under new names.

Obviously, the individual farmer can not make comparative trials of all or even a few of these new varieties. This is the work of the state experiment stations. In Minnesota a system has been organized for the purpose of making comparative trials of new varieties.

## The Variety Test

Two methods of making variety trials are used. In both methods the work is performed under carefully controlled conditions. New introductions from other countries, the progeny of single plant or head selections, and recently purified hybrids are first tested in the rod-row trials, under a careful system of replication. These rod-row trials are carried on at both the central and the branch stations. In these rod-row trials it is possible carefully to compare a large number of varieties and to obtain accurate knowledge of various characters such as disease

resistance, strength of straw, and period of maturity. Only a few of the more promising new varieties or new introductions from other countries are of sufficient promise that they are retained for the field plot variety trials. The more promising new varieties are also obtained from other states and compared with varieties produced in Minnesota.

At University Farm and at each of the branch stations, located at Waseca, Morris, Crookston, Grand Rapids, and Duluth, varieties that appear worthy of trial in the state, whether developed within the state or elsewhere, are grown in triplicated one-fortieth acre field plots for a period of three or more years provided they are not found undesirable in a shorter time.

### Recommended Varieties Decided on at Joint Annual Meeting

Each year as soon as the summarized records can be prepared from the rod-row and the field-plot trials they are brought before a meeting of all the workers at the central and branch stations who are interested in this work. The performance of each variety on trial is considered on its merits and if the records show a new variety superior to the best varieties of the same kind already available, it is placed on the recommended list for the state or that particular part of the state to which it has shown that it is adapted. Varieties introduced from outside the state are given the same careful trial as those developed within the state and, if their performance record warrants it, are placed on the recommended list.

This method of deciding on the varieties to be recommended gives assurance of adaptability and yielding ability and should command the confidence of growers.

### Distributing Recommended Varieties and Keeping Them Pure

As soon as a variety is put on the recommended list, it is increased either at University Farm or at the station in that part of the state to which it is particularly well adapted. When a sufficient quantity of seed is available, it is sold to growers for further increase, at a price somewhat above that of ordinary well prepared seed.

The Minnesota Crop Improvement Association co-operates in registering and certifying seed of these varieties, thus aiding in keeping available a supply of pure seed.

### Recommended Varieties of Farm Crops for Minnesota

The following varieties, having a record for favorable performance under experimental tests, are recommended by the Minnesota Agricultural Experiment Stations:

**WHEAT**

Spring varieties: Common bread wheat, Marquis, Accession No. 1239[1]; Durum wheat, Mindum, Minn. No. 470.

Winter varieties: Minturki, Minn. No. 1507.

**OATS**

Early maturing: Gopher, Minn. No. 674.

Medium maturing: Victory, Accession No. 514; Minota, Minn. No. 512; Improved Ligowa, Minn. No. 281.

**BARLEY**

Six-rowed:

Smooth awned: Velvet, Minn. No. 447.

Rough awned: Improved Manchuria, Minn. No. 184; Minsturdi, Minn. No. 439.

Two-rowed:

Svansota, Minn. No. 440.

**RYE**

Swedish, Minn. No. 2, for general planting.

Rosen, for southern Minnesota and other localities where winter killing is not likely to be a factor.

**FLAX**

Wilt-resistant varieties: Winona, Minn. No. 182; Chippewa, Minn. No. 181; Redwing, Minn. No. 188; North Dakota Resistant No. 114.

**SOYBEANS**

Early maturing: Minsoy, Minn. No. 139; Wisconsin Black, Accession No. 164.

Medium maturing: Chestnut, Minn. No. 110; Habaro, Minn. No. 109; Elton, Minn. No. 167; Manchu, Accession No. 195; Soysota, Minn. No. 142.

**FIELD PEAS**

Golden Vine, Minn. No. 95.

**CORN**

Southern section: For both dry corn and silage production: Silver King, Murdock, Rustler, Minn. No. 13.

Central section: For both dry corn and silage production: Minn. No. 13, Rustler.

Northwestern and north central section:

For dry corn production: Northern grown strains as follows:

Flint varieties: Dakota White, white flint; Gehu, yellow flint; Squaw, various colored flint; Pearl, white flint.

[1] Accession number signifies that the particular variety referred to was originated at some other experiment station but has been tested in Minnesota and found desirable for use in the state.

Dent varieties: Northwestern, yellow capped red dent varying considerably in shade of color; Minn. No. 23, white capped yellow dent; Minn. No. 13, yellow dent; early maturing adapted strains such as Haney's; Moccasin, yellow dent (an early strain of Minn. No. 13 developed at the Grand Rapids station).

For silage production: Minn. No. 13 and Northwestern Dent.

Northeastern section:

For dry corn production: Earliest flints, as Dakota White, white flint; Gehu, yellow flint; Squaw, various colored flint.

For silage production: Northwestern Dent and Minn. No. 13. At the Duluth station sunflowers have given better results for silage than corn.

**ALFALFA**

Grimm.

### Performance and History of Recommended Varieties

The yields in bushels per acre secured at University Farm and the five branch stations in the field plot variety tests are given for the periods for which comparable yield data are available. To facilitate comparison of the different varieties without further computation, the yields are also given in per cent based on the yield of one variety as 100. In connection with the histories, data are also given for results obtained from rod-row trials in cases where the data are of special interest.

## SPRING WHEAT

A comparison of the yields of the varieties that have been tested for five years shows that Marquis has averaged as high in yield as any of the varieties of common spring wheat. The average yields of Red Sask at University Farm and Kota at Grand Rapids are 7.7 and 4.3 per cent, respectively, above that of Marquis, but these differences are so small that they may be disregarded. For this period Mindum equaled or exceeded Marquis in yield at every location except Grand Rapids. Mindum has been compared in yield with both Kubanka and Arnautka, two of the most widely grown durum varieties, and found to be superior in yielding ability under Minnesota conditions.

As Marquis and Mindum have proved the most satisfactory wheats in the tests during the last five-year period, they are the varieties recommended for general planting in the state.

The five-year average yields are given in Table I.

TABLE I

COMPARATIVE AVERAGE YIELDS OF SPRING WHEAT VARIETIES IN BUSHELS PER ACRE AND IN PER CENT BASED ON THE YIELDS OF MARQUIS AS 100

| Variety | No. | Univ. Farm | Waseca | Morris | Crookston | Grand Rapids | Duluth |
|---|---|---|---|---|---|---|---|
| | | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. |
| Marquis | 1239 | 27.2 | 24.1 | 22.6 | 18.8 | 13.9 | 16.3 |
| Kota | 2151 | 26.6 | 21.3 | 21.1 | 18.3 | 14.5 | 14.9 |
| Mindum | 470 | 29.6 | 28.6 | 27.5 | 26.0 | 12.5 | 19.6 |
| Preston | 924 | 26.8 | .... | 22.0 | .... | .... | .... |
| Red Sask | 2193 | 29.3 | .... | .... | .... | .... | .... |
| Haynes | 169 | 23.9 | .... | .... | .... | .... | .... |
| Pentad | 1968 | 27.4 | .... | .... | .... | .... | .... |
| | | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent |
| Marquis | 1239 | 100 | 100 | 100 | 100 | 100 | 100 |
| Kota | 2151 | 97.8 | 88.4 | 93.4 | 97.3 | 104.3 | 91.4 |
| Mindum | 470 | 108.8 | 118.7 | 121.7 | 138.3 | 89.9 | 120.2 |
| Preston | 924 | 98.5 | .... | 97.3 | .... | .... | .... |
| Red Sask | 2193 | 107.7 | .... | .... | .... | .... | .... |
| Haynes | 169 | 87.9 | .... | .... | .... | .... | .... |
| Pentad | 1968 | 100.7 | .... | .... | .... | .... | .... |

Marquis is a beardless, stiff-strawed, common spring wheat of the Fife group. This variety was produced in Canada from a cross between Hard Red Calcutta and Red Fife. Marquis ripens earlier than Bluestem, has stiff straw, and produces good yields of high quality wheat. It has proved of wide adaptability under various spring wheat conditions. Its chief defects are its susceptibility to black stem rust and its somewhat greater susceptibility to scab than some other spring wheats. It is fairly resistant to infections of covered smut. It is estimated that over 75 per cent of the wheat grown in Minnesota is Marquis.

Mindum, Minn. No. 470, is a bearded, white-kerneled, durum wheat belonging to the Arnautka group. It resulted from the selection of a durum kernel found in a common bread wheat. It was sent to the Crookston station in 1905 and proved a good yielder under Crookston conditions. In 1915 and 1916 it gave such high yields in the row tests at University Farm and the branch stations that it was increased and placed in the variety tests. As a result of these tests it has been increased for wider distribution. It is not quite so rust resistant as Pentad, Monad, or Acme, but more rust resistant than the Arnautka commonly grown. It has high yielding ability under Minnesota conditions. Mindum, in common with other durum wheats, is not suited to milling into flour for bread. Tests have shown Mindum to be of good quality for the production of macaroni and other durum wheat products. Pentad, a red durum wheat grown to a considerable extent in the state, is of low quality and should be supplanted entirely by Mindum.

Durum wheats are used in the production of macaroni, spaghetti, vermicelli, and other products of that kind. There is a demand for good durum wheat for the manufacture of macaroni products, but the

total amount needed annually for that purpose is small as compared with the amount of common wheat needed for bread making. Not more than ten per cent of the acreage annually planted to wheat should be devoted to the growing of durum.

Besides those of the recommended varieties, Marquis and Mindum, the comparative yields of a number of other spring wheats are given.

Haynes Bluestem, Minn. No. 169, and Preston have been largely superseded in the state by Marquis.

Red Sask was originated at the University of Saskatchewan, Saskatoon, Canada. It has been tested at two locations and found to be a high yielder altho not rust resistant. The milling and baking tests indicate that it is a desirable wheat from those standpoints. It will be given a wider test.

Kota is a rust-resistant, common spring wheat originated at the North Dakota Experiment Station (11).[2] Where black stem rust epidemics are severe, it sometimes yields higher than Marquis; but ordinarily in Minnesota it scarcely equals Marquis in yielding ability. It is somewhat more susceptible to infection by covered smut than Marquis. The fact that Kota has weaker straw than Marquis (see Fig. 1) and hence often lodges badly, may be noted from the results presented in Table II. In this table per cent lodging refers to the percentage of the row which is lodged, and degree lodging refers to the extent of lodging where 100 represents complete lodging.

From the mechanical standpoint of milling, Kota is somewhat less satisfactory than Marquis. The yellow shade of the loaves baked from flour from Kota as compared with Marquis is not a serious objection, as bleaching the flour readily removes it.

TABLE II

COMPARATIVE STRENGTH OF STRAW OF KOTA AND MARQUIS AT FOUR LOCALITIES FOR AN AVERAGE OF THE YEARS 1921-25—ROD-ROW TRIALS

| Varieties | Univ. Farm | | Waseca | | Morris | | Crookston | |
|---|---|---|---|---|---|---|---|---|
| | Per cent lodged | Degree lodged | Per cent lodged | Degree lodged | Per cent lodged | Degree lodged | Per cent lodged | Degree lodged |
| Kota ..... | 53 | 18 | 91 | 88 | 32 | 25 | 25 | 11 |
| Marquis ..... | * | * | 8 | 31 | 2 | 3 | 2 | † |

* Trace. † Slight.

Certain varieties grown in the field plot tests in 1925 have not been extensively tested in previous trials, altho some of them have been grown for several years in rod-row tests. The data for 1924-25 of the field plot variety trials are given in Table III. In this test Marquis is used as a standard.

[2] Reference by number is to "Literature Cited," page 31.

TABLE III

YIELDS IN BUSHELS PER ACRE OF SPRING WHEAT VARIETIES COMPARED WITH MARQUIS FOR THE TWO-YEAR PERIOD 1924-25

| Variety | No. | Univ. Farm | Waseca | Morris | Crookston | Grand Rapids | Duluth |
|---|---|---|---|---|---|---|---|
| | | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. |
| Marquis ..... | 1239 | 31.2 | 30.9 | 23.2 | 24.2 | 17.1 | 14.9 |
| Marquillo ..... | 2202 | 31.7 | 32.7 | 24.2 | 33.9 | 18.4 | 16.0 |
| Ruby ..... | 2155 | .... | .... | .... | 25.1 | .... | .... |
| Java ..... | 2206 | .... | .... | .... | .... | 21.4 | 19.6 |
| Quality ..... | 2207 | 28.3 | .... | .... | .... | .... | .... |
| Ceres ..... | N.D. 1658 | .... | .... | .... | 31.9 | .... | .... |
| Kota × Marquis.... | N.D. 1656 | .... | .... | .... | 34.8 | .... | .... |
| Pentad ..... | 1968 | 30.4 | .... | .... | .... | .... | .... |

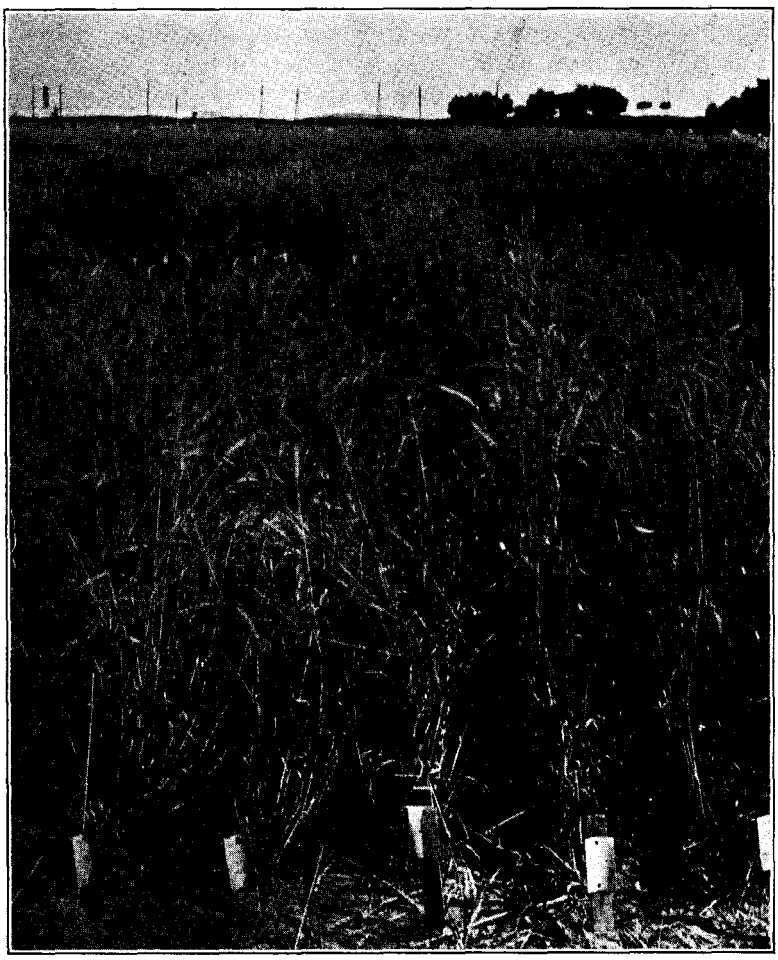

Fig. 1. Comparative Lodging of Kota and Marquis

At left, Kota badly lodged; at right, Marquis, fully erect. Rod rows. University Farm, St. Paul, Minn. 1922.

Comparisons of average yields for the years 1924 and 1925 are not as valuable as those for the four-year period, but are of great interest, as they indicate what recently introduced varieties have done and give an idea of what progress has been made toward the development of a variety that fills the needs of the Northwest better than the standard, Marquis.

Pentad is a rust-resistant red durum of inferior quality for the manufacture of macaroni products. Hence it brings a lower price on the market. It has been extensively compared with Mindum in rod-row tests and usually yields considerably less. When durum wheat that is otherwise satisfactory for the manufacture of macaroni comes on the markets containing over 10 per cent of Pentad, the mixture is classified as Red Durum and brings a correspondingly low price. A mixture of 5 per cent of this inferior variety in wheat which would otherwise grade No. 1 Amber Durum or No. 1 Durum, lowers it one grade.

Ruby, originated in Canada, was tested for several years following its introduction. It was not found superior to Marquis in yield or other characteristics and was eliminated from the tests except at Morris and Crookston. At Morris it averaged 5.5 bushels less than Marquis in 1922, 1923, and 1924. At Crookston, as an average of three years, it has yielded three-fourths of a bushel less than Marquis. This difference is so small that they may be considered as being approximately equal in yield at Crookston. For the two years, 1924 and 1925, it yielded 25.1 bushels at Crookston as compared with 24.2 bushels for Marquis. Judging from these figures there appears to be no place in Minnesota for Ruby. In Canada it is recommended only for the northern portions of the wheat-growing areas where early maturity is necessary in order to escape frost injury.

Quality, a white wheat originated by Luther Burbank, was first tested in rod-row trials at University Farm in 1919. It matured about a week earlier than Marquis but was more severely injured by scab than other varieties and yielded somewhat less than Marquis. It was again grown in 1920. As an average of the two years, Quality yielded 25 per cent less than Marquis and consequently was not placed in the field plot variety trial. Because of its early maturity it has sometimes escaped rust and for this reason has been grown by farmers to some extent. It was placed in the field plot trials in 1924. It has not yielded as high on the average as Marquis and from the tests available it does not appear to be equal to Marquis in baking qualities. Quality is not rust resistant, but the earliness may in some instances aid it in escaping rust attacks. At present it can not be recommended for general use in the state.

The new variety, Marquis × Iumillo, N.S.N. II-15-44, which has been named Marquillo, originated at University Farm by crossing Marquis and the rust-resistant durum variety, Iumillo (5). It was placed in the field plot variety tests for the first time in 1924. It is a product of intensive co-operative studies between plant breeders and plant pathologists at the Minnesota station and the Bureau of Plant Industry of the United States Department of Agriculture. This new wheat has proved rather rust resistant in rod-row trials, and for this reason a statement of its performance in Minnesota is of interest. Average yields in rod-row tests are presented in Table IV in comparison with Marquis.

TABLE IV

COMPARISON OF MARQUIS AND MARQUILLO—ROD-ROW TRIALS*

| Variety | Average yields per acre | | | |
|---|---|---|---|---|
| | Univ. Farm | Waseca | Crookston | Morris |
| | Bu. | Bu. | Bu. | Bu. |
| Marquis | 29.5 | 20.3 | 19.8 | 19.7 |
| Marquillo | 29.4 | 22.6 | 23.3 | 24.2 |

* University Farm averages, 1921-25; Waseca, 1922-23, 25; Crookston, 1921-23, 25; Morris, 1922-23, 25.

The favorable yields in the field plot trials in 1924 and 1925 in comparison with the standard, Marquis, confirm the results secured in the preliminary tests. This new beardless variety is as stiff-strawed as Marquis. Root-rot diseases, under certain environmental conditions, injure the new variety more than they injure Marquis. Loaves of bread made from flour of the new variety compare favorably in volume and texture with those made from flour of Marquis and are creamy yellow in color. The creamy yellow color is somewhat undesirable in comparison with the whiter color of the loaves made from flour from Marquis. However, the fact that most of the flour is bleached as the finishing process in milling, makes the creamy yellow color of the loaves of the new variety less objectionable.

Two new varieties originated at the North Dakota Experiment Station by crossing Kota and Marquis, and listed under the North Dakota numbers 1656 and 1658, were grown in rod-row trials in 1923 at University Farm. North Dakota No. 1658 has been named Ceres. They were obtained from Prof. L. R. Waldron, plant breeder at the North Dakota station. They appeared rather rust resistant and were tested in four localities in 1924 and 1925 in rod-row trials and at Crookston in the field plot variety trial. The performance of these wheats in rod-row tests is given in Table V.

In the field plot trials both the new productions gave high yields as compared with Kota and Marquis. Ceres appears to be nearly as rust resistant as Kota. In the field plot varietal trials at Crookston in

1924 and 1925 it averaged significantly lower in yield than Mindum and two bushels lower than Marquis. In preliminary tests both varieties indicate desirable baking qualities.

Further tests of yield and of other plant characteristics, accompanied by milling and baking tests, are necessary before any one of the three new rust-resistant varieties can be recommended for general use in the state.

TABLE V

COMPARISON OF MARQUIS, KOTA, AND TWO NEW VARIETIES PRODUCED AT THE NORTH DAKOTA STATION FROM CROSSES OF MARQUIS × KOTA, 1924-25—ROD-ROW TRIALS

| Variety | Yield per acre | | | | | Average strength of straw | |
|---|---|---|---|---|---|---|---|
| | Crookston | Morris | Waseca | Univ. Farm | Average | Per cent lodged | Degree lodged |
| | Bu. | Bu. | Bu. | Bu. | Bu. | | |
| Marquis | 22.4 | 26.0 | 21.3 | 31.2 | 25.2 | 4 | 13 |
| Kota | 29.4 | 24.9 | 12.6 | 30.3 | 24.3 | 54 | 37 |
| N.D. 1656 | 35.4 | 26.5 | 22.7 | 33.3 | 29.5 | 48 | 82 |
| Ceres | 29.3 | 27.0 | 21.1 | 33.2 | 26.7 | 15 | 16 |

Besides the varieties for which yields have been given, the following have been tried recently and discontinued: Common wheats—Kitchener, Red Bobs; Durum wheats—Arnautka, Kubanka, Acme, and Monad.

## WINTER WHEATS

In southern Minnesota winter wheat has always had a place in the cropping system on a considerable number of farms. With varieties available that can be depended on to pass through the winter successfully, this crop is making gains in acreage.

Five-year average yields in bushels per acre and in per cent with the yields of Minturki considered as 100 are given in Table VI. Minturki, Minard, and Crimean were the highest yielders for the five-year period at University Farm. The others have averaged less in yield, owing to lower yielding ability or to winter killing. Red Rock killed completely in 1923 and yielded only 2 bushels per acre in 1922. Kanred, Iowa 1946, Basco, and Wisconsin Pedigree were severely winter killed in 1922.

At Waseca and Morris, where the winter killing has not been so severe, Kanred has yielded somewhat better than Crimean and as much as Minturki. In 1920, however, at Waseca, Kanred was severely injured when Minturki escaped injury.

Minturki, Minn. No. 1507, is a bearded, white-chaffed winter wheat which produces kernels of the well-known Turkey type. It is the result of a definite attempt made by the Minnesota plant breeders to produce a hardy winter wheat which also has other desirable qualities (4). Over 200 varieties from foreign countries and from other

sections of the United States have been tried without obtaining any variety which proved fairly satisfactory for all characters. From testing these varieties it was found that Turkey winter wheat excelled in kernel characters and milling quality but was frequently injured during severe winters.

TABLE VI

COMPARATIVE FIVE-YEAR AVERAGE YIELDS, 1921-25, OF WINTER WHEAT VARIETIES IN BUSHELS PER ACRE AND IN PER CENT BASED ON THE YIELDS OF MINTURKI AS 100

| Variety | No. | Univ. Farm | Waseca | Morris | Univ. Farm | Waseca | Morris |
|---|---|---|---|---|---|---|---|
| | | Bu. | Bu. | Bu. | Per cent | Per cent | Per cent |
| Minturki | 1507 | 25.6 | 30.4 | 21.7 | 100 | 100 | 100 |
| Minard | 2199 | 25.9 | 30.6 | 19.2 | 101.2 | 100.7 | 88.5 |
| Crimean | 845 | 25.0 | 25.1 | 17.9 | 97.7 | 82.6 | 82.5 |
| Kanred | 2191 | 21.9 | .... | .... | 85.5 | .... | .... |
| Wis. Ped. | 1585 | 23.2 | .... | .... | 90.6 | .... | .... |
| Iowa 194 | 2190 | 21.5 | .... | .... | 84.0 | .... | .... |
| Basco | 2152 | 21.6 | .... | .... | 84.4 | .... | .... |
| Red Rock | 2154 | 11.6 | .... | .... | 45.3 | .... | .... |

Where winter-killing is not a factor, the Turkey variety produces good yields. Odessa is a red-chaffed, beardless winter wheat obtained from Russia. It matures later than Turkey, produces moderate yields of wheat of undesirable milling quality, and is comparatively winter hardy. Minturki was produced by crossing Turkey and Odessa. The original cross was made in 1902 and the new variety, Minturki, was first increased in 1919. Registered seed of this variety is available in quantity.

In addition to the yields of the recommended variety, Minturki, those of several other promising varieties are included in Table VI.

The performance of Minhardi, Minn. No. 1505, has been presented in former publications. It is a beardless, white, smooth-chaffed wheat, resulting from a cross of Odessa and Turkey. It is stiffer strawed than Minturki and is somewhat more resistant to winter injury but more susceptible to attacks of black stem rust. At University Farm, Minhardi has yielded, on an average, a little better than Minturki. It is not as widely adapted to Minnesota conditions as Minturki and produces grain of somewhat less desirable quality.

Crimean, Accession No. 845, has proved much more winter hardy than commercial Turkey varieties and produces grain of good milling quality.

Minard, developed from a cross made at University Farm with Turkey as one of the parents, has a desirable type of kernel and gives promise from the standpoints of yield and milling and baking qualities.

Kanred was originated at the Kansas experiment station (7). It is one of several head selections from the Crimean variety. It has not

proved as winter hardy under Minnesota conditions as Minturki, Crimean, or Minard. When it has come through the winter without severe killing, it has high yielding ability. It is a satisfactory milling wheat.

Red Rock, originated at the Michigan experiment station (9), has not proved hardy in Minnesota unless protected by a snow covering. It frequently is winter killed 100 per cent. Basco, Wisconsin 408, Wisconsin Pedigree 2, Iowa 1946, and Iowa 1949 have been tested but have not proved as winter hardy as Minturki or Crimean.

## OATS

Oats and corn are the two leading crops in Minnesota, both in acreage and in total farm value.

The five-year average yields of the most promising varieties are given in Table VII, together with the yields expressed in percentages based on those for Victory considered as 100.

TABLE VII

COMPARATIVE FIVE-YEAR AVERAGE YIELDS, 1921-25, OF OAT VARIETIES IN BUSHELS PER ACRE AND IN PER CENT BASED ON YIELDS OF VICTORY AS 100

| Variety | No. | Univ. Farm | Waseca | Morris | Crookston | Grand Rapids | Duluth |
|---|---|---|---|---|---|---|---|
| | | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. |
| Victory | 514 | 61.6 | 67.0 | 61.1 | 55.7 | 49.7 | 55.0 |
| Minota | 512 | 63.6 | 71.1 | 57.8 | 62.1 | 54.9 | 54.4 |
| Gopher | 674 | 63.9 | 85.4 | 65.5 | 64.9 | 48.3 | .... |
| White Tartar | 339 | .... | .... | .... | 49.3 | 45.3 | 54.2 |
| Imp. Ligowa | 281 | 60.1 | .... | .... | 53.7 | 48.2 | 48.6 |
| Liberty Hull-less | 676 | 43.6 | .... | .... | .... | .... | .... |
| | | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent |
| Victory | 514 | 100 | 100 | 100 | 100 | 100 | 100 |
| Minota | 512 | 103.2 | 106.1 | 94.6 | 111.5 | 110.5 | 98.9 |
| Gopher | 674 | 103.7 | 127.5 | 107.2 | 116.5 | 97.2 | .... |
| White Tartar | 339 | .... | .... | .... | 88.5 | 91.1 | 98.5 |
| Imp. Ligowa | 281 | 97.6 | .... | .... | 96.4 | 97.0 | 88.4 |
| Liberty Hull-less | 676 | 70.8 | .... | .... | .... | .... | .... |

On the five-year average basis, Gopher, Minota, and Victory were practically equal in yield at University Farm. On the heavy black soil at Waseca, where ability to stand erect shows in increased yields, Gopher was an outstanding winner. At Morris, Gopher lodged less than several other varieties and averaged higher in yield. Of the varieties of which seed is available, Gopher was slightly higher in yield than Minota and considerably higher than Victory, at Crookston. Minota and Victory were the highest yielders at Grand Rapids, and Victory led at Duluth.

Based on the results at the several locations, Gopher, Minota, and Victory are recommended for general planting in the sections where they have been the highest yielders.

Gopher, Minn. No. 674, formerly called Sixty-Day, is an open-panicled, early-maturing oat with white grain. This variety resulted from a plant selection made in 1917 in a mixed commercial early oat. The purpose of this selection was to obtain a stiff-strawed, early, white oat with high yielding ability (see Fig. 3). It was tested in comparison with the variety from which it was obtained in rod-row trials and also was compared with Iowa 103. It proved more desirable and was then placed in the field plot varietal trials. Tests of this new selection made at both University Farm and the branch stations have shown that it has remarkably stiff straw, high-yielding ability under various growing conditions, and heavy weight per bushel.

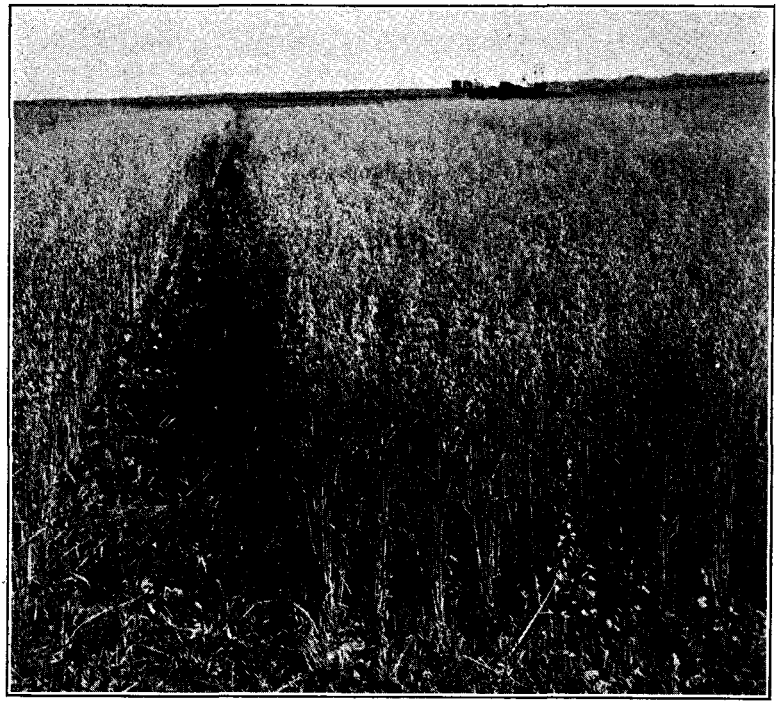

Fig. 2. Gopher Oats at Right
This stiff-strawed, early-maturing variety has a wide adaptation in Minnesota.

Iowar, Iowa 103, and Nebraska 21, three other early-maturing varieties, have been compared in yield with Gopher and found less desirable. Results of a three-year trial in fortieth acre plots in several localities in southern Minnesota are presented in Table VIII. These comparisons show that Gopher performs better on the average in southern Minnesota than either Iowa 103 or Iowar.

TABLE VIII

SOUTHERN AND CENTRAL MINNESOTA OAT YIELDS IN PER CENT WITH THE YIELDS OF GOPHER CONSIDERED AS 100
(Three-year average, 1920-22)

| Variety | No. | Univ. Farm Per cent | Lewiston Per cent | Waseca Per cent | Blue Earth Per cent | Morris Per cent |
|---|---|---|---|---|---|---|
| Gopher | 674 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| Iowar | 670 | 90.3 | 94.8 | 82.5 | 105.1 | 88.8 |
| Iowa 103 | 531 | 96.3 | 89.6 | 82.8 | 82.8 | 81.5 |
| Victory | 514 | 108.8 | 81.7 | 73.5 | 68.6 | 80.0 |
| Minota | 512 | 110.3 | 82.5 | 77.7 | 83.4 | 66.3 |

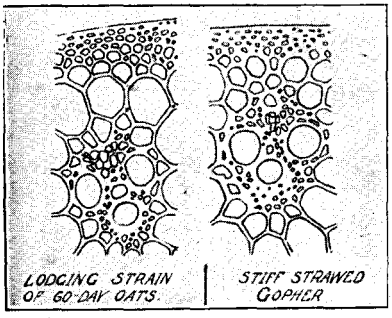


Fig. 3. Relative Thickness of Cell Walls in Relation to Lodging

At left, cross-section of a lodging strain of Sixty-Day oats. At right, cross-section of Gopher. The relative thickness of the cell walls can be appreciated by observing, respectively, the relative area within the cell walls of the two.

[After Garber and Olson (3)]

Minota, Minn. No. 512, is an open-panicled, medium-maturing oat which has shown its ability to give good yields under various Minnesota conditions. It is the result of one of several plant selections made in 1906, from a commercial variety of oats grown on the farm of James A. Bull. It was first placed in variety trials in 1915, and was named Minota in 1919 after having shown its adaptability to Minnesota conditions.

Victory, Accession No. 514, is an open-panicled, medium-maturing, large, plump-kerneled, white oat with straw of good length. The kernels have weak awns or none. It was originated at Svalöf, Sweden, and was first introduced into the nursery at University Farm in 1908. A later introduction came from the Department of Field Husbandry of the University of Saskatchewan, in 1915. It has proved a reliable yielder in Minnesota.

Improved Ligowa, Minn. No. 281, is an open-panicled, medium-maturing, plump, white oat with heavy to light awns. It has straw of medium length and stiffness. It originated through a head selection made in 1895 from the Swedish Select group. It appears to be less desirable than either Minota or Victory.

Results of trials made in 1924 and 1925 in which some new varieties have been added to the test are found in Table IX.

TABLE IX

YIELDS OF NEW VARIETIES FOR THE TWO-YEAR PERIOD 1924-25 COMPARED WITH THEIR PARENTS OR STANDARD VARIETIES

| Variety | No. | Univ. Farm | Waseca | Morris | Crookston | Grand Rapids | Duluth |
|---|---|---|---|---|---|---|---|
| | | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. |
| Victory | 514 | 59.6 | 80.5 | 79.8 | 72.8 | 50.2 | 58.7 |
| Minota | 512 | 60.8 | 86.5 | 79.3 | 76.8 | 54.9 | 58.7 |
| Gopher | 674 | 65.9 | 93.6 | 86.5 | 79.7 | 47.6 | 59.7 |
| Wh. Russian × Victory | 686 | 60.7 | 95.8 | 85.1 | 80.4 | 52.8 | 72.8 |
| Wh. Russian × Minota | 687 | 66.2 | 75.3 | 73.9 | 84.3 | 49.4 | .... |
| Wh. Russian × Minota | 688 | 60.3 | .... | .... | 74.7 | .... | .... |
| Wh. Russian × Minota | 689 | 66.5 | .... | .... | 83.9 | .... | .... |
| Wh. Russian × Minota | 690 | 68.7 | 79.0 | 73.8 | 77.5 | .... | .... |
| White Tartar | 339 | .... | .... | .... | 61.5 | 36.4 | 65.4 |
| Iogren | 675 | .... | 83.0 | 74.9 | .... | .... | .... |

The chief interest in the results for 1924 and 1925 is the test of several new hybrids obtained from crosses of White Tartar (previously called White Russian) and Minota or Victory (2). Over 200 hybrids have been tested in rod-row trials and many of them have appeared the equal of Minota and Victory. Six of these hybrids were placed in the field plot varietal trials in 1924 and they gave evidence of high yielding ability. The new hybrids have resistance to black stem rust, a character obtained from the White Tartar parent. They are all open-panicled varieties similar in appearance to Victory and Minota and have indications of high yielding ability combined with resistance to black stem rust. The data secured in the preliminary tests and in the two years of the final tests establish the fact that varieties of oats can be produced combining yielding ability at least as high as that of any of the varieties now in general use and resistance to black stem rust. No seed of these varieties is available. Further tests are necessary to provide additional data on which final selection can be based.

## BARLEY

Barley is fifth in importance as a farm crop in the state. In the northern part of the state, particularly, it may well be grown much more widely than at present as a feed for livestock. The coming into use of new smooth-awned, high-yielding varieties such as Velvet, which does away with the only serious objection to growing barley, should bring about a more general growing of the crop throughout the state.

The four-year averages are given in Table X together with the yields expressed in percentages based on those for Improved Manchuria considered as 100.

At University Farm, Svansota has yielded higher than any of the other varieties for the four-year period. Velvet yielded higher than the standard, Improved Manchuria, for the four-year period.

TABLE X

COMPARATIVE FOUR-YEAR AVERAGE YIELDS, 1922-25, OF BARLEY VARIETIES IN BUSHELS PER ACRE AND IN PER CENT BASED ON THE YIELDS OF IMPROVED MANCHURIA AS 100

| Variety | No. | Univ. Farm | Waseca | Morris | Crookston | Grand Rapids | Duluth |
|---|---|---|---|---|---|---|---|
| | | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. |
| Improved Manchuria.... | 184 | 38.8 | 62.1 | 38.1 | 40.7 | 28.5 | 30.4 |
| Velvet ..... | 447 | 41.8 | 61.3 | 37.3 | 38.6 | 24.3 | 35.4 |
| Minsturdi ..... | 439 | 43.2 | 52.6 | 33.4 | 41.5 | .... | 26.0 |
| Svansota ..... | 440 | 48.9 | 63.8 | 40.0 | 44.2 | .... | 32.9 |
| | | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent |
| Improved Manchuria.... | 184 | 100 | 100 | 100 | 100 | 100 | 100 |
| Velvet ..... | 447 | 107.7 | 98.7 | 97.9 | 94.8 | 85.3 | 116.4 |
| Minsturdi ..... | 439 | 111.3 | 84.7 | 87.7 | 102.0 | .... | 85.5 |
| Svansota ..... | 440 | 126.0 | 102.7 | 105.0 | 108.6 | .... | 108.2 |

At Waseca, Improved Manchuria and Svansota surpassed Minsturdi in yield.

For the four-year period at Morris, Improved Manchuria and Svansota exceeded Minsturdi in yield. Velvet and Improved Manchuria were practically equal in yielding ability for the four-year period.

The four varieties for which averages are available at Crookston are not far different in yield.

Minsturdi was the lowest yielder at Duluth.

Velvet yielded more than Improved Manchuria at two localities and less than Improved Manchuria in four cases. It appears about the equal of Improved Manchuria.

Velvet, a smooth-awned barley, resulted from a cross between a smooth-awned variety and Luth, a common six-rowed variety of the Manchurian type. In the Velvet variety are combined the very desirable smooth-awned character and the good characters of Manchuria, which has been one of the highest yielding varieties in Minnesota (see Fig. 3). The studies of the reaction to "spot blotch" in which Velvet is referred to as N.S.N. II-20-10 show it to be as resistant to attacks of *Helminthosporium sativum* as Improved Manchuria (6). Velvet was increased in 1925 at the various stations and approximately twelve hundred bushels are available for increase in 1926.

Manchuria, Minn. No. 184, is a six-rowed barley which resulted from an individual plant selection made in 1901. It was increased for distribution in 1918. It is the best variety of the Manchuria group that has been tested in Minnesota, and gives good yields under various Minnesota conditions.

Minsturdi, Minn. No. 439, is a dense-headed, stiff, short-strawed, six-rowed variety produced by a cross between South African and Manchuria. The Manchuria parent had high yielding ability and the South

Africa parent excelled in stiffness of straw. The new variety has stiff straw and good yielding ability. It is particularly adapted to rich or heavy soils where other varieties often lodge badly.

Svanosta, Minn. No. 440, is a two-rowed barley which resulted from a cross between Svanhals, a two-rowed variety, and U. S. Dept. No. 456. It has stiff straw, and has proved a somewhat better yielder than Chevalier. Svansota, Minsturdi, and Velvet are the result of co-operative investigations carried on by the Office of Cereal Investigations of the United States Department of Agriculture and the Minnesota experiment station.

Fig. 4. Left, Minsturdi Barley Standing Erect on Very Productive Land When Improved Manchuria (right) Lodged Badly

Chevalier, a two-rowed variety developed at the Minnesota experiment station has not proved as satisfactory as Svansota. Therefore it is not included in the list of recommended varieties.

## WINTER RYE

Winter rye is the most dependable and profitable grain crop on sandy lands or on other lands which produce low yields of other grain crops.

The yields of the three varieties of rye that have been grown in the trials for a three-year period are given in Table XI.

At Waseca, Rosen rye, a variety developed at the Michigan experiment station (8), has averaged higher in yield than the standard. At each of the other locations, Swedish, Minn. No. 2, has given more satisfactory results than Rosen. The greater winter hardiness of Swedish, Minn. No. 2, as compared with Rosen accounts for its higher average yields in the central and northern parts of the state.

Average yields for 1924-25 for several selections and also for three varieties recently introduced are presented also in Table XI. Further data must be collected before drawing final conclusions. Colorless, Medium Green, and Dark Green, are three selections for pure seed color which were made at the Minnesota station.

TABLE XI

COMPARATIVE AVERAGE YIELDS OF RYE VARIETIES IN BUSHELS PER ACRE AND IN PER CENT BASED ON THE YIELDS OF SWEDISH, MINN. NO. 2 AS 100

| Variety | No. | Univ. Farm | Waseca | Morris | Crookston | Grand Rapids | Duluth |
|---|---|---|---|---|---|---|---|
| Three-year av. yield 1921-23, inc. | | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. |
| Swedish | 2 | 23.6 | 29.5 | 23.6 | 13.5 | .... | 23.4 |
| Rosen | 82 | 20.9 | 32.2 | 21.6 | 7.7 | .... | 21.0 |
| Wis. Ped. | 84 | 23.6 | 30.3 | 23.8 | 11.1 | .... | 21.7 |
| | | Per cent | Per cent | Per cent | Per cent | Per cent | Per cent |
| Swedish | 2 | 100 | 100 | 100 | 100 | .... | 100 |
| Rosen | 82 | 88.6 | 109.2 | 91.5 | 57.0 | .... | 89.7 |
| Wis. Ped. | 84 | 100.0 | 102.7 | 100.8 | 82.2 | .... | 92.7 |
| Two-year av. yield 1924-25 | | Bu. | Bu. | Bu. | Bu. | Bu. | Bu. |
| Swedish | 2 | 26.7 | .... | 32.4 | 17.3 | 46.4 | 15.7 |
| Rosen | 82 | 32.7 | .... | .... | .... | 42.3 | .... |
| Dakold | 93 | 30.5 | .... | .... | 19.8 | .... | .... |
| Petkus | 86 | 31.0 | .... | .... | .... | .... | .... |
| Midsommerog | 87 | 27.8 | .... | 34.8 | 20.5 | 32.6 | 6.7 |
| Colorless | 90 | 25.4 | .... | 32.6 | 23.0 | 41.4 | 14.7 |
| Medium Green | 91 | 32.0 | .... | 31.2 | 17.4 | 42.3 | 11.7 |
| Dark Green | 92 | 29.0 | .... | 32.5 | 16.7 | 39.8 | 13.6 |

Minnesota No. 2 was produced by selection for winter hardy plants in Swedish rye, the seed of which was obtained in 1895 from John Brogard, Henning, Minn. It proved much superior to commercial varieties grown in the state at that time and was increased and distributed in 1908.

Rosen rye, a variety developed in Michigan, has proved satisfactory in the southern part of the state and is recommended for use there. In northern Minnesota on the sandy lands and in particularly exposed locations it winter kills severely.

## FLAX

At present most of the flax produced in the state is necessarily grown on old land in rotation with other crops. These rotations vary in length from 3 to 5 or 6 years. Wilt, the most serious disease of flax in the state at present, is capable of living in the soil for several years even tho flax is not the crop grown on it. Therefore, when flax is grown on a field every three to five years, the wilt is there ready to destroy the plants even tho wilt-free seed is sown.

When flax is grown on the same land as often as once in from 3 to 6 years, the only means of avoiding damage by wilt is to use wilt-resistant varieties. The first wilt-resistant varieties were produced by selection at the North Dakota experiment station by Prof. H. L. Bolley.

The yields secured in the variety tests in this state are given in Table XII.

TABLE XII

COMPARATIVE YIELDS OF FLAX VARIETIES IN BUSHELS PER ACRE AND IN PER CENT BASED ON THE YIELDS OF WINONA AS 100

| Variety | No. | Yields per acre | | | Yields in per cent based on the yields of Winona as 100 | | |
|---|---|---|---|---|---|---|---|
| | | Univ. Farm 4-yr. Av. 1921, 23-25 | Morris | Crookston 5-yr. Av. 1921-25 | Univ Farm | Morris | Crookston |
| | | Bu. | Bu. | Bu. | Per cent | Per cent | Per cent |
| Winona | 182 | 11.9 | .... | 12.8 | 100.0 | .... | 100.0 |
| Redwing | 188 | 13.1 | .... | 14.0 | 110.1 | .... | 109.4 |
| N.D. Res. 114 | 179 | 11.3 | .... | 12.8 | 95.0 | .... | 100.0 |
| N.D. Res. 52 | 173 | 10.2 | .... | 13.4 | 85.7 | .... | 104.7 |
| Chippewa | 181 | 8.6 | .... | 12.3 | 72.3 | .... | 96.1 |
| Selection 1-25 | 186 | 8.7 | .... | 12.4 | 73.1 | .... | 96.9 |
| Selection 74-1 | 187 | 8.9 | .... | 13.1 | 74.8 | .... | 102.3 |
| Blue Dutch | 98 | 9.1 | .... | 11.6 | 76.5 | .... | 90.6 |
| Saginaw | 183 | 5.7 | .... | 8.0 | 47.9 | .... | 62.5 |
| Two-year av. 1924-25 | | | | | | | |
| Winona | 182 | 12.1 | 13.7 | 15.1 | 100.0 | 100.0 | 100.0 |
| Redwing | 188 | 12.8 | 14.5 | 16.0 | 105.8 | 105.8 | 106.0 |
| N.D. Res. 114 | 179 | 11.2 | 13.7 | 15.5 | 92.6 | 100.0 | 102.6 |
| N.D. Res. 52 | 173 | 10.1 | 15.5 | 16.2 | 83.5 | 113.1 | 107.3 |
| Chippewa | 181 | 6.8 | 14.6 | 15.6 | 56.2 | 106.6 | 103.3 |
| Selection 1-25 | 186 | 9.5 | 14.3 | 13.8 | 78.5 | 104.4 | 91.4 |
| Selection 74-1 | 187 | 8.1 | 14.7 | 14.9 | 66.9 | 107.3 | 98.7 |
| Blue Dutch | 98 | 7.8 | 14.6 | 14.8 | 64.5 | 106.6 | 98.0 |
| Saginaw | 183 | 5.0 | 12.1 | 11.2 | 41.3 | 88.3 | 74.2 |
| N.D. 40013 C.I. | 241 | 9.2 | 15.3 | 17.3 | 76.0 | 111.7 | 114.6 |
| N.D. 40015 C.I. | 244 | 9.8 | 15.8 | 17.6 | 81.0 | 115.3 | 116.6 |
| N.D. 40019 C.I. | 280 | .... | 14.6 | 15.8 | .... | 106.6 | 104.6 |
| Argentine | 189 | 6.1 | 13.0 | 13.3 | 50.4 | 94.9 | 88.1 |

At University Farm the flax is grown on the same land every third year and the wilt disease is abundant. The three-year average yields show Winona, Redwing, and N. D. Resistant 114 to be the high yielders at University Farm; at Crookston, where wilt has not been a serious factor, all the varieties except Saginaw are practically equal in yield.

The 1924-25 yields are of interest as an indication of the value of several new varieties.

Three new varieties originated in North Dakota and a commercial lot of seed from Argentine were included in the tests for the first time. The new varieties from North Dakota look promising but more data are necessary in order to establish their value. The plants of the Argentine flax were very short, started to bloom early, and continued to bloom over a longer time than the others. At University Farm, Crookston, and Morris the yield of Argentine flax was low.

Winona, Chippewa, Redwing, and N. D. Resistant are the recommended varieties.

Through the co-operative efforts of the section of plant pathology and the section of plant breeding, three of these recommended varieties have been produced. The work was first started by Dr. E. C. Stakman more than ten years ago (10).

Winona, Minn. No. 182, was derived from an individual plant selection made in 1916 from Minnesota Accession No. 175, which is C.I. No. 16 or N.D. 1221. This variety was increased at University Farm in 1922 and 1923 and approximately 3500 bushels of certified seed is available for planting in 1926.

Chippewa, Minn. No. 181, was derived by bulk selection in 1914 and individual plant selection in 1915 from Accession No. 25, Blue Dutch. It was first increased under the name of Primost, but in 1923 this was changed to Chippewa. It was increased in 1921, 1922, and 1923 at the Crookston station and certified seed is available in quantity for planting in 1926.

Redwing, Minn. No. 188, was produced by bulk selection in 1914 and 1915 and by individual plant selection in 1916 from Accession No. 91. Accession No. 91 was obtained from the United States Department of Agriculture in 1904. It showed high-yielding ability under wilt conditions in the tests at University Farm in 1921, 1923, and 1924, and was a high yielder at Crookston. In addition to being a high yielder, it has the further advantage of a characteristic light blue flower which makes it distinguishable from the other recommended varieties throughout the blossoming period. Seed of this variety will be increased in 1926.

N.D. Resistant 114 and 52 were developed by selection at the North Dakota Agricultural College. Where wilt is present, N.D. Resistant 114 is a higher yielder than N.D. Resistant 52.

Formerly it was thought that wilt-resistant strains of flax readily lost their resistance when grown on wilt-free fields. It is now a well-established fact that the wilt-resistant character is retained for a considerable number of years even tho the flax is grown on wilt-free soil (1).

Wilt resistance is not complete in any variety and therefore "wilt proof" can not be used correctly in connection with any variety of flax now available.

Wilt-resistant varieties are damaged less by this disease when the seed is planted early than when it is planted later in the season. Flax sown at the same time as grain and up to the time of corn planting has averaged higher in yield than that sown later. Seed of wilt-resistant varieties can not be distinguished from seed of wilt-susceptible varieties.

Therefore, in order to be certain that seed of a wilt-resistant variety is secured, it is necessary to purchase registered or certified seed from reliable sources.

## SOYBEANS

This crop is comparatively new in the state. The value of the crop for both seed and hay production warrants its more extensive planting. The use of varieties not suited to conditions in the state when the crop was first introduced retarded its spread very materially.

The average yields of seed and hay are given in Tables XIII and XIV.

TABLE XIII

COMPARATIVE FIVE-YEAR AVERAGE SEED YIELDS, 1922-25, OF SOYBEAN VARIETIES IN BUSHELS PER ACRE AND IN PER CENT BASED ON THE YIELDS OF CHESTNUT AS 100

| Variety | No. | Univ. Farm | Waseca* | Morris | Univ. Farm | Waseca | Morris |
|---|---|---|---|---|---|---|---|
| | | Bu. | Bu. | Bu. | Per cent | Per cent | Per cent |
| Chestnut | 110 | 17.5 | 18.5 | 17.7 | 100.0 | 100.0 | 100.0 |
| Minsoy | 139 | 23.9 | 16.9 | 18.5 | 136.6 | 91.4 | 104.5 |
| Mandarin | 182 | 18.3 | .... | 18.4 | 104.6 | .... | 104.0 |
| Black Eyebrow | 171 | 12.7 | 14.0 | 14.7 | 72.6 | 75.7 | 83.0 |
| Wisconsin Black | 164 | 14.3 | 13.4 | 17.3 | 81.7 | 72.4 | 97.7 |
| Elton | 167 | 18.1 | 15.3 | 17.5 | 103.4 | 82.7 | 98.9 |
| Manchu | 195 | 12.0 | 18.4 | 15.5 | 68.6 | 99.5 | 87.6 |
| Habaro | 109 | 17.1 | 17.7 | 18.9 | 97.7 | 95.7 | 106.8 |
| Ito San | 196 | 10.2 | 14.0 | 15.0 | 58.3 | 75.7 | 84.7 |
| Soysota | 142 | .... | .... | 19.9 | .... | .... | 112.4 |

* Three-year average yield, 1922-24.

At University Farm, in a four-year average for seed production, Minsoy has yielded 5.6 bushels more than the next highest yielding variety. Chestnut, Habaro, Elton, and Mandarin averaged around 18 bushels of seed per acre for the four-year period. Winconsin Black and Black Eyebrow averaged practically 4 bushels less per acre than the varieties just mentioned. Manchu and Ito San yielded comparatively low two years out of three. Ito San not only is a low yielder but it lodges badly practically every year.

TABLE XIV

COMPARATIVE HAY YIELDS OF SOYBEANS IN TONS PER ACRE AND IN PER CENT BASED ON THE YIELDS OF CHESTNUT AS 100

| Variety | No. | Univ. Farm | Waseca* | Crookston | Univ. Farm | Waseca | Crookston |
|---|---|---|---|---|---|---|---|
| Four-year av. 1922-25 | | Tons | Tons | Tons | Per cent | Per cent | Per cent |
| Chestnut | 110 | 2.42 | 2.14 | 2.34 | 100.0 | 100.0 | 100.0 |
| Minsoy | 139 | 1.94 | 1.41 | 2.58 | 80.2 | 65.9 | 110.3 |
| Mandarin | 182 | 1.85 | .... | .... | 76.4 | .... | .... |
| Black Eyebrow | 171 | 2.08 | 2.05 | .... | 86.0 | 95.8 | .... |
| Wisconsin Black | 164 | 1.79 | 1.54 | 2.61 | 74.0 | 72.0 | 111.5 |
| Elton | 167 | 2.07 | 1.45 | 2.12 | 85.5 | 67.8 | 90.6 |
| Manchu | 195 | 2.19 | 2.08 | 2.22 | 90.5 | 97.2 | 93.9 |
| Habaro | 109 | 2.35 | 1.79 | 2.18 | 97.1 | 83.6 | 93.2 |
| Ito San | 196 | 2.06 | 2.08 | 2.38 | 85.1 | 97.2 | 101.7 |
| Early Brown | ... | .... | 2.13 | .... | .... | 99.5 | .... |
| Soysota | 142 | .... | .... | 2.66 | .... | .... | 113.4 |

* Three-year average yield, 1922-24.

At Waseca, Habaro, Manchu, Chestnut, and Minsoy averaged the highest in seed yields.

Chestnut, Habaro, and Manchu proved to be the best yielders of hay. Chestnut, Manchu, Early Brown, Black Eyebrow, and Ito San produced equally good yields of hay at Waseca for the three-year period. Habaro averaged lower in hay yield but is a better bean for southern Minnesota than Early Brown or Black Eyebrow. Habaro and Manchu are the two varieties best suited to southern Minnesota conditions. Early Brown requires approximately the same number of days to mature as Manchu. Therefore in this state it is not an early variety.

Soysota and Mandarin have been high yielders consistently at Morris. Habaro, Minsoy, Chestnut, Wisconsin Black, and Elton have also averaged high in seed yields. Black Eyebrow and Ito San have been unsatisfactory. Hay yields have been taken at Morris, but for a shorter period of time.

At Crookston, Wisconsin Black, Minsoy, and Chestnut averaged 11.9, 11.7, and 10.9 bushels, respectively, for the period 1919-23 inclusive, but Wisconsin Black was the only one of the three to mature in 1924. Mandarin was not included in the tests prior to 1924.

The early varieties, Wisconsin Black, Mandarin, and Minsoy, have averaged as high in hay yields as the later maturing varieties. It is evident that the early maturing varieties are the ones to use for both seed and hay production in the Red River Valley.

Less work has been done with soybeans at Crookston, Grand Rapids, and Duluth than at the three stations already mentioned. At Grand Rapids, Minsoy and Chestnut yielded 2.79 and 2.03 tons of hay per acre, respectively, in 1924. In 1920 they yielded 26.9 and 23.4 bushels of seed per acre, respectively.

At Duluth even the earliest varieties of soybeans produce seed only in an occasional year.

Chestnut, Minn. No. 110, is a medium maturing variety requiring 110 to 120 days for complete development. It is an upright growing variety averaging 34 to 35 inches in height. It is leafy and retains its leaves upon approaching maturity, which is desirable from the hay and silage standpoint. The seed pods turn very dark brown to black upon reaching maturity and the seeds are kidney-shaped and light brown in color. It was developed from a selection of an individual plant in 1909 from seed obtained from the United States Department of Agriculture under the name of Chestnut. It has proved a good yielder of seed and a desirable variety for hay and silage. It was distributed in 1918 as suitable for central and southern Minnesota for seed production.

Minsoy, Minn. No. 139, was derived from an individual plant selection made in 1912. It is a low-growing variety, averaging 22 to 25

inches in height, and maturing in from 90 to 100 days and therefore is not suited to growing with corn in central and southern Minnesota except for early hogging-off purposes. It retains its leaves after maturity, has tawny yellow pods, and rather small, round, light yellow seeds with brown hilums. This variety has averaged high in seed yields in the trials and is recommended for seed production, particularly for northern Minnesota where early maturity is a necessity. Where soybeans are planted with early corn for hogging-off purposes, this variety may be used to advantage.

Wisconsin Black, Accession No. 164, is a selection from a non-uniform variety of the same name at the Spooner station, Wisconsin. It is uniform in plant habit and early in maturity. It is suited to the north central and northern parts of the state for both seed and hay production.

Habaro, Minn. No. 109, was derived from an individual plant selected in 1909 from a commercial variety of this name. It is a very upright, leafy variety of approximately the same height as Chestnut but slightly later in time of maturity. The seeds are light yellow and considerably larger and rounder than those of Chestnut. This variety is a desirable seed and forage variety. It was increased at the Waseca station in 1920, and is a good variety for southern Minnesota for both seed and hay production.

Soysota, Minn. No. 142, developed from an individual plant selected from S.P.I. 28019 at the Minnesota experiment station, is similar to Chestnut in maturity. It has seed of about the same color as Chestnut but can be distinguished by the lighter color of the hilum. It has given good results at Morris.

Elton, Minn. No. 167, was developed from an individual plant at the Minnesota experiment station. It is a week to ten days earlier in maturity than the variety grown under the name in the states to the south. At University Farm and Morris it is satisfactory in both seed and hay yield. While it is not a high yielder at Waseca, it has been one of the best seed producers at Ames, Iowa. It has medium to small, round, light yellow seeds. At Waseca and at Crookston areas of plants on the Elton plots occasionally turn yellow when from 6 to 12 inches high. The cause for this yellowing is not known.

Manchu, Accession No. 195, was introduced from Manchuria in 1913 by the United States Department of Agriculture. The plants of this variety are vigorous, erect, and leafy. It matures in approximately the same number of days as Habaro. The seeds are round, and yellow with black hilums. It is suited to southern Minnesota for both seed and hay production.

## FIELD PEAS

The value of field peas, particularly for hogging-off in all sections of the state and for the production of seed for feeding to livestock, warrants its more extensive use.

Golden Vine, Minn. No. 95, a medium tall variety with small, smooth, yellow seeds is recommended. This variety matures at about the same time as Victory or Silvermine oats and is therefore suitable for growing in mixtures with these for hay or seed production.

Farmers in Wisconsin and Michigan make a fairly extensive use of the pea crop. They grow, besides Golden Vine, Blue Prussian or Wisconsin Pedigree 2, and Scotch Beauty. These varieties are now being tested in Minnesota.

## Varieties of Corn for Minnesota

Minnesota may be divided approximately according to the length of the growing season for corn, into three sections: southern, central, and northern.

A number of varieties and strains which have been included in variety trials have proved to be high yielders, and are recommended for general use. In addition to these there are local varieties or strains which merit comparison with the recommended varieties in careful trials. There are, however, several advantages in favor of growing high-yielding strains of standard varieties.

Both comparative smoothness of ear and moderate depth of kernel are desirable in Minnesota in all sections from the standpoint of securing the highest yields per acre of mature corn. Therefore, in all varieties extremes of roughness and depth of kernel should be carefully avoided. The pinched dent, even in southern Minnesota, is an undesirable characteristic of corn kernels.

In no section of the state should late, tall growing so-called fodder or silage varieties be grown for forage.

## VARIETIES FOR SOUTHERN MINNESOTA

The recommended varieties for southern Minnesota are comparatively tall, and strong growing, requiring from 120 to 130 days to reach maturity. They are recommended for the most productive soils in the section. For the less productive lands the varieties recommended for central Minnesota will give better results. For early hogging-off, the varieties recommended for northern Minnesota may be used.

Silver King is a creamy white dent variety averaging 16 rows to the ear. The kernels are moderately deep and the dent is wrinkled. The cobs are white. The stock from which this variety was developed was brought into Iowa from Indiana in 1862. To H. J. Goddard, of

Fort Atkinson, Iowa, belongs the credit for the early development of this variety. As grown in Minnesota, Silver King is considerably less rough than the original.

For those who prefer a yellow variety, Murdock, a yellow dent corn averaging 16 rows to the ear, is available. In kernel characteristics, other than color, it is similar to Silver King. The cob is red. Little is known of the early history of this variety. In southern Minnesota, Murdock is frequently grown under the name Golden Jewel.

## VARIETIES FOR CENTRAL MINNESOTA

The varieties recommended for central Minnesota mature earlier than those recommended for southern Minnesota. They require from 110 to 120 days to reach maturity. For early hogging-off, the early varieties recommended for northern Minnesota may be used.

Minnesota No. 13 is a comparatively smooth yellow dent, averaging 16 rows to the ear. Early strains of this variety are grown in the western and central portions of the northern section. Seed from which this variety was developed by selection at the Minnesota experiment station was secured in 1893 from a seed firm in St. Paul. The early strains of this variety are more nearly 12- to 14-rowed than 16-rowed.

Rustler is a comparatively smooth 14- to 16-rowed white dent corn, similar to Minnesota No. 13 in kernel characteristics. This corn was brought to the state many years ago by a Minneapolis seed firm. Earlier than this its history is not known. It has been improved at the Minnesota experiment station.

## VARIETIES FOR NORTHERN MINNESOTA

In the northern part of the state, maturity in relation to yield is of prime importance. Hence, to secure satisfactory results, only seed of acclimated strains of the recommended varieties should be used. This necessity is brought out forcibly in the data given in Table XV for corn at Morris, Crookston, and Grand Rapids.

Killing frost occurred on September 12 at Crookston and on September 13 at Grand Rapids. At Morris the corn was mature before killing frosts occurred.

Dakota White was mature at all locations before the frosts occurred. This variety has a medium-sized ear but at Crookston and Grand Rapids gave as high yields of shelled corn per acre as any of the other varieties. This emphasizes the fact that a large ear is not necessary in order to secure a good yield of shelled corn per acre. Pearl flint is very similar to Dakota White except that it produces ears higher up from the ground and hence can be cut with a corn binder more easily than Dakota White.

Considering the yields of shelled corn of the Northwestern Dent, it will be noted that at Crookston the planting from seed produced in the locality had only 4 per cent of soft corn and yielded 10 bushels higher than the planting from seed secured at Amenia, N. D., somewhat farther south than Crookston. A still more striking example is that of Minn. No. 13 grown from acclimated seed and from seed obtained from University Farm. At Crookston, the acclimated strains averaged 16.8 and 17.8 per cent soft corn at the time frost occurred. At Grand Rapids they were both mature. From the seed secured from University Farm practically all the ears were soft at the time of the frost at Crookston so that no yield of mature corn was secured, while at Grand Rapids 23.2 bushels of shelled corn was secured which was very largely soft at husking time and hence was not in a suitable condition to crib.

At Morris, where the three strains of Minn. No. 13 matured before frost, the late maturing strain gave the highest yield.

TABLE XV

COMPARATIVE YIELDS OF CORN IN 1923 FROM NORTHERN-GROWN NATIVE SEED AND CENTRAL MINNESOTA-GROWN SEED, AND FROM SMALL- AND LARGE-EARED VARIETIES

| Variety | Source of seed | Class of corn | Date mature, or first killing frost | | | Per cent of soft corn on Sept. 13 | | | Yield of shelled corn per acre | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Crookston, Killing frost | Grand Rapids, Killing frost | Morris Mature | Crookston | Grand Rapids | Morris | Crookston | Grand Rapids | Morris |
| | | | | | | | | | Bu. | Bu. | Bu. |
| Dakota White | Bismarck, N.D. | Flint | 9/12 | 9/13 | 9/7 | .... | .... | ... | 56.2 | 45.9 | 39.7 |
| Northwestern | Crookston, Minn. | Dent | 9/12 | 9/13 | .... | 3.7 | .... | ... | 53.5 | .... | .... |
| Northwestern | Amenia, N.D. | Dent | 9/12 | 9/13 | 9/10 | 8.3 | .... | ... | 43.2 | 47.4 | 44.4 |
| Minn. No. 13 | East Grand Forks, Minn. | Dent | 9/12 | 9/13 | 9/11 | 17.8 | .... | ... | 40.0 | 31.6 | 39.1 |
| Minn. No. 13 | Grand Rapids. Minn. | Dent | 9/12 | 9/13 | 9/8 | 16.8 | .... | ... | 45.4 | 34.2 | 32.5 |
| Minn. No. 13 | St. Paul, Minn. | Dent | 9/12 | 9/13 | 9/10 | 100.0 | 100.0 | ... | .... | 23.2 | 46.2 |

Killing frosts may be expected in any season in northern Minnesota as early as they occurred in 1923. In 1924 the season was less favorable for corn than in 1923. Therefore these figures, cited for the 1923 crop, should make it perfectly clear that for grain production only acclimated strains of suitable varieties should be used in that section of the state.

## NORTHERN GROWN STRAINS OF VARIETIES FOR NORTHERN MINNESOTA

For dry corn production, acclimated strains as follows:

Flint varieties: Dakota White, white; Gehu, yellow; Pearl, white; Squaw, variegated; or Burleigh, variegated.

Dent varieties: Northwestern, yellow capped red varying considerably in shade of color.

Minn. No. 23, white capped yellow.

Minn. No. 13, yellow (comparatively smooth kernels).

For silage production:

Minn. No. 13 and Northwestern.

At the Duluth station sunflowers have given more satisfactory results as a silage crop than corn.

### Methods of Distributing and Certifying Seed

Each year increase plots of certain of these recommended varieties are grown at University Farm and at Waseca, Morris, Crookston, Grand Rapids, and Duluth. These plots are carefully rogued during the growing season. The crop is carefully harvested, threshed, and cleaned, particular attention being paid to the prevention of mixtures. This improved seed is then sold to farmers who will further grow and increase it.

The experiment station co-operates with the Minnesota Crop Improvement Association in keeping a record of the recommended varieties after they have been distributed to growers. A grower obtaining seed which is being increased from any of the stations may apply through the association for a field and bin inspection of his grain. If the field is in such condition that the inspector thinks the crop will produce good unmixed seed, and if it is relatively free from noxious weeds and diseases, the inspector reports favorably. Another inspection is made of the seed after it is cleaned and ready for use or sale by the grower. If it then comes up to the standard qualifications for good pure seed, as set by this association, a certificate of inspection is issued to the grower and a record is made of the seed. The grower is required to report to whom the seed is sold so that a complete history can be kept.

A crop produced from seed which was obtained from the station increase fields is recorded as second generation seed. Seed can be registered for two generations after being obtained from a station. It may be registered after that only if the grower maintains a special seed plot which is very carefully rogued. Plants from such a seed plot must be cut by hand and threshed by hand. Also he may register seed if a new supply is secured from the experiment station or from another grower who has maintained a seed plot and kept the seed pure.

Hand selected grain which meets the requirements may be registered for three generations. A grower may have his seed recorded with the association after the third year as certified seed if he does not care to maintain a seed plot. Any variety may qualify as certified seed providing it meets certain standards of purity, freedom from disease, and noxious weeds.

The method of inspecting and certifying may be summarized as follows:

1. The grower wanting to have his crop inspected writes to the secretary of the Minnesota Crop Improvement Association, University Farm, St. Paul, for an application blank.

2. The application blank is filled out by the grower and returned to the secretary. The application contains information as to crop, variety, number of acres, and where seed was obtained. It must be accompanied by a fee of $3. One dollar of this is for membership in the association, and $2 is the initial field inspection fee.

3. The secretary makes arrangements to have an inspector visit the farm some time before harvest to make the field inspection.

4. The inspector makes a report on the condition of the crop, its purity, freedom from weeds and diseases, and the general condition of the farm. If everything is satisfactory, a final bin inspection is recommended. Otherwise the field is rejected for registered or certified seed.

5. After threshing, the grower sends in an application for bin inspection. This must be accompanied by a half-pint sample of grain cleaned as he expects to have it for sale, and a final inspection fee of $2. A laboratory test is made as to purity and germination. If the sample is satisfactory, arrangements are made to inspect the seed in the bin. If this is found equal to the sample submitted and up to all requirements, the inspector recommends that a certificate be issued for the seed. The inspector takes a 2-quart sample of the grain, 5 ears of corn, or one quart of grass seed to keep on file at the office.

6. The association sends the grower a certificate showing that the seed has been inspected both in the field and in the bin and is classified as either registered or certified seed. Tags are also provided to be used by the grower as his guarantee to the buyer of the seed.

7. The grower is furnished with cards for reporting sales of seed, so that a record of the seed can be kept after it leaves his possession.

8. The association publishes annually a seed list of both fall- and spring-sown crops, in which all registered and certified seeds are given special notice. These seed lists are distributed widely throughout this and adjoining states.

No definite price is fixed by the association for the various classes of seeds. This is left to the individual. A sufficiently large increase

in price over common seeds is usually obtained to repay the grower for his extra work and expense.

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